

Case-Based Learning and Teaching in Statistics Service Courses

ULTSEC INNOVATION FUND 2013: PROJECT PROPOSAL

1 Planning and rationale

1.1 Background

Since my appointment in 2006, I have been heavily involved in teaching Statistics to non-specialists, mainly students taking degree programmes from the Business School. Having also taught Mathematics students, differences in the requirements between Mathematics students and the non-specialists – in terms of successful curriculum delivery, assessment and feedback – have become apparent. One of the main challenges in Statistics service teaching is student motivation. Mathematics undergraduates (on the whole!) already have motivation – they are studying their chosen subject. In contrast, many non-specialists resent having to take a course in Statistics, have no confidence in their ability, and cannot see the relevance of such a course in their chosen degree programme.

This is not helped by the modes of assessment and feedback we provide for these students which, at best, I believe encourage only *surface learning*. For example, regular, short assessments via computer-based tests and overly prescriptive written assignments based on non-realistic, ‘well-behaved’ and rather contrived datasets often result in high marks for in-course assessment; combined with similar types of examination questions, many non-specialists often achieve high return marks in their Statistics course. However, I am not convinced that this is a good indicator of their success – students often come back to me for help with data analysis in their final year dissertations, and when it comes to being able to handle data from real-life scenarios, it is obvious that our course has failed them. I believe a *case-based* approach to learning could be extremely beneficial to these students, both in terms of their motivation to learn and their genuine understanding of the material.

Case-based learning is not a new concept. In Statistics, many authors have recognised the need for teaching statistical thinking rather than statistical recipes (e.g. Daisley (1979), Nolan & Speed (1999) and Wild & Pfannkuch (1999)). However, very few have focussed on the benefits of case-based learning in Statistics service teaching and, as McNaught *et al.* (2007) point out, fewer still on the compatibility of case-based teaching with different types of feedback and assessment:

“Much attention has been paid to the pedagogy... less interest has been shown to the assessment [*of case-based courses*]. This is problematic, as assessment is often key to the overall success of any teaching innovation.”

1.2 Purpose of the project

The purpose of this project will be to investigate the use of case-based teaching in Statistics service courses at Newcastle, primarily aimed at improving student **participation** and **motivation**, and promoting a **deeper learning** of course material. One strand of this project would involve setting up new case studies based on relevant (real-life) datasets and topical scenarios, obtained via consultations with research-active colleagues in the Business School. To meet the aims of the project fully, however, an overhaul in the assessment and feedback techniques currently used would be required. Thus, another key strand of this project would involve setting up new types of in course assessment and feedback which are more compatible with a case-based approach to teaching than the methods that are currently used. Some attention to the style of delivery of material would also be necessary (e.g. more focus on group learning in seminars).

Case study material will be presented as ‘scenarios’ to students in class, and a problem-solving, collaborative approach to data analysis will be encouraged; the aim being that, from simple exploratory analyses of the data, it will become apparent *why*

we use a particular statistical technique. The hope is that the use of such material will also encourage student participation and motivation. More open-ended consideration of data analysis will be encouraged, and prescriptive ‘handle-turning’ discouraged. As part of this project, some case study material will be set up for use with my current ACC1012 class; any lessons learnt from this trial will then be used to inform a more complete roll-out of this approach with the 2013/14 cohort.

The assessment design, and use of feedback, should match the constructivist nature of the case-based approach to learning and teaching. For example, our traditional in-course assessments (mainly very prescriptive homeworks marked by academic staff and short, repetitive computer-based assessments) are not compatible with case-based teaching; *more* compatible would be non-prescriptive, open-ended individual/group projects, based on real-life datasets, which would include an element of peer assessment and feedback. As well as assessing student performance on a ‘final product’ (e.g. project report/presentation), successful assessment of a case-based module might involve assessment of the case-based activities themselves: for example, information-searching, seminar contributions, group-work and making presentations. Certainly, the purpose of this project would be to consider a shift in assessment and feedback from being solely teacher-centred to actively involving students’ contributions. Hence, new materials will need to be developed to help make this type of assessment and feedback possible – this will include student self- and peer-assessment written *pro formas*, but will also involve the use of video recordings for self- and group-reflection, and the use of some new types of computer-based assessments for more rapid feedback.

1.3 Benefits and intended impact

If successful, there should be a positive impact upon student motivation, participation and deep learning, thus enhancing the overall student experience and better equipping recipients with the skills to undertake independent data analyses in their final year dissertations (and beyond). The initial pilot of these techniques could benefit my class of about 170 ACC1012 Accounting and Finance students; however, if deemed successful, this project has the potential to benefit hundreds of students across a range of academic units. For example, a similar course – MAS1403 – usually has over 300 students from a range of other degree programmes within the Business School, and many other Statistics service courses are taught every year to students from Biology, Medicine, Agriculture, Psychology, etc. Other colleagues responsible for service teaching in Maths & Statistics will benefit from the outcomes of this project, as well as colleagues involved in service teaching from other academic units, and possibly other institutions via networking at teaching conferences (e.g. the ISI conference, August 2013).

Other students – not just the recipients – will also benefit from being involved with this project. The intention is to recruit some former students of MAS1403/ACC1012, and postgraduate students from the School of Maths & Statistics/the University’s MATHSAID centre, to help set up the case study material and direct the scoping and execution of the project; this might be done on an *ad hoc* basis, but also through summer internships (see table below). Greater postgraduate assistance will also be required in seminars, providing these students with valuable teaching experience (an area in which the School of Maths & Statistics scored poorly in the recent PRES). Irrespective of the outcome of the project, my own teaching practice will also certainly benefit from the findings of this work.

2 Project management

2.1 Preliminary timeline

Task	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Initial talks with Business School colleagues	✓	✓									
Seek advice of Bill Foster for use of computer-based-assessments in feedback		✓	✓								
Obtain source material for case studies		✓	✓	✓	✓						
Develop an example case study session: lecture presentation, seminar materials, assessment and feedback materials		✓	✓								
Implement the example case study session in weeks 10 and 11 of ACC1012 (current cohort), as a trial				✓							
Feedback trial case study findings to other colleagues; reflection					✓						
Recruit postgraduate/MATHSAID students to develop ideas			✓	✓							
Recruit Undergraduate summer interns			✓	✓							
Attend ISI conference							✓				
Work closely with students to develop case materials						✓	✓	✓			
Timetable requirements: more seminars, fewer lectures						✓	✓				
Implement case studies with ACC1012 2013/14 intake									✓	✓	✓
Feedback event											✓

2.2 Key contacts

Main project lead: Lee Fawcett; *Other staff from Maths & Statistics:* Bill Foster (Teaching Fellow and e-learning co-ordinator); *Postgraduate students from Maths & Statistics:* Stacey Aston, Jamie Owen and Keith Newman have expressed an interest; *Staff from other Schools/Faculties:* Advice will be sought from Chris Soan, Josie McLaren and Gillian Holmes from the Business School.

Intended beneficiaries: student recipients in ACC1012, but also possibly MAS1403 and other students taking Statistics service courses; staff and students involved in running the project; other staff in the University, and beyond, involved with service teaching more generally.

3 Support and funding

In total, £4,970 is sought in funding for this project (see breakdown below). Funding will be mainly directed at postgraduate assistance to develop resources (see the table on page 2), as well as two summer undergraduate internships, between July–September. The project will also require postgraduate demonstrators to lead seminar sessions as part of the case-based activities previously discussed. Travel costs and accommodation to attend the conference of the International Statistical Institute (at which there is a special session on Statistics Education, and talks about case-based teaching) will be covered by my staff travel allowance. Any e-Learning costs, in terms of computer-based-assessments, will be provided by the School of Maths & Statistics. In terms of my own time, I expect a few days over-and-above my usual workload to suffice.

Item	Calculation	Line total
Postgraduate time: assistance	$3 \times \text{£}13.80 \text{ per hour} \times 40 \text{ hours}$	£1656
Postgraduate time: demonstrating	$2 \times \text{£}25.05 \text{ per hour} \times 10 \text{ hours}$	£501
Undergraduate interns	$2 \times \text{£}250 \text{ per week} \times 4 \text{ weeks}$	£2000
Staff time	Grade G £32.79 per hour $\times 16 \text{ hours}$	£524.64
ISI conference	Early-bird registration fee: $1 \times \text{HK\$}3550$	c.£288.52
	Grand Total:	c.£4970.16

Although much is made in the literature about the high workload attached to case-based teaching, most of this corresponds to the associated initial set-up costs (e.g. sourcing of information for the case studies, writing new student-focused types of assessment etc.). I am confident that the financial support outlined in the table above would be enough to cover these costs. If rolled out beyond the scope of this project, more long-term costs would be incurred, mainly by postgraduate time in seminars. However, we currently use Statistics postgraduates in ACC1012 tutorials anyway; replacing these with case-led seminars would be a more productive use of this existing postgraduate assistance.

4 Impact and dissemination

4.1 Assessment of impact

As discussed, the aims of this project are to improve student participation and motivation, and to promote deeper learning. This might not translate into higher return marks for courses like ACC1012; in fact, as previously mentioned, many students currently obtain high return marks for such courses and this does not always reflect their ability in the subject. If anything, students' return marks might become more evenly spread across the first/second-class range of marks. However, we would expect to see greater enthusiasm for the course in student evaluation questionnaires – particularly in questions relating to how interesting students found the course. In more qualitative open-ended feedback, we would also hope to see students appreciating the relevance of the course compared to students from previous years.

Specifically, multiple sources of data will be used to assess the impact of the case-based approach and the new tools for feedback and assessment. The model used in McNaught *et al.* (2007) will be followed, with data covering feedback from both myself/the student delivery team (e.g. journal reflections) and also the student recipients (data on students' feelings using a study progress questionnaire; data on students' actions using observations from seminar sessions; and data on students' knowledge obtained from their performance in seminars and examinations).

In terms of student participation and motivation, we might expect to see more involvement of students in class and, generally, better attendance for all classroom-based activities (something which is currently an issue in ACC1012). To assess the impact of this project on deeper learning, we might expect to see more thoughtful answers to assignment/examination questions requiring interpretation and discussion. Certainly, in a case-based approach to learning we should be given more opportunity to set much less prescriptive, more open-ended questions, and we should see students being more willing, and able, to attack such questions. An improvement in students' ability to problem-solve, and use initiative, should also be more apparent.

Current ACC1012 students who will be involved in a pilot case study session towards the end of the current academic year will be asked to comment on the new approach to teaching. Their views could be elicited informally, via discussions, or more formally via a short, focussed questionnaire. Certainly, the 2013/14 cohort will be given the opportunity to feed back their views on case-based teaching via an anonymised study progress questionnaire in November 2013. The questionnaire can be set up electronically by the Computer Officer in the School of Maths & Statistics, and the students invited to complete this via email. The views of the postgraduate assistants, who will lead some of the seminars, will also be elicited to measure the success of the implemented changes.

4.2 Dissemination

Key findings from the project will be disseminated internally at the main dissemination event in December 2013; if successful, I will also actively seek links with other Innovation Fund projects at the award recipients' meeting in February 2013. I would be willing to attend any events organised by QuILT to inform others about both the progress and any key findings of the project. For example, I spoke at Newcastle's Teaching and Learning Conference in July 2012 about my use of research-informed teaching; I would be willing to speak at similar events this year about my experiences with this project.

At a more local level, I will discuss my project with other members of staff in the School of Maths & Statistics, and will ask for the opportunity to speak at our annual teaching 'Away Day', usually held in May/June; I will also regularly update my Head of School, and colleagues in the Business School, about the progress of the project.

Casting the net a bit wider, it is my intention to write this work up as a paper to be submitted to a journal in the field of Mathematics/Statistics Education, such as *MSOR Connections* or the *Journal of Statistics Education* (published by the American Statistical Association). I had already thought about attending the conference of the International Statistics Institute in August 2013, which I will partially fund from my staff travel allowance. This conference will host a special session on Statistics Education, and this would provide an excellent networking opportunity – to inform others about this project but also for me to learn about case-based teaching in Statistics more generally.

5 Support from Head of School, Mathematics & Statistics

I am very pleased to support this application. Dr. Fawcett is one of our best lecturers, who has a sustained history of delivering successful service courses. It is certainly true that non Mathematics or Statistics students are usually not well motivated for Statistics courses and Dr. Fawcett's case-based approach is worth serious testing. If the pilot is successful then we, in the School, will provide the resource to integrate the approach next year into a proportion of our service teaching, given the agreement of the collaborating Schools.

Professor Robin Henderson, 21st January 2013.

References

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