

The Lancaster Mathematics and Statistics PhD Programme

Academic year 2011/12



DEPARTMENT OF MATHEMATICS AND STATISTICS

www.maths.lancs.ac.uk

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Introduction to the University and the Department

Lancaster University is a campus-style university, established in the early 1960's on a partly wooded, landscaped site at Bailrigg, about three miles south of Lancaster city centre. The campus includes laboratories and offices, student residences, shops, banks, bars, and indoor and outdoor sports facilities on a single site. Lancaster itself is a small city, with a rich history going back to Roman times. Relative to its size (population approximately 50,000) it has a good shopping centre and very lively entertainment. The surrounding countryside varies between pleasant and superb, including the National Parks of the Yorkshire Dales to the east and the Lake District to the north. The much larger cities of Manchester and Liverpool are about 50 miles to the south.

The Department of Mathematics and Statistics is based in Fylde College, and boasts one of the UK's leading research groups in statistics, and a vibrant pure mathematics research group that specialises in Analysis and Algebra.

Research in Statistics

Lancaster has an internationally recognised reputation for research in areas including Applied Probability, Bayesian and Computational Statistics, Medical and Pharmaceutical Statistics, Social Statistics, Time Series and Extremes. In terms of both numbers of PhDs awarded and research income in the RAE2008 review period LU was ranked the 3rd amongst single institutions in UK.

Almost all of our research involves the development of new statistical methodology, but is motivated by applied problems arising in the natural, social and biomedical sciences. This position at the interface between theory and application gives Lancaster's statistical research a distinctive flavour and involves frequent and close collaboration with colleagues in other university departments and in local research institutes and hospitals. We currently have particularly close links with Biological Sciences, Environmental Science and The Management School, but also individual contacts with many other departments.

Full details of the research in the department can be found from the list of staff research interests, the research group pages on the web (www.maths.lancs.ac.uk/departments/research/statistics), or the list of research activities in Research Groups in Statistics within this document. The department has a number of active seminar series in statistics: the main Statistics seminars, at which visiting researchers present their work are on Friday afternoons; the internal Statistics forum series runs on Thursday lunchtimes; and there are also Royal Statistical Society local group meetings, and various specialist seminar series in areas such as computational statistics, extreme value methods and wavelets.

As well as a strong reputation for international standard research in statistics, the department has a proven record in terms of provision of Masters and Postgraduate level courses and teaching. This has recently been highlighted by the department being designated as UK's only Centre of Excellence in Teaching and Learning for postgraduate statistics. Also joint with the department of Management Science, we run STOR-i, one of only three UK doctoral training centres in the mathematical sciences.

Staff, Research Interests and PhD Projects in Statistics

Professors

Paul Fearnhead	Computational statistics; applications in population genetics; particle filters; perfect simulation
Brian Francis	Quantitative criminology; ranked data and paired comparisons; latent class models; social science applications
Roger Penn	Work/life history analysis; labour markets and training; sociological applications including social class, ethnicity and gender
Jonathan Tawn	Extreme value theory and applications; environmental statistics (oceanography, hydrology and climatology); space-time modelling
Anne Whitehead	Medical Statistics: The design and analysis of clinical trials; design and analysis of toxicology studies; meta-analysis; analysis of ordered categorical data
John Whitehead	Medical Statistics: The design and analysis of clinical trials; analysis of survival data and of ordered categorical data; the use of Bayesian decision theory in drug development

Senior Lecturers

Damon Berridge	Modelling binary and ordinal recurrent events through random effects models with substantive applications in medical and social statistics
Gillian Lancaster	Medical Statistics; study design; methods for assessing health outcome measures in children; reducing bias in ecological studies; clustered observational studies; statistical Education
Kanchan Mukherjee	Robust estimation in nonlinear time series models; weighted resampling

Lecturers

Deborah Costain	Medical statistics; spatial epidemiology; computationally intensive methods
Emma Eastoe	Extreme value theory; environmental statistics
Idris Eckley	Wavelets and multiscale methods; time series: methods and applications; statistics in business and finance
Les Humphries	Criminology
Thomas Jaki	Computational statistics; pharmaceutical statistics; kernel density based parameter estimation
David Lucy	Numerical techniques and data analysis in forensic science
Juyhun Park	Nonparametric regression; functional data analysis; longitudinal data analysis; RNA sequence analysis
Dennis Prangle	Computational statistics; approximate Bayesian computation
Gareth Ridall	Bayesian methods for data analysis; MCMC; trans-dimensional MCMC; applications in medicine and neurology
Chris Sherlock	Stochastic processes (hidden Markov models); MCMC application, methodology and theory
Matthew Sperrin	Analysis of genetic association studies; finite mixture models
Amanda Turner	Probability theory; stochastic analysis; scaling limits of stochastic models

Research Associates

Lisa Hampson	Design and analysis of clinical trials: Adaptive designs; causal inference; group sequential tests; design of paediatric trials.
Juliet Harman	Modelling survival data for materials; social and medical statistics
Jiayi Liu	Longitudinal study on criminal careers; linear mixed-effect modelling; group-based trajectory modelling; growth mixture modelling; age-period-cohort models
Matt Nunes	multiscale/wavelet methods; computational Bayesian techniques; nonstationary time series

Barry Rowlingson	Spatial statistics; geographical information systems
Giorgos Sermaidis	Inference for Diffusions
Andrew Titman	Breast cancer epidemiology; multi-state modelling; survival analysis
Svetlana Tishkovskaya	Statistical education

PhD Students

Karen Baird	Measurement and analysis of vocabulary knowledge in learners of English as a foreign language
Edward Bell	Tau-graph theory and Markov process
Madeleine Yu-Jie Chen	Longitudinal data analysis for ordinal responses
Darmesah Gabda	Extreme value theory and application
Aimee Gott	Wavelets
Claire Hargreaves	Risk of offender recidivism using survival analysis
Ye Liu	Extreme value theory with application to financial data; quantitative financial models
Becki Killick	Wavelets; nonstationary time series; changepoints
KarolinaKrzemieniewska	Wavelets
Dominic Magirr	Medical and pharmaceutical statistics
Gareth McCray	Predictive analytics applied to linguistic data
Richard Mills	Large-scale internet-based communication
Erin Mitchell	Dynamic linear models and its application in producing accurate short term predictions for wind speeds and wind energy
Wee Teck Ng	Medical statistics
Adalbert Ngongang	Past temperature series analysis using tree ring data
Ioannis Papastathopoulos	Extreme value theory and application

Alice Parry	Medical and pharmaceutical statistics
Karen Pye	Medical and pharmaceutical statistics
Stuart Sharples	Social network analysis of delinquency among adolescents
Shafquat Rozi Siddiqui	Multilevel analysis of survey data
David Suda	Stochastic calculus; Bayesian inference; computational statistics, probability theory
Stephen Tang	Joint modelling of longitudinal and survival data; methods for missing data
Sarah Taylor	Statistical modelling and analysis of image texture using wavelets
Simon Taylor	Particle algorithms; online inference and decisions
Ross Towe	Extreme Value Theory and Statistical Downscaling: Oceanographic applications
Jude Towers	Interrogation of relationships between violence against women and poverty and / or economic inequality within a UK policy context
Jenny Wadsworth	Univariate, multivariate and spatial extreme value theory; applications to environmental data
Stephanie Wallace	Quantitative criminology: statistical modelling to measure sentence severity and punishment
Yanyun Wu	Extreme value theory and application
Tatiani Xifara	Markov chain monte carlo methods; Bayesian statistics
Emily Yeend	Children in Care

Research in Pure Mathematics

The Pure Mathematics Section of the Department of Mathematics and Statistics has an established strength in Modern Analysis. This area has undergone development since 2004 through a number of lectureship and professorial appointments. The new staffs have brought additional expertise in Operator Theory, Banach Spaces, Spectral Theory, Noncommutative Stochastic Analysis and Probability.

Research in Algebra has recently been reinvigorated through two new lectureship appointments since 2008. Together with the established senior lecturer they work in representation theory, Lie theory and Lie algebras.

The Section is involved in European and national networks, including the Phenomena in High Dimensions project (through Professor Gordon Blower), a UK-India network (UKIERI network led by Professor Martin Lindsay), the North British Functional Analysis Seminar, and the ARTIN network for Algebra and Representation Theory In the North.

Staff, Research Interests and PhD Projects in Mathematics

Professors

Gordon Blower	Random matrix theory; harmonic analysis of vector-valued functions; Banach spaces of operators; operator semigroups
H. Garth Dales	Functional analysis; Banach algebras; abstract harmonic analysis; multi-norms; measure algebra
Martin Lindsay	Quantum stochastic analysis; noncommutative probability; functional analysis
Stephen Power	Functional analysis; operator algebras and subalgebras of C^* -algebras; limit algebras; operator theory and Hankel operators

Senior Lecturer

Niels Laustsen	Operators on Banach spaces (and algebras thereof); Banach and Banach $*$ -algebras; ideal structure, traces, K-theory; operator algebras
David Towers	Nonassociative algebras

Lecturers

Alex Belton	Noncommutative probability; quantum stochastic calculus; exotic forms of independence; stochastic analysis; functional analysis
Daniel Elton	Analysis of partial differential equations; spectral theory; mathematical physics
Jan Grabowski	Algebra and algebraic geometry with particular interests in Lie algebras, quantum groups, partial flag varieties and cluster algebras and their quantum analogues

Paul Levy	Lie algebras and algebraic groups
Nadia Mazza	Modular representations of finite groups; cohomology of finite groups; fusion systems

PhD Students

Peter Brookes	Modular representation theory of finite groups
Batakrishna Das	Quantum stochastic analysis
Michal Gnacik	Functional analysis (operator algebras, non-commutative L_p -spaces); quantum Probability (quantum Stochastic Calculus)
Tomasz Kania	Banach spaces of continuous functions; operator ideals; operator algebras as Banach spaces; set-theoretic and Boolean approach to functional analysis
Oliver Margetts	Quantum stochastic analysis
Samantha Newsham	Tracy Widom operators associated with Painleve equations

Introduction to the PhD Programme

There are currently three types of PhD within the Department: the *traditional PhD* where formal assessment is wholly by submission and oral examination of a thesis; the *integrated PhD*, where the first 12 months consists of formally assessed taught postgraduate level courses and projects, which if successfully completed will be followed by essentially a traditional PhD (see Appendix C for full details of the scheme). The third one is the STOR-i program the details of which can be obtained from <http://www.stor-i.lancs.ac.uk/About-Us>

The following notes are particularly relevant for traditional PhD students; or Integrated PhD students when they enter their second year. In their first year, Integrated PhD students will find the department's booklet for the MSc programme in Statistical Science invaluable.

There are a number of people who will be a source of information, advice and help during your PhD. These are:

Your Supervisor:

Your supervisor will be your primary source of help and advice during your PhD. We pride ourselves in delivering high-quality, *accessible* supervision. You should expect to have a regular, weekly meeting with your supervisor and feel able to approach them informally at other times and arrange additional meetings as necessary - subject, of course, to the fact that there are only so many hours in the week and your supervisor does have other responsibilities!

Postgraduate Coordinator:

This is Jane Hall (B76; j.hall2@lancaster.ac.uk). Jane is responsible for the administration side of the PhD course within the Department. She is also your first point of contact for any general enquires within the Department.

Postgraduate Research Tutor:

This is Kanchan Mukherjee (B21; k.mukherjee@lancaster.ac.uk). The postgraduate tutor oversees the progress of all PhD students, and you should contact him if you are having problems (particularly if they cannot be discussed with your supervisor). If you are supervised by the postgraduate tutor, then you can discuss any problems with your head of section instead.

Postgraduate Representative:

Postgraduate Representatives for this year is Ross Towe (r.towe@lancaster.ac.uk). The postgraduate representatives attend various departmental and faculty committee meetings, such as the departmental meeting, and computing and the staff-student committees. He should be contacted if you have any general suggestions about the department's provision for PhD students.

You should feel able to speak freely with any of the above people about any relevant issues that concern you.

Assessment procedures

(The following applies to traditional PhDs; the Integrated PhD can, roughly, be thought of as 1 year of training followed by a standard 3 year PhD. As such this Section applies to Integrated PhD students entering their second year, and 1 year should be added to all the timings given. Timings also assume full-time study for a PhD.)

At the beginning of your study, you need to complete the Development Needs Analysis (DNA). In the 1st year, the focus will be on what you need to achieve in order to have a successful confirmation. The details are available at

http://www.lancs.ac.uk/celt/celtweb/faq_research_students

The first formal assessment of your progress will take place at the 4 month of your entry into the PhD program; see Appendix A on the Higher Degree Committee (HDC) for details. The relevant forms for this assessment will be available from the Postgraduate Coordinator. In addition, all PhD students will undertake the equivalent of 10 days training per year; see below.

While you are initially registered as a PhD student, this registration gets confirmed after 10 months of study. Confirmation is based on evidence of progress, and of being able to submit a PhD thesis within 4 years of initial registration. This confirmation is an important step, and requires substantial written evidence of progress and potential for completing a PhD within a reasonable time-scale. (Details of the current procedures for confirmation are given in Appendix B).

In addition to the 10 month appraisal, your progress will also be appraised in your other years of study by the HDC. The aim of these appraisals is to allow you to take time with your supervisor to discuss progress; and plan your work for the coming year. The focus will be on planning your work to be able to finish and submit your PhD within a suitable timescale.

While a traditional PhD is in theory a three year degree, it is usual for students to take anywhere between 3 and 4 years to complete a PhD (as evidenced that the EPSRC are now funding PhDs for an average of 3.5 years). Furthermore 4 years should be viewed as a 'deadline' for your studies; so without any unforeseen problems all students should be able to submit a thesis within 4 years. If you were to need to take longer than 4 years to submit, you will need to apply for an extension (obtaining an extension should not be seen as a formality) and this can be granted only in exceptional circumstances.

Training Opportunities

The Research Councils are placing an increasing emphasis on the training aspects of PhDs. There is now an *expectation* that all PhD students will undertake the equivalent of 10 days training per year. This training should be directed through discussions with your supervisor; and there is a requirement for students and supervisors to undertake training needs analysis at the start of the PhD. You should be given details of a web-based system, through which you are to do this Assessment; and you should discuss the results with your supervisor.

The University is also introducing a system where records are kept of the amount of training each student undertakes each year. It is the student's responsibility to keep track of their training, and you should be given details of the system for recording this by the university. However, note that the 10 days training is just an *expectation*, rather than a requirement of your PhD. Furthermore, whilst in the past the amount of training each student undertakes has not been recorded, most students naturally undergo at least 10 days of 'training' per year.

There are numerous possibilities for training and learning beyond the specific remit of your PhD project:

Courses:

Even if you are not required to take courses as a formal part of your PhD training, you can undoubtedly benefit by attending selected courses offered in the masters programs, either to give you the background you need specifically for your research topic, to broaden your general statistical or mathematical knowledge, or to develop transferable skills.

APTS, MAGIC and NATCOR:

The department is a founder member of three UK schemes for providing training in Statistics (APTS), Mathematics (MAGIC) and OR (NATCOR; which is lead by Lancaster University). These will provide opportunities for subject-specific training for your PhD.

APTS and NATCOR put on week-long residential training courses. All statistics PhD students are expected to attend the APTS courses during their first year; and OR PhD students are expected to attend NATCOR courses during the first two years of their PhD. The department will cover the cost of attending these courses.

MAGIC, to which Lancaster is contributing a course in Operator Theory, makes available a diverse range of postgraduate courses from other UK universities through our interactive GRID access room in our new building.

As well as being of direct use for your PhD, these courses will help give you a strong background and overview of the general subject area. Such background will be of particular importance if you are interested in an academic career.

Department Courses:

Possibilities within the Department are 4th year undergraduate level courses in Pure Mathematics and MSc courses in Statistics. There are also university and faculty wide courses, covering such topics as oral presentations and writing skills, and various aspects of studying for a PhD and thesis preparation. You can get details of these courses from the relevant websites and also from various notice boards and should discuss the possibilities with your supervisor. Existing PhD students will also be able to give you advice on what courses are particularly useful.

Faculty of Science and Technology Graduate Courses:

You can attend a variety of Research Development Program courses listed in

<http://www.lancs.ac.uk/sci-tech/postgraduate/rdp.php>

Seminars:

Seminars, in contrast to courses, are one-off lectures - usually on the speaker's current research. In statistics we run a seminar series with external speakers on Friday afternoons, an internal series on Thursday lunchtimes. In pure mathematics there is a series of seminars run fortnightly on a Friday afternoon. These are a mix of internal and external speakers.

There is also a postgraduate forum series for statistics and mathematics students to which the academic staffs are not allowed to attend. There are also specialist seminar series and reading groups - your supervisor will let you have details of these if they are appropriate for you. Details can be obtained from <http://www.maths.lancs.ac.uk/department/info/newsEvents>

At busy times, you may wonder whether attending all of these is really a good use of your time; particularly as when you start your PhD you may find it difficult to understand much of each seminar. Our expectation is that *you routinely attend seminars* as they are invaluable for developing a broad knowledge of either pure mathematics or statistics; and in particular for learning about cutting-edge research both within and outside the Department.

We also expect PhD students to contribute to the seminar program; on average students will give two talks (either at the internal statistics series or as part of the pure seminar series) during their PhD, normally one each before and after the 16 month appraisal. This is invaluable experience for presenting your work, and good practice for the possibility of giving talks at conferences.

If you do find that too many seminars seem to be a waste of your time, then the fault probably lies with the seminar programme, not with you, and the best response is to tell the seminar organiser (politely!) why you aren't happy with the programme being offered. Seminar organisers are always very pleased to receive constructive criticism including suggestions for speakers and/or topics which the intended audience would like to see on the programme.

Conferences and Workshops:

The Department encourages you to attend and speak at suitable conferences. In some cases, funding for this is available from the Sponsor of the PhD project. For some conferences, separate travel grants can be applied for, and these possibilities should be explored from the conference websites. Otherwise, the Department will support you financially. As a rough guide, support for an international and a national conference to cover travel, accommodation, subsistence and conference registration fees is available together with smaller workshops (such as LMS or EPSRC/RSS postgraduate workshops). The amount available will of course depend on the level of funding that the Department receives from the University, and this may fluctuate.

If you are funded through a grant for a specific project; then that grant should have sufficient funds to cover appropriate travel, and your supervisor will have details about what funds are available.

Students funded through a Doctoral Training Account (DTA) will be able to have travel funded through the DTA; the head of research committee is responsible for the DTA and should be contacted for authorisation.

Teaching:

Postgraduate students are under no obligation to help with teaching in the Department, but almost always have the opportunity to undertake some teaching work if they wish. If you wish to do so, you will be paid on an hourly basis, and you will have the opportunity to attend a short university-run training course before we let you teach in a class.

Most likely, your assigned teaching duties will consist of running tutorials or example classes for undergraduates, and marking the associated homework. The experience of doing work of this kind is of obvious value if you intend a career which will include teaching responsibilities. You may also find that it helps you to gain the confidence in making presentations which is an essential part of many career paths.

The university puts on courses for postgraduate students who are intending to do some teaching. Talk to Julia Tawn (B4c) if you would like to do some

teaching in the Department. She will be able to provide information on the current rates of pay offered for this work.

Department Facilities

Offices and Working base

You should have received an office - probably sharing with between one and three other PhD students. Please feel free to make it as homely as possible - posters, plants, whatever you can to make your office pleasant, and better than the rest.

You may use the internal University mail and telephone system freely, external mail, fax (in B4a) and telephone facilities for official business. Incoming mail will be placed in a pigeon hole for you in B84, where there is also a tray for outgoing mail.

Academic material can be photocopied free of charge on the machine opposite B33 (if this machine is out of use, then you can use the machines in the Psychology Department on C floor), using a Mathematics and Statistics account number which you will be given. The Department will supply seminar or teaching materials (e.g. acetates, overhead pens in B4a) but otherwise we ask that you provide your own stationery.

We strongly advise that you make the Department your working base. The principal advantage of this is that you are then more likely to develop good working and collegial relationships with your fellow students and with staff in the Department. This makes it easier to share ideas and to seek informal help when you need it. Statistical research is very often a collaborative, rather than a solitary activity. Of course, there will be times when you do need to work alone, and when you honestly feel that you can work more effectively at home than in the Department. Ultimately, it is for you to decide what works best for you - but give your departmental office a fair trial, and if there is anything about the working environment in the Department which you find unhelpful, please do let the postgraduate Tutor know. Within our limited resources, we will do whatever we can to deal with any problems.

Working hours and holidays

You are expected to treat your PhD studies as a full time job; this equates to approx 37.5 hours per week. Any holidays must be agreed with your supervisor.

Computing

All traditional route PhD students will be given a departmental laptop to use during their study. This will be arranged during the first weeks of your course. Integrated PhD students will be given a departmental laptop at the start of their second year.

Computing support is offered by Cyrus Gaviri (afternoons only) and David Sole. Please contact them with any computer issues by emailing to support@helpdesk.maths.lancs.ac.uk

If you have a problem or a question, you should:

- Check the departmental webpage on computing information for local users;
<http://www.maths.lancs.ac.uk/department/info/intranet/computing>
here you will find a list of resources to choose from
- Ask around. Usually other graduate students or staff will be pleased to help. We are trying to increase the overall level of computing expertise in the Department and the best way to do this is through helping each other
- Contact computing support. The best methods are through the problem reporting system on the web, or through e-mail. They will get back to you or offer an appointment.

We welcome your views on how computing is resourced and organised within the Department. Please feedback please to the chair of the computing committee or to the postgraduate representative.

Web Pages

Once we have a photograph of you, a departmental web page will be opened for you in a standard format. You can add a link there to any personal pages you have. Certain areas of the departmental web pages will need access via password please contact the computing support team for more information.

Email Mailing Lists

There are a number of departmental mailing lists which can be obtained from the Staff and Student telephone list of the department. If you wish to be added to any of the lists please contact computing support.

Computing within the Department

In the department there are a number of PC labs which can be used by staff, students and registered visitors to the department, these are:

- Lab 1 and Lab 2, Postgraduate Statistics Centre
- Lab A1, Engineering

For more information on using these computer labs please see here;
www.maths.lancs.ac.uk/department/info/intranet/computing/networkinfo/start
ingOut

For information on other computer labs that can be used all over campus, please see here; <http://www.lancs.ac.uk/iss/services/pclabs/>

Connecting Laptops to the network

There are a number of network terminals available within the social areas in the Postgraduate Statics Centre building.

If you have a personal laptop that you wish to connect to the Lancaster University network, please contact the computer support staff; support@helpdesk.maths.lancs.ac.uk.

If you require any other information please look through the computer support pages found here:

www.maths.lancs.ac.uk/department/info/intranet/computing
or email support@helpdesk.lancs.ac.uk.

Postgraduate Statistics Centre

Apart from being the place where we hold many of our seminars, the PSC social area provides an invaluable opportunity to chat with colleagues about anything at all - including but absolutely not restricted to statistics! Daily morning tea/coffee (for unfathomable reasons) takes place at the unusually late hour of 11.00. Rather like seminars, morning tea/coffee is an easy thing to skip if you think you have a busy day ahead of (or behind) you, but it's a great way to get to know people better, unwind for a few minutes, and to be aware of the unofficial departmental gossip.

Journals on the Web

You will undoubtedly require to search for and read relevant journal articles during your PhD. You will have online access for many journals; and can print-out papers within the Department. See <http://libweb.lancs.ac.uk/> for details of what is available. Other journals can be found in the university library. If unavailable there, papers can be obtained through the inter-library loan system.

Other useful sites for searching for relevant papers are MathSciNet and Web of Science. If you are on campus you have free access to them through the library's database list <http://libweb.lancs.ac.uk/databases.htm>. If you are working off campus, you will need to log in or use the VPN – more information here: <http://libweb.lancs.ac.uk/offcampus.htm>

Research groups in Statistics

Statistics at Lancaster is a large and vibrant research community. Much of our research has a strong applied emphasis with research typically being focused at the interface between methodology and applications.

Our research has three distinctive but complementary strengths: the development of advanced probabilistic and statistical theory; a well-defined methodological focus based upon statistical modelling; and extensive collaborative links with colleagues throughout the university and researchers elsewhere.

Although we are a cohesive and contiguous research group, we do have the following research groups.

- *Statistical Methodology for Industry*
- *Statistical Methodology for Medicine*
- *Statistical Methodology for Social Science*

Each research group has (overlapping) smaller subgroups, most of which have their own research activities (such as reading groups, specialised seminar series, etc).

- *Stochastic modelling*
- *Computationally intensive methods*
- *Design and analysis of clinical trials*
- *Statistical Methods for Health Research*
- *Quantitative Criminology and Forensic Statistics*
- *Statistical Methods for Social Research*

For the latest details of the research of each of these groups please see;

www.maths.lancs.ac.uk/department/research/statistics

Research areas in Pure Mathematics

The Department has a lively and growing group of research mathematicians in various areas of Mathematical Analysis and Algebra. Here is an indication of some of the research areas:

- *Operator algebras and operator theory*
- *Noncommutative probability*
- *Random matrices and stochastic analysis*
- *Operators on Banach spaces*
- *Partial differential equations*
- *Lie theory and nonassociative algebra*
- *Representation theory of finite groups and related topics*
- *High dimensional phenomena*

Appendix A: Monitoring of PhD students

HIGHER DEGREE COMMITTEES

In order to monitor the progress of PhD students in the Department of Mathematics and Statistics, each student entering from October 2010 onwards will have a Higher Degree Committee (HDC). The committee will comprise

- the supervisor(s);
- another member of the Department who knows something of the topic, who will act as the Chair and a representative of the Postgraduate Research Committee;
- sometimes a representative of a company or institute that is associated with the project will be invited to join.

The system will apply to all students who are solely registered in this Department. It should be considered for students who are jointly registered in more than one Department, but should not be used if the other Department has conflicting monitoring requirements of their own.

The composition of each HDC is determined on or before the arrival of the student by the Tutor for Postgraduate Research Students, in consultation with the supervisor. Students on 1 + 3 Integrated PhD schemes will have an HDC formed at the time when they begin the research portion of their degree. The committee should meet

- soon after the student starts, to discuss the initial programme and project plans;
- at 4 months (first official appraisal);
- at 10 months (official upgrade point);
- at 16 months (official appraisal);
- at 22 months (official appraisal) and so on.

This schedule will be extended appropriately in the case of part-time students. Apart from the introductory session, at each meeting the supervisor will provide a short half page report on progress and the student will produce a longer report which is mostly a technical account of research progress, and may be a draft chapter or paper. For the 4 month meeting, the student's document needs to demonstrate that work has begun and a page covering progress made, training gained, future plans and issues would suffice. At the meeting, the student will be questioned about the report. Additional meetings may be held if the research lasts for a longer time (official appraisals are needed at 10 and 16 months and at 6 monthly intervals thereafter, but not all of them would need to be a full HDC meeting). A simple form would be completed at the end of each meeting.

The timelines for monitoring and appraisal procedures are summarised below, assuming a 1st October start date. If progress is not adequate the Department may initiate more frequent reviews.

4 months (January/February)

- Supervisor and student to complete progress sections of the appraisal form.
- The HDC meets and considers reports, with possible discussion with students and supervisors.

10 months (July/August) Confirmation to PhD program

All students are initially registered for MPhil. The decision to confirm the PhD will be made at this time.

- The student submits written report covering progress made, training gained, future plans and issues as well as the PhD proposal. Supervisor and student to complete appraisal form. Student to also produce written evidence of progress and plans for future research.
- The HDC meets to discuss progress.
- The Postgraduate Research Committee recommends confirmation or otherwise.
- Decision to be communicated to student.

Students who fail to be confirmed will have one further opportunity to submit written evidence of progress and plans for future research in order to be reconsidered for confirmation. Details of the requirements of this will be given to the student by the HDC and Postgraduate Research Committee, though the resubmission will normally be expected prior to 16 months. If this second attempt is unsuccessful, then the student will be transferred to MPhil status.

16 months and every 6 months thereafter

- Student is normally required to give a talk on their work, usually during the term prior to their 16 month appraisal. This will either be in the Statistics Forum series, or the Pure Maths Seminar Series.
- Supervisor and student to complete progress sections of the appraisal forms. Student to include a provisional date for the submission of the thesis.
- The HDC will review progress against expected submission date, agree remedial action as appropriate.
- Feedback given to students.

Part-Time Students

Part-time students will be appraised at 4, 10, 16, 22 months and so on. The PhD confirmation takes place at 22 months. Written feedback will be given by the HDC and Postgraduate Tutor in all cases. Students will have the opportunity to meet with the Postgraduate Tutor in person to discuss progress. The Postgraduate Tutor will make informal checks of PhD students' progress throughout the year and be available to discuss any problems with students as they arise. Students who are supervised by the Postgraduate Tutor will have the opportunity to discuss progress with the relevant Head of Section.

Appendix B: 10 month confirmation of PhD status

After 10 months of study a decision will be made whether to confirm your registration of PhD. Before the review you need to prepare two documents:

A: Evidence of progress to date

B: An outline for future research

Document A can be one of several formats and need not be written solely for the review: a literature review, good summary and drafts of thesis chapters, a draft paper etc would all be acceptable.

Document B should describe in some detail your plans for the remainder of the thesis. The questions to be considered; why they are important, and how you intend to approach the solutions. A proposed list of contents without discussion is not adequate for review. It is accepted that plans may change as the work progresses.

After the review the PG Tutor will write to you, communicating the decision and commenting on progress. If you are unhappy with the decision you may request a meeting with the Review Panel, and of course have formal University appeal procedures available.

Students who fail to be confirmed will have one further opportunity to submit written evidence of progress and plans for future research in order to be reconsidered for upgrade. Details of the requirements of this will be given to the student by the Review Panel; though the resubmission will normally be expected prior to 16 months. If this second attempt is unsuccessful, then the student will be transferred to MPhil status.

Appendix C: Integrated PhD details

The Integrated PhD is a 4 year PhD programme which involves students taking postgraduate level courses and a dissertation during their first year before progressing onto standard PhD research and all students get an MRes if they progress to the second year of PhD. It is similar to spending one year studying for a Statistics Masters followed by three years on a PhD. Progression to year 2 of the programme is dependent on students performing well during their first year (based on the minimum level of achievement we would expect from someone capable of obtaining a PhD). Students who fail to progress are nevertheless eligible for an MRes (subject to satisfactory performance).

Years 2, 3 and 4 of the Integrated PhD is similar to the normal PhD program and the Departmental research committee oversees the progress of the students from year 2 onwards. The PhD should be examined in the usual way and satisfy the normal criteria for the award.

Appendix D: PhD thesis and viva

Thesis format

For those students studying for a PhD or Integrated PhD, your PhD thesis needs to be submitted and this will be examined during a PhD viva.

The thesis will normally be written in English.

A thesis shall not normally exceed 80,000 words (including any footnotes and appendices but excluding the bibliography), or 100,000 as an absolute maximum. The text of the thesis shall be word processed in double spacing on one side only of good quality A4 paper (210 mm. x 297 mm.), leaving a left hand margin of 38 mm., and a margin of 25 mm. on the other three sides. Diagrams and illustrations shall be reproduced or mounted on similar paper. Candidates shall submit to the Postgraduate Studies Office copies of the thesis (one per examiner) in a secure adhesive binding.

For information on the formatting, length, style and presentation, see

http://www.lancs.ac.uk/celt/celtweb/files/SectionG5_Marp.pdf

As well as an internal and an external examiner, this viva will *either* have a chairperson or be recorded.

Appendix E: Intercalation

An intercalation should be requested if the student is unable to undertake his/her studies during an extended period (greater than one month). This may be for personal reasons such as illness, finance, employment or family responsibilities. It may also be on account of external circumstances such as extended delays in obtaining access to

study materials/resources, or changes in the environment in which the studies are to be undertaken.

During intercalation, students are not entitled to use the library, computer or other university facilities, or to receive supervision or tuition. No tuition fees are charged for this period and departments will not receive any funding for this student during the intercalation period. Periods of intercalation are subtracted from the student's period of registration. Intercalation is not normally approved for periods greater than one year at a time, and usually for no more than a total of two years. Please note that intercalation is granted to assist her/him, and that across the University successful completion of studies is the usual outcome after the return to studies.