Part B - Doctoral Programme Profile

Mathematical Sciences 2020/21

This Mathematical Sciences Doctoral Programme Profile accompanies the University of Southampton ***Doctoral Programme Profile 2019/20,*** and details additional Faculty/programme-specific information.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of study	Full time/part time
Duration in years	4 years + following standard progression for a FT student.
Accreditation details	N/A
Final award	PhD
Name of award	PhD in Mathematical Sciences
Interim Exit awards	MPhil
FHEQ level of final award	8
QAA Subject Benchmark or other external reference	QAA Doctoral Degree Characteristics Statement (2015)
Programme Lead	Prof Jelena Grbic
Date specification was written	26/11/2015
Date Programme was validated	13/05/16
Date specification last updated	30/10/2018

All Doctoral Programme Profiles should be read alongside the University of Southampton ***Doctoral Programme Profile 2019/20*** and the University of Southampton's *Regulations for the degrees of Master of Philosophy and Doctor of Philosophy* and *Code of Practice for Research Candidature and Supervision*.

Programme Overview

Brief outline of the programme

Mathematical Sciences at Southampton has one of the broadest communities of mathematicians in the UK, spanning pure and applied mathematics, statistics and operational research. Our research includes internationally recognised projects with partners in engineering, and physical, biological and social sciences.

Applied Mathematics at Southampton covers a wide range of topics in mathematical physics and mathematical modelling. Our expertise includes gravitational waves, the quantum behaviour of ultra cold gasses, mathematics of biology and medicine and the design of liquid crystal devices, solar cells and batteries.

Operational Research at Southampton has 100% of its research deemed to be world leading or internationally excellent in terms of originality, significance and rigour in the recent Research Excellence Framework (REF) 2014. Our main research areas are computational optimisation (combinatorial, non-linear, dynamic, and stochastic programming) with application areas in scheduling, revenue management, healthcare, game theory, inventories and logistics. Our work has had considerable impact in industries ranging from satellite design, Formula 1 racing, robust supply chain management, and health care provision across the developing world.

The Pure Mathematics Group at Southampton is a leading national and international centre for algebraic topology, and geometric, analytic and algebraic methods in group theory. With expertise in functional analysis, applied topology, algebra, geometry and discrete mathematics we also interact with mathematicians, scientists and engineers to find new ways to exploit sophisticated mathematical ideas.

The Statistics Group is a leading international centre for research in the theory, methodology and applications of the design and analysis of experiments, statistical modelling and biostatistics. As part of the Southampton Statistical Sciences Research Institute (S3RI), we play a leading role in one of the largest groups of statisticians in the UK and were ranked second for 'research power' in the last Research Assessment Exercise.

Aims of the Programme

The aims of the programme are for you to acquire:

- experience of, and the opportunity to gain expertise in, rigorous, leading edge research in a chosen area of mathematical sciences;
- broad knowledge of the contextual background of your research problem in the general field of your chosen subject area (pure, applied, statistics, or operational research);
- a comprehensive understanding of the theoretical foundations of your chosen area of research;
- the ability to interpret and critically evaluate research and scholarship in the chosen area of research;
- a high quality and intellectually stimulating experience of learning in a supportive, research-led environment;
- communication and presentation skills through seminar presentations and production of a research proposal and dissertation;
- the ability to create and interpret new knowledge through original research of a quality to satisfy peer review and merit publication;
- the capacity to present ideas, arguments and research findings effectively to a variety of specialist and non-specialist audiences
- training in generic and transferable research skills;
- a supportive environment so you feel part of a community of scholars and are well placed to pursue a career building on your accomplished research;
- the opportunity to present your work to colleagues, and bring you into contact with the wider research community, enabling you to build networks with others researching in the same field.

Programme Structure

Unlike undergraduate study, the open-ended nature of research means it is not possible to always predict the structure of a programme of study leading to a thesis. The timings listed below are those for a full-time student. Timings for a part-time student are adjusted suitably.

Programme details

Year 1

You should hold regular meetings with members of your supervisory team throughout this and subsequent years. During those meetings a variety of topics relevant to your research and progression can be addressed depending on the need and timeliness. This includes aspects of training, of administrative procedures and due dates, of the research approach and specifics, to your participation in various activities, etc. You can also consult your group's Postgraduate Research Coordinator and the Doctoral Programme Director. Other sources you may wish to consult when dealing with specific issues are listed in your PGR Student Handbook.

Within the first months, you should have completed your Academic Needs Analysis in consultation with your supervisory team. This assessment highlights any modules or training to attend to enhance your studies, including training in postgraduate teaching support. It is expected that you will take a mixture of substantive, technical and skills training courses throughout the year to develop the skills that you need for the whole PhD process.

Students who undertake teaching or demonstrating duties must successfully complete the required training modules. Module leaders will also be expected to provide additional training on the particular teaching required. The availability and precise nature of the teaching opportunity may vary from semester to semester. Some remuneration may be available. Students will be informed about teaching opportunities shortly before the beginning of each academic term by relevant Postgraduate Research Coordinators and Heads of Research Groups.

Throughout the year you will be expected to develop knowledge in your chosen area of research through reading and developing a review of previous work in the area. You will also be developing your research questions and starting to conduct analyses, where appropriate. The relative timescales for these tasks will be discussed with your supervisors.

An important component of the research training involves participating in research workshops and seminars in Mathematical Sciences. Each of the four research groups typically has one or more of such seminar series running with several (inter)national guest speakers, but the specific details may vary from year to year. Attendance to these seminars helps in broadening your knowledge of a field beyond the chosen specific topic. Students are encouraged to make use of these opportunities to meet with other PhD students and academics across their chosen subject area.

An important component of the subsequent research based training in year 2 and onwards involves presenting your research at workshops and conferences. In preparation to this, and also for receiving some initial additional feedback on your research, Mathematical Sciences organises a First-Year Annual Seminar and Poster Event, which is typically held in June. Students who started in September/October will then be about 8 to 9 months into their research. Students who are at least 8 months into their first year are invited to present their work and further research plan to their peers and academics, and also produce and defend a poster about their work on the day.

Year 2

This is a continuation of year 1's activities. Depending on your needs and availability of training courses, you review and implement the training programme for this year.

You are expected to expand on the work that started in year 1 and enter fully in the analysis of the research questions. By the time of confirmation, you are expected to have produced a significant piece of work that provides evidence that you are on track towards meeting the general programme outcomes as specified in Part A by the time of PhD completion.

With your supervisory team, you will set out a plan to present your work to the outside world. This typically includes one or more of the following activities: presenting your work to your peer group within a Mathematical Sciences seminar; presenting a paper or poster of your research at a national PhD-level conference; presenting a paper or poster at an (inter)national academic conference in your discipline; or the preparation of a working paper for submission to a peer reviewed academic journal. The timing of such events is agreed with your supervisory team and may well develop into activities executed in year 3.

Year 3

Evidence of continued progress is provided by the development of the PhD dissertation, by presentations of your research at suitable conferences, workshops or seminars, and possible submission of working papers for academic publication in peer reviewed journals. It is unlikely that further major training will be needed at this stage. The target date for submission of your thesis is normally at the end of year 3 as this may coincide with the end of any supporting studentships.

Year 4

In some cases you may need further time beyond year 3. If you only need some extra time to finish writing up the dissertation, you may wish to go nominal. Please check carefully the thesis submission and examination guidelines in Part A.

Programme Outcomes

Having successfully completed a doctoral programme, a research student will be able to demonstrate the aspects identified in Part A.

Knowledge and Understanding

Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

- the contextual background of your research problem in the general field of your chosen subject area (pure, applied, statistics, or operational research);
- the theoretical foundations of your chosen area of research;
- the ability to interpret and critically evaluate research and scholarship in the chosen area of research;
- how to formulate, analyse, and implement a project for the generation of new knowledge in your chosen area;
- how to conduct rigorous, original research in a chosen area of mathematical sciences of a quality to satisfy peer review and merit publication;
- how to effectively communicate and present your research conform professional practice and academic standards to a variety of specialist and non-specialist audiences.

Subject Specific Intellectual and Research Skills

Having successfully completed this programme you will be able to demonstrate the following key intellectual skills that characterise the mathematical sciences approach to problem solving and decision making:

- the ability to abstract the essential features of complex (real world or mathematical) phenomena and to formalise and construct an approach or model for the critical analysis and evaluation of theory and/or its application;
- a critical understanding of the application of mathematical methodologies to arrive at a series of novel truth statements about or solution approaches for the (models of) investigated phenomena; with rigour in proofs or analysis.
- the ability to identify and convey the relative significance of your work in relation to the existing body of knowledge in mathematical sciences and elsewhere;
- where relevant, the ability to identify and quantify the impact of your work to real world applications, and to validate empirically or otherwise its applicability and the impact of made assumptions;
- the ability to evaluate the applicability of a range of research methodologies to the conduct of mathematical sciences research within your chosen research area;
- the ability to formulate relevant research questions in your chosen area of mathematical sciences and translate these into appropriate research designs.

Learning and Teaching Methods

You will develop core knowledge and understanding through your own research and guided independent study via individual supervision meetings. In addition you will further develop via technical module lectures, tutorials, seminars and presentations as well as student-led study groups.

Assessment methods

Assessment methods will include written examinations, oral presentations, written assignments, research proposal, progression reviews including **Confirmation of PhD Registration** and a thesis with viva voce as described in part A.

Support for student learning

Learning and Supervision

Research students are allocated a supervisory team of at least two members, one of whom will be the main supervisor. You will develop core knowledge and understanding through your own research and guided independent study via individual supervision meetings. In addition, you will further develop via technical modules, tutor-led and student-led tutorials, academic seminars and presentations, and practical classes.

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area.

The University provides:

- library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources
- high speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices; laptops, smartphones and tablet PCs via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations.
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- standard ICT tools such as Email, secure filestore and calendars.
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move.
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Student Services Centre
- Enabling Services offering assessment and support (including specialist IT support) facilities if you have a disability, dyslexia, mental health issue or specific learning difficulties
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards

- Career Destinations, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV
- a range of personal support services : mentoring, counselling, residence support service, chaplaincy, health service
- a Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.
- a Researcher Development and Graduate Centre, which provides professional development and skills training
- An appropriate research environment, as set out in the Code of Practice

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University.
- opportunities for extracurricular activities and volunteering
- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline.

In addition to the University-wide learning support, students studying on the Mathematical Sciences Programme will be able to access:

- Research infrastructure
- A Research Training and Support Grant of at least £750 per annum for up to 3 years (FT) £375 for up to 6 years PT).
- Access to appropriate desk space and computing facilities (as per Faculty policy).
- A supervisory team consisting of at least two members of staff.
- The Graduate School Office for the Faculty of Social Sciences
- Finance- for details of your personal RTSG subproject code and claims
- The Mathematical Sciences Student Centre (building 57)

The Faculty also offer the following learning support:

- Induction programme for orientation, introduction of the programme and staff, and dissemination of materials.
- Postgraduate Student Handbook, including guidance on selection of technical modules.
- Access to all administrative and academic material on the Faculty, Programme and individual module web sites and Blackboard.
- An opportunity to meet with the Graduate School (which comprises an academic representative from each Academic Unit as well as the Director of Graduate School) at a mixture of training and networking meetings. This gives ready access to an independent and impartial source of advice about any issues you may be having during your studies.
- Infrastructure to support your research.
- Access to other staff of the Faculty.
- Access to Faculty cluster of computers with relevant specialist software.

Fees, Additional Costs and Funding

The current fees charged for the programme may be found on the University Postgraduate Fees and Funding website. Other costs specific to the Mathematical Sciences doctoral programme are listed in in Appendix 1.

Any academic offer is distinct and different from any offer of funding. Offers of funding will depend on the availability of funds, the rules governing source of the funds, the academic competition for them, as well as eligibility. Candidates may be in receipt of funding for shorter periods than the length of the programme. This may vary from year to year and within each annual recruitment cycle.

This programme is eligible for funding from the University of Southampton's Postgraduate Scholarship Fund.

Admission

Subject-specific criteria: As a minimum, applicants should have a Merit at Masters in a relevant mathematical subject (mathematics, statistics, economics, computer science, physics, astronomy, engineering, etc) or upper second class at MMath/MPhys, though preference may be given to those students with a Distinction in the MSc or with a first-class honours degree MMath/MPhys. In exceptional cases a first-class honours BSc degree in a relevant mathematical subject where research experience has been gained over at least one additional year after completion of the degree (e.g. as research assistant at another university with a publication record.)

English Language requirement for candidates whose first language is not English: Applicants whose first language is not English and who are not exempt from taking an English Language test, according to the University of Southampton's regulations, are required to obtain a minimum of average of 6.5 overall in the IELTS test, with no individual elements of the test scoring below 6.0 (or an equivalent secure English Language test.)

Candidates will not be able to register for the programme until they have received and offer letter and met and/or accepted the conditions laid out in it.

Career Opportunities

Successful PhD doctorates in Mathematical Sciences can take up positions as post-doctoral researcher or as teaching and research academics.

Because of the solid training in analytical thought and quantitative reasoning, they will also be leading analysts in public or private sectors, with further progression possibilities into managerial roles. Depending on your chosen research focus, this may include (inter)national research centres, central and local governments, statistical offices, central and commercial banks, financial institutions, multi-national firms in various sectors, defence, healthcare, public or private transport, etc. The statistics and OR pathways in particular also form a solid basis for a career in private sector consultancy in areas ranging from financial/risk management to supply chain solutions.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Appendix 1:

Additional Costs

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme typically also have to pay for the items listed in the table below.

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
Approved Calculators		Candidates may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University approved model is Casio FX-570 This may be purchased from any source and no longer needs to carry the University logo.
Stationery		You will be expected to provide your own day-to-day stationery items, e.g. pens, pencils, notebooks, etc.). Any specialist stationery items will be specified under the Additional Costs tab of the relevant module profile.
Textbooks		Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
		prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as **optional** background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.
IT	Software Licenses	There is publicly available software in public workstations and some available via iSolutions, but otherwise you may need to purchase.
	Hardware	Either a desktop PC or a laptop computer will be provided.
Printing and Photocopying Costs		In the majority of cases, coursework such as essays; projects; dissertations is likely to be submitted on line. However, there are some items where it is not possible to submit on line and students will be asked to provide a printed copy. A list of the University printing costs can be found here: http://www.southampton.ac.uk/isolutions/students/printing/