

**Project Title: How one module can serve multiple qualifications through tailored implementation of presentation.**

**Keywords**

Change, service teaching, tutorials, student allocation, students' perceptions of difficulty

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**Title: How one module can serve multiple qualifications through tailored implementation of presentation.**

Students taking qualifications mainly in science, economics and data sciences are now the majority of the students on a second-year undergraduate statistics course. The course was designed as a specialist course for statisticians and increasingly it needs to address the needs of specialists and non-specialists simultaneously. A decision to alter the support structure, rather than the printed course materials, was taken to accommodate this change in the study intentions of the students on the module.

This report covers three main areas:

- meeting the different support needs of students, on the same module, but different qualifications.
- negotiating with a team of Associate Lecturers (tutors) to improve the student experience.
- circumnavigating barriers to the development and implementation of change.

A fundamental change was to move from geographical allocation of students to tutors, to an allocation based on the qualification route of the students. Alongside this change more tutor time was allocated to tutors for working with their own group of around twenty students.

A set of tutorials geared towards specific qualification groups of students were developed and delivered alongside a set of core tutorials. Students had access to all tutorials and most tutorials were recorded. Students who attended a tutorial “live” were found to be more likely to attend a qualification-based tutorial than a core tutorial. The viewings of recordings of tutorials were predominantly of core tutorials.

The changes made as a part of this project were designed to help non-mathematics and statistics students cope with a traditional statistics course. They have, however, also helped tutors to embrace and enjoy the opportunities to communicate good statistical practice to non-statistics specialists. Tutors have had to accept and deal with the much broader range of backgrounds and interests of the students.

The overall aim was to improve the student experience on the module, but we also increased the range of pre-start activities for students. Additional refresh materials were commissioned, and early module materials were made available. This approach integrated well into the school’s existing “revise and refresh” and “early start” programmes.

As it transpired the pandemic led to so many assessment changes across the University which made it impossible to associate any changes in pass rates to this project.

This report covers the 18 months which were funded by eSTEEem project funding and some of the earlier work the eSTEEem project built on.

## 1.Introduction

The module “Analysing data” (M248), has been transformed into a thriving service module whilst continuing to meet the requirement for it to prepare some of its students for final year undergraduate statistics modules. In this context a service module is being defined as, a module that is taken by more students outside the home qualification it was designed for, than on the home qualification itself.

The October 2018 (18J) cohort of students was dominated by students taking a Mathematics or Mathematics and Statistics degree but, even back then, they did not quite form the majority of the students. Four hundred and thirty-four students started the module on 18J and 41% were the “target” group of Mathematics / Mathematics and Statistics degree undergraduates. By the October 2021 (21J) cohort there were seven hundred and fifty-nine students starting the module and the percentage of Maths/Maths and Statistics students had fallen to 28%. Part of the growth in the number of students was foreseeable, because of the introduction of two new undergraduate degrees which included M248 on their compulsory pathways, namely, data science and a single economics degree.

It seemed feasible that Statistics undergraduates were going to struggle with different elements of M248, have different prior experiences, identify positively with different concepts etc. to a student from another discipline. Whilst of course every student’s needs are individual, and we do our best to accommodate them, in reality there is a compromise to be made. It seemed reasonable that students who had chosen similar pathways might share similar backgrounds, anxieties, and motivations in relation to M248 and so grouping students by qualification pathway seemed worth exploring. The hope was that students with similar backgrounds and motivations would find it easier to offer and ask for peer support. Tutors with a specific interest in the student’s chosen qualification and might be seen as more approachable to students when asking about a statistics issue. Finally, by providing tutorial support with tutors supplying examples which included applications from their area of interest and specialism, it was hoped that the M248 ideas and techniques could be seen by the students as more relevant to their qualification.

The students on M248 were following 15 different pathways including some at certificate and diploma level and some students with no qualification aim specified. Tutor groups are groups of twenty students and financially a tutor is penalised if they are allocated less than eighteen students. As over half of the fifteen pathways had fewer than 20 students it was necessary, both to financially protect tutors and in terms of other practicalities, to combine pathways for tutorial support.

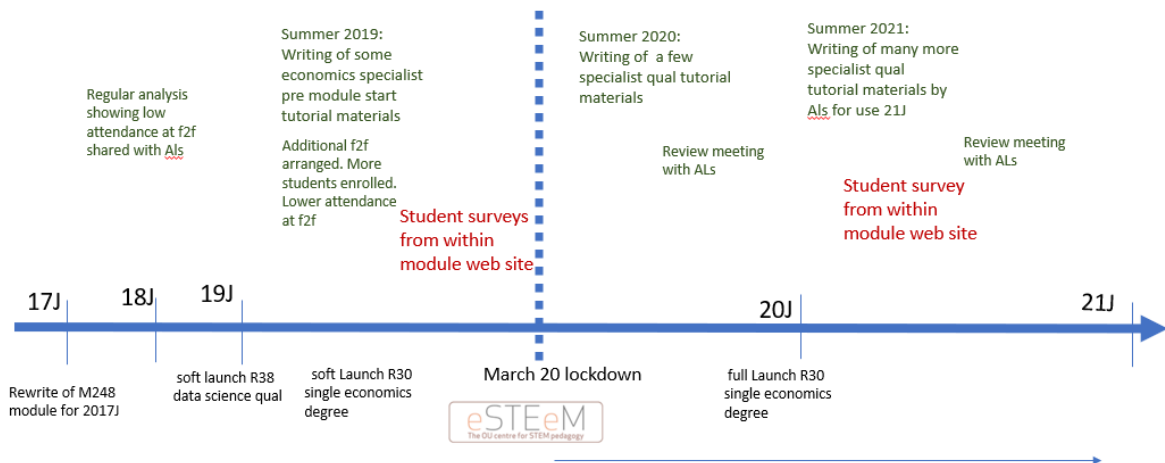
In practice providing tailored support for around three to five different groups, with roughly similar numbers on similar pathways, sounded feasible. In reality, regardless of whether study was towards a degree, a diploma or a certificate, combining Maths and Maths/ statistics students into one group, the single economics and the existing economics with mathematical sciences students into a second group, and data science and computer science into a third group was feasible. All other pathways such as the Open degree, Combined STEM, Standalone and Maths Education were combined into a

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fourth group. In practice these grouping have worked well. The initial choice was made on the basis of actual student numbers on 19J and an element of guess work on how student numbers on data science and single economics would grow. In the event, for 21J, the four groups represented 28%; 20%; 27% and 25% of students respectively.

Figure 1: Approximate project timeline



The work described in this report has effectively taken place over three years and began with 18 tutors, all working co-operatively within a single cluster, and all recruited to deliver a statistics module to statisticians. The current position is that we still work within one cluster and still deliver the same printed material to an end point of the same exam. However, there are now 40 tutors of whom some were appointed specifically to tutor explicit groups of students. Some tutorial support is geared specifically towards groups of students on different qualification routes. The additional recruitment was possible solely because of the large increase in student numbers.

The 18J students were surveyed and the tutors involved in discussions about how to improve attendance at face-to-face (f2f) tutorials. Both students and tutors expressed strong positive views about f2f tutorials but, in reality following the introduction of online tutorials several years earlier, students outside London simply did not attend f2f. The 19J students had some scheduled online tutorials moved to f2f to try and address requests for more f2f tutorials. It rapidly became apparent, however, this just resulted in more tutorials with very low numbers attending. The tutors on 19J were reconciled to the position that attendances of 1 or 2 students could not be justified and the tutors then became heavily involved in planning for alternatives. Subsequently, the 19J students were of course the first group to be affected by the lockdowns and f2f tutorials ceased in March 2020. The 19J cohort were also the first group to see traditional end of year examinations moved online. The 20J students were allocated by qualification group to tutors and were offered a limited set of qualification-based tutorials alongside the standard core set of tutorials. The experience was deemed successful, but the number of qualification-based tutorials was too small. Therefore, the 21J students were offered a full

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set of qualification-based tutorials and this was achieved by recruiting some tutors with additional specialisms, such as economics, alongside their statistical expertise.

The project leads were the module chair and the link staff tutor. The module was regarded as “performing” well and so there was no external pressure for change. This in turn effectively meant we had considerable scope for change and, critically, scope to alter the project to capitalise on emerging ideas. This also enabled the project to play to the strengths that the diversity amongst the Associate Lecturers offered. It also enabled an evidence-based evaluation to be built that did not always have to be numerical or driven by university wide key performance indicators. The project was aiming to directly improve the student experience of a statistics module, especially for non-specialist statistics students. Any positive influence on pass and retention rates would be looked for but these were not the fundamental drivers for the project as measurable differences were deemed unlikely.

The terms Associate Lecturer and tutor are used interchangeably in this report. This is a reflection that formally the University prefers the phrase Associate Lecturer but, in this project, the phrase tutor is much more apt than the phrase lecturer.

## **2. Aims and scope of project**

The initial aims in the eSTEEeM proposal for this project were:

- Identify the pressure points for students studying M248 and classify the differences of these pressure points by qualification route. This will be done through student evaluation.
- Use specialist ALs to identify routes through M248 which will be tailored to each of the main qualifications which students who study M248 are registered for. We anticipate these routes will highlight aspects of the material and assessment which are important pre-requisites for future modules within individual qualifications, as well as noting parts of the module where it might be less important to students to gain a deep understanding for their chosen qualification.
- Allocation of students to tutors by qualification, rather than geography, with tutor group time allocated for qualification-based discussions and tutorials reflecting routes identified above.

These initial aims changed slightly over the period of the project and in a sense became just some of our more specific goals. The aims became somewhat more ambitious, but more nebulous, as it became clearer how much potential the initial project was opening up. The aims might now better be described as:

- To deliver change from a specialist statistics module to a module servicing the needs of both specialists and non-specialist in Statistics at the second year undergraduate level.
- To contribute to a sense of community for students on a service module
- To enable Associate Lecturers to accept the need for change and continue with their customary enthusiasm to look for ways to improve student support.

### **3. Activities**

#### **3.1 Overall approach**

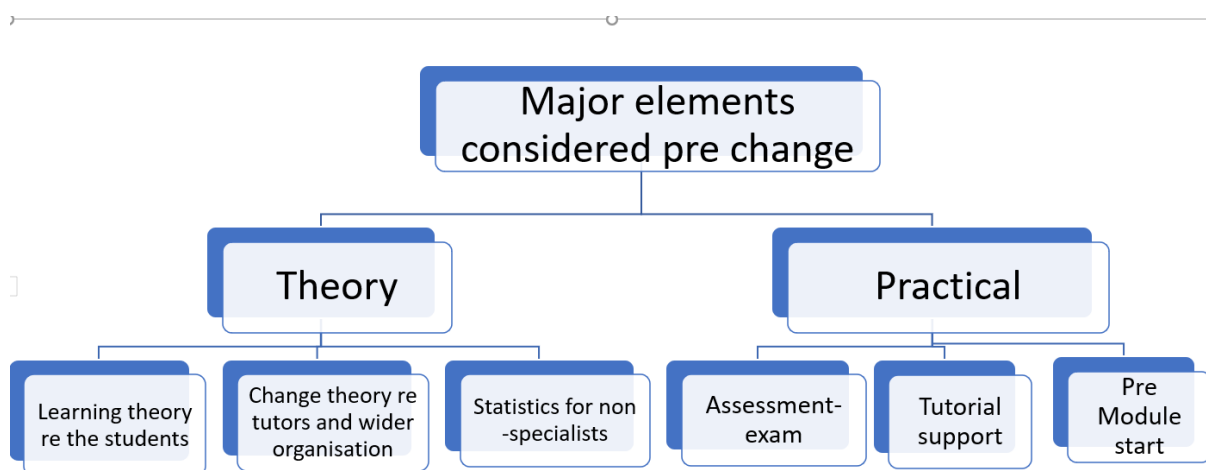
The overall approach had two distinct strands that are summarised in Figure 2. One strand was to consider the areas of theory that might be relevant; the other strand concentrated on the practical realities of where we could make change. Published work relevant to this project was identified and this then influenced both expectations for the project and the approaches taken within the project . Three distinct areas of theory were identified as of interest:

- Student theory of learning, focussing particularly on distance learning students.
- Change theory, specifically in relation to teaching practice
- Teaching of statistics to non-specialists

The theoretical framework was then used as a reference checklist within the project evaluation (see annex).

In terms of the practical strand a key factor was that the module had been rewritten for 2017. This meant the unit materials, all of which are available as printed books as well as pdfs, could not be altered. Whilst this initially sounded a disadvantage in fact it helped us narrow down the focus of the project. We did, however, have considerable scope to change the form of the tutorial support and to provide pre module start materials.

Figure 2: Framework set up at project start



Planned activities fell into three broad groupings:

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- Student activities
- M248 tutor activities
- Activities with other parts of the University.

The “other parts of the University” included substantial interrogation and analysis of data sources held by the University on student access to tutorial recordings and attendance at tutorials. This enabled us to build a comparison between what students told us they did or wanted, and what students did given choices in tutorial provision. Additionally considerable work was required to make an allocation of students to tutors on the basis of student qualification route.

## **3.2 Student activities**

### **3.2.1 Student Questionnaires**

The first activity relating to students was requesting and analysing responses to questionnaires which were placed within the M248 module study calendar on the Virtual Learning environment (VLE). The VLE has some built in tools which enable straightforward questionnaires to be readily built and then easily completed by students. The 19J students were asked about their views on 'sticky points' on the module to date. The questionnaire was issued just over halfway through the module which had both advantages and disadvantages. The former being timeliness and being unaffected by changes that occurred at revision. The disadvantage being that we would only have information on the first seven, of the twelve, units in the module. The questionnaire was anonymous, but enough background information was collected to enable the qualification route and study intensity to be used in the analysis.

The 20J students were also asked to complete a questionnaire just before December 2020, also delivered via the VLE. The question covered a broader range of topics than for the 19J students, including information about tutorials in general, together with three free text questions forming the core of the questionnaire. The intention was to analyse the results using simple text analysis to assess any major difference between the four main qualification groupings. Both questionnaires are in the annex and appropriate University permissions for the survey and analysis work were obtained.

### **3.2.3 Student attendance at tutorials**

Analysis of student attendance at live tutorials and viewing of tutorial recordings was planned as a key contribution to the evaluation of this project. For the 19J students this involved attendance at f2f, live online tutorials and viewings of recordings of tutorials. For the 20J students, for whom we had introduced core and qualification-based tutorials, analysis of attendance at live online sessions and viewings of recordings were planned. The pandemic meant the 20J students were not offered f2f tutorials. This work was undertaken by analysis of records automatically generated and the analysis was designed to be reported at aggregated, anonymous level.

### **3.2.4 Strengthening student pre module work**

The pre module start work was strengthened in two ways. Funding was obtained for an M248 tutor, who was also an economist, to write some materials for economics students who were taking M248 in 19J. These materials included a "handbook" and some example questions which were used in two workshops pre module start. The same materials were available to the 20J economics students and in the summer of 2021 the economics department took over running the scheme and materials were

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moved across to their school site. It was hoped this would encourage a greater number of economics students to access the materials.

It was also possible to volunteer M248 for a pilot which enabled students, before module start, to access the first two units of the module. Additionally, on successful completion of a quiz, students gain access to further units pre module start. Study, pre module start, was supported by including M248 into the general revise and refresh programme already running on the Maths & Statistics school site.

### **3.3 M248 Tutor activities**

#### **3.3.1. Tutor Discussions**

The plan was to address, over a two-year period, the issues of relatedness, competence and autonomy that the literature indicated were likely to be associated with lecturer resistance to change. The first issue tackled was to arrive at a consensus that there was a generic problem which was not specific to any qualification groups of students. Many students and most tutors consistently expressed a preference for tutorial support to be delivered f2f rather than online. The provision of f2f tutorials also meant that the allocation of students to tutors was done on a geographical basis to minimise travel distances to tutorials. However over the last five years or so student numbers at f2f tutorials, whether in the evening or on Saturdays, had dwindled enormously with students in reality attending only online tutorials. Tutors were aware of the very low numbers at their own tutorials but not of those at other tutorials, nor of the relatively high numbers of students at online tutorials. All the tutors had experienced the disappointment of preparing materials, often travelling a long distance, and then finding just one or two, or even no, students present. The first step was to share such information to enable tutors to understand the magnitude of non-attendance at tutorials and to reach a consensus that we could not continue as we were.

The major activity, which included all tutors, was spread over the 18J,19J and 20J presentations. There was a phased set of activities, synchronous and asynchronous, which started with the raising awareness of the low student attendance at f2f events. Following this, the changing nature of the students, in terms of the increasing variety of qualifications students were studying, was discussed. This was also not widely known to the tutors although some tutors had noticed more non mathematicians in their own groups of twenty students. Sharing aggregated data, and forthcoming curriculum plans (which would result in even more economists and data scientists in the future) enabled tutors to see and accept the issue that “no change” really was not an option for M248. We introduced the idea of allocating students to tutors by qualification and there was a consensus view amongst tutors this was worth trying.

This stage took time, which meant that all tutors had several opportunities to voice their views. This approach definitely helped maintain a sense of autonomy.

#### **3.3.2 Tutor preparation of additional materials**

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In the summer of 2020 and 2021 some tutorial materials were prepared by existing M248 tutors who each had expertise in one of the four qualification areas where we wanted to offer the new qualification route tutorials. Tutors were invited to express an interest in undertaking the work which was funded partially from faculty resource and partially by eSTEEem.

### **3.4 Activities with other parts of the University**

Planned activity, outside the direct work with students and tutors, included:

- the analysis of data to inform the project direction and allocate students to tutors,
- securing funding to ensure tutors were not financially disadvantaged if qualification groups were below the minimum size,
- producing a timetable for the students that easily identified the different types of tutorials,
- communication of findings,
- ensuring the allocation of students to students based on qualifications was sustainable and scalable.

The analysis of data covered both data collected specifically for the project, which was effectively from the student questionnaires, and analysis of details held on the University data servers. Analysis was undertaken by programming in SAS, on the University SAS servers, with all programs and data stored then on the secure SAS servers.

Agreement for small tutor groups, if necessary, was obtained from Associate Dean (Four nations and tuition delivery). Agreement to fund any shortfall in pay to tutors was obtained from both the School of Mathematics and Statistics and from the STEM Associate Dean (Four nations and tuition delivery).

Additional information, for 20J, was placed in the main University timetable package (LEM) to enable students to see both core and qualification-based tutorials. This effectively involved replication of all the core entries four additional times to enable students to view sessions in the LEM.

## **4. Changes made in project and unexpected difficulties**

The changes due to the Covid19 pandemic introduced relative few unexpected difficulties to this project. The project's primary aim was not to deliver a measurable increase in pass or retention rates, therefore the change in exam arrangements did not directly impact the project. However, it was hoped that the student satisfaction surveys of the 20J and 21J cohorts would show an increase in student satisfaction. In the event the satisfaction surveys were utterly dominated by comments on online exam arrangements.

The pandemic did result in a large increase in students on the 20J cohort on level 1 statistics (M140) and this added to uncertainties in numbers on this level 2 module (M248) in 21J. Alongside the introduction of the new degrees in Data Science and Economics (both of which include M248 as a compulsory module), this meant it was exceptionally difficult to know how many tutors would be needed for each qualification route in 21J. It was therefore difficult to give some tutors any certainty about the qualification strand of the students in their tutor group and also to recruit new tutors to fill the emerging demand.

The lack of flexibility in both the LEM and the once-a-year timing for changes to the tuition strategy was, and remains, difficult. The 20J survey of students frequently contained student comments about the difficulty of finding out what tutorials were on where.

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Finding tutors willing to write materials in the summer proved harder than expected.

The new AL contract has had no impact to date.

## **5. Main findings: outcomes *and* evidence**

The outcomes of the project, and the evidence on which these are based, are arranged under three broad headings in this section. In some cases, these findings are the result of analysis of, for example, student questionnaires. In other cases, they are a narrative about the current point that the ongoing process has reached. For example, the provision of tutor time, along with the nature of tutorials, has developed over the period of the project and it is expected this will continue to evolve.

The annex contains the student questionnaires for 19J and 20J and some further results from the analysis of 19J data. The annex also contains the theoretical framework referred to in figure 2 which was used as a reference checklist for the project evaluation.

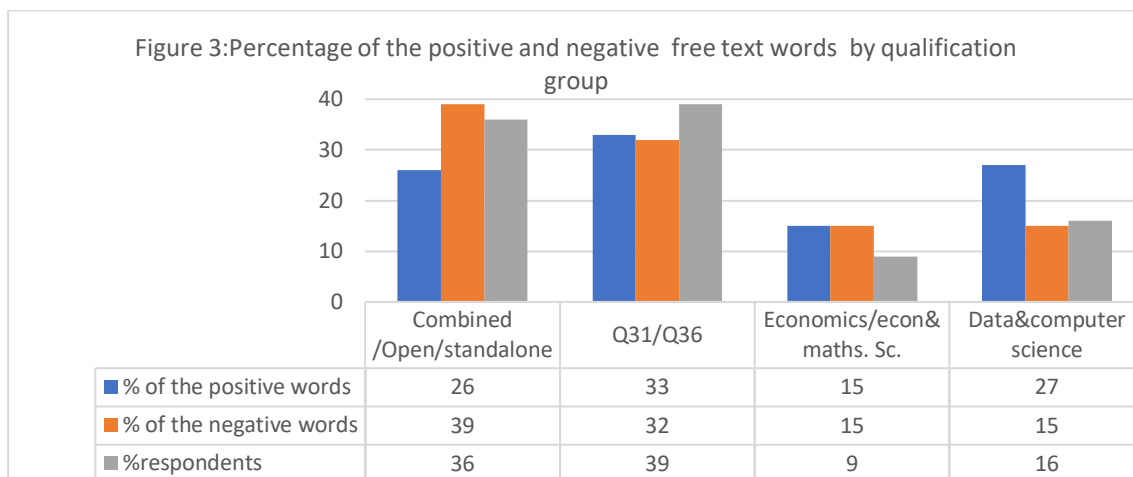
### **5.1 Meeting the different support needs of students, on the same module, but different qualifications.**

#### ***5.1.1. Students on different qualification routes seemed broadly similar in terms of how content they were with the module***

A response to the questionnaire was received from ninety-eight students in the 20J cohort of students, which represented an achieved a response rate of 19%. The 20J cohort were the first to be allocated by qualification group to tutors and to be offered both core tutorials and qualification-based tutorials. Response bias is inevitable in an anonymous questionnaire such as this and a concern, in this analysis, is that the nature of the non-response bias differed by qualification group.

Our students tend to be very positive and very unwilling to be critical in their comments. To try and compensate for this the questionnaire was deliberately anonymous and the phrasing of question 5 was deliberately phrased to elicit negative comments (see Q5 in Figure 3).

Q5: One thing that really irritates me about M248 tutorials is...



A free text question, rather than asking students to respond to items on a Likert scale, was deliberately chosen as the basis from which to build a measure of “satisfaction”. This had the major advantage of not confining student answers to a pre-determined set of questions and allowing students to say as much or as little as they wished. It had the considerable disadvantage that free text analysis is more complex. The relative number of positive and negative words used by each student was identified and then summarised by each qualification group.

From Figure 3 it can be seen that the economists represented 9% of the responses to the questionnaire but contributed 15% of the positive words and 15% of the negative words. Thus, they represented a relatively more vocal group than their numbers suggested but they were as equally balanced in their positive and negative comments. The least vocal group were the Mathematicians/ Statisticians. They represented 39% of respondents but only contributed 33% of the words however, like the economists they were equally likely to respond positively and negatively to the free text questions (33% compared to 32%).

The Computer Scientists/Data Scientists contributed 16% of the responses but 27% of the positive words and hence were relatively the most positive group. The Data Science degree was new (with a first presentation in 19J). This may account for the potentially overly positive as students had been requesting the creation of a degree in Data Science and therefore could be a more generally satisfied group of students. The least positive group were the combined group of “standalone students, Open Combined science students and others”.

**5.1.2. If students were planning to attend a tutorial “live” they were more likely to attend a qualification-based tutorial. If students wanted to view a recording of a tutorial, they were more likely to view a recording of a core tutorial.**

The 20J cohort were the first group of students to whom we offered some qualification-based tutorials. There are 12 units in M248 and for each unit three or four “core” tutorials were offered in 20J. Tutors

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are free to identify key elements in the printed materials to expand on, explain and provide examples for students to tackle; students seem to appreciate the variety this offers.

In addition some tutors were asked to offer qualification-based tutorials. These were shorter, (typically 1 hour rather than 1.5 hours of the core tutorials) and focused on examples from the one of the four qualification strands. There was a more informal approach in these sessions, with an emphasis on students tackling questions in the session. For 20J, only a subset of the 12 units had a specialist qualification-based tutorial. The success in 20J of this combination of tutorials resulted in an increase of qualification-based provision for 21J, with at least one qualification-based tutorial for each of the four qualification strands and for every unit in the module.

**Table 1: Attendance and viewings of tutorials by qualification group**

Table 1: 20 J cohort	Live Attendances per 100 students	Viewings per 100 students*	Number of tutorials 20J	Number of planned tutorials 21J
Core tutorials	4.2	697	47	44
Qualification-based tutorials				
Maths & Statistics	6.1	54.5	3	10
Economics	9.4	164.9	6	18
Computer and data Science	11.4	224.0	6	19
Standalone/Open/other	8.2	331.0	8	16

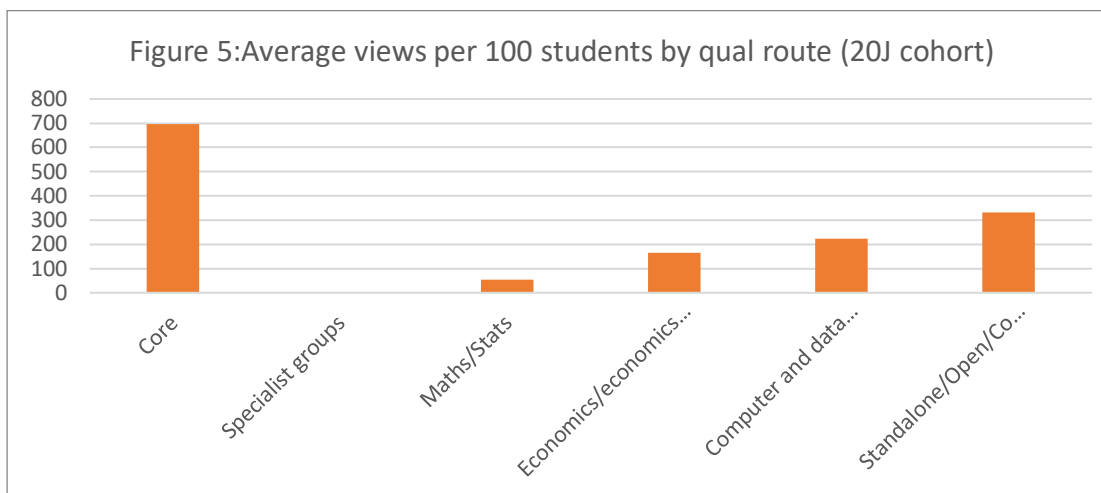
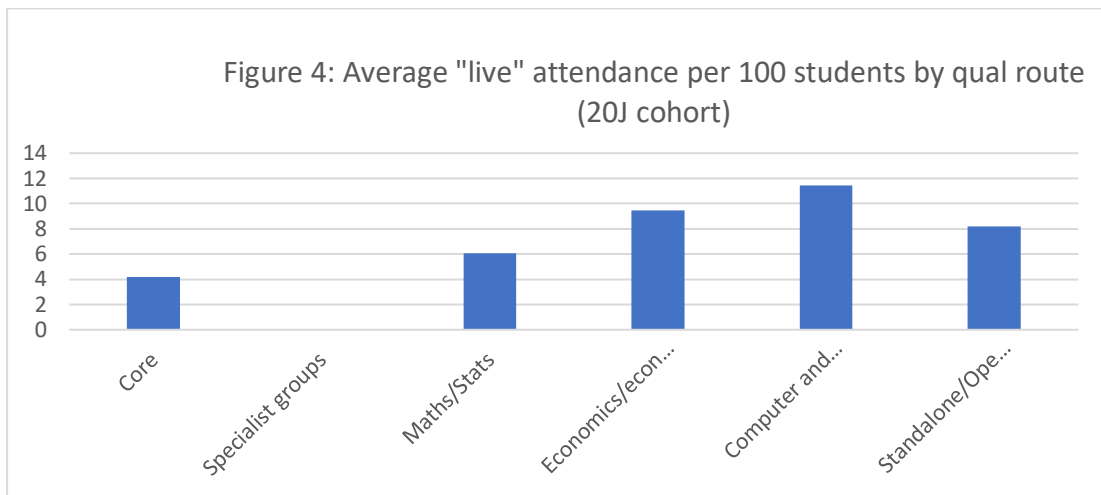
\*Divisor for core tutorials is the number of students at course start on M248

Divisor for specialist tutorials is the number of students in that qualification group at course start

Table 1, along with Figures 4 and 5, supports the idea that if a student is going to attend a tutorial “live” they are more likely to attend a qualification-based tutorial. These tend to be smaller, more informal, shorter and more example based. If students are going to view a recording of a tutorial, they are much more likely to view a recording of a core tutorial.

All tutorials were open to all students, regardless of which qualification a student was studying. Most tutorials (regardless of whether they were core or qualification-based tutorials) were recorded and so could be accessed by students at future dates. Whilst the qualification-based tutorials were open to any student, in practice there was no evidence that, for example, an Economist student would attend a tutorial geared at Mathematics/Statistics students. It is worth noting that for 20J, very few qualification-based tutorials were specially aimed at Maths and Stats students because it was deemed the “core” tutorials met their needs. However, the free text responses did enable a few Mathematics/Statistics students to raise a regret that they had not had more “qualification-based” tutorials.





There were 3830 viewings of the recordings of the core tutorials and 827 viewing of the qualification-based tutorials. Students repeatedly tell us that they watch a part of a recording on an area that they find difficult multiple times and by multiple tutors. In practice many recordings were viewed in the revision period, including many that were partially viewed.

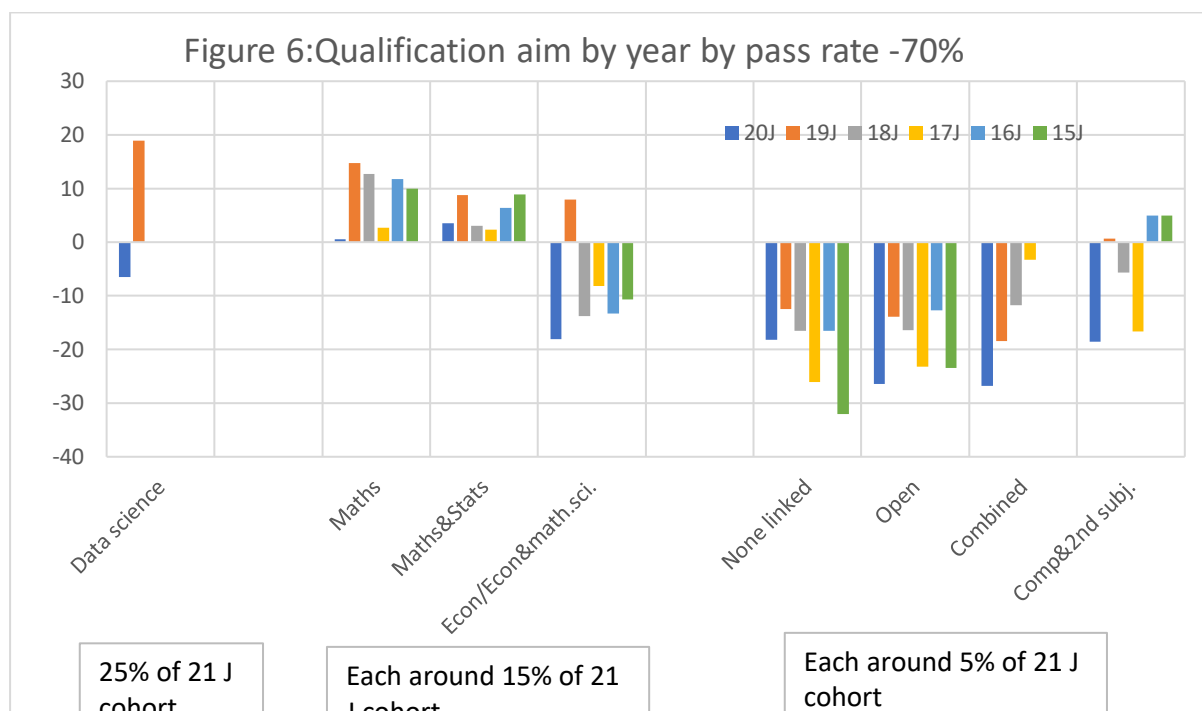
**5.1.3. There was no improvement in the difference between pass rates for the different qualification groups.**

The dominance of Mathematics students, compared to even the Mathematics and Statistics students, in terms of exam success can be seen in Figure 6. Figure 6 shows the pass rates, relative to a baseline of 70%, by a finer division that the four qualification groupings which were used in this project. This more detailed grouping by individual OU qualifications enables the historical bias towards Mathematics students to be identified. The pattern is evident over a long period (the first presentation of M248 was in 2003) and has remained true after the 2017 rewrite of the module. Addressing this imbalance is unlikely to be possible without further overhaul of the exam. The

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examinations changes made for the 19J and 20J results make comparisons of actual pass rates across years problematic.



We had hoped that strengthening the support to students on different qualification routes would narrow the gap between the most and least successful groups of students. In fact, the difference appears to have increased.

Table 2 indicates that the Mathematics and Statistics students have consistently had the highest pass rate, however over the three years 18J, 19J, and 20J students on different qualifications have had the lowest pass rates. In other words, the lowest pass rate is not consistently held by one particularly qualification. Disappointingly the difference in pass rate has widened from 24 percentage points in 2018 to 31 percentage points for the 2020 cohort.

**Table 2: Pass rates by qualification group**

Table 2	2018 cohort	2019 cohort	2020 cohort
Max pass rate	Maths&Stats students with an 80% pass rate	Maths&Stats students with an 84% pass rate	Maths&Stats students with a 72% pass rate
Minimum pass rate	Computing students with a 56% pass rate	Combined Science students a 54% pass rate	Open Degree students with a 41% pass rate
Difference	24 percentage points	30 percentage points	31 percentage points

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## **5.2 Negotiating with a team of Associate Lecturers (tutors) to improve the student experience.**

### ***5.2.1. Tutors positively contributed to shaping new provision***

In the initial discussion with tutors concerns emerged that:

- *the workload might not be fair as the non-mathematics /statistics tutor groups would need more help, and hence more time, than the groups containing Maths and Stats students.* This was generally agreed as a possibility and therefore it was felt reasonable that tutors of these groups should have some of their tutorial hours not timetabled. These non-timetabled hours would be spent in student support as the tutors felt was necessary. This time might be used to support individual students directly, or by taking longer on correspondence tuition because there was more to explain, or through open sessions with the tutor group
- *group sizes might have to be smaller, and so there might be a financial hit, if a group was below the minimum for the full module payment.* This was addressed by funding being sought to ensure that, if there were small groups the tutors would not financially suffer.
- *it would be difficult for tutors to deliver tutorials for groups of students on qualifications other than the tutors' home ground of Maths and Statistics.* This was addressed by funding the writing of some tutorial materials over the summer of 2020 and 2021.

The ability to identify, consider and discuss these concerns through the forums, occasional Adobe Connect meetings and emails meant that we had a smooth implementation.

### ***5.2.2. Tutors are willing to “flex” initial arrangements as circumstances alter.***

Historically on M248, each tutor has ten hours of allocated tutorial time. For 19J these hours were all timetabled with tutors providing typically six tutorials of 90 minutes for each of the units plus revision tutorials. These historic tutorials were roughly equivalent to what is referred in the project as core tutorials. The plan agreed, as “fair” for tutorial delivery in 20J was to decrease the overall number of timetabled tutorials per unit. These timetabled tutorials could be either ‘core’ tutorials or ‘qualification-based’ tutorials. The majority of these timetabled tutorials would be delivered by tutors with Maths and statistics students. In addition, and following discussions with tutors it was agreed that the number of hours each tutor had with their own tutor group should be increased, whilst maintaining the higher timetabled tutorial load of the tutors with Maths/stats students. This enabled all tutors to at least have a welcome and revision session with their students and recognised the extra help the non-specialist statisticians needed.

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Table 3: Use of tutorials hours

Table 3	Tutors with students on Maths/Maths and Maths&Stats qualifications	Tutors with students on all other qualification routes
21J cohort		
Contribution to LEM timetables tutorials	8 hours	4 hours
Time with their own tutor group	2 hours	6 hours
20 J cohort		
Contribution to LEM timetables tutorials	9 hours	6 hours
Time with their own tutor group	1 hours	4 hours
19J cohort	Tutor groups not allocated by qualification route	
Contribution to LEM timetabled tutorials	All tutors had 10 hours of time allocated	

### 5.2.3. Tutors seem broadly content with the new arrangements

Tutors were asked which of the four qualification-based tutor groups they would prefer when the approach was adopted for 20J. There were slightly too many tutors expressing preference for Maths/statistics groups but it possible to “encourage” some tutors to take non Maths /Statistics group of students. Part of the encouragement was a guarantee that in 21J they would have first choice of which qualification group they would like. However, in 21J none of the tutors who had tutored a non-maths/statistics group wished to change to a Maths / statistics tutor group. In fact one new (new to the OU) tutor was appointed to take a Maths/statistics group.

The second piece of evidence showing how much tutors have changed is the activity on the tutor forum. Six weeks into the 21J presentation we held an Adobe Connect session with tutors. There were over 30 posts on the forum before the meeting- a very high number for M248 – and 27 tutors attended. The posts and the discussion were not about moving from geographical to qualification-based allocations; nor were they about “core” and “qualification-based tutorials“, nor about the change to using “visible rooms” In adobe. Instead, the conversation was totally dominated by what to do with the non-timetabled time which they could use with their own tutor group. It was necessary to remind tutors that it was for them to decide because they might need to help individual students more or spend more time on the correspondence tuition – the workload concerns seemed to have been alleviated!

### 5.3 Circumnavigating barriers to the development and implementation of change.

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### ***5.3.1. It is possible to move from a model of geographical allocation of students to an allocation model based on the qualification a student is studying***

In some senses simply the fact this was done is the evidence it is possible. However, it took considerable thought and time to achieve as well as co-operation from AL services. All the initial work needed to allocated students to tutors based on their qualification took place with specially written SAS programs and AL services have since managed to replicate the critical part with a bespoke CIRCE report.

The main system used for allocating students to tutors, NTS, does not hold the qualification the student is following. Therefore SAS programs were built to identify student qualification route, and as students *registered*, students were allocated on a rolling basis to tutors. As groups filled either new tutors were appointed or a change of group was negotiated with a tutor. This process was helped enormously by the long-standing relationship with tutors and over half a dozen tutors who just said “use me where you most need to”. Over the period June to August several tutors were reallocated to different qualification route groups more than once.

The allocation of students to tutors on M248 had always been done “manually” by supplying AL services with a spreadsheet that allowed bulk allocations within NTS at a time. The format of the spreadsheet, produced from SAS, but which will be produced from CIRCE in future, had been perfected in previous years. AL services say that, given their experience in using it, it is faster than auto allocation.

### ***5.3.2. It is not possible to use only the LEM as a means to direct students to the set of core and qualification-based tutorials.***

The 20J cohort students repeatedly told us in the questionnaires and on the forums that it was difficult to identify when tutorials were occurring and in which online room. The solution for 21J has been to manually produce a colour coded excel workbook that students can interrogate by time, date, unit, and core/qualification based. To date no 21J students have expressed a problem finding tutorials.

### ***5.3.3. Additional funding is not required to support small qualification tutor groups***

The rolling nature of the allocation combined with the willingness of tutors to take different tutor groups at a late stage, has meant subsidising small groups was not required in either 20J or 21J.

### ***5.3.4 It is possible to modify a module to offer specialist and service delivery without re writing of the main module materials***

Would it have been more efficient to change the module materials? Perhaps, yes but it would actually have been less flexible and would not have involved the tutors’ in the same way. It has cost around

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200 days to implement, however to replicate this method on another module would take less than half that time now a methodology is established. It is not a cheap option and it was not an easy option although it may appear so to the School of Mathematics and Statistics, who may not fully appreciate the number of 'hidden' hours staff have put into implementing this method. What was clear to the project leads was students dropping out of module because it fails to meet their needs or different schools delivering their own statistics modules is not a good option either and therefore a solution was needed, regardless of the time involved.

## **5. Particular Successes and unexpected outcomes.**

The whole process has brought the tutors together more as a group and had quite a reinvigorating effect in terms of questioning by the tutors of what they do and how. We have held so many positive discussions via the forum and in Adobe Connect tutor sessions. This was not a planned outcome, but it has created a community of practice amongst the M248 tutors and project team.

The puzzle, of how to allocate students to tutors via qualification routes, when there an unknown number of eventual students on each qualification route, was hard and therefore particularly pleasing to solve.

The building of a satisfaction measure from an analysis of free text use of positive and negative words was much more flexible than using satisfaction questions on Likert scales. It provides a methodology to apply easily in the future.

## **6. Impact**

### **6.1 Student experience**

The major impact for students is the wider range of tutorials available with both “core” and qualification-based tutorials available. This increases their opportunity to meet students following the same pathways as themselves and hopefully builds links and a sense of community between students who are studying the same qualification.

We would certainly hope there is potential benefit for students not directly involved in the pilot. The pilot is now embedded as normal practice on M248 and so future M248 students will benefit from this approach. The introduction of the Data Science qualification has already impacted on numbers on other modules, most noticeably MST224 and M249. There may be aspects of the approach developed on M248 that these modules also want to adopt. A new module M348 (which replaces M346) has a first presentation in 22J. This module is specifically written for students studying Economic and Data Science alongside Mathematics and Statistics students. Hopefully there will be elements of tutorial support on M348 which will benefit from the work done by this project.

### **6.2 Teaching**

The project as it stands is difficult to translate to outside the OU, however many universities struggle to find successful ways engage students in service teaching type modules. These modules often have to service multiple qualification and the specialise tutorial support provides one route of thinking about how to tailor example classes in traditional institutions. It is suspected that the qualification-based

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tutorials help non-statistics student deal with statistical anxiety. This is an areas which we feel is worth robust evaluation and we hope to have a follow on eSTEEem project which will research this issue.

### **6.3 Strategic change and learning design**

To date, there has been no impact on our Unit's or the University's policies and practice, however we are working on it!

## 6.4 Any other impact

The collaboration with Economics has strengthened an already close working relationship

## 7. Acknowledgements

All the M248 tutors have been invoked in this change and over half have been contributing to shaping the work since 18J

Funding from eSTEEem , the faculty and the school have all contributed to making it possible to deliver the tutorials and pre module start materials.

AL services have been key in allocating students from a non-standard approach and in developing a CIRCE template.

19J students and 20J students, have been generous with time in completing questionnaires

## List of deliverables

We anticipate submitting a paper for the MSOR connections journal. Presentations were given at:

Nov 17<sup>th</sup> 2021: statistics research day

Nov 5<sup>th</sup> 2021: SHARE: staff tutors Scholarship sessions

Oct 7<sup>th</sup> 2021: Mathematics and statistics scholarship series

Sept 2021: MSOR September conference.

June 2021: HEA June Horizons in STEM conference

March 2021: STEM Teaching Conference

## Figures and Tables

Figure 1: Approximate project timeline

Figure 2: Framework set up at project start

Figure 3: Percentage of the positive and negative free text words by qualification group

Figure 4: Average “live” attendance per 100 students by qual route (2020J cohort)

Figure 5; Average views per 100 students by qual route (2020J cohort)

Figure 6: Qualifications aim by year bypass rate-70%

Table 1: Attendance and viewings of tutorials by qualification group

Table 2: Pass rates by qualification group

Table 3: Use of tutorials hours

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## References

Adrian Bromage, Sarah Pierce, Tom Reader & Lindsey Compton (2021): Teaching statistics to non-specialists: challenges and strategies for success, *Journal of Further and Higher Education*.

Marsha C. Lovett & Joel B. Greenhouse (2000) Applying Cognitive Theory in statistics Instruction, *The American Statistician* ,54:3, 196-206.

R.Yilmaz Mustafa (1996).The challenge of Teaching Statistics to Non-Specialists, *Journal of Statistics education*,4:1.

Svetlana Tishkovoskya & Gillian A.Lancster (2012) Statistical Education in the 21<sup>st</sup> Century. A review of challenges, Teaching Innovations and Strategies for reform, *Journal of Statistics Education*, 20:2.

Viginie Marrz & Geert Kelchtermans (2013) Sense-making and structure in teachers' reception of educational reform. A Case Study in statistics in the mathematics curriculum, *Journal of Teaching and Teacher Education* 29 13-14.

And on the OU scholarship exchange:

### **Increasing online tutorial attendance and the number of viewings of tutorial recordings at**

[https://openuniv.sharepoint.com/:w:/r/sites/units/lds/scholarship-exchange/\\_layouts/15/Doc.aspx?sourcedoc=%7BBBF56E224-596B-4B4E-9518-5C388D3D62C8%7D&file=TutorialHours\\_report\\_final.docx&action=default&mobileredirect=true](https://openuniv.sharepoint.com/:w:/r/sites/units/lds/scholarship-exchange/_layouts/15/Doc.aspx?sourcedoc=%7BBBF56E224-596B-4B4E-9518-5C388D3D62C8%7D&file=TutorialHours_report_final.docx&action=default&mobileredirect=true)

Carol Calvert (M248), Claudi Thomas (MT365), Hayley Ryder (M303), Hilary Holmes (MST125), Katrine Rogers (MST224, MS327, M373) and Sue Pawley (MST124).

## University Approval processes

SRPP: Application number 20202/006

University secretary Office: request to use data owned by another domain 11/11/2019

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## Annex

### 1. Questionnaire of 202J students 98 responses

- 1 We want this questionnaire to be anonymous and therefore we need to ask you two important background questions. The first question is about the qualification you are studying and the second is about your study intensity. Please click on whichever option is the most appropriate at the time you are filling in this questionnaire.

I am studying M248

- As a standalone module
- As a part of S03-the professional certificate in Applied statistics
- As a part of R28/QD- Combined STEM/Open degree
- As a part of Q31/Q36- Mathematicians/Mathematics and Statistics
- As a part of R30/Q15- economics/economics and Mathematical sciences
- As a part of Q46- Mathematics and its learning
- As a part of R38/Q67 -Data Science/Computing IT and Stats
- Other
- No answer

- 2 The send background question is about how many credits, INCLUDING M248, will you be studying on 1st Jan 2021.

- 30 credits i.e. just M248
- 60 credits
- 90 credits
- More than 90 credits
- Other
- No answer

You may be aware that students were allocated on the basis of qualification route to tutors this year instead of the more usual approach of allocation by geographical area. This meant that most students in a tutor group are following similar qualifications and so some tutors have been offered tutor group only sessions.

In the Online tutorial (cluster) room we have been offering core tutorials for every Unit and in the module wide room we have been offering specialist tutorials for Maths & Stats students; Economists; Computer and Data scientists; and Combined STEM/Open degree/standalone students.

Additionally, in the module room there have session on practice quizzes; some catch-up session on earlier modules and some session looking ahead to later modules.

Most sessions are recorded and **all sessions are open to all students.**

- 3 Please tick all the below that apply

- I was unaware that there were any tutorials
- I attended a session with my tutor in the tutorial group room
- I have attended at least one cluster room tutorial session live
- I viewed the recording of at least one cluster room tutorial
- I have attended at least one module room tutorial live
- I viewed the recording of at least one module room tutorial

Please complete the following statement by typing in the box below each question and the box will just expand.

- 4 One thing which would make M248 tutorials more useful to me is...

- 5 One thing that really irritates me about M248 tutorials is...

- 6 One piece of advice about M248 tutorials that I would give other students is...

- 7 Thank you very much for your time. If there is anything you would like to add please feel welcome to email me at [carol.calvert@open.ac.uk](mailto:carol.calvert@open.ac.uk) or add in the text box below

## 2. Questionnaire for 19J students-79 responses

1 We think potential "sticking or pinch points" may vary by qualification and intensity of study. We want this questionnaire to be anonymous and so we need to ask you two important background questions. This question is about which qualification you are studying and the second is about your study intensity. Please click on whichever option is the most appropriate at the time you are filling in this questionnaire

Choose...

2 If you said other could you give more details here?

3 The second background question is how many credits, INCLUDING M248, are you currently studying for - please include resits

Choose...

4 Which of these answers best fits your views about how you have been able, so far, to manage your M248 study within the guidelines in the study calendar

Choose...

5 If you said other could you give more detail here?

6 Which of these topics felt like a "pinch point" for you

- Unit 1-Interpreting graphics like scatterplots, histograms and boxplots
- Unit 2 -Probability density function and cumulative density function's
- Unit 3 - Discrete distributions like Poisson and Binomial
- Unit 4 -Population means and variances
- Unit 5 - The exponential and Poisson
- Unit 5 - quantiles
- Unit 6- Normal dist and sample means and variances
- Unit 7 - Maximum Likelihood estimators
- Other

7 Is there anything that you think the M248 team might do to make it easier for students to manage any pressure points in the module that you experienced? ( the box should just expand as you type in as much or as little as you like)

## 3. Analysis of pinch point information from 19J students

The 19J students were asked which units of the course they felt were "pinch points" and this was then compared to the numbers attending tutorials or viewing tutorial recordings. Many tutorials, or parts of tutorials, would be viewed several times by students. The timing meant information was available from students about the first 7 units only.

Students perceptions of pinch points did not always coincide with an increase in viewings of tutorial recordings. So 22% of students reported Unit 6 as a pinch point but the viewing figures did not support this.

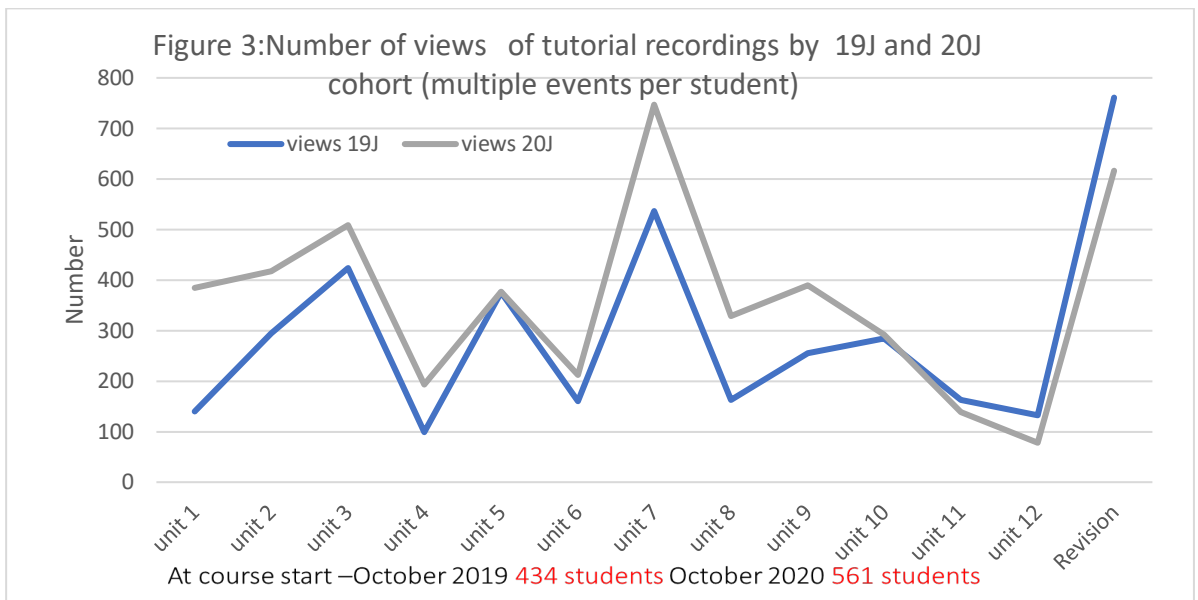


Table 1: Pinch points identified by students in 19J survey

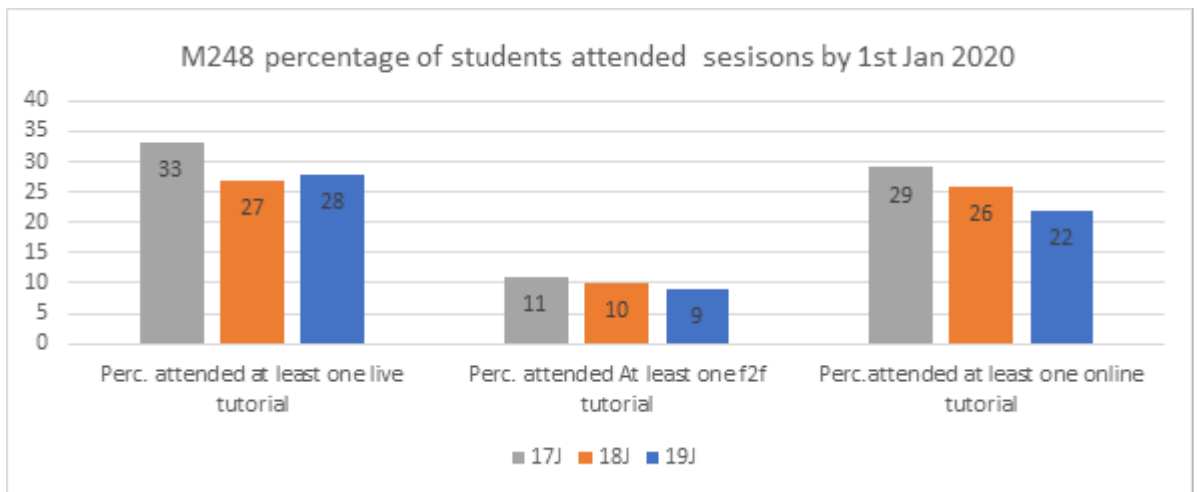
Which of these topics felt like a "pinch point" for you

Response	Average	Total
Unit 1-Interpreting graphics like scatterplots, histograms and boxplots	2%	1
Unit 2 -Probability density function and cumulative density function's	7%	4
Unit 3 - Discrete distributions like Poisson and Binomial	10%	6
Unit 4 -Population means and variances	5%	3
Unit 5 - The exponential and Poisson	28%	16
Unit 5 - quantiles	9%	5
Unit 6- Normal dist and sample means and variances	22%	13
Unit 7 - Maximum Likelihood estimators	57%	33
Other	10%	6
Total responses to question	73%	58/79

4. **Analysis of impact of moving some online tutorials to f2f** Students requests for more f2f tutorials are not necessarily matched by their willingness to attend f2f.

The M248 work was initially designed to try to increase attendance at face-to-face tutorials. The number of f2f tutorials between module start and 1<sup>st</sup> Jan 2020 was increased by four and the number of online sessions correspondingly decreased. The plan over the entire study year would have been to move around 16 sessions from online to f2f but Covid-19 curtailed the programme. Messages about tutorials were posted on the forums and the module news section on two occasions to remind students of the importance of tutorials.

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There was no noticeable change in the percentage of students attending at least one tutorial.

- Above is extract from report on scholarship exchange
- **Increasing online tutorial attendance and the number of viewings of tutorial recordings at**
- [https://openuniv.sharepoint.com/:w:/r/sites/units/lds/scholarship-exchange/\\_layouts/15/Doc.aspx?sourcedoc=%7BBF56E224-596B-4B4E-9518-5C388D3D62C8%7D&file=TutorialHours\\_report\\_final.docx&action=default&mobiledirect=true](https://openuniv.sharepoint.com/:w:/r/sites/units/lds/scholarship-exchange/_layouts/15/Doc.aspx?sourcedoc=%7BBF56E224-596B-4B4E-9518-5C388D3D62C8%7D&file=TutorialHours_report_final.docx&action=default&mobiledirect=true)
- 
- 5 **Evaluation framework** from literature review of potential areas for action for students and tutors; original bid from eESTeM funding and the “other activity items”

<i>Key ideas to consider re Student learning from literature</i>	Possible actions	Actions taken
<b>Attitudes</b>		
Interest/Value/usefulness of statistics	<p>Specific examples from different areas in assessment.</p> <p>Tutorials specifically looking for applications in qualification area.</p> <p>Links made by tutors to existing knowledge from previous study</p>	<p>Done</p> <p>Done</p> <p>Ongoing</p>
Lack of confidence in maths skills	<p>Increased pre course start materials in summer and links to revision materials and forums in summer</p> <p>Specific tutorials pre course start arranged for economist</p>	<p>Done</p> <p>Done</p>

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	Tutorials on skills such as algebra	Currently Study skills; algebra and calculus. To be expanded
Communicate results in a clear manner	Increasing emphasis in exam and TMAs on communication and interpretation. Short computer marked answers in exam removed.	Ongoing
<b>Statistical anxiety</b>		
Fear of asking for help	Working with other students with similar backgrounds in qualification tutorials and in tutor groups based on qualification areas	Ongoing – need to expand use of tutor group forums
Fear of teacher	Establishing the common interest in the qualification area rather than this particular course	Ongoing – still need to recruit more economists so qualification-based groups all have a tutor with expertise in their area.
Interpretation anxiety	Practice- assignments and computer marked practice quizzes	Ongoing to encourage students to use practice quizzes
<b>Prior experience and aptitude</b>		
Training in Statistics/mathematics	Early access in summer to materials Tutorials for economists	Refresh and refresh option on school site done
Expected level of statistics in their course		Not addressed
<b>Key ideas to consider re tutor change from literature</b>		
Relatedness	Convincing tutors of need for change	Primarily done by sharing information not usually available to tutors
Competence	Technical skills – commission of materials written by economists/ computer scientists	Tutors expressed reservations about
Consolidation		
	Relatedness – buy into idea Competence – get stuff written and autonomy-leave space	
<b>Initial aims of project</b>		
Identify the pressure points for students studying M248	To be done by student questionnaire	Done for 19J students and report above in annex
Use specialist ALs to identify routes through M248 which will be		Not done. Series of qualification based tutorials introduced instead.

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tailored to each of the main qualifications which students		Specialist tutors recruited where possible for economics students
Allocation of students to tutors by qualification, rather than geography		Done
<b>Other activities</b>		
Predicted pass rates role in evaluation	Investigate simpler logistic models Investigate if aids interpretation	Investigated and technically feasible but not sufficiently easy to communicate to be valuable.
Free text analysis	Free text analysis in SAS-writing code	Worked well to build a measure of satisfaction
Allocation based on qualification group	In SAS and with AI services – writing CIRCE report to specification developed in SAS	Done and will be easier as fewer changes need year to year BUT has to be done on a rolling basis to avoid small group sizes.