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A SURVEY OF SOME FIFTH- AND
SIXTH-FORMERS' PERCEPTIONS
OF MATHEMATICS

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CHAPTER 1

INTRODUCTION

This Report gives some results of a small but purposive survey of the attitudes of school fifth- and sixth-formers to mathematics as a subject and their opinions as to whether they wished to proceed to further study of mathematics. The survey was conducted by direct face-to-face interviewing of the pupils at their schools during the academic year 1990-1991. The interviewing and the initial analysis of the data were carried out by a fourth-year student, Mr R T Davies, in the Department of Mathematics and Statistics at Brunel University as part of his Final Year Project. The author of this Report was closely involved with the work, as was Dr E J Davis of Henley Management College; both the author and Dr Davis had roles of project supervisors and independent roles concerning survey design and analysis.

The objectives of the survey were twofold - partly a genuine professional interest in researching pupils' attitudes to mathematics, and partly a desire within the Mathematics and Statistics Department to understand more about the potential market of candidates for its courses. In presenting the results in this Report, it is hoped that they will be of some interest within the Department and to the schools which kindly participated in the survey, and perhaps to a wider audience too.

It needs to be stressed at the outset that the work was carried out as a limited exercise mainly within the context of Mr Davies' project. There were heavy constraints in terms of Mr Davies' time and a very low budget for his traveling expenses. No attempt, therefore, was made to contact what could in any sense be described as a random sample of the population of school fifth- and sixth-formers. Instead, the sampling was highly purposive in nature, seeking to reach just a small number of schools of comparatively high academic standards and where it might be expected that there would be a propensity for pupils in each stage of education to wish to proceed to a further stage. On the whole these aims were achieved. It is however clear from the interest of the results, if indeed it was not already clear before the work started, that there is ample scope for a much

larger survey. Such a survey would, however, obviously need to be conducted as a properly resourced professional research exercise.

Considerable care was exercised in selecting schools to be approached as possible participants in the survey. It was felt that schools might have some misgivings about being approached "out of the blue" to participate in such an exercise, particularly as the survey was of a somewhat private nature being focused on a student project rather than an externally funded piece of research. The initial selection of possible participants was therefore based partly on schools where either the author or Mr Davies had personal contacts and partly on schools with which the Department of Mathematics and Statistics had collaborated in various ways over many years. Some attention had also to be paid to geographical considerations in view of the constraints of Mr Davies' time and finances. Nevertheless, a list of a modest number of suitable schools was readily drawn up, these were contacted by letter outlining the objectives of the work and seeking their participation.

The caution in this regard appears to have been justified. Some schools responded very favourably and positively. Some declined for perfectly good and understandable reasons concerning the incidence of examinations and/or timetables that were already full. But it was very disappointing to have had no response at all from some schools, despite follow-up letters and attempts to make contact by telephone.

A list of the schools that eventually participated is provided in Appendix B. It is immediately evident that they are far from a random selection of schools. But, remembering the highly purposive nature of the work as outlined above, they provide a reasonably appropriate coverage of the state and private sectors and of mixed and single-sex schools. Unfortunately no all-girls school is included; one was approached and replied enthusiastically but in the event it was logistically impossible for Mr Davies to visit it. It is also a matter of much regret that no sixth-form college is included, but in this case no positive responses were received.

Very grateful thanks are extended to the Heads and the Heads of Mathematics of the participating schools for so readily allowing the survey to be conducted and for making available the appropriate resources (usually in the form of a private

room). Mention should also be made of Mr M G Godfrey and Mr G R Smith who, without being the Heads of Mathematics at their respective schools, attended to the necessary arrangements and to general matters of hospitality.

Very grateful thanks are also extended to the pupils who allowed themselves to be interviewed and in virtually all cases responded with much honesty and openness and with real interest in the survey. Indeed, a distinct advantage arises here in having the interviewing conducted by a student, for it was clear that the pupils generally found themselves easily able to relate to Mr Davies and to respond both to the basic questions and to probing of particular replies. Mr Davies himself spent much effort in preparing for the interviews and in designing the questions he wished to ask. Both "closed" and "open" questions were used; the interviews were deliberately conducted as a mixture of formal structured questioning and a more informal approach with probing. In order that conversation would not be inhibited by Mr Davies having to make written notes while interviewing was actually in progress, each interview was recorded on a cassette recorder for later transcription. A written summary was made after the conclusion of each interview in case of any problem with the recording, but happily few such problems occurred.

Strict confidentiality was promised to the participating pupils. To honour this promise, this Report provides only an overall analysis and does not analyse responses within the individual schools; nor will such information be reported elsewhere. The numbers involved are quite small, so it is necessary to ensure that individual respondents cannot be separately identified.

Appendix A provides some general background data on numbers of applicants for and admissions to universities through the UCCA scheme over the period 1981-1990; totals for all courses are given and also totals for mathematics courses in particular. Corresponding data for Brunel University are also given in this appendix. The Brunel University data will mainly be of interest internally within the University and the Mathematics and Statistics Department; the national data may be of somewhat wider interest.

CHAPTER 2

EDUCATION BACKGROUND

The late 1980s and early 1990s have seen very major and rapid changes in the education system and an on-going, and very public, debate about the whole nature of education in Britain. It would be futile to try to summarise the situation and provide an up-to-date view, because the up-to-date situation is itself continually changing. However, as the present Report is set in a "time warp" of 1990-1991, a brief review of the situation as at that time is called for.

In the school system, the GCSE examination had replaced the previous O-level and CSE as the examination normally taken by pupils at the end of their fifth-forms (or in some cases and in some subjects a year earlier). It is important to remember that the GCSE was *substantially* different from its predecessors. However, the GCSE was itself in the process of being overtaken by the gradual implementation of the National Curriculum; this would require compulsory testing at the ages of 7, 11, 14 and 16, and the GCSE would need to be redeveloped to be the main vehicle for National Curriculum age-16 testing. (This testing was expected to first occur in 1994 in respect of the subject of mathematics, though this has become a very tight time-scale as the National Curriculum has now itself been redesigned.) These further changes, however, did not really impinge on 1990-1991 fifth-formers; those taking GCSE in 1991 (or who had already done so in 1990) faced an examination that had become reasonably well established in its few years of existence up to that time.

The A-level examination taken by sixth-formers had remained substantially unchanged for some years. In particular, it had, in 1990-1991, not really reacted to the considerable changes in the "input" of its candidates who were now coming forward through the GCSE system rather than (for the most part) via O-levels. This was causing problems, which were particularly noticeable in mathematics because of the strongly sequential nature of the subject; GCSE candidates were often not well equipped for some aspects of A-level courses. Syllabus development of A-levels was beginning to be put in hand so as to reduce the mis-match with the GCSE; but current candidates often had real problems in making the transition

from GCSE to A-level.

A new examination, the AS ("Advanced Supplementary"), had very recently (1989) been introduced in an attempt to broaden sixth-form work. This examination was to be of the same advanced level standard as the A-level but based on only half the syllabus content; it was intended that candidates would be prepared for it by being taught over two years but for half the contact time of an A-level. It is fair to say that the AS had not established itself by 1990-1991 and was not well understood as an addition to the sixth-form "menu". Many schools did not offer AS examinations at all (often because of very real constraints of resources), while where it was offered this was sometimes done as a one-year course, even sometimes for fifth-formers and not sixth-formers.

The general idea of broadening sixth-form work inherent in the AS examination was however widely seen as important- Many authors, in the press as well as in official reports and academic journals, had lamented the highly specialised nature of sixth-form education. Even more lamented was the fact that a very high proportion (about 60%) of children dropped out of full-time education altogether at age 16, evidently not viewing the sixth-form (or other avenues) as providing an attractive route forward. This figure of 60% was in stark contrast with corresponding figures in other countries - notably, about 10% in West Germany (as it then was) and 5% in Japan. The rapid development and widening of a "skills gap" was widely foreseen, much accentuated by demographic trends that meant there would be some 30% fewer 18-year-olds in the population in the mid-1990s than in the mid-1980s. Much was being (and is still being) written about the deleterious effect this would have on the availability of appropriately skilled manpower and the consequences for the competitive position of British industry, business and commerce.

An excellent professional review of the concerns outlined in the previous paragraph is provided by Professor P G Moore (then the Head of the London Business School) in Moore (1990). These concerns apply to skills in all subjects. But they are widely seen as particularly applying to skills in mathematics due to the urgent and increasing necessity to bring numerate approaches to bear on complex modern problems. Thus the argument partly returns to the development of sixth-form mathematics courses that, as well as being rigorous and demanding, will be

interesting and stimulating and will cause pupils to positively want to take them. Many developments that are (hopefully!) of this nature are now in hand (for a review, see Volume 9 Number 3 (1990) of the journal 'Teaching Mathematics and its Applications', much of which is devoted to descriptions of early stages of some of these developments). But in 1990-1991, implementation of most of these was still "just around the corner". Arguably this attaches even more interest to a survey of pupils' attitudes to mathematics at that time.

A summary of one aspect of the above remarks is that in 1990-1991 the interface from fifth-form to sixth-form was a little difficult, at least in mathematics. The interface from sixth-form to university (or other post-school education) may perhaps have been a little easier - for the small minority who had done A-level and done fairly well at it. Universities however were beginning to view the situation with concern. The demographic decline in the number of 18-year-olds meant that universities would need to attract a much bigger proportion of the cohorts to even maintain student numbers, let alone increase them, and this at a time when a gap might begin to develop between A-levels and university courses precisely because of the attention being paid to the emerging gap between A-levels and GCSE. Universities were beginning to make arguments about the necessity for "foundation years" or for a standard four-year course leading to a first degree instead of the traditional three years (or, for institutions offering "sandwich" courses, five years instead of four) - changes that would require major alterations in course design and in financing arrangements. And if such major alterations proved out of the question, there would still need to be changes in the existing course design. Again, perhaps most of this was still "just around the corner" in 1990-1991; so, again, a study of pupils' attitudes at that time to proceeding to post-school mathematical study becomes arguably the more interesting.

CHAPTER 3

RESULTS FOR FIFTH-FORMERS

Fifth-formers were interviewed at six of the seven participating schools (at the remaining school it was impossible to overcome timetabling difficulties), to a total number of 45. Each school was asked to select pupils covering a reasonable range of mathematical ability. The smallness of the total number re-emphasises the points made in Chapter 1 about this being a highly purposive sample and in no sense a random sample of the population of fifth-formers. Although opportunities for statistical analysis are obviously limited, it is hoped that the results are reasonably indicative of the attitudes of the appropriate sub-population of fifth-formers.

In the total of 45, there were 8 pupils who were not British nationals (the corresponding percentage of 18 being another indication of lack of randomness!). These have been included in all the results reported here as they had been and were being educated within the normal school system. They are separately identifiable within the coding system used for the analysis, but no separate results have been reported for the reasons of confidentiality discussed near the end of Chapter 1. It would be a very interesting exercise in a larger survey to investigate whether there are important differences of opinion unique to this sub-population.

The initial questions of the survey attempted to separate pupils' attitudes to mathematics as a subject (did they enjoy it?) from their assessments of whether or not it was difficult, and further to separate both these factors from attitudes to their actual GCSE courses in mathematics. Clearly there was potential here for confusion in the interviewees' minds as to exactly what was being sought, and it would certainly have been difficult to reliably make these separations in a postal survey. But the presence of Mr Davies as a face-to-face interviewer enabled any problems to be overcome, by explanation and by probing (but always with great care to avoid "leading"). It is therefore thought that the analysis of results reported here successfully makes these separations.

Question 1. Enjoyment of mathematics as a subject

As with many of the other questions, the pupils were allowed to respond freely to this question without constraints of pre-specified replies. Their responses were grouped in the coding operation into 'enjoy very much', 'enjoy', 'neutral', 'do not enjoy' and 'dislike very much' (a category that happily remained empty!), with the following results.

Table 3.1 (fifth-formers). Enjoyment of mathematics as a subject.

	Frequency	Percentage
Enjoy very much	6	13
Enjoy	25	56
Neutral	7	16
Do not enjoy	7	16
Dislike very much	0	0
	Total 45	

The favourable overall reaction to mathematics as a subject is immediately clear. Formal statistical verification is hardly necessary, but a routine application of the standard chi-squared procedure to test a simplistic hypothesis of a uniform distribution over these categories (so that for a sample of this size the expected frequencies would be 9 in each category) leads to a very highly significant result (39.33 with 4 degrees of freedom), giving very strong evidence against this hypothesis.

A summary of the responses can be provided by a "weighted average score". Associating "scores" of 1,2,3,4,5 respectively with the categories (1 = 'enjoy very much', 5 = 'dislike very much'), the weighted average is simply calculated as $\{(1 \times 6) + (2 \times 25) + \dots + (5 \times 0)\} / 45 = 2.33$. Thus the "average response" is nearer to 'enjoy' than to any of the other categories, which again indicates the favourable overall reaction. [Care must of course be exercised in interpreting this average score. For instance, if the frequency distribution is bimodal with large frequencies at both ends of the scale, the average will be near the middle of the scale and have little useful meaning. However, inspection of the present frequency distribution shows that no such problem arises here.]

Question 2. Difficulty of mathematics as a subject

Responses here were grouped in the coding operation into the categories ‘very easy’, ‘easy’, ‘reasonable’, ‘difficult’ and ‘very difficult’. The responses were as shown in the table, which also displays a scoring system as it is again sensible to calculate a weighted average score.

Table 3.2 (fifth-formers). Difficulty of mathematics as a subject.

score		Frequency	Percentage
1	Very easy	5	11
2	Easy	17	38
3	Reasonable	12	27
4	Difficult	10	22
5	Very difficult	1	2
		Total 45	

The strong tendency towards the "centre" of this table is immediately apparent, with 'easy' being the most frequently occurring category. The simplistic hypothesis of a uniform distribution over the categories is again strongly rejected by the chi-squared procedure (value of test statistic is 17.11, four degrees of freedom). The weighted average score is 2.67, indicating an average response on the 'easy' side of 'reasonable'.

As the sample is only of size 45, it is easy to draw up and interpret an explicit two-way table showing the frequencies for perceived enjoyment and perceived difficulty of mathematics as a subject. This table is shown below. It is perhaps unsurprising that the frequencies tend to cluster around the diagonal of the table, indicating that relative enjoyment is linked with relative ease, but nevertheless a limited amount of "scatter" can be seen.

Table 3.2(a) (fifth-formers).

Enjoyment of mathematics versus difficulty of mathematics.

	Very easy	Easy	Reasonable	Difficult	V difficult
Enjoy v much	3	3			
Enjoy	2	11	8	4	
Neutral		2	3	2	
Do not enjoy		1	1	4	1
Dislike v much					

Question 3. Attitudes to GCSE mathematics

The pupils were here asked to reflect on their GCSE courses in mathematics (as opposed to their total overall views of mathematics as a subject) and to respond separately as to whether they had found their courses interesting and whether they had found them difficult.

The responses concerning the interest of the GCSE courses could be easily and naturally grouped as 'interesting', 'neutral' and 'boring'. The results were as shown in the following table.

Table 3.3(i) (fifth-formers). Interest of GCSE mathematics.

Score		Frequency	Percentage
1	Interesting	19	42
2	Neutral	14	31
3	Boring	12	27
		Total 45	

Intuitively it appears that the responses are fairly evenly spread over the three categories, and indeed the simplistic hypothesis of uniformity is not rejected by the chi-squared procedure (value of test statistic = 1.73, two degrees of freedom). The weighted average score is 1.84, but this is of limited use here. These results must be seen as disappointing in terms of the efficacy of the GCSE in arousing interest - particularly bearing in mind the very positive overall response to enjoyment of mathematics as a subject (see Table 3.1 above). The two-way table for enjoyment of subject and interest of GCSE provides interesting elaboration: -

Table 3.3(i)(a) (fifth-formers).

Enjoyment of subject versus interest of GCSE.

	Interesting	Neutral	Boring
Enjoy v much	2	3	1
Enjoy	12	5	8
Neutral	2	4	1
Do not enjoy	3	2	2
Dislike v much	0	0	0

The responses concerning difficulty of GCSE mathematics were grouped in the same way as those for the difficulty of mathematics as a subject. The results were as follows.

Table 3.3(H) (fifth-formers). Difficulty of GCSE mathematics.

Score		Frequency	Percentage
1	Very easy	12	27
2	Easy	11	24
3	Reasonable	15	33
4	Difficult	7	16
5	Very difficult	0	0
		Total 45	

There is a very clear tendency towards the 'easy' end of the table. The simplistic hypothesis of uniformity is rejected quite strongly (value of test statistic is 14.89, four degrees of freedom). The weighted average score is 2.38, confirming that on the whole the pupils found the GCSE mathematics course to be relatively easy. Indeed, it is perhaps worth quoting a remark made, wholly unprompted, by one of the pupils : "I found GCSE far too easy, it was interesting but not at all challenging".

It is of interest to recall that the weighted average score for these pupils' perceptions of the difficulty of mathematics as a subject was 2.67. This is somewhat higher than the 2.38 for GCSE mathematics and gives an indication of an overall belief among these pupils that mathematics as a subject is harder than is reflected in the GCSE course. Reasons for this belief are not clear.

Question 4. Attitudes to GCSE coursework

An important feature of the GCSE is the inclusion of coursework as a component of the overall assessment. (Not only is this an important feature, but at the time of writing this report it has become a feature of some controversy in the public debate referred to in Chapter 2.) It was therefore of much interest in the survey to try to discover the pupils' attitudes to coursework.

"Coursework" of various kinds has been an established feature in some subjects for many years; for example, the "chemistry practical" could be viewed as such. It was however a considerable innovation in the subject of mathematics. To help smooth its introduction, the first few years of the GCSE provided an option of taking an assessment which was still wholly by examination; this option was still available in 1991, and it turned out that 8 of the pupils in the survey were taking such a "no coursework" GCSE. These 8 have therefore been excluded from the results reported in this section, leaving a total of 37 respondents.

The pupils were asked, simply, what they felt about the coursework. Their responses could easily be grouped as 'like', 'neutral' and 'dislike'. The results were as shown in the table. No scoring system is attached to this table because it would be meaningless to calculate a weighted average score with such a strongly bimodal response.

Table 3.4 (fifth-formers). Perceptions of GCSE coursework.

	Frequency	Percentage
Like	21	57
Neutral	2	4
Dislike	14	38
	Total 37	

Elaboration is hardly necessary! Paraphrasing somewhat, they either love it or loathe it. This was further brought home by several of the comments made by the pupils, often in strong terms. Selecting just two such comments, one from either side of the argument:-

"I find projects interesting, especially the development of mathematics in teams and actually using it in real problems"

"I find the project work tedious, boring and a waste of time"

Probing of responses tended to find that those who disliked the coursework did so because they found it boring (rather than, for instance, because it was too difficult or too time-consuming). However, relationships in the data between the responses to this question and other questions are complicated and not immediately clear. As an illustration, the following two-way table shows frequencies for the perceived difficulty of GCSE and the perception of coursework; there is some tendency for relative ease to be associated with relative liking of the coursework, but hardly an overwhelming trend, and it would seem that there must be other factors in play here.

Table 3.4(a) (fifth-formers).

Difficulty of GCSE versus perception of coursework.

	Like	Neutral	Dislike
Very easy	5	1	1
Easy	5	1	3
Reasonable	8		7
Difficult	3		3
Very difficult			

Finally in this section, it would be evasive not to address the question as to whether the perceptions of coursework tended to be similar within each school, which would suggest that liking or disliking coursework was strongly associated with the school. However, two issues arise concerning the data. First, the samples within each school are very small, so care must be taken not to read too much into any interpretation here. Second, as discussed in Chapter 1, confidentiality becomes very important at this level of disaggregation. This report therefore confines itself to a cautious statement that five of the six schools did show a strong majority one way or the other, the sixth being fairly evenly spread over the categories.

Question 5. Intended post-GCSE studies

Of the sample of 45 fifth-formers, only 3 (7%) stated that they intended to leave school at the end of the current year. This yet again highlights the purposive nature of the sampling, for the corresponding national figure (see Chapter 2, and Moore (1990)) is around 60%. But it does also indicate that the purposive sampling appears to have been successful for, as described in Chapter 1, it was precisely the sub-population more likely to continue in education that the survey had been intended to reach.

There were thus 42 respondents who intended to continue in education (not necessarily at their present schools, of course). Of these, 23 stated that they intended to study A-level mathematics - an encouraging 51% of the total sample, and 55% of those who would continue in education. (However, the outlook for continuation in mathematics beyond A-level is much less rosy - see Question 7 in Chapter 4.) The remaining 19 either stated that they would not be continuing with mathematics beyond GCSE or, in a very few cases, had not yet finally made up their minds.

The 23 who had already decided to continue to A-level mathematics were asked further questions about this decision. The first table below indicates the subjects they intended to study alongside mathematics, broadly grouped as 'sciences', 'humanities', 'languages', 'mix' (meaning a mixture of more than one of the previous categories) and 'not yet decided'.

Table 3.5(i) (fifth-formers). Subjects intended to accompany A-level mathematics.

	Frequency	Percentage
Sciences	13	57
Humanities	2	9
Languages	1	4
Mix	5	22
Not yet decided	2	9
	Total 23	

While the sciences dominate, 35% of the sample had already decided not to concentrate (or at least not exclusively) on science subjects. This information needs to be viewed alongside the corresponding information from the sample of

sixth-formers - see Question 1 in Chapter 4 - but certainly bears the interpretation that A-level mathematics must cater for (and be seen to cater for) those who wish to couple mathematics with subjects which have perhaps not traditionally been viewed as associated with it.

The pupils' reasons for wishing to continue to A-level mathematics were readily grouped into 'enjoy it', 'good at it' (which it is interesting to note could be distinguished from the previous category), 'means to another subject' (usually physics) and 'don't know' (with a distinct impression in probing that the pupils were subject to outside pressure on this matter). The results were as follows.

Table 3.5(ii) (fifth-formers). Reasons for wishing to continue to A-level mathematics.

	Frequency	Percentage
Enjoy it	8	35
Good at it	9	39
Means to another subject	4	17
Don't know	2	9
	Total 23	

It is pleasing to find such high proportions who either positively enjoyed mathematics or who felt they had a distinct talent for the subject.

Turning now to the 19 pupils who had decided not to proceed to A-level mathematics (leaving aside the possibility that the very few who had not yet finally decided would in the event do so), these were asked their reasons for not proceeding. Every effort was made by Mr Davies to ensure that this question did not appear to be in any way threatening; it is felt that this was successfully achieved, again making the point that there were positive advantages in having the interviewing conducted by a student to whom the pupils could relate with relative ease. Grouping the responses proved somewhat difficult. There was certainly a 'too hard' category, but this included a sub-set of respondents who would have liked to proceed to A-level mathematics if they had not thought it too hard. Similarly, there was a 'don't like it' category, but this included some who were merely negative about not liking mathematics (often coupled with finding it boring) and some who made positive statements about preferring other subjects. Finally, there was one rather diffuse response which has simply been recorded here as 'other'.

Table 3.5(iii) (fifth-formers). Reasons for not wishing to continue to A-level mathematics.

	Frequency	Percentage
Too hard, but would have liked to	4	21
Too hard	4	21
Prefer other subjects	5	26
Dislike/boring	5	26
Other	1	5
	TOTAL 19	

The category of 'too hard but would have liked to' seems particularly sad. The 4 respondents in this category may not seem many, but amount to nearly one-tenth of the original sample of 45 - which, it will be recalled, was a highly purposive sample. To lose 10% of a larger purposive group in this way would be very relevant. Certainly there is an important question here as to whether A-level mathematics is (or is perceived as being) too hard. Further, if the answer is yes, it needs to be considered to what extent this is more than a transient phenomenon due to the current problems at the interface from GCSE to A-level (see the discussion in Chapter 2, and Question 5 in Chapter 4).

It is interesting to note that 2 of these 4 respondents were proceeding to AS mathematics, of which more in the next section.

Comfort can be taken in the fact that only 5 pupils actually gave negative responses about disliking mathematics, with another 5 positively preferring other subjects. This seems to be in general agreement with Table 3.1 which indicated quite strong overall enjoyment of mathematics as a subject. It does suggest that there ought to be a good "market" for A-level mathematics - except that the "too hard" problem evidently needs attention.

Question 6. AS examinations

Little useful information was obtained in the survey about AS examinations. An alternative interpretation is that the survey found that there was not much knowledge of, and even less interest in, the AS. Several of the pupils had to ask Mr Davies what it was. Two of the schools found themselves unable to offer any AS examinations at all. Only 7 of the respondents claimed to be proceeding to any AS examinations and only 2 of these said they would be taking AS mathematics (interestingly, 2 of the 4 in the previous section who considered A-level mathematics too hard but still had a wish to continue with the subject).

The AS examination was only two years old in 1991. Clearly its nature and purpose were not yet really understood. The survey certainly does not suggest any erosion of A-level participation by "trading down" to AS, but nor does it provide much evidence of the AS being used as a way of "trading up" from no post-GCSE study of the subject at all. Perhaps the two AS mathematicians were "trading up" in this way, but this cannot be stated with certainty.

Question 7. Desire to continue to university

This final section of the present chapter deals with how the fifth-formers felt about proceeding beyond school to university and whether mathematics would be the subject they thus pursued. The questioning was done in terms of "universities"; it would be interesting in any further work to try to make a clear distinction between universities and other forms of post-school education.

It will be recalled that 42 of the sample of 45 fifth-formers intended to continue in education at the present stage. No fewer than 35 (83% of those continuing in education, 78% of the whole sample) wished to carry on to university. Only 5 definitely intended not to go on to university, the remainder were as yet undecided. Clearly for this (highly purposive!) sample, university education is a high priority.

The outlook for mathematics at university, however, is much less promising:-

Table 3.7 (fifth-formers). Desire to study mathematics at university.

	Frequency	Percentage
Yes	3	9
Undecided	7	20
No	25	71
	TOTAL 35	

The total in this table refers to the 35 pupils who stated that they wished to proceed to university. Thus 71% of these 35 pupils already knew they would not be studying mathematics at university. Indeed, going back to the original sample of 45 and counting the remaining 10 in the 'no' category of this table, it is found that 78% of a highly purposive sample with high educational potential have already decided, at age 15-16, not to continue with mathematics to degree level. And this despite the fact that mathematics had so far generally been popular as a subject, and the majority would be continuing with it at A-level.

In fairness, it has to be added that some of the pupils in this 'no' category had already decided on their careers and had thus made positive decisions to take subjects appropriate to these careers at university. But the 'no' category also contains several who as yet had no idea what their eventual career would be. Evidently mathematics departments at universities only appeal to a small segment of the sixth-form "market" - a conclusion that is reinforced in the analysis of sixth-formers' responses in the next chapter.

Finally, the survey designers were unable to resist a question asking the pupils if they had heard of Brunei University. It was found that 15 (33%) had done so. At first sight this may not appear too bad, bearing in mind that, being fifth-formers, these pupils might not yet have made any serious efforts to select particular universities. But on the other hand it should be remembered that these were schools with which Brunei University had, in some way, closer contacts than usual - yet *only* one-third of the fifth-formers knew of Brunei. It does therefore appear that there is scope for some targeting of information about Brunei on pupils below the sixth form.

CHAPTER 4

RESULTS FOR SIXTH-FORMERS

Sixth-formers were interviewed at all seven participating schools, the total number being 55. All were studying mathematics (in one case as an AS rather than an A-level); within that constraint, the schools were asked, as they had been with the fifth-formers, to select pupils covering a reasonable range of mathematical ability. Though it had been intended that they should all be in the second year of their sixth-forms, 4 of the selected pupils were in fact in their first year. These have however been included in all the following analyses unless the contrary is explicitly stated.

It bears repetition yet again that this is a small, purposive sample.

A large range of A-level mathematics syllabuses is available in the country as a whole and it is good that this was reflected in the sample. As an illustration, for some pupils "applied mathematics" meant mechanics, for some it meant statistics, and for some a combination of these two areas. Some pupils were taking mathematics and further mathematics. As already mentioned, one was taking AS mathematics. These various combinations have not been distinguished in the results reported here, partly because they all fall squarely within the overall gamut of "mathematics" and partly because it would result in too high a level of disaggregation.

Question 1. Subjects studied alongside mathematics

This was a purely factual question to discover the subjects being studied by the pupils. The results, in a natural if somewhat coarse grouping, were as follows.

Table 4.1 (sixth-formers). Subjects being studied with mathematics.

	Frequency	Percentage
Science (two or more)	31	56
Science and Humanity	8	15
Science and language	7	13
Science and Technology	3	5
Humanities	4	7
Languages	0	0
Mix, no sciences	2	4
	TOTAL 55	

Thus more than half the sample were taking the traditional "maths and science" combination and only 6 were studying no science subjects at all.

The situation regarding the remaining 18 pupils, who were taking a science and a non-science subject ('technology' here being regarded as 'non-science'), is open to alternative interpretations. One interpretation is to put them together with the 31 scientists and then note that no fewer than 89% of the sample were studying at least some science with their mathematics. Alternatively, they could be taken with the 6 non-scientists, leading to the interpretation that 44% of the sample were not concentrating exclusively, or at all, on science subjects. The point is, of course, that these 18 are not a homogeneous group. Some of these pupils were basing their studies in mathematics and science, with a third non-science subject taken essentially as an "add-on", perhaps out of pure interest. For others, it was the mathematics that was the third subject, the prime choice having been of other subjects. And there were some who had genuinely chosen a mixture with each subject being of essentially equal standing. This information was usually apparent in the interviews, but confidentiality forbids its detailed discussion here.

It is interesting to compare the above table with Table 3.5(i) which shows the intended accompanying subjects for the fifth-formers who had already decided to

continue to A-level mathematics. Table 3.5(i) is deliberately classified more broadly, not showing combinations such as 'science and humanity'; this is because much of the interviewing was conducted quite early in the academic year when several of the fifth-formers had not yet firmly made up their minds at a greater level of detail. Nevertheless, reasonable comparisons can be made, though of course with considerable caution in view of the small sizes of the samples.

The outstanding feature is that the proportion in the 'sciences' category is essentially identical in both cases, 57% for the fifth-formers and 56% for the sixth-formers. This shows a remarkable constancy in the proportions of "traditional scientists" in these cohorts.

The situation regarding the remainder rests in part on the interpretation discussed above as to whether it is mathematics or some other subject that is the "add-on third subject" or whether a 'mix' is a genuine mix of subjects regarded equally. In discussing Table 3.5(i), the interpretation offered was that 35% of the sample of fifth-formers had already decided to move at least partly away from the sciences; this interpretation is felt to be valid in view of the sorts of remarks that the fifth-formers made in their interviews while answering this question. This proportion of 35% is not too dissimilar to the 44% in the sample of sixth-formers, if this interpretation is accepted in the sixth-formers' case - though it is felt that a more complex interpretation is in fact needed for the sixth-formers.

Whatever interpretation is made of the matters discussed in the preceding paragraph, it is clearly true that the "traditional scientists" form a large and important constituency for A-level mathematics. But it also appears that there is a constituency of non-scientists who, for a variety of detailed reasons, wish to take A-level mathematics alongside their non-science subjects. Certainly this appears to be a comparatively small constituency, but the question naturally arises of whether it might be much larger if A-level mathematics was perceived as more attractive by non-scientists. The sixth-form survey did not cover any pupils who were not studying mathematics, so there is no direct evidence from sixth-formers themselves as to why the subject had been dropped; evidence from fifth-formers who had already decided not to continue with mathematics is available, however, and is reported in Table 3.5(iii).

Question 2. Reasons for choice of A-level mathematics

The pupils were asked their reasons why they had decided to study A-level mathematics. As with so many other questions, complete freedom of response was permitted, with the answers being grouped in the subsequent coding operation. With a certain amount of probing, it was possible to distinguish cases where pupils' reasons resided in being *good* at mathematics from those where they felt they *enjoyed* the subject; further, it was possible to distinguish overall enjoyment of mathematics as a subject from a more specific enjoyment of the experience of GCSE mathematics. Separate categories for these cases are therefore reported here, and these are also separated from categories for those pupils whose main motive for studying mathematics was as a necessary requirement for some other subject. Obviously there is scope for some overlap (yes, there really were some respondents who said they both enjoyed mathematics and were good at it!) but respondents have been categorised according to what they thought to be the *principal* reason. The coding system also included the possibility that A-level mathematics had been chosen because of an intended career as a mathematician, and this category has been kept in the table of responses even though it sadly remained empty.

Table 4.2 (sixth-formers). Reasons for choice of A-level mathematics.

	Frequency	Percentage
As a future career	0	0
Good at mathetics	8	15
Enjoy mathematics	9	16
Enjoyed GCSE mathetics	12	22
As a means to another subjects	17	31
As a means to another subjects, Specially engineering	7	13
Don't know	2	4
	TOTAL 55	

A comforting interpretation of this table is that (slightly) over half the respondents in the sample were studying A-level mathematics out of enjoyment or talent. But it has also to be noted that, for nearly half the respondents, the principal reason for studying A-level mathematics was not to do so for its own sake but because it was a necessary adjoint to some other subject (engineering being specifically mentioned seven times). As has already been noted above, there was no-one who was specifically contemplating a career as a mathematician.

Question 3. Attitudes to A-level mathematics

The sixth-formers were asked for their opinions about their A-level courses. The questions were similar to those asked of fifth-formers about the GCSE (discussed under Question 3 of Chapter 3).

The responses concerning the interest of the A-level were grouped as 'interesting', 'neutral' and 'boring', as had been done for the GCSE. The results were as follows.

Table 4.3(i) (sixth-formers). Interest of A-level mathematics.

Score		Frequency	Percentage
1	Intresting	30	55
2	Neutral	15	27
3	Boring	10	18
		TOTAL 55	

This is on the whole encouraging for the amount of interest generated by A-level mathematics, with a weighted average score of 1.64 and strong rejection of the simplistic hypothesis of uniformity (value of test statistic is 11.82, two degrees of freedom). The A-level seems to be doing much better than the GCSE in this regard.

However, the next sub-section shows that the A-level is doing very much worse than the GCSE in terms of its perceived level of difficulty. It might be thought unexpected, or at least pleasantly surprising, that a subject that is evidently found on the whole to be difficult is also found on the whole to be interesting. An alternative interpretation might be that the difficulty is found stimulating and thus generates interest. The nature of the interaction between level of interest and perceived difficulty is not clear from the present survey; it may well be very complicated and involve other factors too. Further probing of this interaction would be a useful feature of any future more extensive study.

Table 4.3(iii) (sixth-formers).

Interest of separate components of A-level mathematics.

	Frequency for Pure mathematics	Frequency for mchanics	Frequency for Statistics
Intresting	5	4	3
Neutral	8	7	3
Boring	7	2	3
Total	20	13	9

Table 4.3(iv) (sixth-formers).

Difficulty of separate components of A-level mathematics.

	Frequency for Pure mathematics	Frequency for Machanics	Frequency for Statistics
Very easy			
Easy		1	2
Reasonable	2	3	2
Difficult	11	6	4
Very difficult	7	3	1
Total	20	13	9

The opinions concerning the interest of the separate components appear quite widespread. As far as the difficulty is concerned, it would appear that it is the pure mathematics that is found hardest, so perhaps it is this component that reaches particularly challenging levels.

Question 4. Attitudes to AS examinations

As with the fifth-formers (see Question 6 of Chapter 3), the AS examination was not having much of an impact. Of the sample of 55 sixth-formers, 45 were not taking any AS examinations; 6 of them were taking one AS (usually as an "extra" alongside 3 A-levels) and 4 were taking two. The AS examinations being taken were usually languages or computer studies. As mentioned, there was one pupil in the sample taking AS mathematics, not A-level. However, the sampling process was not designed with the intention of reaching pupils taking AS mathematics. No information was collected as to whether AS mathematics was available in the schools and, if so, how many pupils were taking it and what other subjects it was being combined with. This would be another interesting area for further study.

The 54 sixth-formers taking A-level mathematics were asked why they had chosen to do so and not to take AS.

Table 4.4 (sixth-formers).

Reasons for taking A-level mathematics as opposed to AS mathematics.

	Frequency	Percentage
Wanted to take A-level	34	55
Universities' attitudes	10	27
AS not available	3	18
Had not heard of AS	2	4
Don't know	5	9
	Total 54	

As can be seen, nearly two-thirds of the pupils had definitely wanted to study the A-level (though for a variety of reasons - see Table 4.2) and did not consider the AS.

There were 10 pupils who gave their main reason as their belief that universities would not accept AS mathematics as an entrance qualification. Of these pupils, 7 wished to read science or engineering subjects. The remaining 3 wished to read non-science subjects for which mathematics would virtually certainly not be required as a subject; presumably these pupils felt that universities would nevertheless require the A-level and not the AS even as a non-subject-specific qualification.

Question 5. Transition from GCSE mathematics to A-level mathematics

Problems concerning the interface between GCSE and A-level, particularly in mathematics with its strongly sequential nature, were discussed in Chapter 2. The sixth-formers in the survey were asked how they had found the transition. Their responses were often in strong terms, and were readily grouped as shown.

Table 4.5 (sixth-formers).
Perceptions of the GCSE/A-level interface in mathematics.

	Frequency	Percentage
Huge jump	20	55
jump	12	27
Reasonable gap	17	18
No problem	6	11
	Total 55	

Thus 58% of the sample thought there had been a more than "reasonable" jump from GCSE to their A-level studies and thus that this transition was less than smooth. Only 6 of the sample thought there was no appreciable gap - and all 6 of these had taken GCSE a year early and then taken an "additional mathematics" intermediate examination. As an incidental comment on this table, the one respondent taking AS mathematics falls into the 'reasonable gap' category.

What is not known, of course, is how the transition was perceived by pupils who had taken 0-level (or CSE). Nevertheless, the strong conclusion from this survey is the existence of a real gap between GCSE and A-level, urgently needing attention. Many of the pupils expressed themselves indignant, angry or upset about the gap and their lack of preparedness for A-level studies.

A few direct quotations will give the flavour of the general opinions: -

"A joke! GCSE was very easy and then came the A-level and it just does not compare at all"

"It's an enormous leap, a vast chasm that has got to be filled"

"It was ridiculous. I seemed to fly through GCSE. I got an A. I thought A-level would be just the next step, but everything changes and becomes so much harder - the gap between the two is ridiculous"

"Big shock! Big gap!"

Question 6. Attitudes to a hypothetical change in style of 6th form education

As discussed in Chapter 2, there is on-going debate about the desirability of broadening sixth-form education. The AS examination is intended as a step in that direction, but much more radical alternatives can be found on the continent (and in fact in a very few schools in this country) in the "baccalaureate" systems under which considerably more subjects are studied. The system in use in Scotland is also somewhat broader than the usual English/Welsh A-level system.

Much has been said and written about the desirability or otherwise of making a change from the normal diet of three A-levels to such a broader system and, if any change is made, how far to go. The spectrum of opinion in favour of change ranges from merely an "add-on" AS examination to a full "British baccalaureate". What does not seem to be known is how sixth-formers themselves feel about these ideas. This survey has already reported a relative lack of regard for AS examinations. The opportunity was also taken to go further. Mr Davies outlined to each respondent what, in broad terms, a "British baccalaureate" might entail. He then enquired whether the respondent would prefer such a system or the present A-level system (or something very like it) to be the norm for sixth forms.

Table 4.6 (sixth-formers).
Attitudes to a hypothetical "British baccalaureate".

	Frequency	Percentage
Prefer baccalaureate	20	36
Neutral	7	13
Prefer present system	28	51
	Total 55	

The polarity of opinion is interesting. On simply ignoring the 'neutral' category, the data in fact provide no statistical evidence for other than a uniform split over the two systems in the underlying population. Thus it might be concluded that the underlying population is equally divided in its preferences for the two systems - and with very few not having a preference either way! Two direct quotations, one on each side:-

"I would have preferred to study more subjects because I would then have been able to study languages [as well as sciences]"

"I like the present system because we reach to higher standards and go in depth into subjects"

Question 7. Desire to continue to university

As was the case with the fifth-formers, the questioning here was conducted in terms of "universities" without reference to other forms of higher education. No fewer than 53 of the sample of 55 sixth-formers wanted to continue to university, with just a single 'no' and one 'don't know'. It seems again that the purposive sampling had worked!

However, the outlook for mathematics was fairly bleak. At the time of the interviews, nearly all the respondents had made final decisions about what courses to apply for - and just 6 wished to read mathematics. This amounts to only 11% of the total sample, and remember that this was a purposive strongly-"academic" sample of sixth-formers of whom all but one (the AS pupil) were taking A-level mathematics; which gives an underlying population that must be considered precisely the major recruiting area for university mathematicians.

The following table shows the complete list of subjects that the pupils wished to read at university, grouped into convenient categories. The pupil who had not yet decided whether to seek admission to a university is included here as this pupil had made a firm decision about subject. Some pupils were applying to read different subjects at different universities; in such cases, their preferred choice is shown. The 'other' category of the table includes a few well-defined single subjects (notably "design") and some broad courses spanning many subjects.

Table 4.7(i) (sixth-formers). Subjects desired to be read at university.

	Frequency	Percentage
Mathematics	6	11
Science	16	30
Engineering	14	26
Humanities	7	13
Language	1	2
Medicine/Veterinary	2	4
Other (non-maths)	8	15
	Total 54	

The science and engineering subjects dominate, which is perhaps unsurprising remembering that the majority of the sample were taking one or more science subjects alongside their mathematics. Satisfaction can also be taken in the fact

that, in studying these subjects, the sixth-formers would be likely to make considerable use of their mathematics. However, as noted before, there is a minority constituency of appreciable size for non-mathematical subjects, reinforcing the earlier conclusion that A-level mathematics should not be designed only to cater for mathematicians and scientists.

Those who wished to continue with mathematics were asked why and responded either that they considered themselves very competent or that they enjoyed it (or both!).

It was perhaps more important to try to find out why the 48 who were not proceeding with mathematics had turned away from the subject. Remembering that as many as half the fifth-formers wanted to proceed to A-level mathematics, the lack of interest in further continuation was disappointing. One might have hoped for a positive interpretation along the lines of mathematics opening the door to many other subjects (notably engineering?). While something of this sort did occur, the responses were on the whole more gloomy. They are summarised in the table.

Table 4.7(ii) (sixth-formers).

Reasons for not continuing with mathematics at university.

	Frequency	Percentage
Not interested	21	44
Too hard	11	23
Had considered maths, but preferred others	11	23
Career reasons	4	8
Don't know	1	2
	Total 48	

The sad categories here are of course the first two, which account for two-thirds of the total of those not continuing with mathematics. It is inevitable that there will be some who are 'not interested' in the subject, but it is disappointing that there were so many - in this purposive sample of A-level mathematics pupils and who were, on the whole, finding their A-level mathematics interesting. It is likewise disappointing that comparatively many felt that university mathematics would be too hard for them; what could not be discovered, without much deeper probing, was whether these were pupils who were genuinely reaching the limits of their mathematical ability or whether they had been "put off" by the perceived hardness of the A-level.

8. Brunel University

Finally this report considers the sixth-formers' attitudes to Brunel University.

Of the 55 respondents, four were in the first year of their sixth-forms and so had not yet applied to universities, there was one respondent definitely not continuing to university and one who was not yet sure. The remaining 49 had all already applied for admission to universities, and seven of these (14%) had applied for a course at Brunel. At first sight this seems a reasonable proportion. Unfortunately none of these seven had applied to read any of the mathematics courses offered by Brunel.

Little pattern can be discerned in the reasons why these seven applied to Brunel. Three of them stated that they had applied because they were interested in a particular course offered by Brunel. Two were specially attracted by the industrial training placements that are an integral part of Brunel courses. One applied to Brunel mainly because of an enjoyable prior visit there. The final pupil in this category freely admitted that Brunel was merely a "space-filler" on the UCCA form. The questioning did not extend to finding out which courses these pupils had applied for, once it was established that they were not mathematics courses.

[The author has previously conducted a questionnaire survey of applicants to some of Brunel's mathematics courses, to try to discover the applicants' reasons for applying and for accepting or declining any offer made to them. Results of this survey are available in Goodall (1988).]

The 42 university applicants who had not applied to Brunel were asked why. Again Mr Davies, by his presence as a face-to-face but non-threatening interviewer, was readily able to elicit honest replies. The responses are summarised in the following table.

Table 4.8 (sixth-formers). Reasons for not applying to Brunel.

	Frequency	Percentage
Desired course not offered	12	29
Other universities preferred	8	19
Location	7	17
Visited but did not like	4	10
Unfavourable reports from others	3	7
Grades too high	3	7
Too science/engineering-biased	2	5
Had not heard of Brunel	3	7
	Total 42	

Some of these responses are not exactly complimentary. The more detailed comments made by the pupils help to give some amplification. There was in particular some criticism of Brunel's promotional literature (one pupil's comment was that "the information, that is the literature, on Brunel did not really make it seem that appealing"), while several pupils commented on the "concrete jungle" syndrome which Brunel has clearly not yet been able to mitigate.

Included in the 42 responses in the above table are the six potential university mathematicians, all of whom had chosen to pursue their studies other than at Brunel. Three of these gave their reason as 'other universities preferred' and there was one each in the categories 'visited but did not like', 'grades too high' and 'too science/engineering biased'.

CHAPTER 5

SUMMARY

This was a small, purposive survey of fifth- and sixth-formers in schools of good academic standards and where it could be expected that the pupils would be likely to wish to continue to subsequent stages of education. Attitudes to and perceptions of various aspects of mathematics were explored.

The fifth-formers were, on the whole, enjoying mathematics as a subject. Concerning their views as to the inherent difficulty of mathematics as a subject, there were few who considered it either very easy or very difficult; the overall tendency was to be somewhat on the "easy" side of "reasonable". However, they tended to perceive their GCSE mathematics courses to be rather easier than they felt the subject itself to be. Opinion was quite evenly spread as to whether or not the GCSE courses were in themselves interesting. Most of the respondents were doing coursework as part of their GCSE; opinions about the coursework were sharply polarised.

Slightly more than half the respondents intended to continue to A-level mathematics. Mostly this was because they either enjoyed mathematics or felt they were good at it, though there were some who explicitly viewed mathematics as a means to some other subject. Of those who had decided not to continue to A-level mathematics, about a half simply disliked the subject or had made positive decisions about preferring other subjects; many, however, were not continuing because they felt A-level mathematics would be too hard, and this included some who would have liked to continue to the A-level had they not felt this.

While over half of the potential A-level mathematicians intended to take science subjects as their other A-levels, there remained a substantial minority who wished to study non-science subjects as well as A-level mathematics. There was little knowledge of or interest in proceeding to AS mathematics rather than A-level.

Over three-quarters of the respondents intended to continue to university. However, only a few of these had a potential interest in reading mathematics at

university. One-third of all the respondents had at least heard of Brunel University.

The sixth-formers were studying a wide variety of mathematics syllabuses. More than half were taking science A-levels with their mathematics, but there was again a substantial minority whose other A-level subjects were, wholly or partially, non-science subjects. Slightly over half the respondents had chosen A-level mathematics out of talent or enjoyment, but this left a large minority who viewed their A-level mathematics primarily as necessary support for some other subject. The A-level courses were on the whole perceived as being interesting but difficult, with a *large* step up in difficulty from GCSE. Indeed, "large" is an understatement of many respondents' views of the step up from GCSE, and this gap was also often viewed as unwelcome and even unfair.

Few of the respondents were taking AS examinations alongside their A-levels. Nearly all of them were dismissive of AS mathematics as an alternative to A-level in their own personal schemes of sixth-form studies. However, it is not known whether the schools had other pupils, perhaps not mathematics specialists, taking AS mathematics. Opinions about the desirability of substantially broadening the sixth-form curriculum along "baccalaureate" lines were generally quite firmly held but evenly divided.

Nearly all the sixth-formers intended to continue to university but only a few proposed to read mathematics. Sometimes this was because other subjects were positively preferred, perhaps for career reasons, but there were many respondents who thought university mathematics would be too hard for them or who simply had no interest in taking the subject further. Of those who had already applied to universities, one-seventh (not including any of the potential mathematicians) had applied for a course at Brunel University. Of the remainder, there were many whose desired courses were not offered by Brunel or who positively preferred other universities, but unfortunately there were also some who had formed unfavourable impressions of Brunel.

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APPENDIX A

DATA ON APPLICANTS AND ADMISSIONS TO UNIVERSITIES

These data cover the period 1981-1990. They overlap with and extend similar data for 1971-1986 given in Goodall (1988). The sources of the data are the Annual Reports of UCCA in respect of the national data and Brunel University Senate Papers for the Brunel data. As discussed in Goodall (1988), the detailed quality of the data is surprisingly poor, mainly because of difficulties in setting up wholly consistent definitions of categories; nevertheless, the data are more than adequate for describing the main features.

The national data have discontinuities of definition in 1989 and 1990 caused by the admission of additional institutions to the UCCA system. In 1989, the Cranfield Institute of Technology joined UCCA; this is, however, estimated by UCCA to have had only a very small effect on the overall figures. But in 1990, UCCA was joined by the University of Buckingham and by thirteen Colleges concerned mainly (though not exclusively) with professional training in education; this is estimated by UCCA to account for about 40% of the increase in applications in 1990 and for over (well over) half of the increase in numbers admitted.

The national data are for 'home' candidates except for one case where the contrary is explicitly stated. UCCA's classification of candidates as 'home' or 'overseas' is made on the basis of "domicile"; it should be noted that this means that nationals of other EEC countries are normally classified as 'overseas'. This is an important difference in classification between the national data and the Brunel University data, in which candidates are classified on the basis of the fees required to be paid, so that EEC nationals are regarded as 'home'. (Researchers of national data prior to 1981 should note that, at that time, UCCA also attempted a classification in terms of fee-paying status so that most EEC nationals would probably then have been classified as 'home'.) Further, the Brunel data reported here cover both 'home' and 'overseas' candidates; the latter are sufficiently few

in number not to greatly distort the overall patterns.

The national data cover all phases of the UCCA application procedure - the 'main scheme' (including late applicants), 'CAP' (the continuing application procedure) and 'clearing'. This is also true of the Brunel data in respect of numbers admitted, but the Brunel data for numbers of applicants do not include applicants through 'clearing'.

Normally, each "year" refers to admissions in October of that year of applicants who applied during the preceding twelve months. However, modest numbers of candidates defer their entry for a year (e.g. apply during 1987-88 for admission in October 1989). In the Brunel data, these are duly counted as applicants in the year during which they applied and as admissions in their year of entry; but in the national data, they are counted both as applicants and as admissions in the year of application.

There is a minor problem concerning candidates admitted to universities other than via the UCCA scheme. These obviously will not appear in UCCA's national data, but they will appear among the numbers admitted (though usually not the numbers of applicants) at Brunel. Numbers of such candidates have never been very large and have become progressively fewer as more and more non-standard applications of all types have been channelled through UCCA. A category of some importance at Brunel University up to and including 1985 was that of "direct entrants" sponsored by a company to attend a particular university course; but from 1986 onwards such candidates have been required to apply through UCCA. There is also the category of those who start their university course other than at the beginning of year 1; treatment of these will vary - some will be direct transfers not involving UCCA. Numbers in this category have been small - but could increase enormously if "credit transfer" between courses at different institutions really takes off, which would require very careful re-consideration about how to handle such data in future years.

In the national data, the numbers of admissions really refer to the numbers of candidates actually accepted by a university. Almost certainly not all of these in fact take up their places, though the numbers of such 'non-starters' are probably fairly small. Further difficulties arise in terms of what might be called 'very early leavers' and 'transferers'. The former are those who withdraw

within a few days of starting their courses; it is arguable that they should not be regarded as having actually joined their universities but nevertheless they are counted as having been admitted. The latter are those who transfer to another course (or even, very occasionally, to another institution) soon after starting; here it is arguable that they should be counted as admissions to the course to which they transfer, but in fact they are shown as admissions to the course for which they were originally accepted.

The problems of the preceding paragraph also occur in the Brunel data, in a slightly different form. The Brunel data are compiled internally shortly before the start of the new academic year. Most, though probably not quite all, 'non-starters' will therefore be excluded; but the problems of 'very early leavers' and 'transferers' remain. Even in respect of the 'non-starters', however, complete consistency of treatment is unlikely to have been achieved; indeed, it is known that there are a few minor inconsistencies between data reported in the Senate Papers and the internal records of the Mathematics and Statistics Department. Numbers involved are no doubt very small, and the overall patterns will not be obscured; but the data reported here should not be taken as absolutely accurate to the last digit.

References to 'mathematics' subjects in the national data imply any course listed under UCCA's main mathematics heading ('GI' in the current classification) together with courses identified by UCCA as being 'statistics' with the 'G4' classification. Joint courses involving mathematics are however excluded; UCCA tabulates data for such courses under headings of 'joint courses' that are too broad to be useful here. This is somewhat unfortunate viewed from Brunel's perspective because Brunel has an important role in such joint courses, for example its Mathematical and Management Studies ('GN11') course.

For ease of comparison, indexes have been provided for the main series. As there is one case for which the data definition for 1981 is slightly anomalous, these indexes have been based on 1982 = 100.

NATIONAL DATA

UCCA totals, all universities, all courses

Year	Total applicants (with index 1982=100)		Total admitted (with index 1982=100)		% admitted
1981	149330	95.31	74514	102.59	49.90
1982	156675	100.00	72634	100.00	46.36
1983	157015	100.22	69631	95.87	44.35
1984	156488	99.88	71768	98.81	45.86
1985	157085	100.26	76181	104.88	48.50
1986	152588	97.39	76896	105.87	50.39
1987	152520	97.35	78344	107.86	51.37
1988	156981	100.20	80496	110.82	51.28
1989	171802	109.66	87013	119.80	50.65
1990	193704	123.63	99377	136.82	51.30

UCCA totals, applicants whose first choice was a mathematics subject

(Note : this includes statistics courses but excludes joint courses involving mathematics)

From 1989 onwards, UCCA applicants no longer indicated a ranked list of preferences among their choices of courses.

year	total (with index 1982=100)	
1981	4059	87.67
1982	4630	100.00
1983	4564	98.57
1984	4282	92.48
1985	3869	83.56
1986	3274	70.71
1987	3418	73.82
1988	3620	78.19
1989	n/a	
1990	n/a	

UCCA totals, admissions to a mathematics subject

(Note : this includes statistics courses but excludes joint courses involving mathematics)

(Note : in 1981 (only) this includes overseas students (estimated to be of order about 100))

Year	total (with index 1982=100)	
1981	3102	(103.09)
1982	3009	100.00
1983	2908	96.64
1984	2926	97.24
1985	2874	95.51
1986	2593	86.17
1987	2803	93.15
1988	3078	102.29
1989	3375	112.16
1990	3208	106.61

BRUNEL UNIVERSITY DATA

Brunel University totals, all courses

(Note : this data set is reported back to 1977 as it is not included in Goodall (1988). To quote the series only from 1981, without easy access to the overlap, could be misleading. It would mask the very substantial fall in numbers admitted already well in progress in 1981, and might also disguise the nature of the drop, also substantial though slightly less severe, in numbers of applicants that then about to occur.)

(Note : the numbers of overseas candidates admitted were separately reported from 1982 onwards so, for the sake of interest, this information is included here. It is clear that such numbers must have been very small indeed prior to 1982.)

Year	total applicants (with index 1982=100)		total admitted (with index 1982=100)		Number of overseas candidates admitted (include in Total)
1977	4602	77.76	638	106.87	n/a
1978	4992	84.35	759	127.14	n/a
1979	6260	105.78	736	123.28	n/a
1980	6318	106.76	677	113.40	n/a
1981	6268	105.91	640	107.20	n/a
1982	5918	100.00	597	100.00	7
1983	5740	96.99	638	106.87	11
1984	5147	86.97	710	118.93	14
1985	5571	94.14	692	115.91	26
1986	5553	93.83	685	114.74	18
1987	5797	97.96	725	121.44	38
1988	5904	99.76	751	125.80	34
1989	5931	100.22	789	132.16	56
1990	5791	97.85	900	150.75	76

Mathematics and Statistics Department, individual course data

The data are, for each course and each year, the number of applicants (the upper number in each cell) and the number admitted (the lower number). The abbreviations for the course titles are as follows.

abbrev.	Course
M	Mathematics
AMC	Applied Mathematics with Computation (available 1984-87 only)
M/M	Mathematics with Management Applications
M/CS	Mathematics/Computer Science
M/Ed	Mathematical Studies with Education (withdrawn after 1984)
S/M	Statistics/Mathematics until 1987, Statistics from 1988
S/CS	Statistics/Computer Science (withdrawn after 1987)
MMS	Mathematical and Management Studies

(For information, the numbers of overseas candidates admitted, included in the data, were :

- 1984 1 to M/CS
- 1985 1 to M/M
- 1987 1 to M, 2 to M/M
- 1988 1 to M/M
- 1989 2 to M/CS, 1 to MMS
- 1990 1 to M, 1 to M/CS, 1 to MMS.)

Coarse	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
M	63 5	77 6	80 13	54 6	90 13	74 8	87 9	98 12	64 12	75 12
AMC	-	-	-	5 0	10 4	13 2	8 2	-	-	-
M/M	43 11	40 6	40 6	50 7	35 6	61 8	62 10	90 18	77 18	48 10
M/CS	140 14	128 16	115 17	123 25	112 24	78 14	79 16	67 6	50 12	55 15
M/Ed	45 5	53 4	67 4	84 6	-	-	-	-	-	-
S/M	18 3	28 7	26 2	24 4	32 7	27 4	25 5	25 5	14 6	18 2
S/CS	38 2	45 2	27 3	12 1	24 0	17 2	18 1	-	-	-
MMS	88 8	91 5	102 13	79 13	114 13	112 17	120 20	154 18	155 23	104 22
TOTAL	435 48	462 46	457 58	431 62	417 67	382 55	399 63	434 59	360 72	300 61

APPENDIX B

PARTICIPATING SCHOOLS

Grateful thanks are extended to the following schools which kindly participated in the survey.

Bishopshalt School (state sector, mixed).
The Blue School, Wells (state sector, mixed).
Dr Challoner's Grammar School (state sector, boys).
Lord Wandsworth College (independent, boys, girls in 6th form).
Manchester Grammar School (independent, boys).
Millfield School (independent, mixed).
Wells Cathedral School (independent, mixed).

Thanks are also extended to Parkstone Grammar School (state sector, girls) which likewise agreed to participate but in the event was unable to be visited.

