PROGRAMME DETAILS

Programme Code: F7SM-CDS
Department: Actuarial Maths & Statistics
Main Award: MSC - Master of Science
Full Award Title: Master of Science in Stochastic Modelling and Computational Data Science
Level: Postgraduate Taught

LOCATION OF STUDY

<table>
<thead>
<tr>
<th>Location</th>
<th>Study Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edinburgh</td>
<td>Y</td>
</tr>
<tr>
<td>Scottish Borders</td>
<td>N</td>
</tr>
<tr>
<td>Orkney</td>
<td>N</td>
</tr>
<tr>
<td>Dubai</td>
<td>N</td>
</tr>
<tr>
<td>Malaysia</td>
<td>N</td>
</tr>
<tr>
<td>Approved Learning Partner</td>
<td>N</td>
</tr>
<tr>
<td>Independent Distance Learners</td>
<td>N</td>
</tr>
<tr>
<td>Collaborative Learning Partner</td>
<td>N</td>
</tr>
<tr>
<td>Other</td>
<td>N</td>
</tr>
</tbody>
</table>

ASSOCIATED AWARDS

<table>
<thead>
<tr>
<th>Programme Code</th>
<th>Award</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>F7S0-ZZZ</td>
<td>PGCERT</td>
<td>Postgraduate Certificate in Stochastic Modelling and Computational Data Science</td>
</tr>
<tr>
<td>F7SD-CDS</td>
<td>PGDIP</td>
<td>Postgraduate Diploma in Stochastic Modelling and Computational Data Science</td>
</tr>
<tr>
<td>F7SM-CDS</td>
<td>MSC</td>
<td>MSc</td>
</tr>
</tbody>
</table>

ACCREDITATION

Accreditation by the Royal Statistical Society will be sought.

LEARNING OUTCOMES – SUBJECT MASTERY

Understanding, Knowledge and Cognitive Skills

On completion of the programme, students will be able to demonstrate:

- extensive and detailed knowledge, and critical understanding, of central areas in machine learning, statistical inference, and Bayesian computation, optimisation.
- understanding of the main theories, concepts and tools underpinning the domains of stochastic modelling
- understanding of the main theories, concepts and tools underpinning the computational aspects of data science
- knowledge and critical understanding of data-driven analysis and decisions
- acquisition of a range of new skills required in analysing data sets
- awareness and understanding of current issues in data science, through teaching informed by current developments in professional matters and in research
- detailed knowledge of diverse software, hardware and theoretical tools relevant to statistical inference and data science
- extensive knowledge and understanding of problems in some or all of the following areas and beyond: signal and image processing, computational imaging, communications, robotics, energy, epidemics spread in a population, actuarial science, financial mathematics

Scholarship, Enquiry and Research (Research Informed Learning)

On completion of the programme, students will:

- demonstrate that they have developed and can apply skills in critical analysis and evaluation of a wide
range of theories, concepts, and techniques which arise in the study and practice of working with data
• demonstrate that they have developed problem-solving skills
• identify, analyse and solve problems, and discuss issues, at a professional level critically review existing practices and move on to professional careers with confidence
• gain abilities to critically understand and apply relevant theories and technologies to developing analytical and design skills
• obtain research skills, through review and analysis of current literature
• obtain an understanding of research ethics, and how to appropriately build on the work of others

### LEARNING OUTCOMES – PERSONAL ABILITIES

#### Industrial, Commercial and Professional Practice

On completion of the programme, students will be in a strong position to move on to a PhD position in an area of probability or statistics, signal and image processing, computational engineering, or to obtain a position in a wide range of industrial companies requiring stochastic modelling and computational data science skills to work on big data projects within industry. They will also have the necessary background and experience to enable them to be ready and able to communicate on technical and general matters with peers and senior colleagues.

#### Autonomy, Accountability and Working With Others

On completion of the programme, students will be able to:

- Plan and organise own learning through self-management and time management
- Assess issues associated with working as part of a team
- Communicate their ideas effectively to peers, senior colleagues and general public, using a range of media

#### Communication, Numeracy & Information and Communications Technology

On completion of the course, students will be able to:

- Demonstrate high levels of numeracy as required by the profession of a data scientist
- Adopt a mature and professional attitude to the solution of technical problems in stochastic modelling and computational data science
- Develop and demonstrate skills and techniques in communication with peers and academic/industrial staff, using a range of appropriate methods to suit different levels of knowledge and expertise within the audience.
- Develop and demonstrate critical knowledge and skills in the planning and usage of software tools and numerical techniques to develop, present and communicate information on projects and processes

### APPROACHES TO TEACHING AND LEARNING

Teaching on the course is student-focused, with students encouraged to take responsibility for their own learning and development. The full-time MSc/Diploma course is offered in a traditional campus-based model. The material is organised within 8 full courses. All material is presented in a manner appropriate to postgraduate study. A wide range of L&T approaches and techniques are used to achieve this, from traditional lectures and discussions to demanding tutorial and computer lab work, as well as individual and group projects. Lecturers use a range of tools from chalk and talk to extensive use of web-based materials. Approaches to teaching and learning are continually reviewed and developed with the aim of matching them to the abilities and experiences of our students with regard to the subject area. Specific details
about teaching and learning methods are provided in the appropriate course descriptors.

EDUCATIONAL AIMS OF THE PROGRAMME

This programme aims to

- provide intensive and high-quality education in a postgraduate context in a wide range of subjects in contemporary stochastic modelling, statistical inference and computational data science
- provide a challenging period of study which enables students to test themselves against standards requiring intensive work and strong commitment in a demanding postgraduate environment
- enable students to develop detailed knowledge and critical understanding, and acquire a range of new skills, in central areas in data science
- provide tutorial and discussion opportunities of a style and at a level appropriate for postgraduate studies
- enable students to communicate and work effectively with peers and academic staff, demonstrating appropriate levels of autonomy, initiative, and responsibility
- develop detailed knowledge and skills to deal with diverse and complex technological systems that exist in applications of computational data science and a critical understanding of the range of tools and techniques available to support this process
- provide students at Master's level with the opportunity to plan and execute a significant investigation and write a dissertation requiring detailed and critical understanding in an area of study related to stochastic modelling and computational data science

ASSESSMENT POLICIES

The assessment policy for the programme incorporates a range of assessment types.

Continuous assessment during some courses and summative assessment at the conclusion of courses both contribute to the overall assessment and are used to formally measure achievement in specified learning outcomes.

Understanding, knowledge and subject-specific skills are assessed by coursework assignments and written examinations.

Approaches to assessment are continually reviewed. Specific details about methods of assessment are provided in the appropriate course descriptors.

The programme consists of two phases:

- A taught phase, consisting of a set of 8 full courses, three mandatory and five optional courses. Assessment of the taught phase is through a variety of methods including coursework and/or examination, students must submit all elements of assessment before being permitted to progress.
- A project/dissertation phase over the summer.

Progression to the dissertation phase is dependent on assessed performance. To progress, students must meet the criteria set out in the programme structure document. Students meeting the required standards for Masters in the taught phase will
be permitted to progress.

Students meeting the required standards for Postgraduate Diploma and Postgraduate Certificate in the taught phase, but not meeting the Masters standard, will not be permitted to progress to the dissertation phase.

Students failing to meet the required standards for Postgraduate Diploma and Postgraduate Certificate in coursework and examination in the taught phase will not be permitted to progress to the dissertation phase, nor will they be eligible for any award.

Any student who does not satisfy the requirements for progression will be able to retake the assessment of up to a maximum of 3 courses at the next opportunity, subject to payment of the appropriate fees to the University, and may be required to do so to obtain the necessary credits for completion of their programme or for progression. The method of reassessment for each course is specified in the appropriate course descriptor. Reassessment is only available in the next academic year.

## PROGRAMME STRUCTURE

### Mandatory Courses

<table>
<thead>
<tr>
<th>Edinburgh</th>
<th>SBC</th>
<th>Orkney</th>
<th>Dubai</th>
<th>HWUM</th>
<th>IDL</th>
<th>Coll. Partner</th>
<th>ALP</th>
<th>Other</th>
<th>Stage</th>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>SCQF Cr</th>
<th>SCQF Lvl</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>F21ML</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Statistical Machine Learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>F71MA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Statistical Models</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Optional Courses

<table>
<thead>
<tr>
<th>Edinburgh</th>
<th>SBC</th>
<th>Orkney</th>
<th>Dubai</th>
<th>HWUM</th>
<th>IDL</th>
<th>Coll. Partner</th>
<th>ALP</th>
<th>Other</th>
<th>Stage</th>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>SCQF Cr</th>
<th>SCQF Lvl</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>B31XM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Advanced Image Analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>B31XN</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Multi Sensor Image Fusion and Tracking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>B31XO</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Sampling and Computational imaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>F11AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Mathematical Ecology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>F71DV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Derivatives Markets and Pricing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>1</td>
<td>F71PM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Probabilistic Methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>2</td>
<td>B31XP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Multi-Disciplinary Group Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>2</td>
<td>B81EZ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Critical Analysis and Research Preparation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>2</td>
<td>F11DA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Data Assimilation with Applications to Climate Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>2</td>
<td>F11SS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Stochastic Simulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>1</td>
<td>2</td>
<td>F71AE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>Survival Models</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mandatory courses:

All students are required to take a total of 3 mandatory courses in semester 1 and 2, which are designed to equip students with the foundational tools of stochastic modelling and computational data science:

- F21ML: Statistical Machine Learning
- F71MA: Statistical Models
- F11BI: Bayesian Inference and Computation Methods

Optional courses:

Two coherent streams of options (described below) have been identified, which will allow students to pursue their learning in a more specialised manner, and to focus on domains of most interest to them depending on their background and previous experience. The first and more theoretical stream will build further the student knowledge on the stochastic aspects of data science (Stream SM: Stochastic Modelling and data science). This stream will appeal to students interested in the mathematical aspects of data science. The second and more applied stream will build further the student knowledge on the computational aspects and engineering applications (Stream CDSE: Computational Data Science and Engineering). This stream will appeal to students interested in developing multi-disciplinary knowledge at the intersection between stochastic modelling, computational data science and engineering applications. In order for the combination of options to be pedagogically coherent, other combinations of options than those described in the streams below will not be permitted.

Stream SM - Stochastic Modelling and Data Science:

- F71PM: Probabilistic Methods
- F71SP: Applied Stochastic Processes
- F71SR: Research & Industry Topics
Students select one additional option in Semester 1 from:

Derivative Markets and Pricing (F71DV), Mathematical Ecology (F11AM) and Sampling and Computational Imaging (B31XO) – these courses will give the students a chance to learn about a particular area of applications.

Students also select one additional option in Semester 2 from:

Stochastic Simulation (F11SS), Data Analytics and Time Series Analysis (F71DA), Data Assimilation with Applications to Climate Change (F11DA), Survival Models (F71AE) and Scalable inference and deep learning (B31XN). Similarly to the first semester, these optional courses provide a variety of application areas for students to familiarise themselves with.

The availability of the additional options will be reviewed on the year-to-year basis, subject to timetabling constraints.

Students who take option B31XN must also take option B31XO. These 2 B-coded options offer a chance for students on the SM stream to be investigate some of the computational data science and engineering aspects that is more specific to the CDSE stream.

**Stream CDSE - Computational Data Science and Engineering:**

B31XM: Information theory and communications

B31XO: Sampling and computational Imaging

B31XN: Scalable inference and deep learning

B31XP: Multi-disciplinary group project

B31EZ: Critical Analysis and Research Preparation

**Note:** Combinations of optional courses, other than those in the streams described above, are not permitted for reasons of pedagogical coherency.

**Project and Dissertation phase:**

Students on Stream SM will register for F71DD and supervision will be led by MACS staff.

Students on Stream CDSE will register for B31VZ and supervision will be led by EPS staff.

<table>
<thead>
<tr>
<th>Credits Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory Credits</td>
<td>45</td>
</tr>
<tr>
<td>Optional Credits</td>
<td>75</td>
</tr>
<tr>
<td>Elective Credits</td>
<td></td>
</tr>
<tr>
<td>Dissertation Credits</td>
<td>60</td>
</tr>
</tbody>
</table>
AWARDS, CREDITS AND CRITERIA (PG)

| Awards, Credits and Levels | Overall Credits | Specific Requirements |
|----------------------------|----------------|
| Masters Degree            | 180            | 180 SCQF credits including a minimum of 150 credit at Level 11 |
| Postgraduate Diploma      | 120            | 120 SCQF credits including a minimum of 90 credit at Level 11 |
| Postgraduate Certificate  | 60             | 60 SCQF credits including a minimum of 40 credit at Level 11 |

Award Requirements

<table>
<thead>
<tr>
<th>Award Requirements</th>
<th>Total Course Passes</th>
<th>Overall Mark</th>
<th>Overall Grade</th>
<th>Basis of Overall Mark/Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master (Distinction)</td>
<td>8+Dissertation</td>
<td>70</td>
<td>A</td>
<td>Credit Weighted Average greater than or equal 70% over 8 courses at grades A-C plus a Dissertation at grade A.</td>
</tr>
<tr>
<td>Master</td>
<td>8+Dissertation</td>
<td>50</td>
<td>C</td>
<td>Credit Weighted Average greater than or equal 50% over 8 courses at grades A-D plus a Dissertation at minimum grade C.</td>
</tr>
<tr>
<td>Diploma (Distinction)</td>
<td>8</td>
<td>70</td>
<td>A</td>
<td>Credit Weighted Average greater than or equal 70% over 8 courses at grades A-C</td>
</tr>
<tr>
<td>Diploma</td>
<td>8</td>
<td>40</td>
<td>D</td>
<td>Credit Weighted Average greater than or equal 40% over 8 courses at grades A-E</td>
</tr>
<tr>
<td>Certificate</td>
<td>4</td>
<td>40</td>
<td>D</td>
<td>Credit Weighted Average greater than or equal 40% over 4 courses at grades A-E</td>
</tr>
</tbody>
</table>

DURATION OF STUDY

<table>
<thead>
<tr>
<th>IN MONTHS</th>
<th>Full-time</th>
<th>Part-time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masters</td>
<td>12</td>
<td>24</td>
</tr>
<tr>
<td>Diploma</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Certificate</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

RE-ASSESSMENT (PG)

1. A student who has been awarded a Grade E or F in a course may be re-assessed in that course. A student who has been awarded a Grade D in a course may be re-assessed in that course in order to proceed to or be eligible to receive the award of Masters.
2. A student shall be permitted only one re-assessment opportunity in a maximum of three taught courses. The opportunity for re-assessment in four or more taught courses shall be at the discretion of the Progression Board.
3. Any further re-assessment opportunities in a course will require the approval of the Postgraduate Studies Committee.
4. A student may be permitted, at the discretion of the Progression Board, to be re-assessed in the dissertation, project or other supervised research component of the course of study.

Re-assessment opportunities for this programme will be in the next academic year.

PROGRESSION TO DISSERTATION/PROJECT

In accordance with University Regulations, to progress to Masters level a minimum of Grade C is required