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## CASE STUDY

# Teaching mathematics to Business and Enterprise students in a module based around Excel

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## Abstract

Within this paper, a case study of a mathematics module 'Information Analysis' for Business and Enterprise students will be presented. The assessment for the module consists of four coursework assignments that are all done within Excel. The content of the module, which includes financial mathematics and data analysis, was carefully selected to be relevant and useful to the students further on in their degree and beyond. The module is based around the development of skills such as IT and communication. The students are required to pay attention to how they use Excel, how they present their work and their explanations. Comments from students are generally positive about the opportunity to develop skills within the module and they recognise the benefits surrounding employability. In addition to lectures and computer tutorials, the students have access to a collection of short video tutorials which contain examples of the Excel techniques. In this case study, the challenges of teaching this module will be explored, including teaching students with different abilities, the limitations of the classroom environment and the problem of mathematics anxiety. Details of the content of the module will be provided along with descriptions of the assessment methods and the teaching methods.

**Keywords:** Mathematics service teaching, skills development, employability, coursework.

## 1. Introduction

The students taking courses based in the Business and Enterprise subject area are all required to take the module 'Information Analysis' in their first year of study. Usually the cohort consists of 80-100 students of various mathematical abilities as A-level mathematics is not a requirement for them to undertake their courses. The module was primarily designed around the development of skills rather than the mathematical topics. As mentioned by Cox and King (2006), "*universities now need to focus on employability, preparing students for work*" and the success of their department's redesign was due to "*using employability as the starting point for the redesign, rather than as a checklist to be referenced once design had begun*". The module 'Information Analysis' was designed in a similar way, and consequently the content will not be presented first within this paper. Following the consideration of the skills aspect and assessment methods, the content was carefully selected to be relevant to the students taking the module. Material was embedded in real-life applications throughout in the belief that "*the process of addressing the client-driven problems with real-world contexts may also impact students' beliefs about the usefulness of mathematics*" (Cardella, 2008). The portfolio style assessment adopted encourages learning within assessment rather than just assessment of whether learning has taken place.

## 2. Assessment methods

The assessment for the module is entirely through coursework tasks. The students do four pieces of coursework and are required to submit each one in an Excel file. In addition, they are asked to submit a separate portfolio file of all their work from the entire year. As mentioned by Dochy and McDowell (1997), portfolio assessment is one form of assessment that will "*encourage students to engage continuously and foster a deep approach to learning*". They say that "*key elements of these approaches are reflection, feedback, and integration of learning and assessment*".

At the end of every assignment, the students are asked to write a reflective piece. They include simple reflections on how the module is going, why they think that is the case, how they plan to remedy the situation if it is going badly, areas they need to work on before the next assignment, what they would have done differently, how they used the feedback from the previous assignment, and an estimate of their grade. They are asked to write a slightly longer reflection for the final piece of work, which also includes what skills they developed, how we could improve the module, and how they intend to keep on developing their quantitative and logical approaches to information analysis in the future. Comments from the students' reflections at the end of the 2014-15 academic year have been used throughout the paper.

The students make good use of the feedback throughout the module. One student reported that they *"found the feedback forms very useful as [they] could reflect on [them]"*. Several of the students mentioned that they used the feedback in subsequent assignments to improve. Typical comments were that they *"applied the feedback into the next assignments, reducing the amount of problems in [their] work"* and that the feedback would *"help [them] to improve on the next [assignment]"*. Some students mentioned that they planned to make use of feedback beyond the end of the module. One student commented that they *"intend to use feedback more productively, which will help [them] to achieve the best of [their] ability"* and another said they *"intend to use feedback effectively in the future also because it is evident that it has benefited [their] work progression in [the] module"*.

### 3. Development of skills

The module is built around the development of some skills that are valued by employers. As reported by Archer and Davison (2008), amongst the most important skills when recruiting new graduates are communication skills (ranked 1st), planning and organisation (7th), numeracy (9th) and IT skills (14th).

The particular IT skills that are practised throughout the module are mainly within Excel, a tool used a lot within industry. Comments from the students included that being able to analyse and present data in Excel *"could put [them] at an advantage against other applicants"* and that *"being able to use Excel can be an advantage for [them] compared to someone who has less knowledge around it"*. There is an introductory Excel task within the first assignment, but the students' skills in this area are developed throughout the module in all the exercises. The students are encouraged to use Excel for all the calculations, including using built-in functions and Solver. An example of how the student can use Solver is to answer the following question:

You invest £500 in a savings account with a compound interest rate of 3% per annum. Given that the interest rate is fixed, how long will it take for the amount in the bank account to double?

A quick method of getting a very accurate answer is to use solver to work out the number of years. This requires no use of logarithms and exponentials, a topic that can be very confusing to students.

The students are given a great deal of credit for how they present their work. One student commented that they *"liked how presentation was a large part of the module"* and how *"not many courses/ modules emphasise this"*. As well as making use of Excel, they are marked on the overall appearance of their work. Figure 1 shows the different aspects considered.

	Comments
Contents page	
Hyperlinks	
Clear presentation	
Consistent presentation	
Good use of excel	
Efficient calculations	
Good use of graphs	
Explanations	
Appropriate number of sheets	
1 excel file	
Good use of colour	

Figure 1. Presentation marking grid

The students develop their written communication skills within the module as they are asked to explain all their work to demonstrate understanding. This can be them simply describing what they have done within a calculation or how they have used Excel to carry a task out. The students are expected to give concise explanations that contain enough information.

The students value being able to develop skills throughout the module, particularly ones around organisation and planning. The students found that the module *“taught [them] valuable skills that no doubt will have an impact in later life such as time management”* and that the *“main skills that learnt from working on the Information Analysis assignments this year [were] time keeping and working towards a deadline”*. One student said that overall they *“feel that [they] have been able to take a lot from [the module] which could really benefit [them] in the future when applying for jobs or when actually working in [their] placement”*.

Students and staff are provided with a more thorough mark scheme which includes how many marks are available for each task and its presentation, often with half the marks available for the aspects mentioned above. Along with marking criteria, initial marking of coursework of one student from each group, followed by discussions about discrepancies, means that marking is fairly consistent between different staff.

A draw back of the module is that marking and ensuring all staff are clear about mark schemes is very time consuming. Otherwise staff are very positive about the module. The Business and Enterprise team find the development of skills very useful and have made it compulsory for all their students.

#### 4. Content of the module

Relevant mathematical topics were carefully selected with the students in mind, and topics such as calculus were avoided. The mathematical content of the module is based on what would be useful to the students in their subsequent years at university and, in particular, in employment afterwards. As there are students with varying levels of mathematical ability, the module begins with basic numeracy such as BODMAS, percentages, ratios and general calculations.

Another topic the students look at is probability theory; initially looking at the basics including the use of probability trees, and then probability distributions in the following assignment. The students make use of Excel’s built-in functions so that they can concentrate on looking at when to use the different distributions.

Statistics is a big part of the module as the students are taught how to present data using appropriate calculations such as mean and standard deviation in the first assignment. They also look at how to represent information graphically, beginning with when it is most relevant to use different types of graphs and are given practice at reading information from them. In the second assignment, the students are given a collection of data sets are asked to pick at least two to allow them to demonstrate using the techniques and graphs appropriately.

Within the second assignment, the students are introduced to financial mathematics. They explore topics such as interest rates, inflation and depreciation. In the third assignment, they are asked to research savings accounts and present recommendations for the investment of £5000. They are given very little information, so are encouraged to make a variety of recommendations based on different requirements and circumstances.

The other main topic taught within the module is mathematical modelling. The students are initially introduced to different types of graphs within the third assignment. They create interactive graphs using slider bars for linear, quadratic, exponential, logarithmic, trigonometric and combined models. They investigate what happens when you change the variables in the models and how this affects the outcome and conclusions drawn. As discussed by Alfieri et al. (2011), *“allowing learners to interact with materials, manipulate variables, explore phenomena, and attempt to apply principles affords them with opportunities to notice patterns, discover underlying causalities, and learn in ways that are seemingly more robust.”*

Also within the third assignment, the students fit models to some given data by using the least squares method with Solver and look at how to extend their models to make future predictions. The students do another research task in the final assignment, looking at investments into different commodities. They are encouraged to find appropriate graphs that can be used to predict that will happen to the markets using their modelling techniques. The students look at other factors that might affect the stability and use all the information to form recommendations to a company wanting to make an investment.

The students are asked to provide summaries for different audiences within the module. For example, for the savings account research task they are asked to present their findings and recommendations to a non-numerate graduate, so they have to apply their knowledge on mathematical finance but then have to provide a non-technical report. It was mentioned by one student that they are now *“able to present information at an informative level, as well as draw relevant conclusions from the information [they] have used”* and that *“tasks such as the savings accounts section of the third assignment was useful for this as [they were] required to do research and present [their] findings to suit an audience”*. When looking at fitting models in the third assignment, they have to provide an explanation to a friend on the course why a model is most appropriate, an explanation for the tutor for another model, and an explanation for a not particularly mathematical guitarist friend for the trigonometric model. They are also given the opportunity to present information in a 500 word summary with illustrative graphs as if to a client in the final assignment when they do their commodities research task.

## 5. Teaching methods

The module is taught mainly through lectures and computer laboratories, but there is a great deal of support outside of the formal teaching time. Within the lectures, tools such as the assessment software Socrative were made use of. One student commented that they found Socrative *“a good way of learning and [it] improved [their] understanding”*.

As there are no requirements to have done A-level mathematics for the course, there are students of various levels of mathematical ability within the class. The content and assessment ensure that

many skills other than purely mathematical, such as Excel and presentation, are assessed in the module. Therefore, this stretches the more mathematically capable ones and does not disadvantage the weaker students. Also, no prior knowledge of mathematics is assumed and the module begins with basic numeracy. The students who have done mathematics at A-level are aware that initially they may find the content too easy and they are welcome to bring some of the set exercises along to lectures to work on. They soon discover techniques that they haven't encountered before.

There can be problems with mathematics anxiety within the group from those students who haven't studied any mathematics for a while or have found it difficult. Some students were *"really worried and nervous"*, and had a negative attitude towards the module because mathematics is involved and thought that the module would be a *"massive drawback"*. During the introductory lecture, providing details of where the marks come from and the level of support helps ease these fears. Support is not only available from the staff involved in the module, but there is a daily mathematics support service that the students can use. Other ways of combating mathematics anxiety includes providing reassurance and encouragement on a one-to-one level in tutorials. There is a significant decrease in the mathematics anxiety after feedback from the first assignment is received. One student who commented about being worried at the start of the module, described receiving their first assignment mark as *"incredibly overwhelming and confidence/motivation boosting"*. It was the feedback in particular that helped the students, with one student mentioning that *"feedback was one of the things that help [them] personally grow in confidence in [the] module"*. Another student commented that their opinion of the module *"changed as [they] soon learned that the resources [they] had available were of great benefit allowing [them] to be able to go on and get the [work] completed at the correct pace"*.

There are limitations that the classroom environments has, especially for a module based around Excel. Providing a demonstration within a lecture can be improved by providing the students with handouts to annotate. Moving the examples from the lecture to the computer tutorials improved this slightly as the students could go through them at the same time, but it was quite time consuming as the students worked at very different paces and tutorial leaders would spend full sessions ensuring that all the students managed examples. This left very little time for feedback and other help within the tutorial sessions. From 2013-14, short video tutorials have been used for this module, which are produced using Screencast-o-matic. The students are able to use the videos as many times as they like, can work through the exercises at the same time, pause the videos and access them at any time. Since the introduction of the videos, there has been a significant change in the type of questions the students ask and the number of students attempting more challenging topics, such as working out the mean of grouped data, has increased.

The students described the videos as *"a very useful device in aiding learning"*, that they *"really helped"*, were *"a great aid in [their] studies throughout the year"* and were *"incredibly beneficial in helping [them] to complete [their] assignments"*. They found that if there was *"anything [they] failed to understand in the lectures [they] would work with the videos on Blackboard at [their] own pace and understand the content and apply it to the assignment"*. Comments also included that the videos *"allowed [them] to revisit [their] work whenever"*, that *"watching the videos refreshed [their] memory of what was taught earlier in the week"* and they *"helped [them] to understand some of the topics that [they were] struggling with"*.

## 6. Conclusions

The mathematics module for Business and Enterprise students was created so that they would develop employability skills and includes relevant mathematical content for that particular group. The portfolio style assessment method allows for a process of reflection and for learning to take place within the assessment itself. The students tend to have initial reservations, but are generally

very positive about the module due to the level of support available and the feedback they receive. The problems surrounding teaching Excel within lecture rooms have been addressed by the introduction of short video tutorials, which the students make good use of in their studies. Having a mixture of abilities within the group proves a challenge, but having material that isn't covered by the A-level syllabus and having a large focus on skills, means that all students have content to stimulate them. Overall the module is received very well and student satisfaction is generally very high at the end of the year.

## 7. Acknowledgements

Neil Challis and Harry Gretton were responsible for originally creating the module discussed in the paper.

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