‘Keeping HE Maths where it Counts’

The decline in provision of mathematical sciences courses with more moderate entry requirements: drivers and implications

Professor Nigel Steele

‘We had reached the stage whereby around 20% of our A2 cohort wanted to go onto study Mathematics or a course involving a very high percentage of Mathematics at university. Unfortunately the Mathematics department at our local university has closed and most of our students want to stay in the city. Sadly, we are losing potential Mathematics graduates as they are applying to study alternative subjects rather than move away from the city.’

A quotation from the head of mathematics in a Further Education College [1]

The Council for the *Mathematical Sciences*

The Council for the Mathematical Sciences (CMS) was established in 2001 by the Institute of Mathematics and its Applications, the London Mathematical Society and the Royal Statistical Society. The CMS comprises representatives and observers from the mathematical sciences community, including the Presidents and Chief Executives of these three societies.

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The Council for the Mathematical Sciences
57-58 Russell Square
London
WC1B 4HS
cms@lms.ac.uk

Executive Summary

Introduction

1. Closure of mathematics departments and the termination of recruitment to mathematics courses have a number of effects which are not restricted to the loss of student opportunity, and work against Government and HEFCE targets.

2. The main emphasis of this report is on the availability of high-quality 'local' course provision for able students who, for a variety of reasons, need or wish to live at home whilst studying on a full-time basis.

3. The report also discusses the beneficial effects of Higher Education mathematics and statistics departments on the local community and its economy, and looks at some of the drivers in the HE funding system which threaten the continued existence of some mathematics departments.

The Current Position

4. Mathematics has been recognised as a strategically important subject, and by its nature is the subject that underpins all other science, technology and engineering subjects, and increasingly finance, business and commerce – all primary contributors to the UK economy.

5. Five mathematics departments have closed since 1995 involving both pre- and post 1992 universities. Economic pressures and subsequent university reorganisations have also led to a number of amalgamations between distinct disciplines and a subsequent decline in provision, but are not counted as department 'closures'.

6. The existence of high-quality honours degrees in mathematics with more moderate entry requirements (termed 'broader entry' courses in this report) in universities distributed throughout the UK is vital to achieving aspects of the widening participation agenda.

7. An analysis of the mathematics course provision based on A-level achievement in the UK shows significant areas of the UK where there is no 'broader entry' course provision. Course provision at all entry levels is sparse in the east of England, and absent in North Wales.

The RAE as a driver of change

8. The Research Assessment Exercise has enhanced the visibility of mathematics and funding has been increased leading to the formation of a number of large and highly successful research groups based in the research-intensive universities, and this is to be welcomed.

9. However, a report by the Royal Statistical Society has provided evidence that RAE-based funding decisions have had unfortunate effects in statistics departments: whilst stability has been observed for a small number of top-rated research departments, groups rated 3 or 4 have reduced in size during

1996-2004. A shift in the age profile of academic staff has also been noted in these groups, indicating that staff were not being continuously replaced.

10. Most 'broader entry' courses in mathematics are located in departments with lower RAE ratings, with the implication that these courses exist mainly in a part of the sector which is under threat.

Local economic effects and the impact on teaching

11. University departments have a substantial economic impact on their locality through research and consultancy work. Moreover, one may conjecture that a substantial proportion of graduates from 'broader-entry' courses choose to stay in the general area of the university after graduation and hence contribute to regional economic development in the longer term.

12. An important knock-on consequence is in the availability of specialist mathematics teachers in the region. The government has stated that it aims to ensure by 2014 that 95% of mathematics lessons in schools are taught by a mathematics specialist. This target will not be met on a regional level without a wide network of mathematics courses distributed throughout the UK, a proportion of whose graduates will go on to train to teach in the area.

Conclusions

13. We conclude that reasonable-sized populations should have access to a local mathematics department in order to educate students who need or wish to study at home, and thereby progress the widening participation agenda.

14. We also conjecture that the presence of a mathematics department in an area contributes to the local economy and, by graduate inertia, increases the supply of specialist mathematics teachers. This knock-on effect will be needed if the government's targets for education and hopes for the UK economy as a whole are to be met.

15. For these reasons, we believe that steps need to be taken to ensure that there is an adequate level of provision in mathematics in HE on a sub-regional basis in the UK.

Nigel Steele
June 2007

1. Introduction

1.1 Closure of mathematics departments and the termination of recruitment to mathematics courses have a number of effects which are not restricted to the loss of student opportunity.

1.2 In this report we examine the case for ensuring an adequate level of regional provision in mathematics in HE. The major emphasis is on the case for the availability of high–quality 'local' course provision for able students who, for a variety of reasons, need or wish to live at home whilst studying on a full–time basis. By 'local' we mean within reasonable travelling distance, so that the necessary attendance is possible without overnight stays. Some of these students may come from non–traditional HE entrant backgrounds, so that this local provision contributes to addressing the widening participation agenda. This report looks at some of the drivers in the HE funding system which raise concerns about the continued existence of these courses.

1.3 Widening participation has other aspects, for example, admitting the most able students from non–traditional backgrounds to the most demanding undergraduate courses at prestigious Universities. This aspect falls largely outside the scope of this report.

1.4 Taking a broader view, the Royal Society in its recent report 'A degree of concern?' [2] argues that small and medium–sized enterprises can be very dependent on their local universities and this is apparent in mathematics. The conclusion is drawn by the Society that it is relevant to consider what provision (in science, technology and mathematics) is required at least to that within the English regions. Given the emphasis of this report, this subdivision is too coarse, and it is appropriate to focus more on the distribution of population as well. In support of this view, Stephen Byers, introducing the DTI's 'Excellence and Opportunity' document [3], stressed the importance of this type of link and suggested that Government could help by supporting local or regional networks involving business (especially manufacturing) and universities.

1.5 Mathematics underpins all science, engineering and many social-science disciplines and as discussed in chapter 6.6 is vital in its own right to the knowledge–economy, both nationally and locally. Mathematics delivered through good teachers to school and college students generates improved mathematics functionality in many sectors of the UK economy.

1.6 Staff from the National Centre for Excellence in the Teaching of Mathematics [4] are currently in discussion with the HE mathematics community on how HE maths departments can support mathematics teachers at local or regional level. As envisaged in the Smith report [5], this contact is seen as an important part of the process of continuing professional development (CPD) for school and college teachers. In addition, 'Undergraduate Ambassadors' [6] drawn from mathematics courses have already shown themselves to be a valuable resource in schools, providing support for teachers and role–models for students.

Reasonable travel distance between university department and school is clearly an important issue here.

1.7 **In summary, reasonable–sized populations should have access to a local mathematics department which can educate home–based students who would otherwise not be able to afford to study the subject in HE, which can work with local businesses on mathematically–based problems, and which can work with local schools to stimulate interest in mathematics and its study.**

Terminology:

It should be noted that the term 'department' is not always used in University structures and where it is, it can mean different things. Throughout this report we will use the term 'department' to mean a group of academic staff highly qualified in mathematics and who offer undergraduate courses in mathematics. This may be in addition to other courses they offer either as service provision or for post–graduate students. The term 'mathematics' is used to embrace statistics throughout.

2. STEM Subjects and Widening Participation

2.1 It is recognised, for example in Sir Gareth Roberts' report 'SET for Success' [7] as well as elsewhere, that there is a shortfall in the number of students reading STEM (Science, Technology, Engineering and Mathematics) subjects at university in the UK. In mathematics, the shortage of mathematics graduates shows itself in different ways, for example in the shortage of adequately qualified teachers of mathematics in state schools, and perhaps also in the salary premium enjoyed by mathematics graduates entering certain areas of employment. Following a letter from the then Secretary of State for Education, Charles Clarke, concerning the protection of strategic and vulnerable subjects, HEFCE addressed the problem. In response, they made funding available for initiatives aimed at increasing demand for STEM subjects through its Strategic Development Fund, as a contribution to its strategic aim of widening participation in HE. The 'more maths grads' project is one such initiative developed by a consortium of mathematics bodies, including the members of CMS, HoDoMS and the HEA MSOR Network.

2.2 The project will enable work to be carried out, largely in targeted schools, to stimulate demand from non–traditional entrants to HE for 'mathematics rich' undergraduate courses in HEI's. In the pilot phase, activity will take place in three selected areas in three RDA regions of England (West Yorkshire, Coventry and Warwickshire, and East London). If the aims of the project are achieved, there is expected to be an increased number of students with a good pass in the single subject of mathematics at A–level. It is also expected that amongst this number there will be several whose passes, whilst good, will not be at a level sufficient to gain admission to the more prestigious university courses. For a variety of reasons, perhaps economic or family needs and so on, some students, including some of those in this group, will wish to live at home whilst studying on a full–time programme. Others will wish to study on a part–time basis and the Open University already plays an important role

here. However, some part–time students find it difficult to study almost totally at home and need the stimulus of regular contact with staff and their peers.

2.3 Many full and part–time students wishing to remain at home have found places on courses in mathematics at their 'local' university, which although recruiting nationally, has provided a valuable resource for its community. These universities are sometimes ex–polytechnics and courses at such universities, which we have termed 'local', are often 'practice–based' courses, satisfying that aspect of the Benchmark statement [8] and producing employable graduates, some of whom go on to achieve at the highest levels in fields including academia. It is important that this type of provision, which also in its national role helps to cater for the spread of adequate pass grades in A–level mathematics achieved by applicants, remains available.

2.4 The project is intended to be 'rolled out' to the remainder of the three RDA regions (and ultimately to the UK as a whole) following evaluation of the results of the pilot phase. The Leitch Review of Skills 'Prosperity for all in the global economy' [9] expressed the view that 'It is critical that access to university is dramatically improved so that young people from all backgrounds have a fair chance of attending'. It is also important that once students are admitted to a course at university, there is a fair chance of success. If the dual aims of widening participation and of increasing the number of graduates from 'mathematics–rich' programmes are to be met, then there must remain opportunities for participation in appropriate HE programmes in convenient locations distributed within the UK.

3. The Current Position

3.1 The existence of high–quality honours degrees with more moderate entry requirements (which are termed 'broader–entry' courses in this report) in mathematics in universities distributed throughout the UK is an important element in the achievement of part of HEFCE's strategic aim of widening participation. The courses we are concerned with are three–year programmes classified as G100 by UCAS, and the reason for selecting these is that they potentially open up the full range of opportunities which should be available to mathematics graduates. (Some of these courses will be associated with 4–year 'undergraduate masters' programmes.) The continued existence of some such courses in often, but not exclusively, urban post–1992 Universities, can be precarious.

3.2 Advertised entry requirements for 'broader–entry' courses are set a level deemed to be an indicator of ability to succeed on a valid degree course in mathematics, but are lower than those published by the 'research–intensive' Universities. The published entry grades for G100 courses in the UK are shown in Table 2. The demand for these courses has actually remained fairly steady, but has not grown in line with numbers in other fields, and thus now looks low by comparison. Nevertheless, it is worth emphasising that these courses play an important role in the overall provision of mathematics in HE. In the first place, students from the entire UK, or abroad, with good but not outstanding performance in single mathematics A–level (typically grade B) might well be accepted.

In this way, these courses also serve a valuable function for those students who have received less than perfect mathematics teaching at school and yet have achieved a reasonable performance at A–level in mathematics. Finally, and most importantly, these courses provide local provision in a vital STEM subject for students who wish to study full–time, but who are constrained to live at home for a variety of reasons. Experience indicates that a significant number of these are from backgrounds with no previous experience of HE.

3.3 In a similar way, non–urban, sometimes geographically isolated pre–1992 universities, for example Essex, Stirling, and Aberystwyth provide similar opportunities for local students. Prior to closure of courses, Bangor and Hull Universities also provided this service. Reference to the map in Fig 2 shows very clearly the effect of the cessation or recruitment at Bangor in producing a complete absence of 'broader–entry' provision in North Wales. Similarly, the closure of courses at Hull has removed this type of provision in East Yorkshire.

4. Health of Departments

4.1 Data on Departmental 'Health' is not readily available for mathematics as a whole. However, the Royal Statistical Society has carried out a detailed study of the health of the teaching of statistics focusing on its role as a part of the discipline of mathematics in HE.

4.2 According to a recent presentation [10] by the lead investigator, its draft report concludes that there is clear evidence of the unfortunate effects of RAE–based funding decisions on this teaching. Without a similar detailed study it is not valid to extend these results to the whole field of mathematics, but there is anecdotal evidence to support the view that if this were done, similar results would be found.

4.3 In summary, the study found that groups rated 5 or 5* in 2001 were largely stable over the period 1996–2004, whilst those rated 3 or 4 were reducing in size. Again, the staff age profile in 5 and 5* groups was reasonable, whereas in groups rated 3 or 4 23% were between 55 and 59, with no staff younger than 30. These figures are consistent with the view that staff were not being replaced in these departments. Overall, the number of statisticians in a subset of departments had fallen by 5% between 2005 and 2006, but this was made up of a 1.77% fall in 'strong' departments and a 15.6% fall in 'medium' or 'weak' departments. In the departments in these latter two categories the number of staff is reducing, and without significant research income, the number of research students will also fall, meaning additional teaching duties for those staff who remain. The overall effect means stability for a small number of research elite departments, but rapid decline elsewhere. As our later data will indicate, most 'broader–entry' courses in mathematics are located outside the elite departments with the implication that they are in part of the sector which is likely to be in decline.

4.4 In the presentation, further contributors to this overall effect were seen as certain EPSRC funding initiatives and internal University funding models which militate against teaching in support of other subjects. This work,

known as service teaching, was an important part of many departments' portfolio of courses and has been taken 'in house' by the parent department in a number of universities, purely it seems, for financial advantage. This advantage derives from the funding model adopted by the university but the practice of taking service teaching into the parent department can raise questions about the quality of mathematics teaching to non–specialists.

4.5 It must be reiterated that these results apply to statistics, but there is a strong feeling that they do indeed reflect what would be found in a survey of mathematics departments. HoDoMS, the group which represents Heads of Departments in Mathematical Sciences, is preparing to issue data collection documents to Departments in the hope of obtaining the necessary data.

5. The Research Assessment Exercise and Some Effects Resulting from Funding Decisions

5.1 The Research Assessment Exercise has enhanced the visibility of mathematics research in the UK and, overall, funding has been increased. A result has been the formation of a number of large and highly successful research groups based in the research–intensive Universities, and this is to be welcomed.

5.2 However, other post–RAE funding decisions have had a less desirable effect. To quote the report of the International Review of UK Research in Mathematics [11] 'Another feature of mathematical research is that profound contributions are very often made by individuals or relatively small groups of people, so that individualism remains a bedrock of discovery in mathematics'. The report goes on 'The UK cannot afford to have its high–quality research concentrated in too few leading departments that are competitive at an international level'. Yet this is exactly what seems to be happening. As the RSS study observed, the post–RAE funding decision have been compounded by research council initiatives.

5.3 There is concern that, based on the study carried out in statistics, this effect may carry over into the teaching of the entire subject of mathematics at HE level. If this is the case, then the production of regional deserts in university mathematics research *and teaching* becomes a real possibility.

5.4 The HE Policy Institute, in a note to the House of Commons Select Committee on Education and Skills [12], discussed the 'hierarchy of esteem' amongst university courses in general. The note posited that there are some changes which may lead to the breakdown of this hierarchy, citing the increasing trend for young people to study near home and the increased availability of information on various aspects of the university experience. Whilst there is some, as yet mainly anecdotal, evidence of this happening in mathematics, it would be a slow process with a time–scale which would mean the process would probably be overtaken by other events.

5.5 One element of this data is the amount of teaching received and who provides it. The Institute published a report on the academic experience of students in UK universities [13]. 15000 replies were obtained from the 23000 surveyed to produce 'the most detailed account yet of what students receive when they study at an English University'. Comparisons are made between 'old' and 'new' (post–1992) Universities and show significant differences in the teaching process for the field of mathematical sciences. Whilst the research–intensive universities are included in the 'old' grouping it would be incorrect to associate all others with the 'new' grouping.

	'old' (pre–1992)	'new' (post–1992)
tutorials	60%	89%
seminars	62%	88%

Table 1: The percentage of tutorials and seminars in mathematics given by academic staff in two categories of university.

5.6 Nevertheless, some indications are apparent. In all universities the vast majority of lectures in mathematical sciences are delivered by academic staff; however as Table 1 shows the figures for tutorials and seminars are rather different. Access to specialist facilities is also much greater in 'new' universities. The differences between the two groups are very much at the higher end of the range for different subjects in each case.

5.7 There is no real surprise here: there will be fewer research assistants/students available to take tutorials or seminars in non research-intensive universities, thus more teaching has to be done by academic staff. Obviously, this will normally benefit the students and this is probably appropriate given the lower entry requirement. However, the difference between the two categories is very large and may well be widening as a result of funding decisions.

5.8 A number of the courses which we have categorised as 'broader–entry' are to be found in universities categorised here as 'new' and thus students apparently benefit from the higher level of engagement of academic staff with the entire teaching programme. It would be interesting to be able break down the figure for 'research intensive' and others in the 'old' grouping.

5.9 It is unfortunate that departments providing the 'best' student experience also appear to be those under threat.

6. Some Data and Related Commentary

6.1 In this section we present four Tables and three maps. In Table 2 are shown the published admission requirements for degree courses in mathematics, with a colour coding described in the notes. It is the right of every University to admit whom it chooses, so these grades, obtained from the UCAS web–site, or the University's site itself in case of doubt, are only a guide to actual requirements. Nevertheless, from the point of view of some potential Widening Participation applicants, this Table could be taken to show where a good, but not outstanding, performance in

mathematics at A–level might be well received.

6.2 Table 3 shows the RAE ratings obtained in 2001 for Units 22 and 23, Pure and Applied Mathematics respectively. Colour has been used to denote those universities which did not achieve at least one grade 5 in either Unit 22 or Unit 23. There is clearly considerable commonality in the universities shown in colour in both Table 2 and Table 3. If the work of the RSS is valid and the conclusions it draws on the effect of post–RAE funding decisions on the stability of Departments are correct, then if this is representative of the entire HE mathematics provision, there is genuine cause for concern on a number of fronts, including the opportunities for widening participation.

6.3 Figure 1 shows the location of all universities offering mathematics degrees in the UK. The colour–coding follows that in Table 2. By implication, they will contain mathematics departments which will contribute to the local economy as described elsewhere. It is noticeable that the Thames Valley, the East of England and most of Wales contain only black circles, corresponding to Universities with higher entry requirements.

6.4 In Figure 2, we show only the distribution of the Universities coloured either red or blue in Table 2, that is, the Universities likely to be the main contributors to widening participation in mathematics while at the same time fulfilling the wider roles outlined in Section 1.

6.5 In Figure 3 we show a grey–scale map of the population density Great Britain. It is evident from the map in Figure 2 that 'broader–entry' provision is currently available in several areas, around London, the Midlands, Lancashire etc.. However within regions of high population density and also in some regions of medium population density, in figure Figure 3, there is no such provision available. The area to the north–west of London is such an example.

6.6 As already observed, termination of recruitment to courses at Bangor and Hull has had a noticeable effect with the whole of North Wales and East Yorkshire without provision of any kind. In fact, the picture is bleak in terms of 'broader–entry' courses in the whole of Eastern England, Wales and in the central and western parts of southern England. Overall, the picture is depressing and a cause for concern.

6.7 It is interesting to examine the location of mathematics provision in a little more detail. Table 4 we show where mathematics courses and, by implication, other mathematical 'services' are located in cities with a population greater than 30,000. There are a number of towns with large populations which do not have city status and the same information for these is given in Table 5. In both Tables 'Y' is used to show the presence of a mathematics degree programme: 'YB–E' denotes (also) the availability of what we have termed an 'broader–entry' course. 'U' denotes the existence of a University without a mathematics programme. The absence of provision in Hull and Bradford reflects recent closures, and the closure of the course at Sunderland has further contributed to the mathematics desert in the East of England.

6.8 Table 5 reflects, in many cases, areas of relatively recent population growth. In some cases universities have been created, but mathematics provision is not widespread. In others areas, established universities operate local campuses delivering their programmes. Sadly, mathematics programmes do not appear to be offered in such cases.

6.9 As a particular example, Lincoln has a new University located on an impressive modern campus in the middle of the city. A course in mathematics, or even one rich in mathematics, is not offered at this University and one may wonder about the effect on local, mathematically able students in the area. Will, they, as before, leave the area to pursue the subject, or, perhaps and in some cases at least, more likely, elect to study a different subject which is offered in Lincoln? This decision will face many students in other cities and towns where a similar lack of provision applies. Actually, this concern seems to apply to the entire STEM subject area in a number of cases.

6.10 A strong regional presence of Mathematics and Statistics is important in terms of access to higher education opportunities. However in addition, Universities have a substantial economic impact on their locality through their direct activities including research and consultancy. A survey of graduates from HEI's in the North-West of England [14] confirmed the existence of 'local' students, with a strong commitment to the region, who worked in the North-West after graduation. Moreover, we believe that there is a tendency for a proportion of graduates tend to stay in the general area of the University after graduation and hence contribute to regional economic development in the longer term. Given the importance of Mathematics and Statistics to the knowledge economy, a region without a strong presence in these disciplines will likely miss out on this additional boost to regional economic development to its long term detriment. The Government's policy is to promote greater economic growth in regions that lag behind the UK GDP per capita average. In general these are the very regions where we have concerns for the future provision of Mathematics and Statistics.

6.11 In its evidence in January 2005 to the Select Committee on Science and Technology inquiry into strategic science provision, the London Mathematical Society noted five departments of mathematics had closed since 1999. These closures are a genuine and very real cause for concern, particularly given their locations and the effect on 'broader–entry' provision.

6.12 One of the major concerns of the Smith Report [5] involved the number and level of qualification of mathematics teachers. The report identified a role for HE mathematics departments in supporting schools and colleges. Specifically in paragraph 6.19 the report stated that 'The Inquiry believes that there should be closer working between all HE mathematics departments, schools of education and their local schools and colleges.' The report goes on to identify some advantages for teachers and pupils of such a relationship. One such advantage was the possibility of encouraging pupils to consider a career as a teacher of mathematics. Implicit in carrying out this role is the existence of a local HEI with a

mathematics department.

6.13 It has been conjectured that those who enter school teaching are more likely to attend a local or regional university, and to remain in the area on qualification. Those who do go further away are also less likely to return to their home areas. Data to support or reject this conjecture is needed and might be a significant factor in developing a strategy to improve the supply of mathematics teachers. According to a survey carried out by NFER [15], during the academic year 2004–2005, 24% of those teachers who were teaching mathematics 'were either non–specialists or were predominately teachers of other subjects'. Actions to support such a strategy clearly need to be taken if we are to meet the government's target of 95% of mathematics classes being taught by a specialist by 2014.

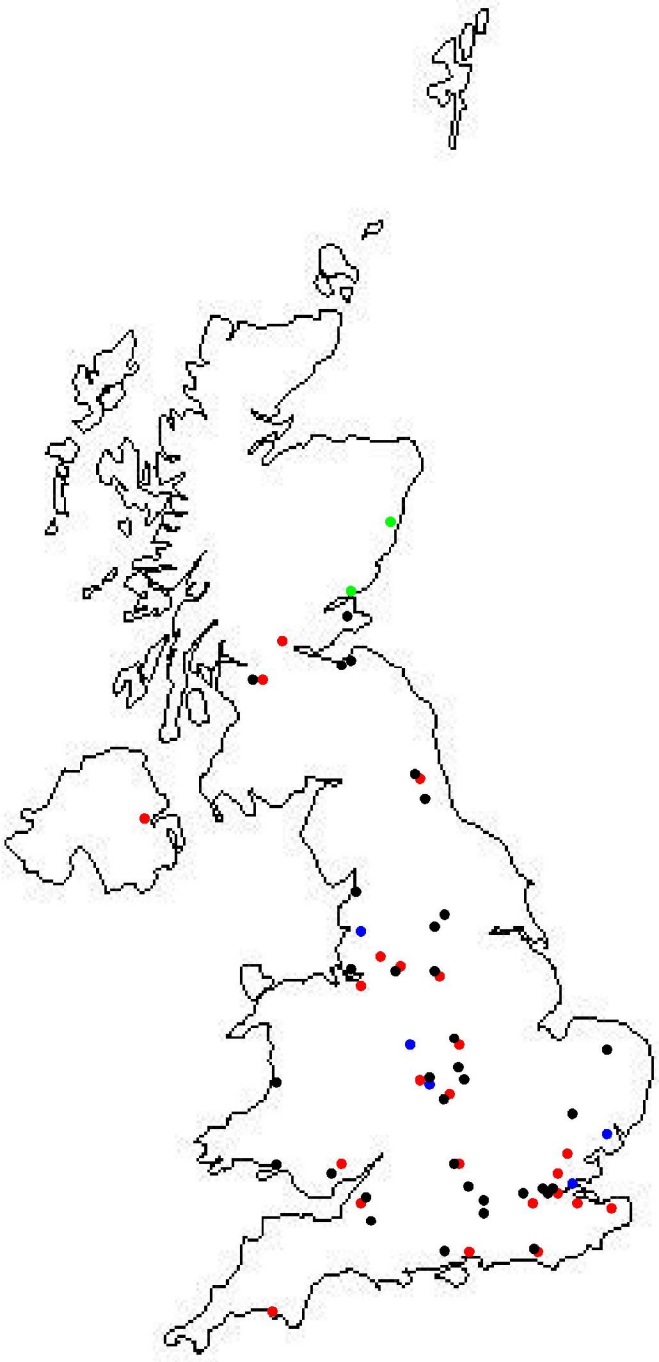

Figure 1: Location of Courses in Mathematics in the UK

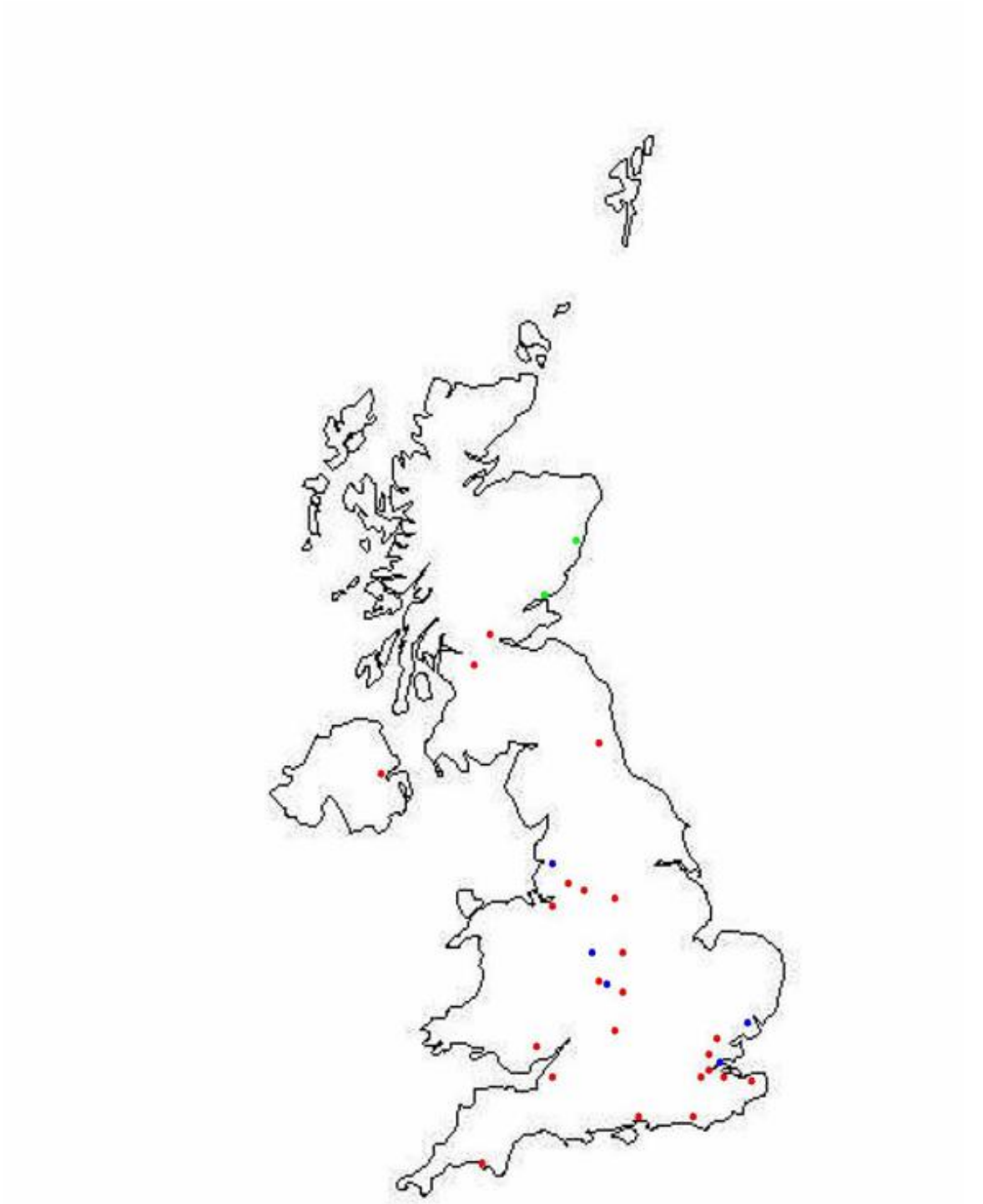

Figure 2: Location of 'Broader–Entry' Courses in Mathematics in the UK

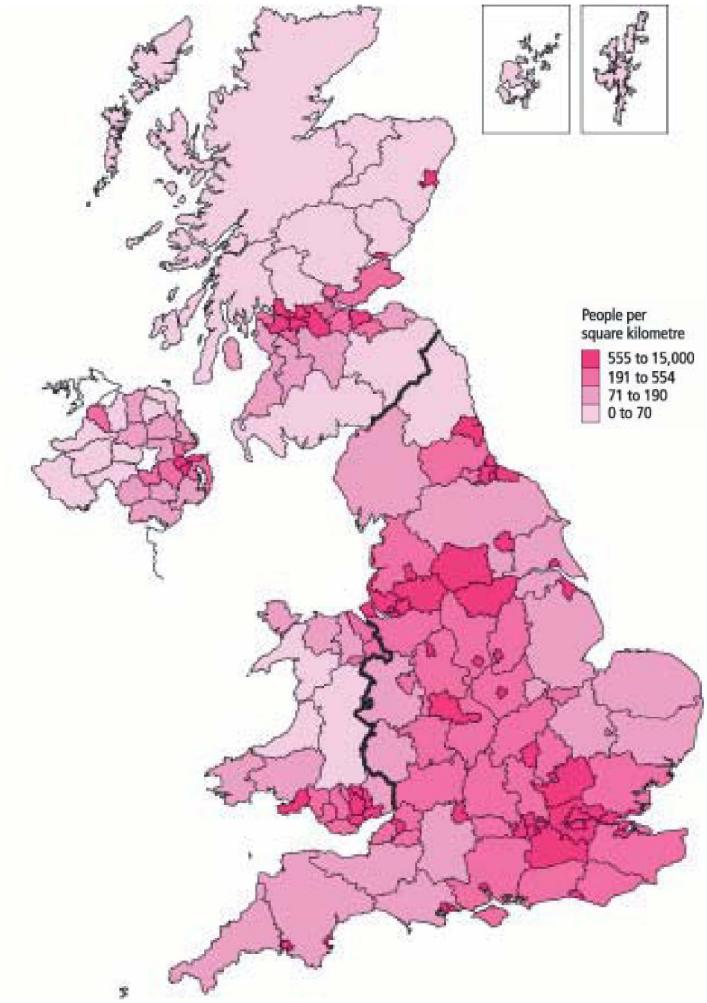

Figure 3: Population Density

Counties, unitary authorities, Inner and Outer London in England, unitary authorities in Wales, council areas in Scotland and district council areas in Northern Ireland for 2004.

Source: Census 2004 – based population estimates, Office for National Statistics; General Register Office for Scotland; Northern Ireland Statistics and Research Agency

COURSES IN MATHEMATICS (G100 UNLESS OTHERWISE SHOWN)					
University	**Points †**	**Grade**	**University**	**Points †**	**Grade**
Aberdeen *	300	B	Aberystwyth	300	B
Aston	280-320	C	Bath **	340-360	A
Birmingham	300-320	A	Bolton	230	Pass
Brighton	260	Pass	Bristol	320-360	A
UWE, Bristol (G101)	240-260		Brunel (G104 sandwich)	300	B
Cardiff	320	A	Central Lancashire	280-320	Pass
Chester	260	C	City	260	B
Coventry	240	B	Dundee *	300	B
Durham	340	A	UEA	300-320	A
Edinburgh	320	A	Essex	280-300	B
Exeter	280-320	B	Glamorgan	240-280	C
Glasgow	240-260	?B?	Greenwich (G140)	160	Pass
Heriot-Watt	300	Pass	Hertfordshire	180-220	Pass
Imperial College **	360	A **	Keele	280-300	B
Kent	260	B	King's College	320-340	A
Kingston	260	Pass	Lancaster	320	B
Leeds	340	A	Leicester	300-400	A
Liverpool	300-320	B	London Met.	120-160	Pass
Loughborough	300	A	Manchester	320-340	A
Manchester Met	200-260	C	Newcastle	320-340	A
Northumbria	260	C	Nottingham	340-360	A
Nottingham Trent	260	B	Oxford Brookes (G140)	160	C
Plymouth	200	B	Portsmouth	240	Pass
Queen Mary College	280	B	Queen's Belfast §	260-280	B
Reading	300	B	Royal Holloway	320	A
Sheffield	300	A	Sheffield Hallam	200	Pass
Southampton	340	B	St Andrews	340	A
Stirling	220	Pass	Strathclyde	260	Pass
Surrey	340	A	Sussex	320	A
Swansea	300	B	University College	380	A
Warwick ¶	390-420	A *	York	320-340	A
Wolverhampton (G140)	160-220	Pass			

Table 2: Published Admission Requirements

*Oxford and Cambridge have not been included in this table as they set Entrance Tests (although both feature in Figure 1). Universities shown in red admit on minimum points totals which are **less** than 280, and have a (maximum) requirement of grade of B in A-level mathematics. Those shown in blue require 280 points alongside (at most) a grade B in mathematics. Those shown in black* require students to have gained **more** than 280 points **and** a grade A in A-level mathematics. *The two Scottish Universities shown in green offer entrance to year one of a four–year programme, see note * below.*

† Where not given by the University, points are calculated on A–level grades alone unless there is a specific pass requirement at GCSE level.

* Admission to year 2, Admission to year 1 on 240 points and a good performance in maths and one other technology subject.

** Strong preference for second quantitative subject, especially Further Maths.

§ Entrants with lower qualifications could be admitted to year 1 of a four–year programme.

¶ Pass in Step/AEA or Further Maths at A or AS–level required.

RESEARCH RATINGS FOR DEPARTMENTS OFFERING COURSES IN MATHEMATICS (G100 UNLESS OTHERWISE SHOWN)					
University	**Unit 22**	**Unit 23**	**University**	**Unit 22**	**Unit 23**
Aberdeen	5	4	Aberystwyth	3b	4
Aston			Bath	5	5*
Birmingham	5	5	Bolton		
Brighton		3a	Bristol	5	5*
UWE, Bristol		3a	Brunel (G104 sandwich)		5
Cardiff	5		Central Lancashire		
Chester		3b	City		4
Coventry		3a	Dundee		5
Durham	5	5*	UEA	5	4
Edinburgh	5*	5	Essex	3a	3a
Exeter	4	5	Glamorgan		
Glasgow	5	5	Greenwich (G140)		
Heriot-Watt		5	Hertfordshire		
Imperial College	5*	5*	Keele	2	5
Kent	3a	5	King's College	5	5
Kingston			Lancaster	4	
Leeds	5	5	Leicester	5	5
Liverpool	5	5	London Met.		
Loughborough		4	Manchester	5	5(4)
Manchester Met.			Newcastle	5	4
Northumbria		3a	Nottingham	5	5
Nottingham Trent		3a	Oxford Brookes (G140)		3a
Plymouth	3b	3a	Portsmouth		5
Queen Mary College	5	4	Queen's Belfast	3a	
Reading	3a	5	Royal Holloway	5	
Sheffield	5	5	Sheffield Hallam		
Southampton	5	5	St Andrews	5	5
Stirling	3a		Strathclyde		5
Surrey		5	Sussex	4	5
Swansea	5		University College	5	5
Warwick	5	5*	York	5	5
Wolverhampton					

Table 3: Research Ratings Achieved in the 2001 RAE. Universities shown in blue did not achieve a 5 or 5 rating in either of Units 22 or 23.*

MATHEMATICS PROVISION IN CITIES WITH POPULATIONS ABOVE 30,000							
	CITY	**POP.**	**COURSE?**		**CITY**	**POP.**	**COURSE?**
1	London	7,172,091	YB-E	29	Norwich	174,047	Y
2	Birmingham	970,892	YB-E	30	Swansea	169,880	Y
3	Glasgow	629,501	YB-E	31	Dundee	154,674	YB-E
4	Liverpool	469,017	Y	32	Oxford	143,016	YB-E
5	Leeds	443,247	Y	33	York	137,505	Y
6	Sheffield	439,866	YB-E	34	Peterborough	136,292	–
7	Edinburgh	430,082	Y	35	Gloucester	123,205	U–
8	Bristol	420,556	YB-E	36	Newport	116,143	– ¶
9	Manchester	394,269	YB-E	37	Cambridge	113,442	Y
10	Leicester	330,574	Y	38	Exeter	106,772	YB-E
11	Coventry	303,475	YB-E	39	Worcester	94,029	U–
12	Hull	301,416	U–	40	Bath	90,144	Y
13	Bradford	293,717	U–	41	Lincoln	85,963	U–
14	Cardiff	292,150	Y ¶	42	Derry	83,699	–
15	Belfast	276,459	YB-E	43	St. Albans	82,429	–
16	Stoke	259,252	YB-E †	44	Chester	80,121	YB-E
17	Wolverhampton	251,462	YB-E	45	Wakefield	76,886	–
18	Nottingham	249,584	YB-E	46	Salford	72,750	U– ‡
19	Plymouth	243,795	YB-E	47	Carlisle	71,773	–
20	Southampton	234,224	Y	48	Lisburn	71,465	–
21	Derby	229,407	U– §	49	Hereford	56,373	–
22	Brighton & Hove	206,628	YB-E	50	Lancaster	45,952	Y
23	Newcastle	189,863	YB-E	51	Canterbury	43,552	YB-E
24	Portsmouth	1870056	YB-E	52	Salisbury	43,355	–
25	Preston	184,836	YB-E	53	Durham	42,939	Y
26	Aberdeen	184,788	YB-E	54	Winchester	41,420	–
27	Westminster	181,766	U– *	55	Inverness	40,949	–
28	Sunderland	177,739	U–	56	Stirling	32,673	YB-E

Table 4: Provision of mathematics courses in cities. Source: www.lovemytown.co.uk based on 2001 Census publications Key Statistics for urban areas in England and Wales Table KS01, Key Statistics for Settlements and Localities Scotland Table KS01 and Northern Ireland Census 2001 Key Statistics for Settlements Table KS01.

U Indicates the presence of a University in the city.
YB-E Indicates that the University has a 'Broader-Entry' course
¶ The University of Glamorgan at Pontypridd provides a course of the type classed as 'broader–entry'.
† There is mathematics provision at Keele University.
‡ There is 'broader–entry' provision at Manchester Metropolitan University. Manchester University is also close.
§ Nottingham and Nottingham Trent Universities are reasonably close.
* There is provision in London as a whole.

DISTRIBUTION OF COURSES IN MATHEMATICS IN OTHER LARGE URBAN AREAS							
	TOWN	**POP.**	**COURSE?**		**TOWN**	**POP.**	**COURSE?**
1	Reading	232,662	Y	15	Ipswich	138,718	–
2	Dudley	194,919	–	16	Telford	138,241	–
3	Northampton	189,474	U–	17	West Bromwich	136,940	– ¶
4	Luton	185,543	U–	18	Stockport	136,082	– §
5	Milton Keynes	184,506	U– †	19	Slough	126,276	–
6	Walsall	170,994	– ‡	20	Watford	120,960	–
7	Bournemouth	167,527	U–	21	Rotherham	117,262	–
8	Southend	160,257	–	22	Eastbourne	106,562	–
9	Swindon	155,432	–	23	Sutton Coldfield	105,452	– *
10	Huddersfield	146,234	U–	24	Blackburn	105,085	–
11	Poole	144,800	–	25	Colchester	104,390	YB-E
12	Middlesbrough	142,691	U–	26	Oldham	103.544	–
13	Blackpool	142,283	–	27	St. Helens	102,629	–
14	Bolton	139,403	YB-E	28	Crawley	100,547	–

Table 5: Provision in large towns Source: www.lovemytown.co.uk based on 2001 Census publications Key Statistics for urban areas in England and Wales Table KS01, Key Statistics for Settlements and Localities Scotland Table KS01 and Northern Ireland Census 2001 Key Statistics for Settlements Table KS0

U Indicates the presence of a University in the town.
YB-E Indicates the presence of a 'Broader-Entry' course
¶ The Universities of Aston, Birmingham and Wolverhampton are reasonably close.
§ Manchester and Manchester Metropolitan University are within a reasonable distance.
† The Open University is based in Milton Keynes, but does not have undergraduates on campus.
‡ Wolverhampton University is nearby.
* Aston University is within reasonable traveling distance.

7. Conclusions

7.1 Steps need to be taken to ensure that there is an adequate level of provision in mathematics in HE on a sub–regional basis in the UK. The level of this provision needs to be such that it ensures that high quality honours degree courses in mathematics are available with entry requirements set at a level which indicates a good, but not necessarily outstanding performance in mathematics at A–level. HEFCE's strategy for the support of strategic and vulnerable important subjects currently depends on a demand–led approach and it has chosen to support raising of demand through its widening participation actions. Thus, mathematics provision needs to include courses which are accessible to non–traditional HE entrants attracted to mathematics via Widening Participation activities.

7.2 Taking a wider view of mathematics provision in a university, the existence of mathematics expertise is an essential requirement for the support of both teaching and research in the related or dependent disciplines. As observed by the RSS in the case of statistics, the amount of direct service teaching has reduced in many universities, often as an unintended consequence of internal university funding models. Loss of the income generated through this work (which is by no means limited to the teaching of statistics) has put increased pressure on some mathematics departments and this in turn can undermine the existence of courses in mathematics itself, thereby contributing to the loss of provision.

7.3 Economic pressures and subsequent university reorganisations have led to a number of amalgamations between distinct disciplines. Sometimes this leads to a positive result with the formation of a harmonious and economically successful grouping. This is not always the case however: some mergers have left mathematics or statistics groups feeling impoverished and undervalued. This situation is to be deplored, since in such circumstances there will be a reduced appetite for research achievement and teaching development. Mathematical sciences will not thrive and thus not produce the various forms of expected benefit to the local economy.

7.4 The maps of the UK show that there are already areas of significant population where 'broader-entry' (in the sense defined above) mathematics honours degree courses cannot be studied without leaving home. In 6.6 we noted the bleak situation in the whole of eastern England, Wales and in the central and western parts of southern England. We also highlighted some recent events which have exacerbated the problem.

7.5 As discussed in chapter 6.6, there is an economic impact on areas where there are no university–based mathematics and statistics resources to support local industry and business. This impact may well go undetected in the short–term, but will eventually adversely affect economic regeneration or development.

7.6 There are a number of urban areas with high populations, with new

Universities or University campuses operated at a distance by established Universities. Welcome as this development should be, it is unfortunate that mathematics does not feature in the HE programmes on offer. The overall result could be that students who would prefer to live at home and otherwise would have studied mathematics will choose to study another subject, which is probably unlikely to be another STEM subject, on offer locally.

7.7 HEFCE has decided that the protection of STEM subjects must be on a demand–led basis, hence the funding for projects to increase student demand, mainly through widening partcipation initiatives. For the reasons we have outlined above, if this is to work in mathematics, then there needs to be an adequate level of provision of 'broader–entry' courses within the UK. If the RSS analysis is to be believed, then a major driver in the demise of courses (in statistics) has been post–RAE funding decisions, which while they have produced good concentrations of research capability, may have then gone on to produce over–concentration in all aspects of the subject, including its teaching. Writing in the Guardian on 16th January 2007, Peter Knight [16] the ex vice–chancellor of the University of Central England justified his closure of the mathematics department in 1986, as being based on lack of demand. There have been several others since that date, and it would be tragic if at a time when action is being taken to drive up demand, further closures mean that such demand cannot be met appropriately.

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Professor Nigel Steele
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