# Programme Specification

# Data and Decision Analytics (2019-20)

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.

| | |
|---|---|
| Awarding Institution | University of Southampton |
| Teaching Institution | University of Southampton, University of Southampton, Malaysia Campus |
| Mode of Study | Full-time |
| Duration in years | 1 |
| Accreditation details | None |
| Final award | Master of Science (MSc) |
| Name of Award | Data and Decision Analytics |
| Interim Exit awards | Postgraduate Certificate |
| | Postgraduate Diploma |
| FHEQ level of final award | Level 7 |
| UCAS code | N/A |
| Programme Code | 8212 |
| QAA Subject Benchmark or other external reference | Mathematics, Statistics And Operational Research 2007 |
| Programme Lead | Joerg Fliege (jf1w07) |
| Pathway Lead | |

## Programme Overview

**Brief outline of the programme**

Having a good understanding of the process of deriving actionable insights from data has enormous benefits. The MSc programme in Data and Decision Analytics provides students with the ideal skill sets in mathematical modelling, statistical analysis, and computation to help make better decisions based on data. These prepare students to pursue a wide variety of career opportunities in commercial companies or the public sector. This programme, with its vocational focus, is designed to provide training in a broad range of analytical skills as well as soft skills (e.g. in communicating results to managers/executives). The MSc programme is also an excellent preparation for embarking on a PhD programme in Operational Research, Statistics, or Data Science.

A highlight of the programme is the three-month summer project: it may be either in Operational Research, Statistics, or Data Science (or the interface between the three). You will have the option to bid for an external project, which is usually based nearby in a sponsor organisation and requires working on a real problem of practical importance to the sponsor. You also have the option to work on an internal project which might involve data from external sources. The MSc project consists of an individual investigation and is under the supervision of a member of staff. This project enables students to integrate and consolidate skills learned on the course (and to fulfil deliverables for the sponsoring organisation in the case of an external project).

A dissertation on the project work must be submitted soon after the end of the taught period of study and students are required to complete their work by the middle of September.
Your contact hours will vary depending on your module/option choices. Full information about contact hours is provided in individual module profiles.

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**Learning and teaching**
The full-time MSc is completed over a 12-month period. There are two semesters of taught material, which account for 60 ECTS (120 CATS), together with an MSc project (typically undertaken in the summer), which accounts for 30 ECTS (60 CATS).

The structure of the programme provides you first with the necessary foundations in Operational Research and Statistics. It then allows you to select several option modules from a broad range of topics so that you can specialise in Operational Research, Statistics, or Data Science (or choose a balanced portfolio of options). These modules are complemented by careers talks, with speakers from a wide range of organisations providing an appreciation of the developments in, and use of, Operational Research, Statistics, and Data Science in practice, and presentations on employability skills.

Training and education in the theory and methods of Operational Research, Statistics, and Data Science are provided, with an emphasis on practical problems arising in organisational contexts. The skill sets include mathematical modelling, numerical computation and computer programming, and collecting and analysing data.

While studying for your degree, you will develop key transferrable skills, such as written and oral communication, presentation skills, teamwork, the use of IT (e.g. for Optimisation, Simulation, and Statistical software), time management, and basic research skills including the use of the web and the library.

**Assessment**
The taught element of the programme comprises two semesters of taught material, with assessment via coursework assignments and examinations, which take place at the end of each semester. The MSc programme is completed, subject to achievement of progression requirements, with a project lasting typically 3 months.

# Special Features of the programme

The CORMSIS Business Advisory Board: This Business Advisory Board is a good indicator of the high regard in which the Southampton MSc programmes involving Operational Research are held by outside organisations. Its purpose is to ensure that the MSc programmes produce graduates with the requisite skills for the needs of industry. It also provides a focal point for liaison between the OR Group and industry. You have the chance to meet the Committee several times during the year. Major companies including JP Morgan, Ford, Shell, Rolls Royce, BT, Boeing, Tesco, Dstl and HM Revenue & Customs are represented on the Advisory Board.

**Please note:** As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our Disclaimer to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's programme validation process which is described in the University's Quality handbook.

# Educational Aims of the Programme

1.     train you in the theory and methods of applied statistics to an advanced level;
2.     introduce you to the main techniques, methods and approaches of operational research, emphasising both the underlying concepts and their practical application;
3.     introduce you to the main techniques, methods and approaches in data science, emphasizing a variety of applications;
4.     offer you the opportunity to study more specialised topics selected from a range of options, but within a coherent framework;
5.     develop your operational research, statistical, and data science skills for problem solving, including (a) mathematical modelling of deterministic and stochastic systems, and designing solution approaches; (b) statistical modelling;
6.     give you the opportunity of gaining practical experience of applying the problem-solving skills you have

learned, by working on a project with an external organisation;
7.       develop key transferable skills, including personal organisation, teamwork, finding and using information, and written and oral communication;
8.       develop programming skills in R and in Python.
Students who undertake the dissertation stage of the programme should also be able to demonstrate:

9.       An in-depth knowledge and understanding of an individually researched topic studied as the main project;
10.      Skill in organising their research work and in presenting their findings by the production of a substantial dissertation on their chosen project topic.


# Programme Learning Outcomes


## Knowledge and Understanding


On successful completion of this programme you will have knowledge and understanding of:

A1.     operational research methodology including the role of mathematical models in problem solving;
A2.     statistical theory at an advanced level;
A3.     a range of techniques from deterministic and stochastic operational research and data science that are required for tackling a variety of practical problems;
A4.     the application of statistical methods to practical problems in new or unfamiliar environments;
A5.     statistical modelling techniques used in the analysis of statistical data;
A6.     the use of IT resources, including optimisation packages,  major statistical analysis packages such as R, and generic data science languages such as Python;
A7.     an individual research topic, and skills in organising research work and in presenting findings by the production of a dissertation.


### Teaching and Learning Methods

Acquisition of knowledge and understanding is through structured exposition based on lectures (A1 - A6), computer workshops (A1, A3, A4, A5, A6), tutorials (A1, A2, A3, A4, A6), individual and group work (A1, A3, A4), private study (A1 - A7), seminars and case studies (A1, A3, A4), and a supervised project (A7).


### Assessment Methods

Every module is assessed, either by an examination or coursework, or a combination of both. Some of the coursework requires the use of specialist optimisation, simulation, statistical, or data mining software to solve problems and to build models. Other key requirements are to write reports and to give oral presentations.

Examinations will primarily assess learning outcomes A1, A2, A3, coursework will primarily assess A1, A3, A4, A5, and A6 and the dissertation will assess A7 (and others, depending on the nature of the topic).


## Subject Specific Intellectual and Research Skills


On successful completion of this programme you will be able to:

B1. evaluate quantitative management problems and to construct appropriate mathematical, computational, or statistical models;

B2. use computer packages for certain techniques in operational research, statistics, and data science; including interpretation of the output;

B3. apply operational research, statistical, and/or data science techniques and approaches to a real-life project;

B4. discuss and communicate ideas/results orally and in written form to specialist and non-specialist audiences;

B5. analyse mathematical models and select a suitable solution methodology;

B6. synthesise various statistical techniques to carry out and interpret statistical analyses;

B7. synthesise relevant materials acquired from the library and internet.

B8. apply core operational research techniques, such as mathematical programming (linear, nonlinear integer programming), game theory, simulation and statistical methods. (For students who choose to specialise more on operational research)

B9. design a statistical experiment and conduct the appropriate analysis in new or unfamiliar environments, and critically assess the use of particular statistical techniques in practice. (For students who choose to specialise more on statistics)

B10. apply core data science techniques, such as data mining, machine learning, and data visualization, and critically assess the use of particular data mining techniques in practice. (For students who choose to specialise more on data science)

### Teaching and Learning Methods

The use of mathematical and statistical models and their interpretation by applying suitable techniques is fundamental in operational research, statistics, and data science, and so this is emphasised throughout the teaching and learning experience. Computer work is an integral part of the programme, and specialist computer packages are used for mathematical programming, simulation and statistics. Computer programming is taught through Python, statistical analysis through R, and spreadsheet modelling through Excel. The subject specific skills are covered in lectures, computer workshops, tutorials, seminars and group work.

### Assessment Methods

The various methods of assessment described involve analysis, modelling and problem solving (B1, B4-B10). Where computer work is involved, coursework is the vehicle whereby the skills learned are assessed (B2). The project, involving a practical application of operational research, statistics, and/or data science, is assessed by a dissertation (B3).

## Transferable and Generic Skills

On successful completion of this programme you will be able to:

C1. write reports on your analysis of a problem together with your results and conclusions to specialist and non-specialist audiences;

C2. present the results of your work by means of oral presentations;

C3. manage an individual research project;

C4. demonstrate teamwork skills;

C5. collect and synthesise information from a variety of sources including the internet, textbooks and journal articles;

C6. apply IT skills and use various software packages in use for data science, optimisation, simulation and statistics;

C7. organise your research work and the presentation of findings by the production of a substantial dissertation on an individual research topic;

C8.     contribute confidently and appropriately to discussion;
C9.     practice the skills you have acquired (organisation, time management, problem solving, critical analysis, independent learning, etc.) that will support lifelong learning.

**Teaching and Learning Methods**

A variety of methods of teaching and learning are used, appropriate to the learning outcomes as described above. An induction programme teaches written and oral communication skills, and teamworking, and these skills are used in several modules. Written and oral communication skills are developed further in the module Presenting Reports. The use of IT plays an important role throughout the programme. During the project, your portfolio of skills, including library research, time management and communication, is developed further.

**Assessment Methods**

Throughout the programme, the clear communication of your analysis and problem-solving approach is part of the assessment criteria, either implicitly or explicitly. For the coursework and project work, a proportion of the assessment is related to communication (C1 and C2) and where appropriate to the appropriate use of IT (C6) and to internet and library research (C5). Some coursework involves working in groups, and a proportion of the assessment is assigned to teamwork skills (C4). The dissertation will assess the skill set in (C1, C2, C3, C5, C6, C7, C8 and C9). The skills referred to in C9 are implicit in all modules, and their mastery will contribute to the overall standard of your work.

# Programme Structure

The programme structure table is below:

Information about pre and co-requisites is included in individual module profiles.

Where optional modules have been specified, the following is an indicative list of available optional modules, which are subject to change each academic year. Please note in some instances modules have limited spaces available.

## Pathway

Part I
Typical programme content

This programme, with its vocational focus, is designed to provide a firm grounding in Data Science and Decision Analytics, as well as practical experience of applying methods from both fields. This is combined with training in a broad range of additional numerate skills covering mathematical modelling and optimization. It is thus suitable preparation for a career in a variety of sectors. The programme will equip students with a range of in-demand skills for extracting and handling 'big data', discovering and communicating meaningful patterns from the data, and applying sophisticated tools from mathematics, operational research, and statistics, to help businesses and government organisations make better decisions. It has close links with the MSc Operational Research in Mathematical Sciences and the MSc in Business Analytics in Southampton Business School, with many optional modules available to both sets of students and a common set of projects on which to base a dissertation.

## Programme details

The structure of the programme and the modules currently offered are set out below. Of the modules shown, some are compulsory (i.e. enrolment is automatic) and others are option modules. Against each semester, you are directed to which modules are compulsory and which are options. The option modules listed constitute an indicative list. There will always be choice but the options might vary between years. A complete list of option modules currently available on your programme can be found via the Student Record Self-Service system (https://studentrecords.soton.ac.uk/BNNRPROD/bwkkspgr.showpage?page=ESC_PROGCAT_FINDPR).

A flexible and inclusive approach to learning and teaching will enable any student who meets the entry requirements to access the curriculum and demonstrate achievement of all the intended learning outcomes. This approach should minimise the need for individual alterations to be made for students with particular learning needs.

The University works within a Credit Accumulation and Transfer Scheme (CATS) and the European Credit Transfer Scheme (ECTS), full details of which are in the University Calendar (http://www.calendar.soton.ac.uk/sectionIV/cats.html).

The programme is normally studied over 12 months full-time or 24 months part-time. The taught component of the programme consists of 30 study weeks divided into two semesters during which time students study 60 ECTS/120 CATS. Students who successful complete the taught component undertake a three-month period of supervised research for a Master's dissertation at a value of 30 ECTS/60 CATS.

### Part I Compulsory
In addition to the following modules, MATH6167 (CORMSIS practitioner talks and project briefings) is also Compulsory (0 credits).

| Code | Module Title | ECTS | Type |
|------|-------------|------|------|
| MATH6161 | Deterministic OR Methods for Data Scientists | 3.75 | Compulsory |
| MATH6005 | Introduction to Python | 3.75 | Compulsory |
| MATH6168 | Machine Learning | 7.5 | Compulsory |
| MATH6145 | Presenting Reports | 3.75 | Compulsory |
| MATH6001 | Project | 30 | Compulsory |
| MATH6166 | Statistical Computing for Data Scientists | 3.75 | Compulsory |
| MATH6170 | Statistical Inference for Data Scientists | 7.5 | Compulsory |
| MATH6164 | Stochastic OR Methods for Data Scientists | 3.75 | Compulsory |

### Part I Option
Select 52.5 credits from the following:

| Code | Module Title | ECTS | Type |
|------|-------------|------|------|
| MATH6169 | Flexible Regression | 7.5 | Optional |
| MATH6119 | Analytical Consultancy Skills | 3.75 | Optional |
| MATH6025 | Bayesian Methods | 3.75 | Optional |
| MATH6112 | Computer-based statistical modelling | 3.75 | Optional |
| MANG6054 | Credit Scoring and Data Mining | 3.75 | Optional |
| MATH6147 | Data Analytics | 3.75 | Optional |
| COMP6237 | Data Mining | 7.5 | Optional |
| COMP6234 | Data Visualisation | 7.5 | Optional |
| MATH6027 | Design of Experiments | 7.5 | Optional |
| MATH6017 | Financial Portfolio Theory | 3.75 | Optional |
| MATH6011 | Forecasting | 3.75 | Optional |
| MANG6100 | Game Theory for Business | 3.75 | Optional |
| MATH6158 | Managing Uncertainty and Risk | 3.75 | Optional |
| MANG6229 | Multivariate Statistics for Data Mining | 3.75 | Optional |

| Code | Module Title | ECTS | Type |
|------|-------------|------|------|
| MATH6120 | Nonlinear Optimisation | 3.75 | Optional |
| MATH6146 | Revenue Management | 3.75 | Optional |
| MATH6021 | Survival Analysis | 3.75 | Optional |

Part II


Part II Compulsory

| Code | Module Title | ECTS | Type |
|------|-------------|------|------|
| MATH6001 | Project | 30 | Compulsory |


## Progression Requirements

The programme follows the University's regulations for *Progression, Determination and Classification of Results : Undergraduate and Integrated Masters Programmes* and *Progression, Determination and Classification of Results:  Postgraduate Master's Programmes* as set out in the University Calendar: http://www.calendar.soton.ac.uk/sectionIV/sectIV-index.html

## Support for student learning

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 Hartley Library.
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling. Support includes daily Drop In at Highfield campus at 13.00 – 15.00 (Monday, Wednesday and Friday out of term-time) or via on-line chat on weekdays from 14.00 – 16.00. Arrangements can also be made for meetings via Skype.
- assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia)
- 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 and Employability services, 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.
- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls and in the local community (18.00-08.00).
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.

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.

Associated with your programme you will be able to access:

· Module co-ordinators support. Module co-ordinators will be available at designated times during the week to discuss issues related to the particular modules you are studying at the time. This will be in addition to class contact time.
· Personal academic tutor.  As soon as you register on this programme, you will be allocated a personal academic tutor.  S/he is a member of the academic team and will be available to discuss general academic issues related to the programme as well as offer advice and support on any personal issues which may affect your studies.
· Module handbooks/outlines.  These will be available at the start of each module (often in online format). The handbook includes the aims and learning outcomes of the module, the methods of assessment, relevant background material to the module and a session-by-session breakdown of the module together with appropriate reading lists.
· Within the Faculty, administrative support is provided by your Student Office which deals with student records and related issues and with queries related to your specific degree programme.

## Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

· Regular module and programme reports which are monitored by the Faculty.
· Programme validation, normally every five years.
· External examiners, who produce an annual report.
· A national Research Excellence Framework (our research activity contributes directly to the quality of your learning experience).
· Institutional Review by the Quality Assurance Agency.

The programme content is regularly reviewed by the CORMSIS Business Advisory Board. This ensures that you will be taught topics held to be important by business and industry.

Further details on the University's quality assurance processes are given in the *Quality handbook*.

## Career Opportunities

Having a good understanding of the process of deriving actionable insights from data has enormous benefits. Data scientists help organisations handle large amounts of data being produced thanks to digital technologies. Data science has seen an unparalleled expansion as the data-driven economy grows. Increasingly organisations require skilled professionals who can handle large datasets and managers who can utilise the resulting analysis to make impactful decisions. Decision Analytics is the application of scientific methods to the study of complex organisational problems. Even within the same organisation, Decision Analytics tends to be highly varied because of its project-driven nature. This breadth of experience offers an exciting and rewarding career in many organisations.

As a graduate in Data and Decision Analytics, you will be ideally equipped to not only design and use data science applications and to analyse and reason about data, but also to infer optimal decisions based on data. This will enable many Data and Decision Analysts to progress to a career in general management. Moreover the nature of the work brings a Data and Decision Analytics graduate into early contact with senior management and it can offer opportunities for rapid career advancement.

Here is a (by no means complete) list of typical careers for graduates in Data and Decision Analytics:

· Consultancy as a Data Analyst, Operational Researcher, or Statistician.
· Data Scientist or Operational Researcher to provide strategic planning or improving operation in an organisation, in Business and Governments

- Investment Banking & Finance, Data Analysis, Revenue Management
- Analyst in start-ups based around new opportunities in the booming data-driven economy;
- Statistician in government, finance, insurance, market research, Environmental Statistician (e.g. in environmental organisations),
- Study for a PhD in Operational Research, Statistics, or Data Science
- University Lecturer

## External Examiner(s) for the programme

Name: Dr Jonathan Thompson - Cardiff University

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their Personal Academic Tutor in the first instance.

**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. More detailed information can be found in the programme handbook.

# Appendix 1:

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory 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 also have to pay for:

**Additional Costs**

| Type | Details |
|---|---|
| Stationery | You will be expected to provide your own day-to-day stationary 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 prefer to buy their own copies. These can be purchased from any source.<br><br>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. |
| Placements (including Study Abroad Programmes) | Students who are allocated to summer projects with external companies outside Southampton might receive relocation support. Details will be arranged between the student, the company and the MSc program coordinator. |
| 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 models are Casio FX-570 and Casio FX-85GT Plus. These may be purchased from any source and no longer need to carry the University logo. |
| Design equipment and materials | Standard construction/modelling materials will be provided where appropriate, unless otherwise specified in a module profile.<br><br>For customisation of designs/models calling for material other than standard construction/ modelling materials, students will bear the costs of such alternatives. |
| 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: https://www.southampton.ac.uk/isolutions/students/printing-for-students.page |

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.