Faculty of Science and Technology

Department of Mathematics and Statistics

Postgraduate Statistics Centre

HEFCE Final Self-Evaluation Report

Prepared by Gillian Lancaster and Ruth Allen

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Postgraduate Statistics Centre
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Contents

Part One – Statistical Information

a)	Name of CETL	Postgraduate Statistics Centre (PSC)
b)	Name of Institution	Lancaster University
c)	Contact name	Dr Gillian Lancaster
d)	Name of person submitting the self-evaluation	Dr Gillian Lancaster
e)	Start date of CETL	1 August 2005
f)	End date of CETL	30 September 2010
g)	Lead Director(s) and dates associated with CETL	May 07-Sept 10 Dr Gillian Lancaster; Dec 05-April 07 Prof Brian Francis, Acting April 05-Nov 05 Prof Amanda Chetwynd
h)	Total amount of award: capital and running	£4.85 million distributed as follows: Recurrent funding: £2.5 million over 5 years. Capital funding for a new building: £2.35 million, of which £267,000 was allocated for furnishings and equipment, including all audio-visual equipment, wireless networking, PCs, laptops and software. The University contributed a further £1.05 million to cover costs of an additional bridge with glass walkway to link to the Department of Maths and Statistics in Fylde college.
i)	Brief description of what capital used for	The capital has funded a new building to expand the postgraduate activities of the department and provides state of the art new teaching space. Environmental issues were taken seriously, and the building, designed by architects John McAslan, conforms to the highest environmental assessment rating (BREEAM excellent). The site for the building occupies a unique location within the University. Sitting within a newly formed landscaped area containing a wild flower garden, this area links the existing buildings of Fylde and Furness Colleges with their new residences adjacent to the perimeter road. The north face of the building is glazed and gives views out to the landscaped space. There is also a water feature that runs the length of the north side of the building that allows natural drainage of rainwater from both the site and from the building itself. The south face has louvred solar protection to cut out direct

		sunlight and incorporates solar chimneys that promote passive ventilation of teaching spaces by recovering and re-circulating the building's warmth to keep rooms cool in summer and warm in winter. On the ground floor of the building there is a large foyer with high and low level seating providing open space that is used for short course buffets as well as casual meetings, a new 50-seater lecture theatre with in built dual screens, video camera, data projector and visualiser and podcasting facilities that allow teaching to reach beyond the traditional lecture room environment. A Personal Response System (PRS) system has also been purchased with 90 handsets. In addition there is an access grid room for remote teaching to other universities, funded by the MAGIC project, two computer labs offering a mixture of Windows and Linux environments to suit modern teaching. The first computer lab contains 24 fixed server clients laid out in rows, and the second room is designed as flexible teaching space for staff to experiment with layout for different teaching styles and has available 35 laptops, with the possibility of expansion into the small teaching room annexe via a sliding wall. A bridge links the existing department to the first floor. On the first floor as well as 10 offices, a kitchen with fresh coffee machine and postgraduate library there are two open-plan social learning spaces to promote informal interaction between academic staff and postgraduate students, where they can drink coffee and discuss work, or study more formally at tables some of which are portable. There is also a meeting room and consultancy suite which provides space for one to one mentoring of postgraduates from other disciplines as well as providing training opportunities for our own students. Photographs of the new building can be found on our website at www.maths.lancs.ac.uk./psc.
j)	What will these facilities be used for in academic year 2010-11 (indicative/anticipated)	The Head of Department (HoD) and PSC director wish to retain the building as a Postgraduate Statistics Centre in its current form focussing on the full range of postgraduate (PG) statistics activities, as a university resource. It is likely that the ground floor teaching rooms will be placed on the university's central booking system, and the building and equipment maintained centrally by the Estates department.

k)	Average number of persons employed at any one time (in FTEs) and by type (academic, admin, other)	Academics: 7.25 Academic visitors: 0.2 Research Associates (RAs) including Facilitator: 2.5 Admin/secretarial: 1.2 Other - IT technician/Web officer: 1.5
l)	What are staff employed by the CETL going to do when funding ends?	Academic staff: 4 full-time and 1 part-time indefinite lecturers will go onto university payroll and stay in the department; 1 part-time professor will return to department payroll; 1 part-time professor will return to another department; 1 fixed term lecturer will remain employed on other grants 1 fixed term lecturer will provide maternity cover 2 RAs will remain employed on other grants 1 part-time RA not yet clear 1 RA/Facilitator seeking funding to complete outstanding CETL work Admin: 1 CETL secretary not yet clear 1 part-time PG secretary will remain employed by the department Other: 1 web officer not yet clear 1 part-time IT technician will remain employed by the department
m)	Number of 'spin out' projects funded. List project by title and amount awarded. Name institution if other than host.	13 mini projects funded 8 other projects funded See detailed list of projects in the Appendix (page 57).
n)	Number of peer reviewed/other outputs that relate to CETL work	9 peer-reviewed publications (published or submitted) and 2 near to submission 11 written conference papers 24 conference presentations/posters 13 invited talks 3 booklet articles 2 occasional discussion papers and 1 in preparation See full list of outputs in the Appendix (page 62).
o)	Number of events held to develop or disseminate work beyond the CETL in the last three years: internally and externally. Please also draw	(i) 14 conferences and events (ii) 25 masterclasses and workshops (iii) 30 CETL teaching and learning seminars See full list in the Appendix (pages 51, 55 and 60)

	attention by means of a short paragraph each to 3-5 events that have been especially important or noteworthy.	Special events held at Lancaster: 1. Modern Bayesian Methods, April 2010 This was a day event to celebrate Professor Murray Aitkin's 70th birthday and was significant because he was the founder of the Centre for Applied Statistics at Lancaster in the 1980s, from which the GLIM software package and our short course programme originated. 2. Research Students Conference, March 2009 Our research students organised this four-day national annual event in statistics at Lancaster in 2009 with sponsorship and support from the PSC, providing them with invaluable experience in the running of a large national conference for 140 research students. 3. CETL-MSOR conference, September 2008 This two-day conference has been a jointly organised and sponsored event in teaching maths and statistics between the PSC, Sigma CETL, HEA MSOR and Royal Statistical Society Centre for Statistical Education since 2008. The conference was held at Lancaster in 2008 with over 120 delegates, the largest number to date at that time, and provides a forum for the dissemination of good practice. 4. Opening ceremony event, February 2008 The new PSC building was officially opened by Professor Sir David Cox on 21st February 2008. The half day event was attended by 107 invited delegates from across the UK, as well as the University Chancellor, Sir Chris Bonington, and Vice Chancellor, Professor Paul Wells. The day received substantial newspaper and media coverage (see Question 6 for more details).

Part Two – Evaluative Reflection

Question 1: Please reflect on how effective your CETL has been in contributing to the objectives set out for the CETL initiative when it started

Introductory commentary: 'I had a dream ……. Lancaster Postgraduate Statistics Centre'

A personal view by Professor Brian Francis, one of the three original CETL award winners.

"In applying for the CETL initiative as a newly appointed Professor of Social Statistics, I had two major ambitions. The first related to the lack of top-quality statisticians willing to teach and to motivate social scientists and medical researchers. I wanted to find a way both to encourage statisticians to become enthused about social science, and also to encourage social scientists to become enthused with the ideas of data analysis. For social scientists, in particular, statistics suffered from a legacy of bad research methods teaching and a kneejerk reaction to quantitative methodologies which used numeric data. The common view in social science was that proper research involved interviewing and observation rather than statistical analysis even though the samples might be heavily biased. Moreover, the typical social scientist did not read papers with any statistical analysis thus not being able to read the bulk of US social science. The solution was to develop training courses which truly engage social scientists by demonstrating the use of such methods to answer research questions that are unable to be addressed through other routes. The second ambition was to gave a truly world class training centre where such training could take place - well equipped with a wide range of software, and well supported by staff. Our external courses at that point were run in a dark room in the library with poor quality computers and with no facilities for students to use their own laptops. We strongly needed an environment where innovative teaching could take place.

What has happened at Lancaster has surpassed all my expectations. We have a beautiful RIBA-award winning building with state of the art teaching labs. This encourages external and internal people to give courses, both to external participants from a wide range of backgrounds and countries. The courses cover a wide range of levels and not only do external people attend, but Lancaster staff are also attendees, and they are able to see new teaching ideas as well as disseminating them through their own teaching. The building became an ESRC regional training centre, and is a centrepoint of the Lancaster node of the ESRC National Centre for Research Methods, which has a remit to disseminate quantitative skills to UK social scientists. The only downside has been the time-limited funding, and the fact that there is no HEFCE initiative taking the place of the CETL. Excellence in teaching does need to be rewarded as much as excellence in research. I now look with interest towards the views of the new government concerning the increase in student fees and the fact that an increase needs to lead to a better quality student experience, and wonder whether HEFCE views on supporting excellent teaching will need to change again!"

Our reflections on how effectively we have contributed to the objectives set out for the CETL initiative at the beginning are as follows:

i. To reward practice that demonstrates excellent learning outcomes for students.
The strategic aim of the PSC is to be an international centre of excellence, through the reward of CETL funding in recognition of our expertise in PG statistics training and research-led teaching. Staff who are already research-experts in their field have spent resources and time transferring their excellence into teaching in order to broaden the sphere of influence. In-depth evaluation clearly shows that staff, that have been part of this reward scheme have both recognised and benefited from the CETL initiative, which has given them the opportunity to innovate and develop their research excellence into demonstrable outcomes for students. Student numbers have increased year-on-year and feedback confirms consistently high student satisfaction. Excellent teaching is translated into high quality PG degrees and over 95% employment of students leaving the PSC. Reward has involved state-of-the-art teaching space, space to research and the availability of extensive grant money to develop ideas and create enterprise in teaching. The impact of this on teaching and therefore learning has been substantial.

ii. To enable practitioners to lead and embed change by implementing approaches that address the diversity of learners' needs, the requirements of different learning contexts, the possibilities for innovation and the expectations of employers and others concerned with the quality of student learning.
Great efforts have been made by all teaching staff within the PSC to develop practice that supports the learner and time has been spent on developing ideas in close collaboration with students, defining and redefining new ways of reaching learners with different needs and requirements and providing the students with access to cutting edge pedagogy-led teaching and staff with a manageable test-bed for new ideas. Statistics tuition has a substantial catchment area of students from a wide-variety of disciplines and backgrounds, and staff are continually challenged to adapt teaching for different learning contexts, which may themselves change year on year. CETL funding has provided the 'time out' and resources to do this. All too often innovative teaching within a research-led university is sidelined in favour of research activities. The CETL has given gravitas and importance to the pursuit of excellent teaching – raising the profile of such a pursuit in line with countries such as America and Australia. Lessons learned can be used to embed a strategy for dealing with learning in a variety of contexts, be it with full time students, students with families and jobs, foreign students, students from other disciplines or learners returning to statistics through their own workplace or CPD. The resultant output from such a variety of learning contexts will continue to be disseminated within and beyond the sector and should convince all those with a vested interest in the quality of student learning, that it is possible to deal with heterogeneity of learners without sacrificing quality teaching. Employers are rewarded with students who leave the PSC as highly-skilled, well-rounded and sought-after individuals, achieved by an approach to learning that is essentially vocational and developed through simulated work-based practice in-line with the expectations of employers.

iii. To enable institutions to support and develop practice that encourages deeper understanding across the sector of ways of addressing students' learning effectively.
Much time has been spent evaluating the impact of new and innovative practice developed within the PSC. It is through this continual approach of appraisal and re-evaluation, that it has been possible to draw out a strategic approach to teaching and learning that can help the

institution and others develop a greater understanding of how to meet learners' needs. We have had access to a wide range of students, a range perhaps not all disciplines will have a chance to engage with, and as such are in a good position to disseminate our findings. However, this is a continual process and impacting upon a sector within just five years is an unlikely outcome. The approach of the PSC has always been to keep advancing knowledge little by little, starting from within the Department of Maths and Statistics and working outwards into faculty, institution, sector and community. Like the approach to teaching and learning statistics, developing practice that encourages a deeper understanding of students' learning needs is stepwise and gradual – building on experiment and tacit knowledge to develop an approach that is reproducible by those within the discipline but also beyond the discipline. A sound understanding of how best to ensure that students learn effectively is the key desirable of all teaching projects and innovations that the PSC has supported.

iv. To recognize and give greater prominence to clusters of excellence that are capable of influencing practice and raising the profile of teaching excellence within and beyond their institutions.

The CETL award was the first step in recognising one particular cluster of excellence within Lancaster University, namely PG statistics. The reward of new facilities and grants continued to generate its own reward in terms of staff satisfaction and higher levels of output. In this sense, the CETL award has generated a positive recursive loop. The CETL grants have attracted staff, who are keen to influence their sphere of practice, however we also hope that the PSC has given others the opportunity to develop and share ideas and practice that otherwise may not have been forthcoming. Research associates and PhD students have been given the opportunity to develop teaching skills, in many cases flourishing into new potential clusters of excellence for the future – projects such as training for PhD students in consultancy skills would not have been funded if it were not for the CETL initiative. The ethos of the PSC has also meant that staff who are naturally teaching rather than research focused have had an opportunity to develop their work in an environment where it is held in high esteem. The mentoring of new clusters of excellence we hope will have a knock-on effect beyond the institution in the years and decades to come.

v. To demonstrate collaboration and sharing of good practice and so enhance the standard of teaching and effective learning throughout the sector.

All staff within the PSC have been encouraged in the collaboration and sharing of their work. Academic, research and support staff alike have actively engaged in delivering seminars and invited talks, attending and presenting at conferences and writing up work for publication. Although it is hard to quantify the immediate effect of this on effective learning throughout the sector, many projects and new initiatives have been well-received throughout the sector, including projects on the use of learning space impact on learner identity, the outcomes of problem-based learning and ways to reach a range of students using technology. A regular approach of the PSC has been the development of a Teaching and Learning seminar series which aims to share good practice within the university but is open to anyone within the sector. The seminars are posted openly on the PSC and university website for anyone to access, and we have actively encouraged representatives from other local CETLs to come and share their best-practice with us, in order to promote dissemination. We feel however that this is one area where greater inroads could have been made earlier at a higher strategic level, as many CETLs remain isolated entities despite their potential as a whole for influencing good practice across the sector.

vi. To raise student awareness of effectiveness in teaching and learning in order to inform student choice and maximize student performance.

Students have not failed to notice the world-class facilities that are available for them within the PSC and it is hoped that in the first instance these students will be the best source of publicity for future students. Students within the PSC have an important role in the life of the CETL – they have been open to pedagogic innovation and engage well with it. We have strived to be open and transparent in the mission of the CETL so that students not only realise the issues surrounding teaching and learning, which they may encounter themselves on their professional journey, but also so that they are empowered at every stage to engage further with their own learning potential. Innovation within teaching has invariable led to greater choice in terms of the way a student can learn. The PSC offers a variety of learning spaces that may be open-plan and bustling but also closed, quiet and industrious. Students can study modules that are team-taught and have varying degrees of group or independent work. They are encouraged in active, peer-learning approaches and can choose the level at which they engage with their tutors and lecturers due to the informality that is encouraged between postgraduates and staff. Students have the opportunity to learn online in digital environments as well as by conventional means, and at every stage their preferences are evaluated and listened to in order to enhance the options available to them. Students are always invited to teaching and learning seminars in the hope that their awareness will one day bear fruit in further pedagogic development and they will gain a more general appreciation of how different people learn in different ways, an empathy that will be needed in the workplace. The CETL initiative has been successful in providing choice for the learner and we hope that innovation such as this, will lead to further choices in the future as we constantly discover and rediscover the myriad of needs of the learner in an ever changing world.

Question 2: Please set out the aims and objectives specific to your CETL at the start; and for each one reflect how well these have been achieved

The five core aims of the PSC are listed below. To achieve these aims we adhered to ten strategic objectives two of which relate to each aim. A table is given in Appendix 1 summarizing how our long-term core aims, medium-term strategic objectives and short-term achievements inter-relate.

AIM 1: To become a regional, national and international centre of excellence in the PG training and development of statisticians

Objective 1. To extend and enhance existing opportunities for PG statistics students

The CETL funding has enabled us to develop and strengthen our existing MSc, PhD and short course programmes, which in turn enables us to promote a contemporary perspective. Firstly we have restructured and expanded our MSc programme for statistics specialists, creating one **MSc in Statistics** course **with new pathways** in Medical Statistics, Pharmaceutical Statistics and Environmental Statistics from 2008/9, which has only been made possible with CETL funding. The MSc course has received accreditation from the Royal Statistical Society. This programme as well as the Integrated PhD programme that we offer, is **for students from a maths and statistics background** and provides a rich source of postgraduate research students.

Secondly, from 2006/7 onwards we have introduced a new MRes in Applied Social Statistics within an integrated ESRC-funded PhD programme, and developed new statistics modules for the **MSc in Applied Social Statistics**. This again has enabled us to adopt a new pathways approach for 2010/11 in Crime and Forensic Statistics, Health Research and Teaching Statistics up to pre-university level that identifies more clearly our strengths and our commitment to supporting teachers in schools. This MSc/MRes programme caters **for students from any discipline**, who are numerate and wish to enhance their quantitative skills. Its modular two-day courses are ideally suited to those seeking a continual professional development (CPD) qualification, who can study on a part-time basis over 2-5 years. The courses form the basis of our **short course programme**. Whether or not the courses are studied for a qualification, all participants may receive a certificate of attendance upon request for CPD accreditation.

Thirdly, we have expanded our short course programme for external participants with the addition of six **new Applied Statistics courses,** and four **new courses in Pharmaceutical Statistics** to cater for professional statisticians who wish to refresh and enhance their skills in line with new methodological development. These courses are also offered as MSc modules. Our impact, benefits and evidence of effects are discussed more fully in Question 4.

Objective 2. To develop collaborations with other institutions to provide specialist training

The Department of Maths and Statistics is a member of four national training consortiums that provide specialist statistical training to researchers from a variety of backgrounds: the Lancaster-Warwick-Stirling node of the National Centre for Research Methods (NCRM), one of six nodes funded by the ESRC for the training of social scientists in quantitative methods, and the National Taught Course Centre for OR (NATCOR), Academy for PhD Training in Statistics (APTS) and Mathematical Access Grid Instruction and Collaboration consortium (MAGIC) which are funded by EPSRC for the training of maths, statistics and operational research postgraduates. These training opportunities have been greatly enhanced with the provision of the new state of the art facilities within the PSC building and additional administrative support to run advanced courses.

For example, CETL funding has provided NATCOR with a new short course booking system developed by the PSC web officer and has enabled Lancaster to host an APTS week-long short course programme in 2010.

As well as adding value to existing consortiums the CETL funding has enabled us to establish strong links with several national external bodies with common interests. We have worked closely with the Royal Statistical Society Centre for Statistical Education (RSS CSE), the Maths, Stats and OR network (MSOR) and the Sigma CETL, holding six monthly network meetings to discuss activities and develop common interests. This has led to invitations to speak on PG statistical education at a Statistics Festival in Plymouth, two articles in RSS News, an invited publication in MSOR Connections on the work of the PSC and an invited paper on statistical literacy, as well as the joint development with the RSS CSE of a new distance-learning course which is to be offered as a Teaching Statistics pathway on the MSc. In addition, we have jointly planned and sponsored the annual CETL-MSOR conference for the past three years to disseminate good practice, which was hosted at Lancaster in 2008.

AIM 2: To motivate, encourage and provide quantitative inquiry-led training for students from other disciplines

Objective 3. To expand and develop our innovative style of inquiry-led statistics teaching into other disciplines

In cross-faculty collaborations we have developed our service course teaching for students from other disciplines with new, revised or enhanced modules for MSc courses in Management Science, Psychology, Biology and Environmental Science, as well as contributing to Faculty PhD Research Training programmes (RTPs). Cross-departmental development with three other university departments within the Lancaster University Management School (LUMS) has resulted in a new MSc in Quantitative Finance for 2010/11, which is targeted at the international student market. We have also been able to restructure our statistical consultancy service for staff and PhD students across the university, resulting in a new consultancy co-ordinator's post within the department, outreach presentations and external consultancy work for other institutions.

Objective 4. To develop innovative biomedical courses within the new medical school

For the past four years we have provided statistical consultancy externally at the Royal Preston Hospital for Manchester University medical students on placement. This has proved to be popular with the students in planning their research projects and led to the development of a new introductory statistics course for the students in 2009. In addition, we have held discussions to plan a new MSc in Environment and Health in collaboration with the new School of Health and Medicine. The new school was only established towards the end of 2008 and had an immediate remit to establish their undergraduate medical curriculum. These discussions are therefore still on-going.

AIM 3: To give Lancaster trained PG students in all disciplines enhanced quantitative skills which will influence their whole approach to research

Objective 5. To instigate a Master Class programme with visiting quantitative experts providing specialist training in emerging substantive subjects

Our ability to host short courses and hold masterclasses has been greatly increased due to the new facilities provided in the PSC building and the administrative support of the PSC staff. We

regularly hold masterclasses on a range of topics, at introductory, intermediate and advanced levels, inviting statistical experts in the field from as far away as the USA and Australia. These masterclasses are run on a non-profit making basis to keep registration fees down and provide participants from the UK and Europe access to methods and software in the latest emerging substantive areas. The masterclasses have successfully enabled researchers to establish some collaborative links with experts, and several have been run jointly with the NCRM node.

Objective 6. To develop a visiting fellow scheme

For those wishing to spend some time at Lancaster to develop their research and/or teaching interests and gain new experience working abroad, we have established a visiting fellow scheme. Fellows typically visit for periods from 3 months to one year usually on a part-time basis. To date we have had visiting lecturers from Brazil, Iran, Greece and Sri Lanka. To forge new links with external institutions, we appointed three senior visiting fellows in 2009/10. The first fellow is a senior statistician from the Health and Safety Executive in Bootle and the second is a Professor of Social Statistics from Utrecht University. They work with the MSc students and staff to provide consultancy and support in teaching and learning, which may include supervision of an MSc dissertation or running a discussion group, as well as seeking new collaborations. A third senior academic from the RSS CSE at the University of Plymouth has focussed specifically on school outreach as a precursor to launching the Teaching Statistics pathway on the MSc.

AIM 4: To develop critical thinking in the use of statistics at a level appropriate for each group of students

Objective 7. To provide motivational and focussed PG training workshops in a range of disciplines

In addition to the masterclasses, we hold focused PG training workshops for a range of disciplines where there are usually opportunities to bring and discuss your own data with the tutors. In this respect we have contributed courses to the RSS/EPSRC graduate training programme on event history analysis and wavelets, as well as holding a very popular hands-on workshop on Geospatial Software. A forensic science programme has been established in conjunction with the University of Edinburgh and courses have been held both at Lancaster and at venues around the UK and in Europe. This has subsequently enabled us to offer a new MSc pathway in Crime and Forensic Statistics.

We have organized and hosted several national conferences and day events to share ideas and good practice, including the CETL-MSOR conference mentioned above, a conference for research students on Phenomena in High Dimensions (probability and geometry), the national Research Students Conference in statistics that was organised by our own research students in 2009, a two-day meeting on Statistical Extremes and another on Modern Bayesian Methods to celebrate the 70th birthday of Professor Murray Aitkin, founder of Lancaster's Centre for Applied Statistics in the 1980s.

Objective 8. To expand the use of web-based teaching, video material and on-line datasets

The PSC uses the Moodle Virtual Learning Environment (VLE) to host a range of e-learning materials. These materials are provided free of charge and may contain videoed courses. By hosting our own publically available VLE potential students are able to view and evaluate a selection of our course material when choosing where to study. As well as serving as a platform

to advertise and disseminate, the VLE is used within our service teaching to other departments and by the NATCOR taught course programme. A range of new resources continues to be developed increasing the availability of web-based materials, including a new distance-learning course in Genomics. Experimentation with new technological advances in teaching has led to the use of Personal Response Systems and Computer Based Assessment tests in some MSc modules, as well as video-capture of consultancy case studies and screen captures of hand-written notes.

AIM 5: To reward existing excellence in PG teaching.

Objective 9. To develop teaching excellence in our new statistics lecturers

Explicit considerations of teaching ability and potential were considered in the selection process for all CETL appointments. New academic staff are assigned mentors to help them settle in to the department. Their teaching is also peer reviewed with constructive feedback and assessed as part of our PG annual teaching review. New staff are encouraged to take the Lancaster Certificate of Academic Practice or the MSOR Statistics Lecturer Training course and several CETL-funded lecturers have done so. Training is also given in the use of the new flexible learning facilities within the new building and in how to create a personal page by the web officer.

Objective 10. To further enhance and reward the teaching excellence of all staff

Staff reward for excellent teaching is an important part of the HEFCE remit and our greatest reward has been the improved working environment within the new building. Teaching innovation points are awarded within the department workload allocation schedule to recognise that the development of new high quality course material is time-consuming. The HoD agreed to integrate CETL teaching innovation into staff appraisal procedures to become part of colleagues' performance development reviews. Funds have been made available for attending CPD courses or conferences as well as for small grants to improve existing courses. IT support is available to all staff for creating web-based teaching material and on-line datasets. A high priority is given to the encouragement of staff to generate publications and other outputs, including research papers that will enhance future teaching pedagogy in statistical education research.

Question 3: Please add any objectives that emerged as the CETL developed, and reflect on these as for question 2

Objective: To promote and market our training courses in the national and international arena

By the very nature that we are a PG statistics training centre, it has been important to raise the profile of the work of the PSC both nationally and internationally. The CETL initiative has enabled more dedicated time and impetus to be given to marketing and publicity to attract new clients. A great deal of effort has been put into developing new publicity materials in the form of posters, flyers, brochures and banners, which have been used to advertise the MSc, PhD, short course and masterclass programmes via email lists and targeted mail shots, and at CETL-related events and international conferences where we have had exhibition stands and sponsored advertising. A restructuring of the departmental website to better incorporate the PSC and a new PSC website and e-brochure have maximised advertising of our training courses on the web. Over the past three years the Director has given many talks at international conferences and meetings promoting the work of the PSC, and in 2008 the Deputy Director visited Kosova as part of a University delegation, which secured places on the MSc in Applied Social Statistics for five Kosovan students. In 2008 we also negotiated a trial collaboration with the RSS Professional Development Centre to host two of their one-day workshops outside of London and to jointly market two of our short courses within their programme in an attempt to facilitate access to specialist training across the country.

Objective: To stimulate pedagogical research and the use of new technologies in teaching statistics across the sector

Pedagogical research into Statistical Education is well-funded in the USA and also has a high profile in New Zealand and Australia, but not in the UK. To contribute to improving its profile and stimulating interest we have sponsored and/or organised several sessions at the Royal Statistical Society's annual international conference for the past two years. The Society represents over 7000 statisticians worldwide. In 2009 we promoted an international perspective with invited speakers from the USA, Australia and Slovenia, that included the past and current presidents and vice president of the International Association for Statistics Education (IASE). This session was videoed and the talks put on the PSC website to promote wider dissemination.

To stimulate pedagogical research amongst lecturing staff within the department and across the university thirteen awards of up to £5000 have been made in response to two calls for mini project proposals in 2008 and 2009. Several CETL innovation meetings were also held within the department to generate interest. A stipulation of the award was that staff should disseminate their findings at conferences, in publications and through presentation at our CETL teaching and learning seminars. These outputs are available on the PSC website found at www.maths.lancs.ac.uk/psc.

Objective: To actively engage in fostering and developing new partnerships with client organizations

Initiatives to develop knowledge transfer partnerships with internal and external clients are becoming increasingly important to research funding councils and staff have given a high priority to addressing the demands of end users. Firstly, the remit to increase and deepen the impact of excellent statistics teaching practice across the sector has incorporated collaborations

with external clients into the project work of the students, resulting in several published research papers. Collaborations have included work with Johns Hopkins University in Baltimore, AstraZeneca, Liverpool University and the Royal Liverpool Children's Hospital. These liaisons in turn have stimulated the award of annual MSc student prizes by two industrial partners (Tessella and PSI).

Secondly, becoming engaged in third mission activities has led to the development of a successful joint department bid with the Department of Management Science in LUMS to fund a new EPSRC Doctoral Training Centre from 2010/11. The bid has pledged additional financial support from industrial partners that include Unilever Research, Shell Research and the Met Office Hadley Centre. The centre will provide high level training for PhD students, working on statistical solutions to problems pertinent to industry. The scheme is looking to recruit 50 PhD students over five years between the two departments and offers increased PhD stipends and a new MRes in Statistics as part of its integrated training programme.

Question 4: Irrespective of your answers to questions 2 and 3 above, please reflect on, and draw out the achievements and benefits of the CETL

Lancaster Postgraduate Statistics Centre: a co-ordinated approach

The PSC is a subject-specific CETL that focuses entirely on postgraduate statistics education, encompassing all postgraduate teaching and learning activities within the Department of Maths and Statistics. The CETL funding has enabled us to co-ordinate effectively, build, restructure and strengthen our existing statistics training programmes and to develop new initiatives, creating a natural synergy between existing and new activities. All of our courses have benefitted from the increased publicity and marketing enabled through the CETL grant. With our strong track record of high quality and innovative statistics teaching combined with our increased capacity for delivering new postgraduate statistics modules, we are able to attract exceptionally high-quality students to study on our MSc courses. The enhanced reputation of our new accredited MSc in Statistics programme has attracted new studentship funding from the Medical Research Council, National Institute for Health Research and several pharmaceutical companies and the increased student numbers bring in extra income for the university. The potential benefit of our MSc in Applied Social Statistics in providing enhanced quantitative skills and as a CPD qualification for professionals from other disciplines has yet to be realized. The new pathways for the MSc are now in place and will be offered in 2010/11. Extensive marketing of this opportunity will take place next year.

To monitor our progress a review of MSc, PhD and short course numbers by year is given in Appendices 2 and 3, showing a substantial increase in registrations for 2008 and 2009, almost reaching our target of 30 students per year. Short course numbers have greatly exceeded our expectations since 2007/8, doubling to 439 and 473 participants per year, respectively, for the last two years, and attracting an increased number of external participants of 26% and 35% and of internal participants across the university (staff and PhD students) of 15% and 18%, respectively for 2008/9 and 2009/10. The PG service and PhD RTP courses we teach are given in Appendix 4, and show a consistency of numbers over time although numbers are dependent upon student registrations in the related departments. Since 2005 we have service taught over 700 MSc students from other disciplines as well as training over 300 PhD students through the RTP programmes. A list of all the masterclasses and workshops we have held to develop and enhance statistical skills is given in Appendix 5. These courses attract external participants from across Europe, with total participant numbers generally varying between 10 and 25 of which 3-5 may travel from outside the UK. We consistently receive good feedback for all of our courses, which demonstrates we provide an excellent student experience (see examples in the appendices).

Evaluating and enhancing the student experience

Enhancing the student experience has been a key objective of the PSC, underlying all our training provision. A comprehensive evaluation has enabled us to measure to what extent we have been successful in adding value to the student learner's experience through our approach to teaching and learning and also through the provision of the new open-plan social learning space. Whilst it is hard to quantify and assess satisfaction of students and their experience of studying, feedback indicates that we are continuing to deliver strong, research-led teaching and have provided a purpose built dynamic learning environment, which both enhances the opportunities for student engagement and simulates an open environment for peer-learning. Students testify to better relationships with staff as a result of the proximity of both parties within the learning space

(a point corroborated by teaching staff and witnessed through observational study) and engage in more group work as a result of the space provided. This is a mode of learning that many mathematicians and statisticians may not be used to, but find beneficial as it is more typical of a consultancy or work environment. Within the innovative learning space, students have the opportunity to develop their own strengths and skills and this often takes the form of taking on roles within the peer-group in order to complete work, which builds confidence and the ability to actively learn together. We have also seen that the provision of a dedicated Masters area enhances the students' opportunity to build a peer support group that is useful socially and for seeing the students through a work-intensive year. In recognition of the CETL award given to Lancaster University and to reward excellence in learning, we have created two annual CETL student prizes for the highest achievers on each of the MSc programmes.

A programme of consultation with students throughout the lifetime of the CETL has ensured that any feedback given by the students on how to improve their experience within the department, has been listened to and acted upon. Notably, a reorganisation of technology provision and rooms available for quiet work were provided as a result of students bringing to our attention ways in which their learning potential could be improved. We support students in any way we can with the provision of software and hardware such as laptop provision for long-term usage. This has been of particular benefit to international students, including five Kosovan students. We recognise that the student experience does not just relate to our own masters students but also to those to whom we deliver service courses and those who visit us for short courses, workshops and masterclasses, and feedback is closely monitored. We have evaluated the quality of our service courses which has led to both curriculum changes and increased student satisfaction.

Many of the projects undertaken by CETL funded staff are designed to have real and demonstrable positive impact on the student learning experience, finding new ways to convey difficult concepts to students, increasing their awareness of learning resources and enhancing the effectiveness of their learning. One project is aimed at ensuring students get the most from their time within the PSC in the 'soft' as well as the 'hard' discipline skills, focusing on employability and transferable skills. Whilst careers sessions are not a compulsory part of the course, students testify that they are worthwhile and help them feel supported in their transition to employment.

Addressing the national shortage of trained statisticians

It is important to remember that the PSC was set up to help address the current shortage of highly trained research statisticians, against a backdrop of increasing decline in quantitative skills more generally. The department's collaboration in national training consortiums (NCRM, NATCOR, APTS and MAGIC), the university's designation as an ESRC Regional Training Centre and our MSc, PhD and short course programmes, and occasional masterclasses and workshops are all impacting on the national agenda to train people in statistical methodology and enhanced quantitative skills, both statisticians and non-statisticians alike. In doing so this increases Lancaster's reputation as an international training centre for postgraduate statistics in line with our HEFCE CETL remit. Our Masters students are a rich source of doctoral students with 15 staying on to study for a PhD in Statistics over the past three years (3 in 2007-8, 4 in 2008/9, 8 in 2009/10). Moreover, from 2010/11 we will attract even more PhD students, with a target of 50 over 5 years, when we become a designated EPSRC doctoral training centre in a newly funded joint scheme with colleagues in Management Science, with a focus on bridging the gap between research and industry. The MAGIC project facilitates the synergy of activities within the whole department by linking Maths with Statistics and by providing an access grid room within the new

building giving us a facility for holding short courses at remote sites. In addition to offering Lancaster's expertise to students from other institutions, it has greatly increased the choice of specialist modules on offer to students studying on our undergraduate programmes. A seminar to clinicians in neurological statistics and a masterclass to Lancaster students and external participants have also been successfully delivered via the access grid node, connecting with sites as far away as Brisbane, Australia and the University of Pompeu Fabra in Barcelona.

Developing quantitative skills in students and researchers from other disciplines

In contrast to the advanced training opportunities available for statistics postgraduates, it is important to develop and provide a clear and varied range of training courses for postgraduates from other disciplines through service teaching and applied short courses. Unfortunately 'statistics anxiety' is widely acknowledged in students from other disciplines and any innovations to break down these barriers are to be encouraged (Verhoeven, 2006). For example, in 2007 we carried out a survey of staff and students in the Lancaster Environment Centre (LEC) to determine perceived need and to see whether we could improve our current provision. This resulted in a publication and several conference presentations setting out recommendations for successful service teaching, in addition to a revised service course for LEC. It is important to engage with students at the level at which they feel most comfortable, to put problems into their own subject-specific context and to provide motivating examples from real life. Team teaching is one approach that we have used in a course for research students in the social sciences, where a social scientist from politics and a statistician teach together, have debates and discussions with each other and demonstrate to the students how such partnerships can benefit research:- *"Watching instructors debate using different methodological approaches allows students to see the advantages of different disciplines…"* (student feedback, 2008). Other positive feedback is found in the Appendix. In another criminology course we have used stimulating crime examples from newspapers and simple data visualization to put measurement, basic numeracy and statistics into context. A new project on communicating statistics is reviewing the problems and solutions found in the statistical education literature and developing new examples from the literature and media to stimulate motivation. A cross-section of our pedagogical work is being presented at the International Conference on Teaching Statistics in Ljubljana in July 2010.

Investment in new facilities, technologies and mini teaching projects

The facilities of the new building have been pivotal to our moving forward and making in roads into becoming an international training centre in PG statistics education. We can now accommodate twice as many students on short courses and masterclasses as was previously possible and run several courses simultaneously because of the increased space and dual PC labs. It has also provided us with the ability to hold major conferences and day events for dissemination and outreach within the wider community. These events are listed in Appendix 6 and include eminent keynote speakers.

The setting up of a mini project funding scheme has been very successful in motivating lecturing staff to conduct pedagogical research and experiment with new technologies in their teaching. The scheme has provided funding for lecturers to employ PhD students on a temporary basis to assist in develop of materials and other outputs, which adds value to the postgraduate student experience as well as providing funding for conference presentations. Other lecturers have used the funding to employ an RA or to buy new equipment to enhance their teaching. For example, podcasting is a relatively new concept within higher education and we are using it increasingly to capture seminar presentations and to record lectures for reflection and review. Another mini

project is aiming to set up a dataset archive to aid in teaching different statistical methods that we hope in time will become a public depository with well defined searching criteria. A list of all our teaching projects is given in Appendix 7 together with a brief summary and funding.

To stimulate ideas, disseminate different pedagogical practices and encourage the use of learning technologies we run a CETL teaching and learning seminar series. A list of past themes and seminars is given in Appendix 8. On many occasions sessions have included invited experts in the field. Seminars are advertised throughout the region, many are on generic themes suitable for a non-statistical audience and anyone is welcome to attend. Talks from the seminar series are posted on the web along with occasional videos to disseminate more widely new methods and strategies of learning. The PSC also provides support for and hosts a university-wide Maths Forum set up by the university's Centre of Excellence in Learning and Teaching (CELT) to discuss issues that relate to student learning such as poor maths skills, dyscalculia or dyslexia, and has funded the production of two brochures on enhancing maths and quantitative skills.

A list of all our CETL publications, presentations and conference papers is given in Appendix 9.

Question 5: Have there been any disappointments in how the CETL has developed/what it has achieved. What are they, why did they happen?

There have been disappointments in how the CETL project has developed. Firstly, there was a severe delay in recruiting academic staff to the project. The known national shortage of statisticians and its impact on recruitment delayed the start of the CETL until 2006. Posts were advertised in 2005 but most posts stayed unfilled until September/October 2006. In addition, the promotion of the first CETL Director to Pro Vice Chancellor in December 2005 after only a few months in post, and the subsequent delay in filling the post of Director until May 2007 meant that the Centre was without a full-time director for a period of 18 months. During this period the Deputy Director became acting director, although as NCRM node director his time was limited, and two assistant directors, with similar restrictive high level responsibilities, were appointed at 0.l FTE each. The underspend on salary resulted in the newly appointed director's funded time on the project being changed from 0.5 FTE to 1.0 FTE until the end of the project. Once in post the director negotiated an extension of the end of the grant to 30 September 2010, ran an Away Day for departmental staff to increase awareness of the CETL and to stress the importance of working to achieve the objectives of the project, and set up a number of new RA posts to stimulate activity.

Secondly, the knock-on effect of the delays curtailed the impact and dissemination of the work of the PSC in subsequent years. The PSC is now near to the end of its third academic year under the new director and outputs from the various teaching and learning initiatives are beginning to bear fruit. However, several of our new initiatives only become available from 2010/11, and there is still outstanding project work to be completed and written up for publication before our impact can be fully assessed. It is also inevitable that dissemination activities will become diluted once the funding ceases.

Thirdly, an additional effect of the recruitment problems is that it has left little time to seek and secure further new funding before the end of the CETL, with all efforts being heavily focussed on achieving our aims and objectives within the restricted time period. It is likely that the PSC will lose some of its support staff and unlikely in the current financial climate that any university funding will become available to continue our work. Given the dedication and hard work of the CETL staff in building up the reputation of the University and Department of Maths and Statistics through the work of the PSC, and its raised profile as an international training centre for postgraduate statistics, then this is the most disappointing aspect.

Question 6: Please reflect on the difficult and easier aspects of getting the CETL going and of getting your messages across

Setting up an infrastructure for the PSC

In setting up CETLs within institutions two distinct methods of infrastructure seem to have been adopted. Either CETLs were set up as separate centres where all staff time was dedicated fully to achieving their aims and objectives, or CETLs were integrated into existing frameworks with staff given a range of CETL-related and other, usually departmental, duties. There are pros and cons to both approaches; for example, in those CETLs where staff operated as a separate centre output was high but towards the last year of the project, staff and directors were leaving because of the insecurity of their positions. In contrast the integrated approach did help maintain staff positions and uphold morale, with some staff being kept on or encouraged to apply for vacant positions, but this produced divided loyalties between the CETL and department.

The PSC falls into the latter 'integrated' category, mainly because of the difficulties in staff recruitment as this was considered a better strategy for attracting staff. The infrastructure for integrating the PSC into the Department of Maths and Statistics was put in place by the HoD, Acting Director and Assistant Directors in 2006. The post of Director was set up as a full-time indefinite post with a standard departmental research role, flexible teaching role and the administrative duty of Head of Postgraduate Teaching, as well as the strategic duty of directing the work of the CETL. The full time equivalent (FTE) of one indefinite CETL lecturing post and one fixed term CETL lecturing post were allocated to each of the 3 administrative statistics sections that formed the Statistics Group within the department. The three fixed term lectureship posts were used to buy out teaching within each section, and thus provide additional capacity within the sections so that everyone in the Statistics Group has the opportunity and obligation to contribute to the work of the PSC. CETL activities originating from each section should therefore amount to 2.0 FTEs each year from 2007/2008 onwards. The six lecturers are supervised by the three Heads of Section, and each Head of Section reports back to the CETL Management Committee. Whilst this has benefitted the department and ultimately helped secure lecturing posts, four of which the university has agreed to make indefinite at the end of the award, it has been harder to stimulate CETL activity in some of the lecturers, particularly in the production of teaching and learning outputs.

Stimulating staff participation in the work of the PSC

Academic staff contribute to the work of the PSC in a variety of ways. The two CETL-funded MSc course directors apply their excellent teaching expertise to ensuring the efficient maintenance and running of the two MSc courses. They organise an annual teaching review day for all postgraduate teaching staff and write an annual review report which is presented to the Faculty PG Studies Committee each year. A third CETL-funded lecturer is course tutor for the MSc in Statistics, and also bridges the gap between UG and PG teaching, and a fourth as short course co-ordinator has developed the new Forensic Statistics programme. These staff sit on the PG Teaching Committee, which is chaired by the PSC Director. Other academic staff develop materials and teach on the MSc and short course programmes, and/or they provide service courses to other departments or contribute to Faculty RTPs. They may also run an occasional masterclass for both students and external clients, or special subject-specific research events. Several lecturers maintain and promote the consultancy appointment system that benefits all staff and PhD students across the university. Our contribution to several national training consortiums

is also covered by lecturing staff. All these staff add substantial value to the total student experience through their expertise and positive attitude to teaching and learning.

As a research-led department there is a strong emphasis on research outputs in readiness for the next Research Excellence Framework and outputs with respect to teaching and learning are regarded as less important. The most effective way of motivating and stimulating staff participation in pedagogical research has been through the CETL mini project funding scheme. At first most staff did not realize the potential of applying for a small teaching grant until it was recognised that these could fund PhD students and RAs to help get the work done, with the add-on effect of beneficial experience for those employed and a published paper. The initial perception was that this was extra work that they would need to do themselves instead of becoming a 'supervisor' of the work. In total we funded thirteen mini projects over two years on statistics education research across the university, in addition to eight other teaching projects supported by the PSC.

Raising awareness across the university

In January 2008 a CETL Awareness Symposium was held to raise the profile of the work of the PSC within the department and to plan activities for the opening ceremony event, which took place upon completion of the new building at the end of February 2008. The symposium was deemed to be a success with very positive interest and feedback; it was attended by 34 staff. In addition, a regular CETL news slot was incorporated into the departmental newsletter. The official opening ceremony was an important event for the university with invitations going out to key people from all over the UK representing the private and public sectors and across the university, and 107 people attended the event. The building was officially opened by Professor Sir David Cox, and the Chancellor and Vice Chancellor of the university gave speeches along with Professor Sir David Cox and the PSC Director, preceeded by poster displays, tours of the building and lunch. The day was deemed a great success, and received newspaper coverage, an article in the Times Higher Educational Supplement and the Director was interviewed on BBC Radio Lancashire. In June 2009 we held a second departmental Away Day to focus on dissemination of good practice, as well as to plan departmental strategy in teaching and research. In addition, the university Maths and Quantitative Skills Forum that we have hosted, invited talks given by the Director and our extensive advertising across the university through adverts on TV monitors within departments and by email have all helped to raise awareness of our work and opportunities for training in statistics. These activities have been key to raising awareness, maintaining interest and stimulating participation in the work of the PSC.

Core operational structure of the PSC

A significant amount of time has been spent on setting up core structures for the new centre (management, finance, facilities, publicity and marketing), so that we can operate efficiently, host external masterclasses, conference events and seminars, and set up effective teaching and evaluation projects. We have ensured that regular departmental CETL Management Committee meetings and External and Internal Advisory Board meetings take place, that the financial system was restructured in line with the university system and the new building was completed on time. We have worked hard in planning and negotiating facilities for the new PSC building particularly with respect to student-focussed learning space and audio-visual equipment.

The Director supervises an enthusiastic group of support staff and researchers to achieve the PSC strategic aims and objectives, and regularly mentors them to ensure their academic and personal

development. The operating efficiency of the PSC is underpinned by four support staff. The PSC secretary works hard to promote the professional image of the PSC, and administers and advertises the masterclasses and workshops and various other meetings as well as conference promotions. The web-technician has developed several efficient web systems and ensures the departmental website and short course booking system is regularly maintained, and the half-time IT officer ensures that the courses run smoothly in the PC labs. The CETL RA/Facilitator carries out some administration tasks as necessary but focuses mainly on pedagogical research. For example, she has developed a novel approach to evaluating learning space, which has been presented at conferences and external meetings as well as to the Deputy VC and Faculty. The three remaining CETL RA posts are set up as training positions, such that they are able to conduct their own supervised research as well as taking part in MSc teaching and teaching related projects. For example, one RA organises the CETL Teaching and Learning seminar series inviting participants from around the North West region. This provides a forum for invited guest speakers and dissemination of teaching project outputs. Talks are also placed on the PSC website to influence practice more widely. Another RA has focused on the use of technology in teaching and has assisted in teaching an MSc module incorporating new technologies, such as Personal Response Systems (PRS) and Computer-based Tests (CBTs), which has resulted in several conference presentations and a submitted paper. The third and most recently appointed RA is working on setting up a data archive website which is a joint initiative led by the NCRM node director who is also Deputy Director of the PSC. The Director, Deputy Director, RA/Facilitator, secretary, web officer and CETL RAs form the core CETL team, which meets regularly to plan and co-ordinate PSC activities. In general these regular core team meetings have been very productive and ensure everyone knows what is happening. CETL team discussions centre around publicity, marketing, conferences and event planning, as well as how best to facilitate evaluation and help academic staff to make best use of the new technology and the building space.

Question 7: Has your CETL adopted/used/been based around any specific theories, e.g. of change, or of student learning?

In the initial proposal for activity within the PSC we drew upon explicit theoretical models of practice related to problem solving and educational perspectives on inquiry-based learning. The pedagogic approach is designed with an awareness of the different backgrounds of our students; that is, students from both non-statistical subject disciplines and those with a strong mathematical and/or statistical background. Our CETL is somewhat unique in its subject-specific nature and therefore much of the pedagogy is taken from the large volume of research done on statistics education rather than generic educational research. We use different approaches to teaching and a variety of assessment methods that are underpinned by pedagogic research as summarised in Moore and Cobb (2000). We recognise and support the paradigm shift from the traditional view of statistics as a subset of maths to the philosophy that statistics is part of scientific investigation and as such we use a different order of teaching called the 'statistical problem solving paradigm' (Stuart, 1995). The approach of the CETL has been to enhance and develop practice within a broadly constructivist educational framework, however we are careful to maintain a balance represented by a strongly activity-based learning philosophy. Active learning is an essential part of our teaching style and has been shown to help students (Bradstreet, 1996; Garfield, 1995; Lovett and Greenhouse, 2000; Moore, 1997), particularly those from a non-mathematical background (Schaeffer et al 2004). Many of the styles we adopt are outlined as particularly beneficial by Garfield (1995). Cooperative and collaborative learning is brought to the fore in order to develop subject-strong students with a highly vocational skill set that supports the employability agenda and the demands of the subject discipline within industry. Building confidence in students for consultancy work is a key feature of our work in training PG statisticians, providing them with real-world skills whilst still maintaining academic rigour.

Teaching and learning initiatives in the PSC have been motivated by a desire to stimulate the modern learner. Within this remit, technology and the environment have been key grounds for experimentation at the cutting-edge of pedagogic innovation. This combined with tried and tested methods for teaching and learning have helped to bring the strategy of the PSC in line with the desire to build student identity within the discipline of statistics. The PSC has initiated and supported projects that encourage innovation in teaching and learning to take our understanding of modern learning one step further than at present, not just at postgraduate level but within the department as a whole. Each project is underpinned by its own theoretical or educational perspective tailored to the pedagogy of teaching statistics but in line with the aims of the PSC as a whole which seeks to find new ways to enhance teaching and learning for the learner. For example, one project seeks to use Problem Based Learning as the underpinning educational approach for a module that was previously lecturer-led by traditional methods. Another project sought to develop self-learning materials in line with the theory that improved statistics education needs to begin with clearer statistical thinking and reasoning (Garfield et al., 2000). Projects are as diverse as experimenting with hybrid and distance learning technologies, developing courses around problem-based learning techniques, using computer based tests to monitor learning, team-teaching between staff from different departments and technological solutions for enhancing student learning at all levels such as video and screen capture technology. All teaching and learning activity is underpinned by substantive evaluation and dissemination in order to share best practice within the wider community, as well as serving as an inspirational pool for new ideas.

Question 8: Reflecting on the last five years what other important messages are there that you want to convey about your CETL - its successes, difficulties, impact

Enhancing quantitative skills and improving statistical literacy in the wider population

Quantitative reasoning in an evidence-based society is a key component in public debate as well as government, business and individual decision-making processes and the discipline of statistics plays a key role (Smith 1996). The public perception of statistics has changed little since the quote used by Disraeli, that "there are three kind of lies: lies, damn lies and statistics", was published in the Times in 1895. In general people do not understand what statisticians do and what statistics are used for, they think that the subject requires a high level of numeracy and are often baffled by the jargon used (Hand, 2009). Risk and uncertainty play a part in every day life crossing many boundaries and influence society in many ways, including politics, finance, law and order, and health and medicine, but the confused nature of media reporting and the public reaction to it is also a cause of concern (Spiegelhalter, 2008). It has been therefore not only a challenge but also a great opportunity for us to try and stimulate a wider interest in statistical thinking.

The opportunity to promote quantitative reasoning in the general population must start early in the education system. We have endeavoured to engage with teachers in schools to support them in delivering a statistics syllabus with confidence and will continue to do so. In general, it is important to engage with students at the level at which they feel most comfortable, and to put problems into their own subject-specific context. This promotes interest in the subject and facilitates questioning when there are misunderstandings.

Creating enterprise in teaching statistics

The provision of statistic courses at a variety of levels (eg. introductory, intermediate, advanced) gives students the freedom to begin to develop statistical literacy skills at their own pace, with the added motivation of having real problems to solve. Once their appetite has been cultivated then they may be enticed to think and reason more deeply and study intermediate methods pertinent to a more sophisticated analysis. This may be the level at which many researchers wish to remain, but by this time they should have gained sufficient skills to use simple statistical modeling approaches and also the confidence to discuss their work with a statistician when they need to collaborate. The more adventurous having developed a reasonable mathematical and statistical foundation, can go on to study more advanced and complex techniques such as those found in a typical MSc in Statistics syllabus, and coming from a non-mathematical and statistical background to attain this level of competency is to be highly commended.

In general, there are many opportunities for enterprise and innovation but most are missed. Staff may be restricted by time and workload, not see the potential benefits within a bigger picture and not grasp opportunities when they arise. It takes time and dedication to step out and cultivate new outreach opportunities and collaborations with other departments, institutions and client groups and by taking a co-ordinated approach this can happen. Strategically focused planning enables the load to be shared and the burden halved. The PSC is an integral part of the Mathematics and Statistics Department enabling all staff in the Statistics Group to participate in a variety of initiatives, and its success is due to their enthusiasm and commitment to high quality teaching and learning. Today many of our MSc modules double up as short courses and are

delivered as two, three or four day courses. To provide further training regionally and nationally we run occasional masterclasses and workshops at all levels, inviting visiting experts in the field. This is an excellent way of not only supplementing CPD opportunities for external researchers but also enhancing the training of PhD students and staff across institutions.

Experimenting with technology

There are many useful resources available to stimulate self-directed learning and for use by staff to enhance their teaching practice. We are building up a library of resources containing a range of DVDs, Computer Aided Learning programmes and videos, as well as the e-learning courses described above that can be used by students or staff as part of a practical learning session. For staff in particular web-based resources such as useful web links for stimulating teaching and learning, podcasts and presentations of seminars on teaching and learning, and details of teaching projects and pedagogical publications are available on the PSC website.

There are now many different technologies that can be applied to enhance or augment teaching and learning. Whilst they may be successfully applied in most lecturing situations they do need careful evaluation as there is the possibility of both detraction from subject matter and protraction of lecture length. We have interviewed our students and asked for regular feedback on our new initiatives, which have included PRS, CBT, podcasting and ePDP. This is vital for discovering their deficiencies, assessing their relative merits and developing better ways of delivery.

There is also an increasing need to provide accessible courses that can be studied part-time and off-campus. However, the development of distance-learning courses is very time-consuming and expensive and needs adequate resources and on-going funding for the development of good self-explanatory learning materials and a clear target market. To date the PSC has developed one distance-learning course in Genomics which was funded as a mini teaching project.

Using consultancy and collaborative research

Another approach to stimulate interest in statistics is to provide a consultancy service for staff and PhD students across the university. This enables one to one sessions by pre-arranged appointment to go over problems and facilitates more in depth discussion. Advice is given on a range of topics from basic statistical methods, study design and software packages to more advanced statistical methods. We also use this medium to train our own statistical PhD students in statistical consultancy skills. If the problem is felt to be beyond the capabilities or inclination of the person seeking advice, usually determined after several appointments, then a research collaboration can be negotiated. Alternatively the statistician could become a joint PhD supervisor of the student, which ensures that responsibility has been taken by the statistician to provide statistical advice and help when needed by the student. This has been very successful in capability building, and usually takes the student to a level of knowledge beyond that which they would have achieved without this support. It also demonstrates and promotes the merits of multidisciplinary collaboration for future grant applications. Over the last year we have been asked to give talks on study design and writing statistics support into grants at several research training events.

Question 9: Reflecting on the last five years what important messages are there that you want to convey about the experience of being part of a wider 'movement'/experience of other CETLs

Gaining a broader PG perspective by belonging to a wider movement

Within the wider community the multi-disciplinary and multi-faceted issues facing PG education are wide ranging and challenging. The CETL initiative, and our membership of it, has enabled us broaden our horizons and gain a wider perspective, experience and appreciate a sense of community, and reflect upon and question current practice. In the current financial climate problems have become compounded and intrinsically linked with an ever-increasing shortage of resources and the threat of unemployment. Yet this comes with a clear message that for universities in the 21st century there is a need for more focused co-ordination, innovation and enterprise to remain ahead of the game and survive the economic downturn. This unique challenge provides us with an exciting opportunity to review current practice, seek new opportunities and step into a new competitive world as 'enterpreneurs'. Universities are well placed in this respect being furnished with intellectual talent and world-leading achievements, which to date have been clustered around groups of eminent individuals. However to compete in an ever-changing international arena there is a need for more collaboration and integration of activities and the recognition of a variety of skills at all levels, with new initiatives building upon previous achievements, rather than existing as isolated events. This type of activity will provide an excellent training ground for new up and coming investigators.

Against this backdrop of enterprise is the day to day business of teaching and learning which underpins PG education. The environments in which PGs study should be welcoming and friendly with social learning space to encourage interaction between staff and students and to allow PGs to gain some experience of academic life during their studies. Whether or not they choose this vocation, it is important that our PGs are equipped with the necessary skills not only to be experts in their chosen subjects but also to be well-rounded individuals, who are career-minded with a clear desire and aptitude to develop a level of professionalism beyond that which most PGs might expect during their student experience.

Focusing on the total student experience

HEFCE places high emphasis on the total student experience including recruitment and retention of students from diverse social backgrounds, and the development of skills and awareness that enhance employability. Toward this aim PG students in all disciplines need enhanced quantitative skills that will influence their whole approach to research, and to develop critical thinking in the use of scientific and qualitative research methods at a level appropriate for each group of students. This includes transferable skills flavoured with a strong sense of self-worth, confidence and integrity, good communication and writing skills, a good level of numeracy, presentational and organisational skills and team working that will enhance their personal portfolio and CV, demonstrate relevant competencies to prospective employers, and prepare students well for future employment in the job market. Research Training Programmes provide valuable training in generic research methods, and widening participation of PGs as Graduate Training Assistants provides well-established teaching experience, as well as adding to their Personal Development Portfolio. There is much to gain in motivating and encouraging

multidisciplinary inquiry-led training for PhD students, for example, from the natural, social and management sciences, to gain appreciation of each others disciplines and in planning for the real working environment. In some areas, such as statistics, PhD students will also benefit from training in consultancy. This unified strategy is being promoted by the new ESRC PG training framework, with the establishment of coherent university-wide training provision to build upon synergies between disciplines.

Question 10: Please reflect on work emerging from your CETL that has been 'transferable', i.e. useable beyond the home audience for which it was originally developed

Addressing key national issues

Within the national arena PG and International students are firmly placed on the Government's agenda. Universities are now placed within the new Department of Business, Innovation and Skills, further emphasising the new agenda in innovation and enterprise. We have found that many university staff are nervous to embark on such endeavours, but at its root enterpreneurship is nothing more than to *start to do something, ie. to have a go and try something new. For PG lecturing staff* this might mean to embrace the digital economy and new technology and start to think about innovative ways to provide PG courses and train research students. *For Heads of Departments* this might be to assert a measure of control over the departments economic future and encourage and co-ordinate initiatives. *For Faculties* this might be to oversee and promote inter-departmental and inter-disciplinary collaborations, and to professionally market and advertise their particular strengths. There will be many personal and sometimes dormant contacts between academics and overseas institutions and businesses that can be pro-actively awakened to expand international partnerships.

The Quality Assurance Agency for Higher Education (QAA) have noted that there is a growth in the numbers of students studying in higher education at the same time as being employed, and using their workplace as a site of learning and assessment. Employer engagement is a new area of activity and increasing importance, both in the development of government policy and in the strategic development of many institutions. Employer-responsive provision reflects employers' needs, and should be designed in consultation with employers and delivered in an appropriate way. There is a need for universities to become more flexible in the types of student they recruit, the range of learning opportunities made available and the mode of study they offer, for example, programmes such as ours that can be studied part-time over five years; delivered as 2-4 day short courses/modules; by distance learning. Moreover, we recognise that there needs to be a balance of academic knowledge and professional competence (eg. employability, transferable skills, consultancy skills) in the award of credit, whilst maintaining the same high academic standards.

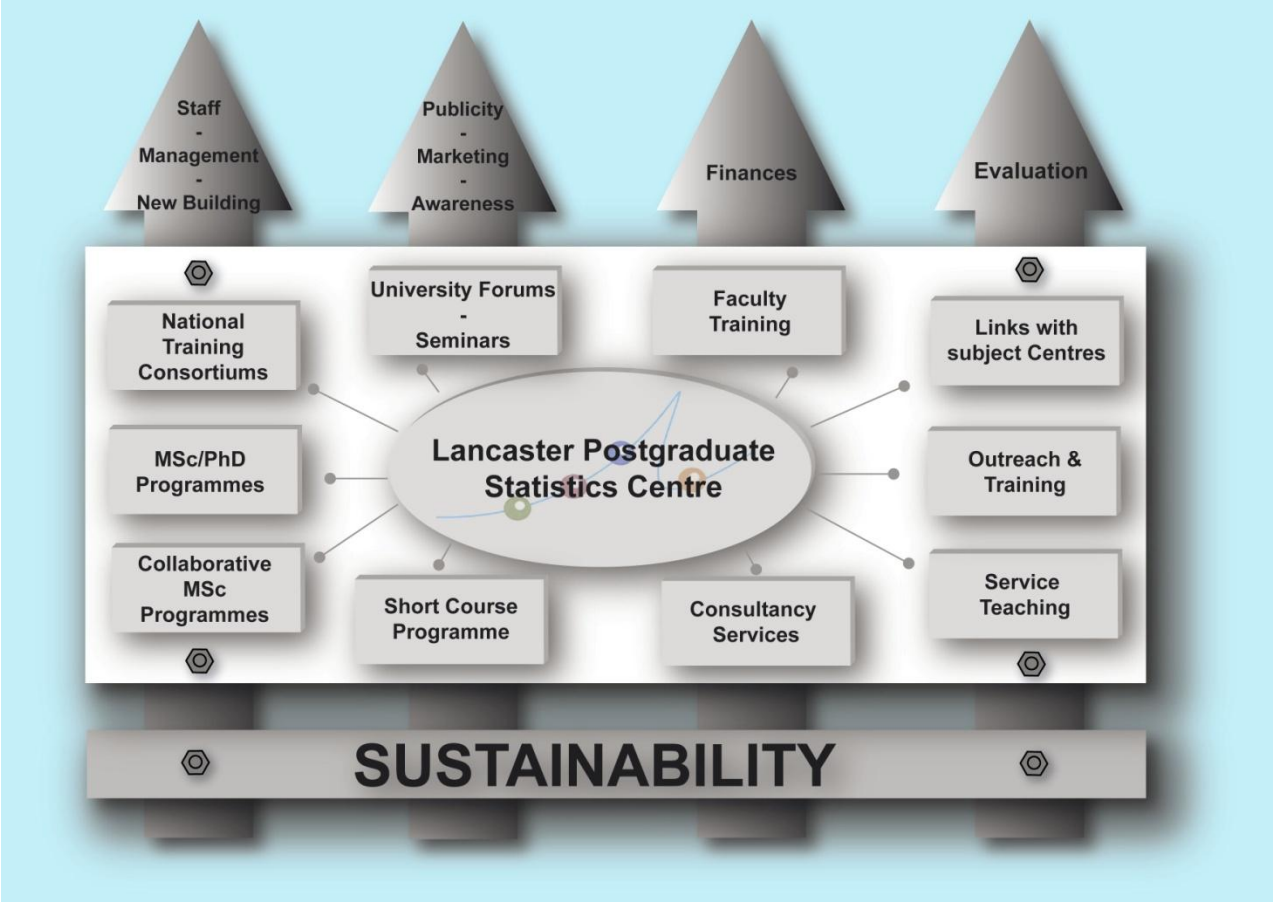
Strategic co-ordination and planning

At a strategic level, the PSC has been driven by the desire to create a co-ordinated and enterprising approach to teaching and learning that can be applied to any department within any institution. We take a research-led approach to teaching that emphasises cooperation and interaction with other disciplines. We have endeavoured to provide a road-map for progress that is accountable to teaching and learning within the discipline of statistics but that does not preclude others.

An overview of the structure and function of the PSC is given in Figure 1. The diagram shows how the key activities (the squares) are upheld by four underlying elements - staffing and management, awareness and publicity, finance and evaluation (the arrows) that give a supporting structure across all activities, and which together form our *modus operandi* and basis for sustainability. Whilst this is our specific roadmap it is clear that such a diagram presents a co-

ordinated approach useful for strategic development and planning in any institution - the squares can be filled in with other activities appropriate to the discipline and department.

Figure 1: Structure and function of the PSC



The PSC strategy for change can be conceptualised as being delivered through a hub with permeable boundaries, where agents for change are encouraged beyond the PSC to deliver a co-ordinated strategy for teaching and learning that brings the emphasis on sound pedagogy to the foreground. Creating a strategy for change has, from the outset, required participation of all stakeholders within the PSC – its academic staff, support staff, students and visitors. Theoretical grounding for this strategy has been based on the problem solving paradigm as well as the tacit knowledge that came with the inclusion and additional appointment of staff with demonstrable expertise in teaching statistics.

An important strand of the strategy for change has been to consider teaching and learning on a broader scale, looking at the impact the CETL can have beyond the department and into the institution and the community. To this end evaluation of service teaching has been a focus of the PSC as well as finding new strategies for reaching the non-statistics community. This has taken the form of new motivating introductory courses in statistics, as well as proposals for CPD for teachers in schools. These projects have great potential for future investment as they are long-term projects that form part of a wider government agenda for the STEM disciplines.

At an organisational level the CETL advisory boards have been agents for advice and accountability– where the PSC annual business plans have been presented and discussed in order to ensure success. The CETL management committee has been instrumental in overseeing progress, rooting with management, staff and students alike. Departmental committees and smaller groups at a praxis level (eg. Postgraduate Teaching Committee, CETL team and staff-student committee) help to keep change in line with department and PSC strategy and ensure the continual target of changed pedagogical practice is achieved through the various teaching and learning activities. In addition, the work of the PSC has benefited from continual consultancy with educationalists from the Centre for Study in Education and Training (CSET) in order to embed pedagogic developments successfully and usefully for all involved. This collaboration has invariably influenced the evaluation work done within the centre and led to a strong strand of research on the interaction of learners with physical space as well as the development of identity through space and collaboration within it.

Question 11: How will the work and achievements of your CETL continue after HEFCE funding ends?

Embedding change within the wider community

About ten years ago the Government commissioned a review called 'SET for Success', led by Sir Gareth Roberts, which was published in April 2002. The review highlighted the shortage in students taking numerical subjects. In addition postgraduate education did not lead to the development of the transferrable skills required by employers and yet this level of education was fundamental to the development of the highest level of skills. These finding were being reiterated elsewhere. In the EPSRC International Review of Mathematics in the UK, published in 2004, it was stated that "MSc programs in Statistics are of major benefit for both industrial and university sectors in the UK, but are perennially under threat. They should enjoy greater security and support." A recent review of the state of statistics in UK universities by Smith and Staetsky (2007) re-emphasised the shortage of statistical staff and the alarming decline in statistics as a taught subject in the UK. Our successful CETL bid wanted to begin to address these problems. We emphasised the belief that research quality and research-led teaching is crucial in teaching postgraduate statistics specialists. We have found that our approach to producing well-trained Masters students provides a rich source of doctoral students. This in turn produces highly trained researcher statisticians and begins to address the current shortage of young statisticians in the public and private sectors. Eight out of 19 (42%) of our MSc in Statistics students stayed on to study for a PhD in 2009/10 and the majority of our statisticians entering the job market found immediate employment working in academia, the pharmaceutical industry, government or industry. The destinations of most of our MSc students are listed on the PSC website. The professional development of our statisticians into highly-trained individuals with good transferable skills has impressed some employers to the point that they have contacted the course director to ask for more new recruits.

The shortage of young statisticians is a major national problem which is compounded by the general lack of understanding of what statisticians do – seen in maths students as well as those from other disciplines, why statistical methods are important in high quality research and the decline in appreciation of the importance and relevance of statistical literacy skills in schools. Whilst there will always be a finite but relatively small population of undergraduate maths and statistics students wishing to study statistics at a higher degree level, our holistic model includes training in statistics for students and staff from other disciplines, and therefore widens enormously the potential for statistics training within the national research community. We have shown that within the right environment researchers can flourish and follow a complete pathway of training, through the provision of 'hands-on' training workshops and a wide range of short courses covering introductory to advanced techniques, but it needs investment and resources to sustain this level of high quality provision. We are very proud of the achievements of all our PG students, but in particular those who join us from non-maths and statistics backgrounds, from disciplines as diverse as linguistics, medicine, computing and biology, who reach a level of competency to MSc or PhD in applied statistical methods are to be highly commended. Both our statistics specialists and those from other disciplines are well-rounded students, who may well become the inter-disciplinary research leaders of the future.

Embedding change within the university

The PSC has brought exceptional benefits to the university in ensuring that substantial investment goes directly into innovative teaching and learning within statistical education so that both current and future users of statistics, supported by excellent, motivated teachers, can look forward to an inspiring, challenging and worthwhile learning experience. Our ethos has been one of scholarship, experimentation and innovation, participation and partnership, inclusivity and community. We have taken a part-embedded and part-transmuted approach to our work and have been given a great deal of autonomy by the institution. We have taken a light-touch approach to procedures whilst ensuring a degree of alignment with institutional goals and tolerated open-endedness in project plans. The cross-fertilisation of our ideas within the institution is at an early stage within university governance but we hope that it will bear fruit in the longer term. At a meeting in September 2009 with the Deputy VC several immediate impacts of the PSC upon the university were discussed and identified. These are listed in Table 1.

Table 1: Strategic impact of the PSC across the university

1. Dissemination of PSC work both nationally and internationally has increased the university's reputation
2. The PSC has taken a holistic and integrated approach to conceptualising and integrating PG Teaching and Learning within the university
3. The reputation of the university has been enhanced with the award of a HEFCE grant to develop a quality PG teaching and research training centre
4. The PSC has provided added value to the recruitment of PG taught and research students which is central to the university's strategic plan
5. The PSC has enhanced the PG portfolio of the university by introducing new courses and restructuring existing courses in line with current demand
6. Through its constant reflection and innovation the PSC has been responsible for encouraging changes in Teaching and Learning practices

As a result of our experience we have started a PSC occasional discussion paper series to encourage colleagues to think outside the box and write about issues that might provoke debate and discussion within the university. The director wrote the first paper on the future of PG Education to stimulate discussion on an agenda for change, advocating a strategy for a co-ordinated and enterprising approach to Teaching and Learning, which has been described in Questions 9 and 10. She recently presented the work of the PSC along with this strategy to the University Learning, Teaching and Assessment Committee, which was well-received.

Our second discussion paper written by the CETL RA/Facilitator expounds the value of social learning space for learners, through the evaluation of our own new state of the art building (described on pages 3 and 4). It describes a new quantitative method for researching space which is reflective and innovative in its approach. The paper emphasises the role that our physical space has to play on the student learning experience, as well as the importance of accounting for space usage in an increasingly financial and resource-conscious sector. We are encouraged to view learning as a process which can take place anywhere on the campus, and as such presents a study of the PSC as an example of space where students and staff refigure their relationships, develop their identities within the discipline and engage in types of learning that are enhanced by the availability of an open, flexible and supportive environment. The work has been presented at various national conferences and invited seminars, as well as presented to the university as a method for future space evaluation. A proposal has also been submitted to the university to develop the research methodology with application to a purpose-built new learning zone at Lancaster. A third discussion paper is planned on the use of technology in teaching and learning. We would like to see the adoption of our discussion paper series university-wide to begin a forum for exchange of ideas for change with facilities on the web for related discussion.

Embedding change within the Department and Faculty

The PSC has been a great asset to the department and faculty, both in raising the profile of our expertise in PG statistics education and also our international research reputation. The new building will continue to house our PG training courses and to be a base for our masters students and a place for informal interaction between PhD students and staff. There has been a shift in pedagogical practice within the department through the influence of well-motivated teaching staff, with a systematic use of web-materials and technology, student initiated technology and peer-directed learning. For example, in applying lessons learned a computer lab in Fylde College is now being refurbished to integrate technology into lecturing and computer lab teaching. In addition, the extensive experience gained by the director in managing, reshaping and establishing the PSC and by the CETL team as a whole in securing and consolidating our reputation through their dedicated hard work and professionalism can only benefit future initiatives in which they become involved. Negotiations are currently taking place with respect to the continuation of the PSC over the next year to complete outstanding work but as yet its future is uncertain. To ensure this legacy is not lost, within the department the PSC director will remain Head of Postgraduate Teaching and Chair of the PG Teaching Committee and therefore will sit on the Department's Policy and Resources Committee. In this capacity she will continue to influence and have an active role in developing postgraduate strategy and policy, including recruitment, marketing and publicity, as well as overseeing new developments to retain our position in the market place. Within the Faculty of Science and Technology, the director sits on the Faculty Postgraduate Studies Committee and is also a member of the Faculty SciTech Vision Steering Group; a group which actively promotes excellence in teaching and learning for all science and technology students at Lancaster. Working with academic staff, students and external stakeholders they explore new and creative ways to improve student engagement and share best practice across disciplines. The experience gained through the work of the PSC has already stimulated the interest of the group with respect to learning space and the student employability agendas.

Question 12: Do you think there are any emerging aspects of your CETL activity that will have greater importance in the future?

In the current climate there is a wealth of opportunity for academics to promote PG education and to seek out new markets for recruitment. Motivating academic staff to take risks and experiment remains the greatest challenge, yet presents major potential benefits. By working together and taking small steps one at a time, enterprise is created. Co-ordination and the recognition of peoples' different strengths and contributions are key factors in achieving success. The PG Statistics Centre provides a good working model. We have taken risks, pioneered new innovative learning approaches, piloted the use of technology and started to influence pedagogical practice in teaching and learning. This was the hope for the CETLs in the original HEFCE remit. Our legacy for implemented and sustained change has been through curriculum and programme development and inquiry-based learning, taking a general co-ordinated and integrated approach. In addition, the emphasis on enhancing the total student experience, including their employability and the informal and social networking of staff and students, provides a unique preview for PGs of life in the workplace. We have a wider national and international profile and we think that it is crucial to maintain the PSC in this arena if Lancaster is to retain its impact.

At Lancaster there are currently no confirmed plans to continue the work of the PSC post 2010, although it is now integrated into the department and its legacy will remain. We are resource dependent and five years is not a long time in which to instigate and embed change within large organizations - but it does show that it is possible. Seeds have been sown and do have the potential to grow cultural change, which includes the potential research/teaching nexus extending to professional services such as human resources through personal development review and estates management in the design of learning space. Strong championing from senior managers and cross-fertilisation at an early stage with university governance have benefitted some CETLs in becoming quickly embedded into institutional strategy, however our structural autonomy and relative freedom from bureaucratic processes has been the key to our success and that of many other CETLs.

In moving forward from being the universities of today to becoming the universities of tomorrow, we would like to see the teaching and learning agenda reflect more closely that of the Research Excellence Framework in terms of emphasizing academic achievement through publications, outreach and enterprise. For this to happen a new funding source would be needed similar to the existing research councils to which individuals or groups of individuals can apply for small, medium and large teaching and learning grants. This would not only enable the work of the CETLs to continue, as the 'experts' in the relevant fields, but also open up the opportunity for other institutions to take part. This in turn would generate new interest from academics and make teaching and learning a strategic priority, whilst preserving a good level of autonomy. It is hoped that this debate will continue and have greater importance in the future as HEFCE reviews and seeks to synergize the lessons learned from the CETL initiative. Today the sector needs CETLs more than ever but their value needs to be embedded in HEFCE's teaching and learning strategy.

Question 13: Any other comments

The Postgraduate Statistics Centre at Lancaster University

A concluding commentary: perspectives on change in teaching and learning

by Professor Murray Saunders, Centre for Study in Education and Training (CSET)

The formative evaluation of the CETL programme (Saunders M et al., 2008) as a national strategy reveals an overall positive narrative for the development of the CETLs as 'nodes' of teaching and learning focused activities. The evaluation pointed to a range of positive effects. As the national evaluation report suggested, these effects tended to be circulating around the direct beneficiaries of CETL resources but there is growing evidence that effects are beginning to move out from the enclaves of practice within CETLs and, in some cases, are being used to strategic effect within institutions. In the case of the Postgraduate Statistics Centre (PSC) at Lancaster University, the strategy of embedding the CETL within current practices, building on the existing array of courses and learning activities, has helped to maximise its effects.

A stand–out feature of the work of the PSC has been the inquiry led approaches to statistics which has a particular bearing and relevance to the interdisciplinary and cross disciplinary focus of the Lancaster University mission. These approaches have reconstructed the use of statistics within applications in the social and management sciences (Psychology, Sociology and Criminology for example) as well as in the Health Sciences. This approach has the benefit of embedding statistical capability within the research and inquiry preoccupations of the students rather than as an add-on or decontextualised experience which has tended to diminish both the propensity of students to use statistics effectively and the 'fear' factor many researchers have of quantitative analysis if they have not had a numeracy background.

The distinctive approach has launched collaborations both nationally and internationally through the ESRC, Royal Statistical Society and the HEA. The visiting Fellow scheme has attracted participants from Europe (Utrecht) and from Brazil and Sri Lanka. As well as the support offered to general research uses of statistical methods, the PSC has developed leading edge opportunities for exploration through its Master Class programme with regular visiting experts. The PSC has also been able to innovate in the more general area of research into Teaching and Learning within Higher Education through its evaluation of the way the learning spaces associated with the PSC building (which was funded through the CETL programme) stimulate learning. This two storey building was the focus for innovative research into the way in which learning spaces might be used, particularly in the informal learning dimension.

The work undertaken within the PSC has already had an effect on teaching practice and the student experience. While some effects can be hard to monitor in a systematic way, they can also be pervasive, subtle and occur over a long period. Immediate effects on individuals can translate into wider effects over time as individuals move into different positions or gain coordinating roles where their experience can act directly as a resource for innovation. Effects can also be discerned at disciplinary and interdisciplinary levels where transformative processes concerning the student experience are beginning to filter through.

From the perspective of an external evaluator, it is possible to discern that practitioners and the PSC core staff (through reward) have experimented in an innovative way with aspects of teaching and learning such as course content, learning process and assessment within statistics. This has enriched and extended the expertise of teachers (particularly with new statistics lecturers) within the postgraduate programmes and has provided inquiry led statistics teaching into other programmes across the University. The longer term influence and potential of this enrichment is difficult to estimate but the PSC may be important in developing a cadre of 'extended' teaching and learning practitioners within statistics which is designated as a strategically important yet 'vulnerable' subject. The approach being developed within PSC of a wide range of specific and general foci for statistics within disciplines constitutes an interesting and important strategic direction.

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Appendices

Appendix 1 Summary of relationship between long, medium and short term aims

Appendix 2a MSc and PhD registrations

Appendix 2b MSc courses feedback

Appendix 3a Short course numbers

Appendix 3b Short course feedback

Appendix 4a Service course numbers

Appendix 4b Service course feedback

Appendix 5a Masterclasses and workshops

Appendix 5b Masterclass and workshop feedback

Appendix 6 Conferences and events

Appendix 7 Teaching and learning projects

Appendix 8 CETL Teaching and learning seminar series

Appendix 9 Peer reviewed publications and conference papers

Appendix 1 Summary of relationship between long, medium and short term aims

Long-term Core Aims	Medium-term: 10 Strategic Objectives	Short-term: Achievements to Date
To become a regional, national and international centre of excellence in the PG training and development of statisticians	To extend and enhance existing opportunities for statistics postgraduate students	MSc in Statistics with pathways in Medical, Pharmaceutical, Environmental Statistics; MRes in Applied Social Statistics; MSc in Applied Social Statistics pathways in Crime and Forensic Statistics, Health Research, Teaching Statistics up to pre-university level; opportunities for external Masters projects (eg. John Hopkins, Baltimore; Astrazeneca); 10 new short courses; CETL prize for excellence in learning; marketing and publicity
	To develop collaborations with other institutions to provide specialist statistical training in a range of disciplines	ESRC NCRM, ESRC RTC, NATCOR, APTS, MAGIC training consortiums; new DTC grant; RSS Centre for Statistical Education – Teaching Statistics distance learning course for teachers of maths (mini project); CETL-MSOR conference; RSS Professional Development Centre collaboration
To motivate, encourage and provide quantitative inquiry-led training for students from other disciplines eg. natural, social and management sciences	To expand and develop our innovative style of inquiry-led statistics teaching into other disciplines	MSc in Quantitative Finance; Faculty ResearchTraining programmes for PhD students; New/expanded MSc modules for service courses in Management Science, Psychology, Biology and Environmental Science; restructuring and expansion of consultancy service
	To develop innovative biomedical statistics courses within the new medical education provision at Lancaster.	Consultancy and introductory short course for Manchester medical students; MSc in Environment and Health – ongoing discussions following the creation of a new School of Health and Medicine
To give Lancaster trained PG students in all disciplines enhanced quantitative skills which will influence their whole approach to research	To instigate a master class programme with visiting quantitative experts providing specialist training activity in emerging substantive areas	Masterclasses and workshops run in collaboration with leading experts in the field in a wide range of subjects from introductory to advanced levels; hands-on practicals; collaboration with NCRM node to run some jointly
	To develop a visiting fellow scheme	Visiting lecturers from Brazil, Iran, Greece, Sri Lanka; senior visiting fellows from Health and Safety Executive, Utrecht University and RSS CSE
To develop critical thinking in the use of statistics at a level appropriate for each group of students	To provide a motivational PG training workshops in a range of disciplines.	Forensic Science Programme; RSS/EPSRC Graduate Training: Event History Analysis, Introduction to Wavelet Analysis; Statistical Genomics; Geospatial software; subject-specific and pedagogical conferences and events
	To expand the use of web-based teaching, video material and on-line datasets	Moodle VLE; new short course booking system; on-line e-learning courses; PRS, Podcasting facilities; DVD library; Miniprojects: Self-learning materials for UG/PG; Online screen capture; video-captured consultancy case study;
To reward existing excellence in PG teaching	To develop teaching excellence in our new statistics lecturers.	Mentoring of new staff; Peer review of lectures; Annual module review process; Funding for CPD; Lancaster/MSOR Teaching Certificates; Funds for training eg. consultancy skills, pedagogical research; IT/web support; website creation
	To further enhance teaching excellence of all staff	Facilities of new building including teaching and social learning space; CETL Awareness Symposium; CETL Innovation meetings; funding for conferences, training courses; CETL workload allocation points; CETL CPD in appraisals; IT/web support; mini projects funding scheme; sponsorship for conference session on statistical education

Appendix 2a MSc and PhD registrations

Masters/PhD Programmes	Student Numbers								
	2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10
*MSc in Statistics								New pathways	
Medical Statistics	4	9	18	8	12	4	5	8	7
Pharmaceutical Statistics	-	-	-	-	-	-	-	2	6
Environmental Statistics	-	-	-	-	1	0	1	8	6
Statistics	-	-	-	-	6	7	6	-	-
PgDip Statistics	-	-	-	-	1	0	0	1	1
PhD	5	6	11	9	6	4	6	8	12
**MSc/MRes in Applied Social Statistics		MSc begins				MRes begins			
MSc	-	3	2	3	3	4	2	6	2
MRes/PhD	-	-	-	-	-	1	2	4	4
Masters Programmes TOTAL (excluding PhD)	**4**	**12**	**20**	**11**	**23**	**16**	**16**	**29**	**26**

** Before the 2005/6 academic year, there was only the option of an MSc Medical Statistics and from 2005-2008 3 separate MSc courses in statistics (medical, environmental, statistics) ran.*

***New pathways begin 2010/11*

Appendix 2b MSc courses feedback

Topic	*MSc Applied Social Statistics (cohort from 2008-2009)	*MSc Statistics (cohort from 2009-2010)
General comments on the year as a whole	"The course has given a really good overview and the modules have made me start to pick the things that I think are going to be really useful in the future" "I think this is probably the hardest thing that I've ever done but I absolutely love it, which is really unusual because normally if something is so hard and so frustrating it does start to grind you down...I think that's a really massive thing, to actually want to come in and enjoy walking through those doors. I don't walk through with a sense of dread even though I know that it's going to be really challenging when I come. I think that says a lot about the department "I've really, really enjoyed it and it's given me loads of tools that I never thought I would have so quickly and easily" "I feel like I've learnt so much compared to what I learned at my undergrad in a much, much shorter space of time." "I know we talk about things we don't like but by and large 95% of the time here has been fantastic." "I like the fact that I'm getting paid to learn something really interesting and really useful. I think that's incredible." "This Masters has provided an invaluable grounding in a range of methodologies that I can apply in my research. Coming from a non-mathematical background, I was given support throughout the programme from a number of friendly and helpful staff members." "Whilst I arrived from a non-mathematical background I have found that the courses and support provided by the department were both accessible and substantial"	"The lectures are really good, the group atmosphere is great." "Although there's times when you were almost ready to leave the course because the workload was too crazy, now it's done and you've made it through it feels quite good to have done it, quite a nice achievement as well." "It has been hard work but it feels worth it and it's why you come here." "You do come here and the course is well structured and there are a lot of interesting modules that you wouldn't have even have thought of and you do think that a lot of thought has been put into creating it."

Careers and Employability	"I think it's a fantastic opportunity to learn these skills which I'm learning at the moment and hopefully they'll be in demand in the jobs market when I finish." "I do feel equipped now to go into a job. I thought I did after my 3 years bachelors but now looking back who knows how I would have coped because I think this year has put everything together, put it into context, actually showed you how to use statistics rather than just learn it."	"I couldn't even write a report but now we're doing that as a standard thing so it's just simple things that you use in a job as a statistician that we now know that we didn't know before. That's very strong for this course." "The careers sessions were really useful." "I think the projects are a good thing because that's probably how you'd been using the stats in a job."
Staff	"The staff clearly understand what they're talking about but they also have the ability to rephrase anything that we don't understand...and also just seem genuinely interested in what they're doing! So yeah they're great." "I like the close proximity (of staff offices and student areas). I think you'd feel less of a department if you were just shoved somewhere else."	"Staff put themselves out, step out of their job specification and try and help us because they want to help us rather than because they're our teacher." "Having staff and students in the same area just makes them (staff) more approachable for when you need them. You can just go and sit with the head of department!" "At Undergrad there's still a definite divide then just all of a sudden you're having cups of coffee…….I think that's really nice" "Lots of the lecturers make a lot of time outside of the modules and it's not a problem and it's not *"oh I'll try and fit you in*", it's just assumed that you will go...you know there's no problem with that. I really like that."
Understanding	"At the beginning I was really worried when I didn't understand. I could sit a day and not understand anything and it was very frustrating but now my understanding of statistics is getting better all the time" "I think it's more improved my ability to help other people and tell them what they need to do with data basically... and I definitely think it has improved my research skills."	"I would (recommend this course) because although it's been hard work I feel that I actually understand statistics now. Before if I'd gone into a stats job last year I would have been lying my way through the job and that's the honest truth. This year, although it's a lot of work, you feel confident in what you're doing."

Structure and delivery	"Always knowing that you're going to walk in and find a place is great. I think the way that the timetables are structured despite the fact they're long days is usually quite good." "(Where they are available) tutorials are really, really good!" "...as this course has gone on more and more we make an effort to talk to externals participants, just because they're actually really interesting, they're actually coming here to learn the same stuff we're learning...a lot of what we see, how it's used comes from the externals, if you decide to go and talk to them and stuff like that. Having externals on our courses has been quite interesting and useful"	"I have learnt so much from writing projects. It's put everything we learnt into perspective because you've actually applied the theory or whatever it is and it helps so much more than the lectures in some ways."
Facilities, space and resources	"It's really nice to have a base because in my previous department you just didn't have that at all, it was just a corridor. There was no social space for students or anything so I really like the building and I like coming here and having a base" "It's a very good place to work; you won't be kicked out of a room." "I think it has quite an industrious atmosphere compared to a lot of places, like the library where people just sit around and gabble. It feels like people come to work which is nice, people don't come just to gather in a massive group in the corner. And it's light and it's clean and things generally work."	"We sit in the MSc area and it's brilliant" "The key fob access is a really good idea because I think I'm not the only one who's been here on a Saturday and a Sunday." "It's nice to have designated MSc space. Even just for somewhere to sit and have lunch. It's nice to actually see each other when we're not tearing our hair out." "I think these are the best kind of facilities that we've got. (Computers) anywhere else are slower or older versions and the space is nice as well. We're right near the lecturers if we've got to go and ask them questions and you're not disturbed by other people." "it's nice to sit up in the Master's space and have a change of scenery when you've done your work"
<u>Comments by External Examiners:</u>	***"MSc/MRes in Applied Social Statistics continues to be one of the leading programmes in this important area"*** ***"I was impressed by the apparent high standard of teaching. This is clearly a very good course with a high quality of teaching."***	***"This is an impressive MSc programme, run by an impressive team. It achieves the difficult goal of stretching the best students … while providing appropriate support for weaker students, across a very broad range of topics and skills."***

*A detailed focus group evaluation of the MSc in Applied Social Statistics was conducted on the 2008/09 cohort, and evaluation of the MSc Statistics was conducted on the 2009/10 cohort.

Appendix 3a Short course numbers

Course Title	*Number of Registrations						
	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10
Mathematics for Statistics	10	8	4	3	5	12	6
Statistical Methods	12	12	5	9	5	12	6
Statistical Inference	11	10	6	6	5	12	6
R	9	8	6	12	11	25	40
SPSS for Windows I	21	31	18	24	16	17	19
Generalised Linear Models	10	11	12	5	7	16	16
Methodological Debates in Social Science	6	6	6	4	4	11	14
Secondary Data Analysis	6	13	5	10	10	17	21
Atlas.ti	21	28	25	25	18	29	36
Questionnaire Design	16	13	12	11	7	14	13
Sampling Design	3	11	4	9	7	14	12
Duration Analysis	10	9	5	10	7	16	8
Event History Analysis	9	10	9	11	6	7	-
STATA	10	15	11	13	8	29	20
Structural Equation Modelling	13	13	14	41	26	23	40
Bayesian Methods	11	14	8	10	10	22	16
Multi-Level Models	15	13	10	5	14	15	17
Applied Social Science Research	5	7	6	4	5	11	6
Methods for Missing Data	9	11	8	10	10	19	14
Data Mining Techniques	10	11	7	9	8	16	19
SPSS for Windows II	14	21	14	6	7	18	12
Longitudinal Data Analysis	-	-	-	28	18	16	22
Textual Analysis	-	-	-	-	2	4	4
Techniques of Social Research	-	-	-	-	2	4	4
Systematic Reviews	-	-	-	-	-	9	-
Pharmacological Modelling	-	-	-	-	-	9	24
Survival and Event History Analysis	-	-	-	-	-	25	23
Genomics	-	-	-	-	-	5	10
Adaptive and Bayesian Methods	-	-	-	-	-	17	17
Total	231	275	195	265	218	439	473

**Includes MSc/MRes in Applied Social Statistics students, MA in Sociology/Applied Social Science students, PhD students, university staff and external participants*

Note: 3 new courses begin in 2010/11:Quantitative Criminology, Evaluating and Quantifying Forensic Evidence, Teaching Statistics up to pre-university level

Appendix 3b Short course feedback

WHAT WERE THE MOST VALUABLE PARTS OF THE COURSE?	WRITTEN COMMENTS
Course delivery and structure	"course notes were clear, detail and followed a logical sequence of complexity" "the lecturers making no assumptions about previous knowledge and pitching accordingly" "good, well structured, step-by-step notes are very important" "getting to practice observational research" "covered a lot of material at a good pace" "the module was well organised and gave me a fundamental knowledge."
Understanding	"practicing having to design, administer and discuss improvements for a questionnaire – it really helped me understand the difficulties in questionnaire design" "It seems like statistics is a very useful subject"
Relevance	"learning about the archives of data that are available" "I didn't know there was so much data out there and freely available! Useful too as now I know where to look for data sets for my PhD and how to get hold of them and all the information about them!" "using examples brought the subject to life"
Staff	"clearly the lecturers had thought about the best way to get information across to a mixed audience of mathematicians and non-mathematicians...for the first time in any course I never felt lost!" "the lecturer provided a very supportive atmosphere and was happy to provide additional help required" "the tutor's attempts to motivate the learning of particular theoretical points were very well thought out." "taking time to answer the most obtuse of questions in a non-patronizing manner – recognising that the subject may not be straightforward for some of us"
Interaction	"getting to have discussions with other students was valuable"

Appendix 4a Service course numbers

PG Module	Student Numbers					
	2004/5	**2005/6**	**2006/7**	**2007/8**	**2008/9**	**2009/10**
BIOL421	41	26	28	29	40	28
LING401	-	-	12	17	-	-
MGT525/OWT509	-	64	42	33	50	63
PSYCH401	25	32	45	26	29	45
PSYCH402	26	32	41	26	25	30
TOTALS	**92**	**154**	**168**	**131**	**144**	**103**

Appendix 4b Service course feedback

WHAT WERE THE MOST VALUABLE PARTS OF THE COURSE?	WRITTEN COMMENTS
Course structure and delivery	"hands-on practical activities" "the split between lecture and practical for one hour was very effective" "workshop sessions were helpful particularly as an opportunity to discuss aspects of the subject in more depth" "lab sessions gave the opportunity to put the theoretical lecture material into practice"
Understanding	"improved my overall understanding of statistics" "as a result of the understanding I've gained from the course I have a better understanding of scientific papers" "it was all related to applied examples, could really understand how/why certain tests were being used"
Relevance	"the knowledge that statistics can be helpful in qualitative research" "A strong reminder of the importance of the quantitative link as a qualitative practitioner, that cab bring about the necessary credibility that is needed; there are times when numbers speak very well"
Staff	"patience and understanding of the tutor" "being able to discuss things with helpers in the class" "it's useful that the lecturers' disciplines differ as their explanations also differ and ensure that everyone understands" (team-taught module) "Being taught by two different teachers" (team-taught module)

Electronic feedback	**2007/2008**	**2008/2009**	**2009/2010**
[*]**Question 1: How did you find the module as a whole?**	**Mean Score**	**Mean Score**	**Mean Score**
Postgraduate:			
BIOL421	2.30	3.86	4.33
MGT525	3.90	3.75	NYA
OWT509 (taught together with above)	4.13	3.61	NYA
PSYCH401	3.63	3.76	NYA
PSYCH402	3.13	3.86	3.52
Research Training Programme (RTP):			
[**]FST Stats 1	3.88	3.80	NYA
[**]FST Stats 2	-	3.85	NYA
[**]FST Stats 3	-	3.88	NYA
FASS508 (1/2 module)	2.88	4.07	4.25
FASS509 (1/2 module)	3.13	4.29	4.13
FASS512 (taught jointly with Soc Sci)	4.09	3.83	3.90

[*]Scores measured on a likert scale from 0 to 5 (poor to excellent)

[**]Used different evaluation form – scores estimated

NYA – not yet available

Appendix 5a Masterclasses and workshops

DATE/S	SPEAKER	TITLE	Masterclass (MC) or Workshop (W)
24/06/10 – 25/06/10	Barry Rowlingson, Jason Jorgenson, Jo Cook, Dr Carson Farmer	Open Source Geospatial Software (SPLINT CETL, Leicester)	W
22/06/10 – 24/06/10	Dr Dave Hessen	Introduction to Item Response Analysis using R	MC
25/05/10 – 26/05/10	Prof Joop Hox	Structural Equation Modeling using MPlus	MC
19/05/10	Prof John Whitehead	Design of Early Phase Clinical Trials	W
22/04/10	Prof Peter van der Heijden	Methods for Sensitive Questions	MC (Cancelled)
21/04/10	Prof Peter van der Heijden	Population Estimation for Difficult to Reach Populations	MC (Cancelled)
19/04/10 – 20/04/10	Prof Adrian Bowman Dr Matt Nunes	Advanced R	MC
23/03/10 – 25/03/10	Prof Michael Greenacre Dr Raul Primicerio	Multivariate Data Analysis for Environmental Biologists	MC
21/01/10 – 22/01/10	Barry Rowlingson, Prof Roger Bivand, Jason Jorgenson, Dr Carson Farmer, Jo Cook	Introduction to Open Source Geospatial Software	W
30/11/09 – 02/12/09	Dr Mikis Stasinopoulos Prof Paul Eilers Dr Robert Rigby	Introduction to Modern Smoothing Methods: GAMLSS and P-Splines in Action	MC
14/10/09	Iram Awan (organizer)	NATCEN/NCRM Workshop 'Survey Skills'	W
06/10/09	Gill Meadows (organizer)	ESDS Workshop 'Introduction to Government Survey Data'	W
24/09/09– 25/09/09	Dr David Lucy	Quantifying and Evaluating Forensic Evidence	MC
30/03/09 – 01/04/09	Dr James Carpenter	Handling Missing Data	MC

17/11/08 – 18/11/08	Barry Rowlingson, Dr Jason Jorgenson, Dr Virgilio Gomez-Rubio, Jo Cook	Open Source Geospatial Software	W
29/09/08 – 02/10/08	Prof Linda Collins Dr Stephanie Lanza Dr Bethany Cara Bray	Latent Class Analysis for Cross-Sectional and Longitudinal Data	MC
10/09/08	Prof Alan Agresti	Modelling Ordinal Categorical Data	MC
01/04/08	Prof Adrian Bowman Dr Richard Newton Barry Rowlingson	User Interfaces and Interactive Graphics in R	MC
25/06/07	Dr Juliet Harman Dr Damon Berridge	Dissertation Writing Day	W
22/06/07 – 23/06/07	Dr David Lucy	Forensic Evidence Evaluation (Cracow, Poland)	W
16/05/07	ESRC (organizer)	Survey Link Scheme	W
28/03/07 – 29/03/07	Centre for Longitudinal Studies (organizer)	Teaching students quantitative methods using resources from the British Birth Cohorts	W
02/03/07	Dr David Lucy	Statistical Human Identification (Dundee)	W
25/09/06 – 26/09/06	Prof Ernst Wit Prof Paul Fearnhead	Statistical Genomics Days in Memory of Nick Smith	W
17/09/06 – 22/09/06	Prof A. Walden Prof D. Percival	Introduction to Wavelet Analysis	W
17/09/06 – 22/09/06	Prof R. Henderson Dr O. Borgan	Event History Analysis	W
14/09/06	Dr David Lucy	Introductory Statistics for Anthropologists (Dundee)	W

Appendix 5b Masterclasses and workshops feedback

WHAT WERE THE MOST VALUABLE PARTS OF THE COURSE	WRITTEN COMMENTS
Course delivery and structure	"the lectures were well timed and not too rushed" "the provision of printed materials on USB drives was very generous and a must for other courses." "balance between lectures and practicals was excellent, as was the content" "well structured and data presented simply"
Understanding	"I am likely to go on and use the theory I learnt. Will use to understand statistical outputs from another software package" "the course was really useful for consolidating my knowledge" "the approach to teaching is intuitive, so even non-statisticians can fathom the jist" "I really enjoyed the practicals which helped put what we learnt during the lectures into perspective"
Relevance	"I am likely to go on and use all of it. This course is highly relevant to my work" "really good to put everything into context by discussing real-life projects" "the resources provided for further study afterwards seem likely to be very useful for applying learning directly in our own work"

Facilities	"Excellent computer room, very spacious with good facilities" "the statistics building at Lancaster is a lovely working environment. Excellent place to have a course" "good, prompt technical support was always on hand" "food was excellent and pre-course arrangements were excellent" "good venue, facilities, computers support, food and general ambience!"
Interaction	"sharing of real problems with other participants"

Appendix 6 Conferences and events

DATE/S	ORGANISERS	EVENTS HELD IN PSC	NUMBERS ATTENDING
01/07/10	Dr James Groves, Dr Gillian Lancaster	"Aiming higher in teaching maths and stats in schools" – planned event for teachers of maths Speakers to include: Dr Richard Lissaman (MEI), Dr John Marriott (RSSCSE)	tbc
29/03/10	Prof. Brian Francis	Modern Bayesian Methods. Special guest speaker: Prof Murray Aitkin (QUT, Australia),70th Birthday Anniversary Event.	40
08/06/09	Dr Gill Lancaster, Deborah Stewart, Dr Ruth Allen	CETL Away Day – Dissemination of teaching outputs Speakers: Dr Gill Lancaster, Prof Brian Francis, Dr Ruth Allen, Dr Amanda Turner, Dr Juhyun Park, Prof Jon Tawn, Anne Thorley, Dr Joe Whittaker	35
06/05/09	Dr Moira Peelo	Maths and Quantitative Skills Forum: "What does Maths Grade C GCSE mean?" Speaker: Dr Kirsti Ashworth (Lancaster)	16
23/03/09 – 26/03/09	Research students (Ben Taylor, Matt Sperrin, Rebecca Killick)	Research Students Conference - The 32nd Research Students' Conference in Probability and Statistics. Keynote speakers: Prof David Hand (RSS President, Imperial), Prof Peter Diggle (Lancaster)	140
23/09/08 – 24/09/08	Prof. Jon Tawn	Research Meeting, UK Statistical Extremes Speakers included: Prof Anthony Davison (Ecole Polytechnique Federale de Lausanne), Prof Jon Tawn (Lancaster)	25
15/09/08 – 19/09/08	Prof. Gordon Blower	Phenomena in High Dimensions, Conference. Keynote speakers: Prof Imre Leader (Cambridge), Prof Boguslaw Zegarlinski (Imperial) and Prof Francois Bolley (Paris X).	29
08/09/08 – 09/09/08	Dr Gillian Lancaster, Dr Bev Abram, Prof Brian Francis	MSOR-CETL Conference – "Shaping the Future of Maths & Stats in Higher Education". Keynote speakers: Prof Alan Agresti (Gainsville, Florida), Prof Adrian Bowman (Glasgow), Prof Markus Hohenwarter (Linz, Austria)	120
29/05/08	Prof Tony Pettitt and Dr Gareth Ridall	Seminar on 'Statistics in Neurology' for clinicians in Brisbane – delivered remotely via Access Grid	6
09/05/08	Dr Moira Peelo	Maths and Quantitative Skills Forum- "The Student Experience" Chair: Prof Amanda Chetwynd	12
29/04/08	Dr Catherine Fritz	Maths and Quantitative Skills Forum – "Teaching Statistics" Speaker: Dr Catherine Fritz	15
21/02/08	Sarah Wroe, Dr Gillian Lancaster, Dr Bev Abram, Lucy Smethurst	Opening Ceremony of Postgraduate Statistics Centre Special guest and keynote speaker: Prof. Sir David Cox (Oxford) Other speakers: Chancellor Sir Chris Bonington, VC Paul Wells, PSC Dr Gill Lancaster	107

14/01/08	Dr Gillian Lancaster and Dr Bev Abram	CETL Awareness Symposium. Speakers: Dr Gill Lancaster, Prof Brian Francis, Dr Bev Abram, Christian Cable, Lucy Smethurst, Dr Thomas Jaki, Prof Roger Penn, Dr Damon Berridge	34
28/03/07	Dr Moira Peelo	Maths and Quantitative Skills Forum – "CPD". Speakers: Dr Moira Peelo, Dr Rebecca Whitehead, Dr Bev Abram, Dr Liz Ackerley, Dr Andy Folkard, Dr Catherine Fritz	31

Appendix 7 Teaching and learning projects

Mini Projects 2008-2009				
Names(s)	**Title of project**	**Comment on outcome**	**Outputs***	**Funding**
Damon Berridge & Roger Penn	The development and dissemination of resources for the teaching of statistical consulting skills to postgraduate students.	Production of a set of multi-media presentations which can be used as support material in the teaching of statistical consultancy skills to postgraduate statistics students.	The multi-media presentations will be placed on the PSC web page. There will also be dissemination through a teaching seminar. This seminar will be videoed and placed on the PSC web page.	£4939
Andy Folkard, Ruth Allan, Gill Lancaster, Chris Sherlock, Bev Abram	Maximising the efficiency and effectiveness of statistics provision at Postgraduate level across Lancaster Environment Centre (LEC)	The project delivered recommendations on how to improve service teaching of statistics to non-mathematicians within LEC. Subsequently the course was rewritten.	Peer-reviewed paper submitted, Conference proceedings, presentations, T&L seminar	£3000
Thomas Jaki	Genomics – a bioinformatics course goes online.	An introductory course on statistical genetics has been developed and run successfully multiple times for both postgraduate students and external participants.	A journal article, seminar. Course went live in 2009. In addition HEIF4 funding has been secured for a continuation project.	£1800
Neville Davies & Gillian Lancaster	Development of a distance learning course *Certificate in Teaching Statistics up to Pre-university level*.	Distance-learning materials were created, peer-reviewed and the course was accredited by the RSS in late 2009. For teachers of maths in secondary schools.	Course launched at RSS CSE in academic year 2009/2010, and to be offered as a MSc pathway in 2010/11. Various conference presentations at teachers conferences.	£5000
Juhyun Park & Matt Sperrin	Development of self-learning materials for non-specialist postgraduates and maths undergraduates.	To design self-learning materials that accompany main lectures of an intro statistics course for 1st year UGs and non-specialist PGs. Can be used as stand alone materials for learning at the students' own pace. The materials will be tested within the department and feedback will inform the revision and development of the materials.	Journal article in preparation, conference proceedings and conference presentations. Also a teaching resources web link	£4850
Amanda Chetwynd & Hilary short	Problems past and present: teaching statistics through its history.	Funding is for research to write a new book on the use of the history of statistics in teaching. The aim of the book is to provide a series of problems in the history of statistics and to show how they were approached and finally solved.	Several chapters researched and written. Publisher being sought.	£4985

Mini Projects 2009-2010				
Names(s)	**Title of project**	**Comment on outcome**	**Outputs***	**Funding**
Ruth Allen, Debbie Costain, Gill Lancaster, Moira Peelo	Making employability relevant – engaging postgraduate students with ePDP	Project aims to embed employability competency skills amongst PG students of statistics, using tutorials and a trial of e-portfolio tool PebblePAD.	Evaluation of the project is underway. Initial project findings have been disseminated at a local level with plans to deliver nationally in autumn 2010.	£4988
Amanda Chetwynd/ Hilary Short	Problems past and present: teaching statistics through its history (2)	This is an ongoing project to write a book on the use of the history of statistics in teaching.	Chapters completed and final chapters being written 2009-2010. Book has been accepted for publication by OUP.	£4964
Thomas Jaki	A comparison of a hybrid course to a fully distance learning course	Enhancement of the previously designed Genomics course that combines distance learning elements with traditional in-class teaching and to set it up to allow for a fully distance option to be run.	Course modifications allow for participants to follow the material at a distance. To help independent learning, simplifications to the software requirements for the course have been made. Programme to be rolled out in Autumn 2010 as well as publication.	£4450
Gareth Ridall	Simulation based approaches for the teaching of statistics in introductory courses to non-mathematicians.	This grant will introduce and evaluate the introduction of non-parametric resampling techniques to statistics students from a non-mathematical background. We aim to evaluate the use of the bootstrap and permutation or randomization tests.	A website is planned where resources can be downloaded. A second desired outcome is to implement the approach in a service course for the Biology department.	£5000
John Towse, Andrea Towse, Dennis Hay	A flexible database for teaching and learning with statistical data sets in the psychological sciences.	The aim of the project is to design, develop and maintain a web-enabled repository and interface for storing and accessing postgraduate level-datasets relating to psychological research.	On completion, the project will lead to the establishment of an on-line system that contains MSc project data. This is ongoing.	£1584
Amanda Turner	Building confidence in computing through peer-directed learning	The project aims to demonstrate that peer-directed learning is an effective means of building confidence in computing skills, and that coupled with automated assessment it can provide an inexpensive way for institutions to teach students how to problem solve using mathematical and statistical software.	Journal paper and conference dissemination are planned for summer 2010 including CETL-MSOR annual conference. It is hoped that this research will encourage the increased uptake of peer-led learning within UG statistics teaching.	£5000
Joe Whittaker	Statistical foundations of partial least squares: a short course.	*Project on hold due to illness.*	*Project on hold due to illness.*	£5000

Other CETL teaching projects				
Name(s)	**Title of project**	**Comment on outcome**	**Outputs***	**Funding**
Svetlana Tishkovskaya and Gillian Lancaster	Communicating Statistics	There is a need for statistical literacy to be better promoted amongst non-statisticians. A literature review has been conducted and a new course on communicating statistics to non-statisticians is being planned.	Review of literature being prepared for publication. Compilation of examples of statistics in the media in order to build a framework for a new course, ongoing development.	CETL funded RA
Ruth Allen, Sadie Williams and Gillian Lancaster	Learning Space	Research on how a new purpose-built building affects student/staff identity and enhances the practice of teaching and learning that has received much attention/interest.	Publication being prepared on new methodology; presentations to Faculty, SRHE and CETL conferences.	CETL funded RA
Andrew Titman, Gill Lancaster	Using Personal Response Systems for postgraduate teaching of small groups	The use of PRS questions as a knowledge check has been successfully incorporated into the Principles of Epidemiology MSc module for the past 2 years, following the purchase of a new PRS system. Questions have been modified, deleted and new ones added after testing as appropriate.	Publication submitted and paper to be presented at the ICOTS international conference in Ljubljana, July 2010. SOLSTICE presentation, CETL conference poster.	CETL funded RA
Lucy Smethurst, Ernst Wit, Gill Lancaster	Developing questions for teaching and learning using Personal Response Systems and Computer Based Tests	Development of (i) the first set of PRS questions and revision of teaching materials for the course Principles of Epidemiology 2007. Problems with old PRS software hampered delivery, (ii) a set of questions using Question Mark Perception for a computer based test used in the same module.	This project became incorporated into the above project when two staff members subsequently left.	£10000
Gillian Lancaster, Brian Francis, Gareth Ridall, Damon Berridge	Training PhD students in statistical consultancy	This is a project to train PhD students in consultancy skills comparing three approaches: direct observation, 'see one, do one' approach, and hands on collaborative problem solving	Paper and poster to be presented by PhD students at the ICOTS international conference in Ljubljana, July 2010.	£3000
Debbie Costain	Using computer based tests to monitor student learning	The project aims to consolidate course material in the intensive MSc modules: students answer a few questions regarding the key ideas of that days lectures/ labs.	Whilst planning is underway, implementation and evaluation of this project is for 2010/2011.	£1000
Brian Francis, Valmira Hoti & Gill Lancaster	Creating an archive of datasets for teaching and learning statistics	Whilst other data archives are available for statistical data, there is currently no comprehensive archive specifically for teaching.	The newly built dataset archive will be available as an open-access resource and self-depository.	CETL/ NCRM funded RA
Damon Berridge & Rob Crouchley	E-learning materials for SABRE: Further development of R and Stata plug-ins for SABRE	To make Sabre 7.0 accessible to the widest possible audience, it needs to be operationalised both within R and within Stata. **T**o do this, two existing plug-ins need to be developed further using specialist expertise	Sabre 7.0 will be accessible as a resource for all users - extending the capabilities of Sabre to fit bivariate/trivariate models to ordinal data.	£1000

*Publication details available in Appendix 9.

Appendix 8 CETL Teaching and Learning Seminar Series

DATE/S	SPEAKER	TITLE	THEME
tbc July 2010	Dr Damon Berridge Prof Roger Penn	The Development and Dissemination of Resources for the Teaching of Statistical Consulting Skills to Postgraduate Students	M
tbc June 2010	Dr Les Humphreys	Developing numeracy in criminology students through crime data	TL
8th June 2010	Prof Steven Young	Managing MSc dissertations: Challenges and opportunities with large groups	TL
13th April 2010	Dr Thomas Jaki	Using Technology in Teaching Statistics	M, T
9th February 2010	Prof Karen Evans	Putting Knowledge to Work: A New Approach	N
12th January 2010	Barry Rowlingson	Information Systems for Academic and Research Support	T
24th November 2009	Dr Carl Scarrott	Interactive Activities for Large Service Courses	N, SC
3rd November 2009	Dr Norman Powell	Exploring the Relationship Between Personalised Learning and Enquiry-Based Learning in Enhancing the Student Learning Experience	N
27th October 2009	Dr Ruth Allen	Enhancing the Student Experience in a Postgraduate Environment: Two Mini Projects	M, SC
9th June 2009	Dr Andrew Titman	Introduction to Personal Response Systems	T
19th May 2009	Dr Jamie Wood	From Delicious to Diigo: Using Social Bookmarking to Support Inquiry-Based Learning	T
28th April 2009	Prof Sue Smith	Embedding Enterprise in the University Curriculum	N
17th February 2009	Christian Cable	How to Build a Website in 60 Minutes!	T
3rd February 2009	Dr Margaret MacDougall	Statistics in Medicine: A Risky Business?	P
15th Dec 2008	Dr Philip Sedgwick	Teaching Statistics Through Problem-Solving in an Integrated Curriculum	P
25th June 2008	Dr Jenny Freeman	Innovations in Curriculum Design: Involving Subject Specialists when Teaching Statistics to Non-Statisticians	P
22nd May 2008	Dr John Marriott	A Problem Solving Approach to Teaching Statistics	P
7th May 2008	Dr Gill Vince	Problem-Based Learning in Medical Education	P
13th March 2008	Dr Damon Berridge Prof Roger Penn	Developing e-Learning Resources in Applied Social Statistics	T

DATE/S	SPEAKER	TITLE	THEME
24th September 2007	Lucy Smethurst	A Practical Demonstration of Computer-based Assessment for MSc Modules in Statistical Science	T
28th June 2007	Georgia Georgiou Tim Ellis	An Introduction to Computer-based Assessment	T
29th May 2007	Georgia Georgiou Tim Ellis	Innovative Ideas Using Mobile Learning Technologies	T
9th March 2007	Prof Judith V. Grabiner	Why Should Historical Truth Matter to Mathematicians?	S
4th December 2006	Dr Andrew Folkard	How to Succeed at Teaching Maths and Statistics to Mathophobic Students – An Ongoing Search	SC
20th November 2006	Dr Rebecca Whitehead	The Student Maths Skills Project : Preliminary Findings	SC
6th November 2006	Kjeld Larson	Can Classroom Mathematics be more like Research Mathematics?	SC
5th June 2006	Prof Mark Stoner	Engaging Students: They work more, you work less!	N
11th May 2006	Barry Rowlingson	Subversion with latex (and other files)	T
1st March 2006	Dr Mary Kynn	Creating Illustrations, Screen Captures and Animations in 10 Mouse Clicks or Less	T
25th January 2006	Tim Ellis Georgia Georgiou	Effective Postgraduate Learning using the LUVLE (Lancaster University Virtual Learning Environment)	T

S – Special Lectures
P – Problem-Based Learning
T -- Use of Technology in Teaching Statistics
SC -- Statistics Service Course Innovation
N -- Novel Strategies for Statistics Teaching
TL -- Strategies for Teaching and Learning
M – Teaching Mini-Project

Appendix 9 Peer-reviewed publications, conference papers and other outputs

PSC journal publications – Teaching and Learning

Abrams B. and Francis B.F. (2007) Introducing the Lancaster Postgraduate Statistics Centre – a Centre of Excellence in Teaching and Learning (CETL). *MSOR Connections*, 7(2), 11-15.

Allen, R., Folkard, A., Lancaster, G. A., Sherlock, C. and Abram, B. (2010) Statistics for the biological and environmental sciences: improving service teaching for postgraduates, *Journal of Statistical Education*, Addressed referees comments.

Allen, R., Williams, S. and Lancaster, G. (2010) Evaluating social learning space in the university: a new method for measuring impact on learning and teaching, *Studies in Higher Education*, In Preparation.

Jaki T. (2009). Recording lectures as a service in a service course. *Journal of Statistics Education, 17(3), 1-13.*

Jaki T. and Autin M. (2009). Using a problem-based approach to teach statistics to postgraduate science students: a case study. *MSOR Connections*, 9(2), 40-47.

Lancaster G.A. (2010) How statistical literacy, official statistics and self-directed learning shaped social enquiry in the 19th century. *Statistical Journal of the International Association for Official Statistics.* In press.

Lancaster G.A., Francis B. and Allen R.A. (2009). Lancaster postgraduate statistics centre: creating enterprise and innovation in teaching statistics across disciplines. *MSOR Connections*, 9(1), 41-46.

Peelo, M. and Francis, B. (2009) Tackling mixed messages: embedding advanced numeracy in graduate identities. *MSOR connections*, 9(4), 23-27.

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Allen R. *Statistics for the biological and environmental sciences: improving service teaching for postgraduates.* International Conference on Teaching Statistics (ICOTS), Ljubljana, Slovenia, 11-16 July 2010.

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