The University of Sheffield MSc in Statistics started in 1965. Until now it has been given entirely in a traditional format (with lectures, laboratories and exercise classes) and exclusively to students able to attend the University. Most were full-time students but occasionally we had part-time students taking the course over two or three years. Since we generally made no particular provision for these in constructing the timetable most part-timers were not working in regular jobs. From this year, however, we are offering a new part-time distance learning version of the course alongside the established version. This is available to students studying anywhere in the country and we anticipate that most students taking it will be in full-time employment. This note explains the motivation for the new course, outlines how it is being implemented through web-based and other means and offers some reflections on our experience so far.

Background and Motivation

The Sheffield MSc is broad-based, aiming to give a thorough preparation for a professional statistical career in any branch of the subject. Over the years since 1965 well over 400 students have graduated from the course. Those looking for jobs have had little difficulty in finding them and many others have continued with postgraduate study for a PhD, sometimes after a year or two of working. Typically a third and sometimes more than a half of each MSc cohort eventually complete a PhD either in Sheffield or elsewhere; those going straight to employment often work in research teams either as RAs in academic environments or within R&D groups in large companies. The result is that Sheffield MSc graduates are well represented throughout the statistical profession both in the UK and elsewhere. At any statistical meeting in the UK of more than a handful of people there is usually likely to be at least one Sheffield MSc graduate, indeed there were three at the meeting on the 9th May when this presentation was given at the OU.

Demand for the course continues to be healthy. In the year 2000–2001, immediately before the developments described here, there were 17 students, in line with the average complement over recent years. The course can thus be counted as successful in helping supply a national need for statistical training. Why then does it need a distance learning capability?

A bid in 2000 to EPSRC for award of a Master’s Training Package prompted the Department to try to envisage the likely pattern of needs for statistical training over the next decade or so. The background to the thinking was concern about the continuing national shortage of statistically trained people, as evidenced by widely-reported difficulties in filling statistical jobs and the national lack of understanding of statistical ideas. It is interesting that exactly the same concern lay behind the setting up of the MSc course in Sheffield in 1965. The recently changed arrangements for support of undergraduate students have resulted in many students completing their first degree course with a large burden of debt. It is understandable that many wish to take a job rather than a Master’s course. A change in the pattern of recruitment to traditional MSc courses might be expected in consequence. When, later, the student feels able to contemplate MSc training they may be established in a job and may have personal and family commitments that would make full-time attendance for a traditional MSc course difficult. For such a student, it was argued, some more flexible, part-time arrangements would be helpful. Such arrangements could be attractive to other groups too: those trained in other disciplines but having to do statistical jobs with only limited background, and those trained in statistics
some years ago and now wishing to update skills and knowledge. Accordingly, the Department of Probability & Statistics decided to set up a part-time distance learning arm to the Sheffield MSc.

There was unanimous agreement that the new course should be of high quality – fully equivalent in standard to the current residential MSc. We see the only way to achieve equivalence is to have identical assessment procedures (examinations, assignments and deadlines) for all students taking the course, whether as a resident or as a distant student. The only difference would be that the distant students would take the course over two or maybe three years instead of twelve months. A practical necessity was that the new course would be developed and sustained within available departmental resources.

The MTP proposal including the suggested distance learning element was successful and brought half-time funding for a Distance Learning Manager (DLM), and some secretarial help. These funds have been used to buy out teaching and administration time of an additional regular member of the lecturing staff. The DLM’s job is to coordinate development and delivery of the materials for the new course and to liaise with the distant students. Apart from this extra support, the set-up and maintenance costs for the new course have had to come from within the department. We comment on resource issues below. The other elements of the MTP funding cover support (fees for all EU students plus a standard maintenance grant for UK residents) for approximately the equivalent of twelve full time students. However, our intention stated in our bid is that we will split this to give support to nine residential full-time students and thus cover fees and other expenses (see below) of cohorts of six DL students per year.

The limits on time and manpower available for development of the new course dictated evolution rather than revolution. It was decided from the outset that what would be offered to DL students would be based on existing modules from the full-time course, rather than completely newly-developed material. It was also decided that we would use tested methods of delivery rather than attempt radical innovation. After all, the purpose of the course (and our expertise) centres on the statistical training it conveys, and not on experimentation in educational technology. For advice on educational technology and on distance learning issues we were fortunate indeed in being able to call on the expertise of a specialist unit within the University, the Sheffield University Learning Media Unit (LeMU). Their guidance and support have been invaluable. Following the advice of Adrian Powell and Ruth Sharratt of LeMU we decided to use the package WebCT for delivery of the course.

There may well be alternatives to WebCT but the advantages of being able to tap into in-house expertise far outweigh any merits of competitors.

**Current Structure**

Our MSc course is designed to cover the three elements of technical knowledge of the core of Statistics, practical & professional skills and work on an extended project leading to a dissertation. Our aim is to deliver all of these elements in full without compromise to distant learners.

The existing residential course combines study of these elements by:

- Lecture modules, problem solving classes and extended assignments on various technical topics in Statistics. Typical lecture modules cover Linear Modelling, Inference, Bayesian Statistics, Dependent Data, Sampling, Experimental Design, Medical Statistics, Probability Modelling, Industrial Statistics, Econometrics, Mathematical Biology, some being in parallel with our level 3/4 MMath undergraduate programme and only the first few being compulsory for all students;
- Modules developing practical & professional skills, learnt through projects, practice in communication, both written and oral, rôle play, group work and work in the statistical computing laboratory;
- A substantial statistical problem, studied individually under the active supervision of a member of staff and written up as a dissertation accounting for one third of the overall assessment for the course. Most work on this would be done over the summer months and often this would be based on a practical problem brought by a client from outside the department or even outside the university.

Additionally, as a preliminary we distribute full notes and exercises of a ‘Foundation Block’ in early summer before the start of the course. This block is intended to fill in the gaps in basic material; students are expected to submit work on the exercises before the start of the course and this is followed by some classes in the preliminary week before the term starts. Other sessions in the preliminary week are devoted to statistical computing etc.

The only compromise we are making for the DL version initially is that we do not intend to offer any optional modules in the technical core and so we can limit the amount of material that has to be prepared and presented in distance learning form to just the first eight of the topics listed above. The substantial staff cost per student, especially but not exclusively on the third element,
means that we do not envisage opening the course to large numbers of DL students, unlike some other distance learning courses in similar areas. It is likely that in the first few years numbers on the course will be limited to fifteen residential and about eight (or maybe ten) new DL students per year, two thirds of these receiving EPSRC support through the MTP funding.

**Advice Received**

Initial discussions we had with LeMU and within the department and colleagues elsewhere identified many key needs of DL students which perhaps had not seemed so apparent for our traditional full-time residential students. However, we realise now that many of these are relevant to them as well, even if in lesser degree, and we feel that concentration on these has improved the course we offer in total.

The first of these concern the qualities of the students themselves. They need time, determination and commitment to the course to a much greater extent than the traditional full-time MSc student who proceeds direct to the course from a first degree. It is not an easy option to take the course part-time as a DL student and our admissions criteria have to be at least as stringent, if not more, than for full-time residential students, i.e. a good first degree in a mainstream mathematical subject with at least some knowledge of basic probability and statistics. We suspect that in the past there has been the temptation to regard part-time (though ‘residential’) study as an option for borderline candidates. This year we have been fortunate in attracting well-qualified and highly motivated students to the course (and resolute in not accepting others) and so we have not experienced the high drop-out rate that we had been warned to anticipate — at least not yet! Indeed only one of our initial intake of seven has suspended studies for twelve months because of unexpected domestic disruption with their employment etc.

An element emphasized by many of those offering advice was that for the DL students we needed to replace the benefits full-time students obtain just from being resident within the department and attending lectures. In particular these include the general encouragement of contact with other students and lecturing staff (and secretarial staff) giving quick resolution of queries and the opportunity for raising points of discussion as well as the recognition that they are not alone in finding some technical points in lectures opaque and badly explained. It was stressed that it was essential to have a definite ‘route map’ stating in advance what would be provided, when it would be provided and how it would be provided, what to expect and what not to expect. Perhaps we have not been alone in not considering these issues fully for our regular students.

An issue related to that above is the need for rapid and informative feedback, another point emphasized by our professional educational advisors. Again, we admit that we had on occasion been lax in providing this for our regular students who could always be reassured by a quick verbal comment face to face before the full written comments on submitted work were available. There is not this opportunity with DL students who need the encouragement that they are on the right track and not straying off course. It soon became part of the DLM’s job to ‘encourage’ those of us teaching the modules to provide this quickly.

With the principle of evolution rather than revolution our starting point for the DL material was existing lecture material, which for most modules consisted of full printed notes, printed exercises and example sheets and (mostly) handwritten outline solutions. It was clear that we needed to amplify and supplement the lecture material to make it more self-contained. More importantly we saw that we needed to provide more simple ‘tasks’ (or five-finger exercises) which would reinforce each lecture and provide further encouragement and self-feedback to the DL students in particular. These needed to be much simpler and quicker than the more substantial exercises which in many cases are [parts of] former examination questions. They had to be simple tests specifically on the material in just the previous lecture or two and which could be done in a few minutes, perhaps even just mentally. This was indeed a point that our various advisors highlighted. Again, this is a feature which is of clear educational benefit to all of our students, not just the DLs.

**Initial Plans**

The structure we settled on for the DL students was to have a total of three residential weeks during their period with us. These would be in September at the very start of the course and then two further weeks in June in the first and second years. The first of these covered the foundation block and basic material but the main purpose of the week was to establish contact between the DL and residential students and between them and the staff, especially those most closely in the DL provision. The plan included several social events, including a couple in the evening, some of which were just for the DL students and staff. The second residential week in June was scheduled to cover final revision sessions and then the examinations, with the remainder of the week devoted to various modules including professional skills and group work involving collaboration between DL and
residential students. Again, several social events were included in the schedule. A similar schedule in June in the second year was envisaged. DL students spreading the course over three years would additionally need to come for just the examinations on the final two modules in the third year.

These residential weeks were specifically designed to establish early contact and rapport, primarily between the DL students and the staff, the contact with the residential students was also seen as important but to a lesser degree. To maintain contact through the year we planned two further strands. The first was one of the key roles of the DLM. Each DL student was required to send an informal report to the DLM each week saying how work had progressed over the preceding days, either by email, and the DLM would chase these up if they did not arrive. Additionally, the DLM had the rôle of personal tutor for all of the DL students, a rôle which was intended to be much more active than the underwriting safety net provided by tutors of the residential students and so might involve telephone conversations from time to time. The aim of this provision was to identify difficulties early and remedy them quickly if possible. Often these contacts would reveal that problems arose on our side, glitches in the provision of material and slackness in feedback for example.

The second strand was to take advantage of WebCT’s provision of discussion boards (many similar packages provide such a facility). Some illustrations of these are given in sections below. As well as separate boards for each module we established ones for general matters and queries. All staff and students (including the residents) had access to all of these (students only if they were taking that module). We included two further boards for separate private discussion for staff and for students. A key purpose of the separate module discussion boards was to maintain contact between the lecturer responsible for the module and the DL students. It was also intended that these should encourage contact between the DL and residential students taking the same module. Often these boards would be used for raising technical queries. The lecturer concerned would monitor these and encourage discussion between the students (both DL and residents) and provide an answer if no one else did. Further, each lecturer would provide a summary each week of what material had been covered during the lectures, what further points had arisen (e.g. if queries had arisen in lectures), what background material would be needed in the near future and draw attention to any changes or corrections made in material already distributed.

All of the above elements were designed to substitute for the missing experience of being at lectures and day to day face to face contact between staff and students. Of course, for the resident students they still had this so these elements were an additional facility for them though they had to be encouraged to utilise and, more importantly, contribute to them.

Great effort was put into to enhancing the existing course material. This had been prepared in either LaTeX or Word, in about equal proportions, following the taste of the lecturers concerned. Initial experimentation with converting everything into HTML quickly revealed that this was impractical. The solution adopted was to convert both LaTeX and Word into Adobe Acrobat .pdf format before placing on the WebCT server. Some elements, such as study guides, syllabuses etc could be converted into HTML and this was preferred where practical, not least for the sake of speed of access. It may be noted that both TeX and Word can accommodate hyperlinks which can be carried through into .pdf format. Had the material been written totally from scratch then HTML could have been a preferable option.

WebCT provides a calendar facility which can be used as a basis for a ‘Route Map’, but needs to be supplemented by a more discursive study guide to give an idea of relative proportions of time to spend on different aspects of modules etc.

Lessons from Experience

Now that the first two teaching sessions have passed it is possible to reflect on some of the lessons learnt so far. In summary, providing a DL course in parallel to the existing course has been substantially more work than anticipated. Opinions differ but most of those of us involved would concurs with a figure of something like an additional 150% load. Roughly, this is composed of about 50% in setup costs and 100% in running the course. Further, much of the additional load in running it is unscheduled. Overall, most of us feel that the delivered product (from the point of view of the residental students) has been enhanced though one drawback noticed by some of us is the danger of over-teaching of the residential students.

The setup costs consist of enhancing the course material, making it more self-contained and not reliant, for example, on clarifications and additional examples that were given in lectures. This cost will eventually reduce but only slowly — none of us feel that we have this right at first iteration. Running the course in DL mode requires responding quickly to queries and providing rapid feedback. This is essential to prevent DL students in particular from loosing touch (or feeling that they are loosing touch). Further, it takes much more time to
provide a written reply on WebCT discussion boards than answering someone verbally. To ensure involvement of all of the students we pressed even the residential students to use WebCT as the preferred means of raising queries. On occasions this meant cutting and pasting direct email enquiries onto WebCT (see below for an example) or on us reporting queries which had been asked face to face. This was necessary to include the DL students into the community of people taking the module. However, it requires much more time and effort than answering quickly face to face with an individual questioner.

A further cause of the substantially increased load was the collection of work (e.g. exercises on modules) to be marked and returned. Previously this had been largely ‘optional’, both for the lecturer in offering it and for the student in doing it. This past year we have been much more insistent in requiring the DL students to submit these exercises since this was a good (and almost only) indicator for monitoring their progress and contact with the course, unlike residential students where we can see if they are around and in lectures. Some of us feel that seeing if students are sitting in lectures is not enough and we should be harmonising they way all students are monitored.

Provision and monitoring of exercises is perhaps a relatively minor element. Much of our MSc course is reliant on more substantial assignments and writing of reports on data analysis. Whereas general comments, and indeed individual ones, could be conveyed verbally, for DL students there needs to be a more detailed written report, either on individual submissions or on WebCT discussion boards.

The provision of all the additional features required by the DL students has undoubtedly enhanced the overall quality of our MSc course. It could certainly be argued that this is purely because we have started thinking about educational aspects (routemap, feedback, simple reinforcing task sheets etc) which we could and should have done irrespective of the DL needs. Certainly the prospect of DL students concentrated our minds and provided the stimulus. However, it is noticeable that in some respects there is a danger of over-teaching; [residential] students are expecting too much. Since so much more material is provided in full printed form many students are now expecting everything to be provided. For example, the simple weekly task sheet might be designed to encourage students to read through a particular section more carefully by asking ‘Verify result 2.3’ (which perhaps was given with ‘It is easy to show that …’). Some students are now expecting and waiting for ‘full printed solutions’. Of course, this expectation can be lessened by more careful explanation in the ‘routemap’ and study guide, though clearly some students will nevertheless resent this apparent omission in provision. Ultimately, the only solution is to refuse firmly and resolutely.

Some Problems Arising

Apart from the various problems and difficulties indicated above, many of us found problems arose because of a feature not mentioned earlier. This is that some of our lecture courses are given in common with undergraduates, at least in part. For example, Medical Statistics is taken not only by most of the MSc students but also around 100 undergraduates from our level 3/4 MMath and level 3 BSc programmes; Multivariate Data Analysis is taken by around 50 undergraduates. These students had no access to WebCT (we did not want the discussion boards to become unmanageable) so they had no access to the web material, in particular to the various data sets and outline solutions which are easily handled by WebCT. Full lecture notes could of course be printed in advance and distributed. An easy, though time consuming, solution was to provide what were essentially duplicate web pages for this material that all undergraduates could access, (the URL for some of these is given below). It is a drawback that there seems no easy way of transferring material loaded into WebCT directly to ordinary web pages.

A more pressing problem, arising particularly because of the presence of large classes of undergraduates is What Are Lectures For? If all the web material is self-contained and all solutions etc are made available on the web, what can be done in the lectures that is useful, maintains interest yet is not essential for the understanding of the course (otherwise it would have to be provided on the web for the DL students and the circle bites back). This problem arises only because of the presence of both residential MSc students (who are encouraged to mix with the DL ones) and undergraduates. Consequently, it is not realistic to ‘hide’ the web based material from those attending the lectures. Attempting to read out the lecture notes which the students have in front of them is of course a disaster. Even displaying the notes and talking around them, highlighting key points, is unsatisfactory. One solution is to use the lectures to provide more examples worked on in detail in the lectures (e.g. on the board or OHP), more real time demonstrations of practical analyses in software packages (which requires an LCD projector and laptop) and summary lecture notes displayed on either OHP or by PowerPoint. Some of these can be provided to the DL students at a later date and indeed one course did provide copies of the PowerPoint slides on the web.
One future intention is to make more use of some of the facilities in WebCT for submitting work and monitoring progress. The intention is that this will be implemented for all the MSc students, though probably not for the undergraduates at present. Indeed, currently resources do not allow for compulsory submission of all exercises with detailed marking and feedback, certainly not for the larger classes.

**Some Technicalities**

Software used in Sheffield for teaching statistics has largely been based on Minitab at undergraduate level and with S-PLUS, WinBUGS and some SAS at MSc level with occasional use of SPSS, though we are now moving towards S-PLUS at undergraduate level as well (next year S-PLUS will be used exclusively in first year). Our CHEST agreement permits students to buy copies of most of these packages (on a one-year licence, renewable only with a new licence number) for home use within the UK. We have thus had little difficulty in software provision for the DL students. Additionally, we have required them to use Microsoft Office which we cannot provide and so they have to purchase this themselves. This was a reluctant decision and we did consider alternatives but we felt it essential to avoid extraneous problems that could arise if we tried to accommodate a variety of different systems.

We advise on minimum computing requirements but we cannot help with purchase of hardware and so the DL students have to provide this themselves. Some students are in employment where these are provided but the licence agreements for software under CHEST typically conflict with installation on machines to which other people have access.

Next year we shall be providing the Data Analysis module in DL format. This module currently requires much collaborative work and collaborative report writing and presentations, sometimes with rôl¿ play. These are part of the professional skills aspects of the course. We are now beginning to consider seriously how we can achieve our aims for this course but can as yet offer no satisfactory solution other than saying that 'You must do it' and suggest that joint presentations can be produced in PowerPoint which can be exchanged by email just as easily as Word files for the reports. The rôle play elements could be deferred until a residential week but this would alter our current schedule where we aim to complete the sequence of submitted reports well before the end the second semester. A point emphasised by the DL students in the feedback meetings during residential week was their need for some flexibility in work patterns and that this might conflict with wishes of the residential students. Of course, this can be regarded as an added feature that our students will benefit from coping with, both residents and DLs.

One future intention is to make more use of some of the
course for the whole MSc. This affects the way we have provided the material for individual modules.

Figure 1 shows the opening welcome page and the signal that material has change since it was last accessed. Figure 2 gives the home page with indicators of access to the individual modules. Since PAS6011 (Multivariate Data Analysis) is not currently being taken by 3-year DL students they do not have access to it. Pages for individual modules may be linked contents pages as in or can just be similar to the home page. A disadvantage of the linked contents page is that it is not possible to date-release individual chapters in sequence, however moving through from one chapter to another is facilitated.

Figure 3 shows the index of discussions and the presence of new discussions on one module’s board. It is a quick job to check for the presence of new discussions from time to time and whether they need to be dealt with urgently or not. WebCT also has an email facility which can be automatically redirected to the home email to alert for more pressing queries.

Often, supposedly urgent queries raised by email are best left for more open discussion though in some cases it is perhaps good to maintain goodwill and preserve anonymity of the questioner, as in Figure 4.

The copies of the slides of this presentation referred to above give a few more examples of WebCT for those who are interested.