Accounting for students' mathematical preparedness for Finance and Business degrees

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Introduction

Background: A level reforms

A wide-ranging reform programme of General Certificate of Education (GCE) Advanced level (A level) in Mathematics and Further Mathematics is currently underway, with new qualifications due for first teaching in England in 2017. All A levels are moving from a modular to a linear system, requiring students to take their examinations at the end of the two-year A level course, rather than throughout as is currently the case. Furthermore, the optionality currently available in the choice of A level Mathematics units will cease, with the content of this qualification becoming 100 per cent prescribed, whilst Further Mathematics will have 50 per cent prescribed content. Although this will assist in reducing the variability in students' mathematical backgrounds when they begin university study, the Applied Mathematics content (currently available in Statistics, Mechanics and Decision Mathematics topics) that students are able to study will therefore be reduced.

These two qualifications prepare students for the workplace or undergraduate study in a range of STEM (Science, Technology, Engineering and Mathematics), Medicine and Social Science subjects. Consequently, the reforms will have implications for a large number of new undergraduates. This article reports on part of a large-scale study of over 4,000 undergraduates and 30 lecturers of these subjects regarding their perceptions of the existing A levels as preparation for the mathematical components of their degrees, as well as their motivations for, and experiences of, studying Further Mathematics (Darlington & Bowyer, 2016).

Business Studies is a broad field of study. Indeed, MacFarlane (1997) argues that this is "an eclectic, multi-disciplinary area" and that there is "no singular concept of 'Business Studies' " (p.7). Therefore, this study sought to ascertain the views of students of a discipline whereby mathematical skills are highly important, yet rarely demanded of prospective applicants at A level before commencing university study.

Undergraduate Business Studies

In the United Kingdom (UK), the number of students studying full-time for undergraduate degrees in the area of Accounting, Business and Management has been steadily increasing since the early 2000s. Data from the Higher Education Statistics Agency (HESA) (2016) show that the proportion of all UK undergraduates studying for these courses increased consistently throughout this time, last year comprising 13.8 per cent of the UK's undergraduate student body[1].

1. HESA produces data according to the University and Colleges Admissions Service (UCAS) subject classification codes (JACS). The subject area which most closely matches the subject of this article is 'Business and Administrative Studies'.

At the school level, there were 26,745 A level Business Studies candidates in 2014 (3.2% of all A levels), a number which has been decreasing since a peak of 36,834 students (4.9% of all A levels) in 2001 (Joint Council for Qualifications [JCQ], 2015). This change may be in response to the fact that students have begun to opt for more traditional subjects, such as those recommended by the Russell Group (2013).

Mathematics in Business Studies

Mathematics requirements for undergraduate courses in the UK

A study by the Higher Education Academy (HEA) regarding the mathematical preparedness of undergraduate students of Business and Management degrees (Cottee, Relph, & Robins, 2014) found that, of the 131 English universities offering Business and Management courses, for 2013 entry:

- 41% did not specify a Mathematics requirement;
- 40% required a grade C at General Certificate of Secondary Education (GCSE);
- 16% required a grade B at GCSE;
- 2% required a grade A at GCSE; and
- only 1% required A level Mathematics.

However, although Mathematics requirements for entry to study Business-related degrees are varied and reasonably low, more than a quarter of new undergraduates studying Business in 2011 had A level Mathematics (Vidal Rodeiro & Sutch, 2013, p.17). Furthermore, in 2011, 9.8 per cent of A level Mathematics students went on to study Business and Administrative Studies (BAS) degrees at university (Vidal Rodeiro, 2012, p.5). The most popular A level subjects amongst these students are given in Table 1. Of these 2.7 per cent had taken A level Further Mathematics (Vidal Rodeiro & Sutch, 2013, p.16).

Table 1: Top 10 most popular A level subjects amongst Business and Administrative Studies students (Vidal Rodeiro & Sutch, 2013)

Rank	*Subject*	*Proportion of students (%)*
1	Business Studies	38.0
2	Mathematics	27.3
3	Economics	17.9
4	Psychology	15.1
5	General Studies	13.0
6	History	11.2
7	Geography	10.4
8	English Literature	9.6
9=	Media Studies	9.5
9=	Sociology	9.5

The HEA's (2014) study into the mathematical preparedness of Business Studies undergraduates also interviewed lecturers and undergraduates. Interviews with lecturers of these courses revealed that they did not feel that a grade C in GCSE Mathematics was an adequate entry requirement. However, pressures to recruit sufficient students for the course meant that lecturers did not believe it was possible to raise the requirements. Furthermore, only 87% of students knew that there would be quantitative elements to their degree, and 26% reported that they encountered more Mathematics than they had expected. Nearly a quarter reported that they found quantitative methods (QM) to be different to what they had expected, and 20% described themselves as "someone who struggles with quantitative methods" (Cottee et al., 2014, p.25). This is despite the same study indicating that the majority of degree programmes in the area of Business and Management have compulsory QM courses in the first year. In the United States, the picture is different – a large (*N*=684) American study found that students majoring in Business Studies were generally positive about their experience of the statistical elements of their course, more so than students of other Social Sciences (Griffith, Adams, Gu, Hart, & Nichols-Whitehead, 2012).

The minimal Mathematics requirements for Finance, Business and Management (FBM) courses are therefore intriguing when contrasted with the Quality Assurance Agency for Higher Education (QAA)'s benchmark statement for 'general Business and Management' degrees. The QAA specifies that graduates of these degrees must conduct "effective problem solving and decision making using appropriate quantitative and qualitative skills including identifying, formulating and solving business problems". Students should also develop "numeracy and quantitative skills including data analysis, interpretation and extrapolation" (QAA, 2007b, p.3). One might question whether a student should be able to demonstrate a capability in these areas before beginning their course, or whether universities are expected to teach these areas to students from scratch. The low Mathematics entry requirements suggest that universities either teach this content to their students, or expect that GCSE Mathematics is sufficient to equip students.

Similarly, the benchmark statement for Accountancy degrees (QAA, 2007a) states that graduates must have "numeracy skills, including the ability to manipulate financial and other numerical data and to appreciate statistical concepts at an appropriate level" (p.3). This makes specific reference to the development of statistical skills, something which Levine (1992; cited by Parker, Pettijohn, & Keillor, 1999) found when researching the topics taught in quantitative courses for undergraduate Business Studies students. The five most commonly covered topics were estimation and hypothesis testing, probability distribution, linear regression and correlation, descriptive statistics and tables and charts. Furthermore, Dunham (2002) claims that fundamental mathematical ideas in Finance include compound interest, present and future values, options pricing, debt repayment and cash flow.

A study of the most commonly taught mathematical topics in the top 50 business schools in the United States revealed all of these topics to be embedded in Statistics. Additionally, a study of 25 lecturers and heads of departments in UK universities that offer Business and Management degrees found that the areas of Mathematics taught most frequently included descriptive statistics, correlation and regression, graphical representation of data, the use of Excel, probability, algebraic manipulation, time series and forecasting, fractions, percentages and decimals, and calculus (Cottee et al., 2014). Again, the basis for these topics (excluding calculus) is in Statistics.

Impact of Mathematical backgrounds on performance

Empirical research into the impact of school Mathematics performance in undergraduate FBM degrees is mixed.

Surprisingly, a study by Rowbottom (2013) on a sample of 430 students at a Russell Group university, where 56.5 per cent of students had A level Mathematics, found no relationship between 'pre-university numeracy' and performance at any point in their Accounting degree. Similarly, Gammie, Jones, and Robertson-Millar (2003) found that prior performance in secondary Mathematics examinations in Scotland had no significant impact on the performance of a sample of 79 Accounting and Finance students at Robert Gordon University. A very small longitudinal study (*N*=39) by Bartlett, Peel, and Pendlebury (1993) found that those with A level Mathematics did not significantly outperform those without in Accounting examinations at a UK university.

However, Guney (2009) found that students with better GCSE and A level Mathematics grades performed better in Accountancy, although performance at GCSE was more indicative of future performance than at A level. The data suggested that it might be more important for admissions tutors to ask for high GCSE Mathematics grades than to ask that students have taken A level Mathematics. In the United States, Brookshire and Palocsay (2005) found that amongst 310 students, overall school performance had a greater impact on Business Studies students' performance than did their Mathematics performance alone, although this did have a positive impact. Additionally, Keef (1988) found that, in a New Zealand university, prior attainment and exposure to Mathematics had only a negligible effect on students' performance in Accounting.

Nevertheless, it has been found that stronger mathematical backgrounds have a positive impact on the performance of Business Studies, Accounting and Finance students in Hong Kong (Gul & Fong, 1993), Iran (Zandi, Shahabi, & Bagheri, 2012), the United States (Gist, Goedde, & Ward, 1996), Australia (Alcock, Cockcroft, & Finn, 2008), Canada (Standing, 2006), and Malaysia (Tho, 1994). Furthermore, Koh and Koh (1999) found that a Mathematics background based on achievement in International A level Mathematics grades had a significant impact on the performance of 526 students of Accountancy in Singapore. Indeed, Keef (1988) argues that Mathematics is a vital part of a Business undergraduate's education in the UK.

Many of the studies referenced in this review are rather old. The issue regarding mathematical preparedness of undergraduate FBM students is an issue that appears not to have been addressed for many years. The recent drive to promote STEM subjects has resulted in increased interest in this area (e.g., Cottee, 2014), though there are not a lot of publications. Education systems at the secondary and tertiary level change constantly and the nature of FBM and related disciplines have evolved over the last decades. Hence, caution should be taken when interpreting the outcomes of the research outlined in this section.

Changes to A level Mathematics and Further Mathematics

The research on which this article is based, summarised in Darlington and Bowyer (2016), was conducted in response to the forthcoming changes

to A level Mathematics and Further Mathematics from 2017 (Department for Education [DfE], 2013). The nature of the reforms planned meant that the perspectives of current undergraduates regarding the current A levels were sought in order to inform the development of the new specifications, as well as to consider the implications of the reforms for universities and prospective students. It is therefore important to set the scene for this research in terms of outlining the content and structure of A level Mathematics and Further Mathematics.

AS and A level Mathematics

Presently, A level Mathematics comprises four compulsory Core Pure Mathematics units of equal weighting, with two Applied Mathematics units. These units may be chosen from the following strands:

1. Mechanics;
2. Statistics; and
3. Decision Mathematics.

It is not necessarily the case that students will be able to take the units that they want to. Restrictions on resources and timetabling within their schools and colleges may mean that they are given a restricted choice, if at all.

Within each of these strands are between two and five sequential units, depending on the particular strand and awarding body. The more advanced units (e.g., Mechanics 3 and above) can only be studied as part of Advanced Subsidiary (AS) or A level Further Mathematics.

Students may study either two units from the same strand (e.g., Statistics 1 and Statistics 2) or one from two different strands (e.g., Mechanics 1 and Decision Mathematics 1). Hence, there are six[2] possible routes through A level Mathematics.

At AS level, students must take two compulsory Core Pure Mathematics units and one applied unit (Mechanics 1, Statistics 1 or Decision Mathematics 1).

The reformed qualification will see the removal of optionality in the applied units. Students will all study a mixture of Statistics and Mechanics material (though not necessarily the same as the content of the current Statistics 1 and Mechanics 1 units), after the A level Content Advisory Board recommended the removal of Decision Mathematics from A level Mathematics (ALCAB, 2014).

AS and A level Further Mathematics

A level Further Mathematics comprises two compulsory Further Pure Mathematics units, plus four optional units. At AS level, students must take Further Pure Mathematics 1 and two optional units.

The optional units can be selected from any of the three standard Applied Mathematics strands offered within A level Mathematics or from an additional two Further Pure Mathematics units. There are therefore a large number of possible routes through Further Mathematics[3].

Method

A large number of different degree titles fall under the area of Business Studies, most of which require a level of mathematical competency. Hence, all universities which offered degrees in the area of Business Studies and Finance (including Accounting) were contacted, requesting their participation in the study. Relevant departments were asked to pass on the details of an online questionnaire aimed at students who fulfilled two criteria:

1. They must have been in their second year of study or above, in order that they could reflect on their experiences so far; and
2. They must have taken at least AS level Mathematics, and this must have been taken no earlier than 2006 (when the qualification underwent restructuring).

Those who took International A levels were not permitted to take part, as the structure and content of those qualifications are different to the domestic qualifications.

The questionnaire surveyed students regarding:

- their mathematical background;
- their current studies;
- their perceptions of the A level(s);
- the factors which motivated them to take Further Mathematics (if applicable); and
- their experience of Further Mathematics (if applicable).

The questionnaire comprised a mixture of multiple choice questions, closed questions and open-ended questions. It was developed by the authors and an A level Mathematics expert, before being piloted by three recent graduates of mathematically-demanding degrees. Small changes were made in response to the piloting. The questionnaire was made available in an online format, and was open for responses between September and December 2014.

Results

Sample

After data cleaning, a total of 104 responses were retained. It was considered inappropriate to conduct statistical testing for differences between groups in responses to the questionnaire due to the small sample size.

- **Institution of study:** Participants in the online questionnaire came from 25 different universities. There was an average of 4.1 participants per university (SD=3.1). Of the universities attended by participants, 89.3% attended universities in England, 4.9% in Scotland, 3.9% in Wales and 1.9% in Northern Ireland.
- **Degree programme:** Only 2.0% of participants were studying for undergraduate Master's degrees, with the remainder studying for Bachelor's degrees. Participants studied for 31 different specific degree courses, which have been simplified in this report into five degree areas (see Table 2). Most (55.8%) were studying for joint honours degrees within FBM, although some studied combinations with Law or Economics.
- **Year of study:** There was a mixture of participants currently in their second (60%), third (33%) and fourth (7%) years of study.

2. (1) M1+M2; (2) S1+S2; (3) D1+D2; (4) M1+D1; (5) M1+S1; (6) D1+S1.
3. Students are not allowed to take units as part of Further Mathematics that they have already taken as part of A level Mathematics.

Table 2: Students' degrees (includes joint honours)

Degree area	*No.*	*Proportion of participants (%)*
Accounting	44	42.3
Management	18	17.3
Business Economics	17	16.3
Finance	16	15.4
Business	9	8.7
Total	**104**	**100**

Participants' academic performance

A level performance: Participants had a mixture of backgrounds in A and AS level Mathematics and Further Mathematics. A quarter had taken both Mathematics and Further Mathematics to A level (see Table 3).

Table 3: Participants' A level qualifications

Mathematics qualification(s)	*No.*	*Proportion of participants (%)*
AS level Mathematics only	8	7.7
A level Mathematics only	61	58.7
A level Mathematics + AS level Further Mathematics	9	8.7
A level Mathematics + A level Further Mathematics	26	25.0
Total	**104**	**100.1***

*Due to rounding

In both subjects, most participants achieved an A or A* grade, which is disproportionate to the proportions of students who achieve these grades nationally (see Figures 1 and 2). Furthermore, the 77 per cent of participants who achieved an A* or A is a much higher proportion than the 32 per cent of all undergraduate FBM students who achieved the same grades in A level Mathematics in 2011[4]. This overrepresentation of high-achievers was taken into consideration throughout the analysis, although the majority of FBM students who took A level Further Mathematics in 2011 did have an A or A*.

Most participants were awarded their final Mathematics or Further Mathematics A or AS level in either 2012 or 2013 (42.4 per cent in each), with 1 student in 2006, 3 in 2010 and 11 in 2011.

A level Mathematics units: Participants were asked which optional units they studied as part of A and AS level Mathematics and Further Mathematics. The data suggest that it was most common for students to study a mixture of different areas of Applied Mathematics rather than specialising in one particular area (see Figure 3). It was more common for participants to have taken more Statistics units than Mechanics, with 60 participants indicating they had studied at least one Mechanics unit, and 89 indicating they had taken at least one Statistics unit.

University results: Students were asked about their performance in their previous year's examinations, where applicable (see Figure 4). Most participants were awarded Upper Second-class degree honours (usually a result of 60–69%), with small numbers achieving a Third-class degree result, and two students failing their examinations.

4. 2011 is the most recent year for which this type of data is available.
5. 'Business and Administrative Studies' is the most relevant grouping of student available in her study to this sample.

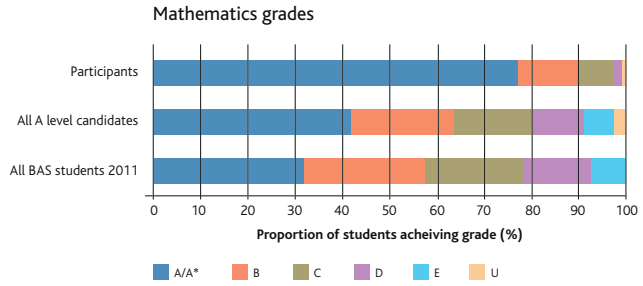

Figure 1: Participants' AS or A level Mathematics grades
Additional data from JCQ (2015) and Vidal Rodeiro[5] (2012).

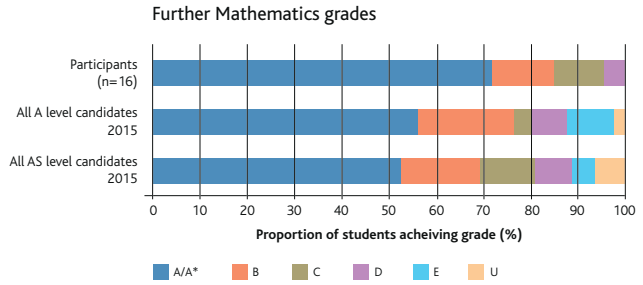

Figure 2: Participants' AS or A level Further Mathematics grades
Additional data from JCQ (2015).

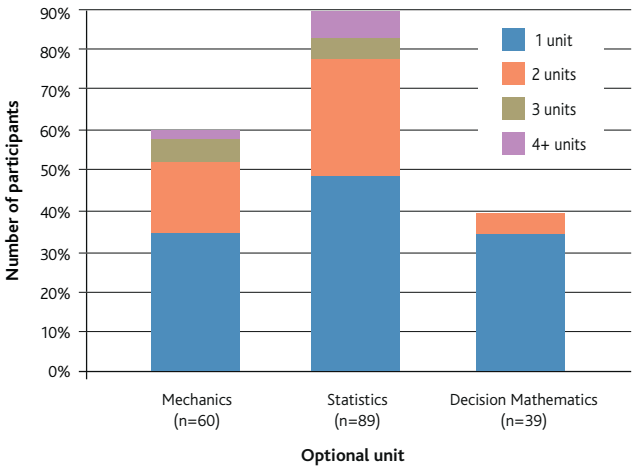

Figure 3: Optional units studied

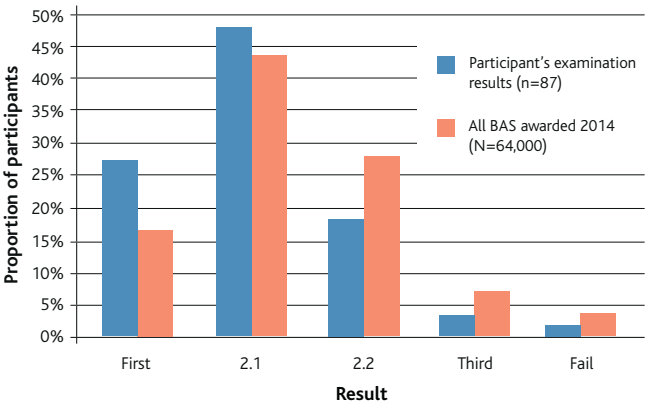

Figure 4: Previous year's examination results
Additional data from HESA (2015).

Figure 4 shows that this sample is perhaps more representative of the high-achievers; however, it should be noted that the participants may have performed better in their end-of-year examinations than they would do in their final degree examinations.

Which optional units are most helpful?

The data suggest that the most useful of the optional units for FBM undergraduates to have studied at A level are in Statistics (see Figure 5). Of the participants who took Statistics, 96.6% reported that they found

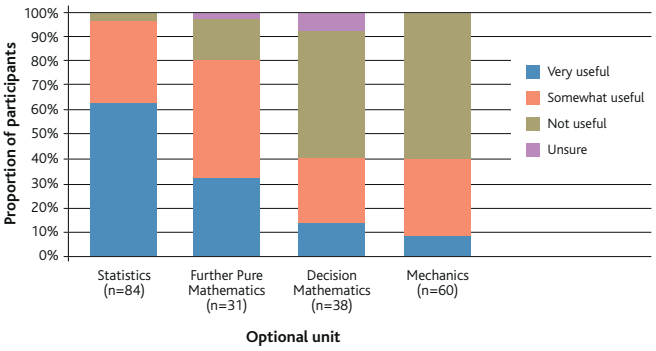

Figure 5: Participants' views of the utility of optional units

it very or somewhat useful. Mechanics and Decision Mathematics were considered to be of similar utility to each other (less than 40% found them very or somewhat useful). Additionally, approximately 80% found Further Pure Mathematics units to have been useful, although of lower utility than Statistics.

6. These statements were taken from a study by the Qualifications and Curriculum Authority (2006) which examined student participation in A level Mathematics, but are applied here in the context of Further Mathematics.

What motivates students to take Further Mathematics?

Approximately 34% of participants had taken Further Mathematics to AS or A level, meaning that their motivations for doing so could be investigated.

When asked to indicate factors which motivated their decision to study Further Mathematics from a list of 15 statements[6] (see Figure 6), it emerged that the participants had mainly been influenced by three main areas in their decision to study Further Mathematics:

- **An enjoyment of Mathematics:** 87.9% of participants reported that they were influenced 'a lot' by an enjoyment of school Mathematics. Only one participant reported that this did not influence their decision to study Further Mathematics.
- **Perceived utility:** Not only did 68.8% of participants report that they were heavily influenced by the utility of Further Mathematics, but 87.9% reported that they were influenced to some extent by the consideration of studying for a Mathematics or Mathematics-related degree at university.
- **Fit with other A levels:** Most participants (81.8%) reported that Further Mathematics fitting well with their other subject choices had some influence on their decision.

The data suggest that very few students were strongly influenced by what their peers were studying and their school Mathematics department's results, and that there was no strong parental influence.

What are students' experiences of studying Further Mathematics?

Students who studied Further Mathematics were asked to describe their experiences of studying it. Their responses were largely positive (see Table 4).

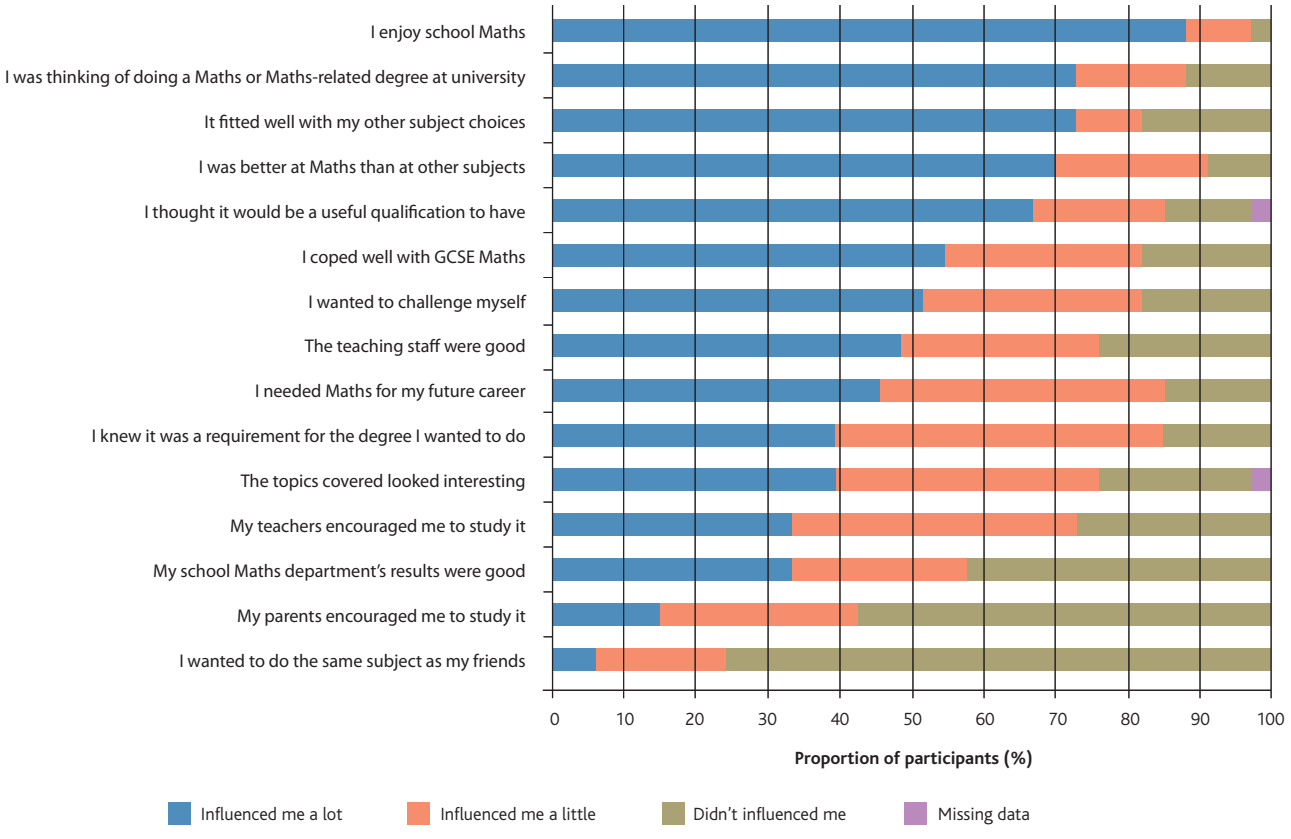

Figure 6: Participants' motivations for studying Further Mathematics (n=33)

Table 4: Participants' experiences of studying Further Mathematics

Statement	*Strongly agree*	*Agree*	*Neither agree nor disagree*	*Disagree*	*Strongly disagree*
	Number of participants (%)				
I am glad I took Further Maths	20 (60.6%)	10 (30.3%)	1 (3.0%)	2 (6.1%)	0 (0.0%)
I took Further Maths because I was thinking of doing a Maths or Maths-related degree at university	17 (51.5%)	8 (24.2%)	4 (12.1%)	3 (9.1%)	1 (3.0%)
I found Further Maths challenging	15 (45.5%)	11 (33.3%)	7 (21.2%)	0 (0.0%)	0 (0.0%)
I enjoyed Further Maths	13 (39.4%)	15 (45.5%)	3 (9.1%)	2 (6.1%)	0 (0.0%)
Further Maths was my most difficult A level	11 (34.4%)	7 (21.9%)	6 (18.8%)	7 (21.9%)	1 (3.1%)
In my first year at university, we were taught material that I had learned in Further Maths	10 (30.3%)	10 (30.3%)	3 (9.1%)	5 (15.2%)	5 (15.2%)
Most people on my university course studied Further Maths	3 (9.4%)	5 (15.6%)	6 (18.8%)	13 (40.6%)	5 (15.6%)

Only a quarter of participants reported that they thought that most people studying their university course had taken Further Mathematics, although 60.6% agreed that they had covered material that they had learned in Further Mathematics during their first year at university.

This overlap suggests that there may be benefits to studying Further Mathematics in addition to Mathematics in order to ease the transition into the mathematical element of FBM degrees. However, only 39.4 % of participants reported that they strongly agreed that, 'Studying Maths and Further Maths was sufficient preparation for my degree'. Conversely, it could also be argued that an overlap in A level Further Mathematics content and first year undergraduate Mathematics could mean that students become bored. However, repeating material that students are already familiar with would give them an advantage.

Overall, 84.9% of participants agreed that they enjoyed Further Mathematics and 90.9% agreed that they were glad that they had taken it. However, whilst 78.8% reported that they found it challenging, and 81.8% that it was more demanding than A level Mathematics, only 56.3% reported that it was their most difficult A level.

How useful are the A levels?

The data suggest that students were largely in agreement that A level Mathematics and Further Mathematics were good preparation for the mathematical component of their degree (see Figure 7).

A large majority of participants (83.7%) indicated that Mathematics was good preparation for their degree, with a smaller majority (65.6%) indicating the same of Further Mathematics. No participants with a Further Mathematics qualification described it as bad preparation, and only one participant reported the same of A level Mathematics.

7. Source: OCR (2013).

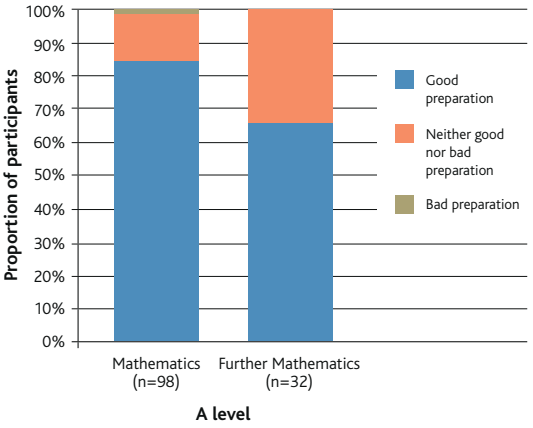

Figure 7: Students' perceptions of the utility of the A levels as preparation for their degree

What improvements could be made?

In addition to the multiple choice questions, participants were asked two open response questions. The first question asked whether there were any additional topics that are not currently incorporated in the A level courses that would have been useful. There were 46 responses. The majority of suggestions for additional topics focused on the inclusion of Financial Mathematics, especially Basic Accountancy for students on Accountancy courses and Basic Economics for participants on Economics-based courses. A smaller proportion of students also suggested that the statistical content at A level should be made harder and more in-depth, with specific topics focusing on a greater variety of distributions. These topics are depicted in Table 5.

The second question asked participants whether there were any improvements that could be made to the A levels to make them better preparation for FBM undergraduate courses. There were 61 responses. Comments about potential improvements to both A levels centred on suggestions that they should cover a greater depth of content. Most participants also suggested that the inclusion of more real-world applications would be beneficial, particularly in contexts relevant to Business or Economics. The responses also indicated that students had varying opinions about the difficulty of the A levels. Broadly similar proportions of participants reported that an increase in difficulty would be welcome, or that the existing level of challenge had been sufficient preparation for their degree course.

Additional, but less frequent, suggestions were that there could be a stronger relationship between the style of examination question at A level and at university, and that a greater understanding of the material and theory would have been beneficial.

Table 5: Topics participants suggested for inclusion at A level

Topic area	*Topics*	*OCR Mathematics Unit(s) covering topic*[7]
Financial Mathematics	Basic Accountancy Econometrics	
Probability and Statistics	Computer-based software Continuous probability distribution Advanced hypothesis testing *p*, *z*- and *t*-values Bayes' theorem Regression models	 S2, S3 S2 S4
Calculus	Matrices Partial differentiation	FP1

Limitations

A self-selecting study of this nature suffers from a number of classic limitations, as well as some limitations specific to this study:

- Participation was doubly self-selecting. That is, students self-selected in their decision to complete the questionnaire, but their opportunity to do so was also based on self-selection on the part of the university departments which were the vital link between the researchers and the students. Data reported in Figures 2, 3 and 5 were therefore compared with national data in order to give an indication as to whether this sample might be skewed in terms of its composition.
- It could be that students who felt particularly strongly (either positively or negatively) about their mathematical preparedness and its impact on their transition to tertiary study may have felt more compelled to take part.
- This study only incorporates the views of students who had taken post-compulsory Mathematics qualifications. We cannot contrast their responses with students who did not take A levels in Mathematics and/or Further Mathematics.
- Finance, Business and Management are a wide field of study. Therefore, it is possible that degrees in Management, for example, may be less mathematically demanding than degrees in Finance. The responses of participants studying across these different areas were compared using statistical analysis where sample sizes were large enough to do so. No significant differences were found between groups, though caution should be taken when interpreting the data outlined in this article.

Implications and recommendations

The data collected in this work suggests that current FBM students regard both A level Mathematics and Further Mathematics as good preparation for the mathematical content of their degree. In particular, Statistics units were considered to be the most useful applied units, with 96.6 per cent of participants describing them as either very or somewhat useful preparation.

These findings indicate that, despite conflicting results in the studies outlined in the introduction, prior Mathematics qualifications may benefit students' performance in undergraduate FBM courses. That students regarded Statistics as the most useful optional units may seem unsurprising when considering the type of Mathematics commonly required in FBM courses. In particular, sampling methods, hypothesis testing, probability and confidence intervals have been found to be commonly taught topics in first-year courses (Haskin & Krehbiel, 2011), and the Statistics units in A level Mathematics offer basic grounding in these areas. Consequently, prospective FBM students would benefit from specialising in Statistics during their A level studies.

The proposals for the reformed A level Mathematics mean that some Statistics content will become compulsory for all students. This will reduce the variability in undergraduates' Mathematics backgrounds, which is beneficial for admissions tutors. However, it also has implications for students who would have benefitted from specialising in one strand. For example, a student going on to study FBM at university, under the current system, would benefit from taking Units S1 and S2 in A level Mathematics. However, new proposals mean that learning Statistics in depth would require a student to take Further Mathematics.

Sampling, hypothesis testing, *t*-tests, and statistical significance will become compulsory content in the reformed A level Mathematics. Furthermore, there is a new requirement that students handle real, large datasets, although there is currently no guidance on exactly how large these datasets are expected to be, nor how this will be assessed. It therefore seems likely that taking A level Mathematics will continue to be good preparation for FBM courses once reforms have taken place. Furthermore, studying Further Mathematics also appears to be beneficial preparation for prospective FBM undergraduates. Although most participants reported that they did not believe the majority of their peers had taken Further Mathematics, they reported that they had covered some material from Further Mathematics in their first year at university. Additionally, no participant reported that Further Mathematics had been poor preparation for their undergraduate studies. Participants' positive opinions about Further Mathematics, coupled with the overlap in material, suggest that Further Mathematics is a useful qualification for FBM undergraduates to have.

It is not immediately clear whether the benefit of taking Further Mathematics lies in the opportunity to study more advanced Statistics units, or in the exposure to advanced Pure Mathematics content. Participants were very positive about the utility of Statistics units, but Further Pure Mathematics units were also well-received. Moreover, students' suggestions for additional topics to be included at A level incorporated calculus and matrix algebra as well as statistical topics. This suggests that both areas are beneficial preparation. The reform of A level Further Mathematics thus has implications for the preparedness of FBM undergraduates in the future, as the awarding bodies decide what optional content should be available for students to choose.

A further implication of this study is that, given the mathematical entry requirements for FBM courses are very low, universities may wish to reconsider their current requirements and schools and careers advisers should take note. Given that Mathematics has been the most popular A level subject overall for the past two years, and participants in this study were enthusiastic about their experience of post-compulsory Mathematics, it is not unreasonable to suggest that universities ask prospective students for at least AS level Mathematics. A level reform provides an opportune time for admissions departments to review their current entry requirements in light of the forthcoming changes. Those giving students advice when choosing A level subjects should also be made aware that, though A levels in Mathematics or Further Mathematics are not generally required of students going on to study FBM, there are clear benefits.

Additionally, the introduction of new Level 3 Core Mathematics qualifications[8] may also be of interest to FBM departments, as these courses will allow students who do not wish to study A level Mathematics to develop their statistical competency. With the introduction of compulsory statistical content in AS and A level Mathematics and the proliferation of post-compulsory Mathematics courses, the opportunities available to prospective FBM students to increase their mathematical preparedness before university are increasing. Universities can therefore take advantage of these developments in order to increase the overall mathematical proficiency of new cohorts.

8. Core Mathematics qualifications will be aimed at students who achieved at least a grade C in GCSE Mathematics, but who do not wish to study A level Mathematics. Some specifications will contain substantial amounts of statistical content.

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