

PROGRAMME SPECIFICATION

Bachelor of Science with Honours (SW) in Mathematics and Data Science

Awarding institution	Liverpool John Moores University
Teaching institution	LJMU
UCAS Code	GG14
JACS Code	G100
Programme Duration	Full-Time: 3 Years, Sandwich Thick: 4 Years
Language of Programme	All LJMU programmes are delivered and assessed in English
Subject benchmark statement	Mathematics, Statistics & Operational Research (MSOR) 2015
Programme accredited by	Institute of Mathematics & its Applications
Description of accreditation	This programme will meet the educational requirements of the Chartered Mathematician designation, awarded by the Institute of Mathematics and its Applications, when it is followed by subsequent training and experience in employment to obtain equivalent competences to those specified by the Quality Assurance Agency (QAA) for taught masters degrees.
Validated target and alternative exit awards	Bachelor of Science with Honours in Mathematics and Data Science Bachelor of Science with Honours (SW) in Mathematics and Data Science Diploma of Higher Education in Mathematics and Data Science Diploma in Higher Education (SW) in Mathematics and Data Science Certificate of Higher Education in Mathematics and Data Science
Programme Leader	Ian Malabar

Educational aims of the programme

This programme provides a solid grounding in how mathematics, statistics and data science, supported by IT solutions, are applied to the analysis of big data encountered in industry, business and research organisations. Hence it may be characterised as 'practice-based' (as referred to in the MSOR benchmark statement).

Its main aims are:

- to provide students with an opportunity to enhance their mathematical and statistical education by studying broad, yet integrated subjects which have application in data science.
- to produce graduates with the mathematical and statistical knowledge to model, solve and analyse problems using the increasingly sophisticated quantitative techniques adopted by major commercial institutions.
- to provide students with a comprehensive understanding of current and developing data science approaches.
- to provide students with relevant technical skill and experience in the application of the methodologies and techniques of data science.
- the development in students of skills which can be utilised in unfamiliar situations, e.g. the ability to conjecture, justify and evaluate.
- to enhance students' key and transferable skills such as communication, applications of IT, working with others, improving their own learning, etc.
- to develop in students an awareness of knowledge and skills necessary for a career as a data scientist.
- to produce graduates capable of progression to postgraduate areas of study in data science and in mathematical and statistical disciplines in general.
- to encourage students to engage with the development of employability skills by completing a self-awareness statement.

- for students undertaking a placement year the aim is to provide students with an extended period of work experience at an approved partner that will complement their programme of study at LJMU. This will give the students the opportunity to develop professional skills relevant to their programme of study, as well as attitude and behaviours necessary for employment in a diverse and changing environment.

Alternative Exit/ Interim Award Learning Outcomes - Certificate of Higher Education

A student who is eligible for this award will be able to:

- Develop a thorough grounding in the basic mathematical concepts and methods needed to solve a range of problems with scientific, business and statistical applications.
- Appropriately use mathematical and other software to support conceptual understanding and problem solving.
- Explore and analyse a set of data either 'by hand' or using statistical software, e.g. Minitab.
- Develop the required background knowledge of probability and random variables so that they can make use of a number of formal statistical models in their analyses.
- Develop computer programs using elementary programming constructs.
- Apply the theoretical techniques of linear algebra in a practical context.
- Discuss a range of practical aspects of data science and apply the associated tools and techniques used.
- Develop robust models for the storage and processing of data.

Alternative Exit/ Interim Award Learning Outcomes - Diploma of Higher Education

A student who is eligible for this award will be able to:

- Use simple and multiple linear regression models and one-way and two-way Analysis of Variance models.
- Apply probability distributions to tests of statistical inference.
- Employ techniques of risk management through which they can assist decision makers in making informed decisions in the face of uncertainty.
- Understand computing in an increasingly sophisticated technological world.
- Understand the principles of designing, deriving and developing solutions through the application of data scientific approaches.
- Evaluate the appropriateness of different approaches to problem solving.
- A student who successfully completes a placement year will be eligible for the Sandwich award and will, in addition to the above, be able to demonstrate the professional and personal skills necessary for effective employment within a professional environment.

Target award Learning Outcomes - Bachelor of Science with Honours (SW)

A student successfully completing the programme of study will have acquired subject knowledge and understanding as well as skills and other attributes.

Knowledge and understanding

A student who is eligible for this award will be able to:

- A1. Demonstrate their knowledge and understanding of a range of fundamental areas of mathematics, statistics and data science.
- A2. Apply analytical techniques and algorithms to solve quantitative problems relating to data science.
- A3. Use and apply a range of mathematical and statistical software to solve problems.
- A4. Identify the role of computers and I.T. in data science and apply programming techniques.
- A5. Apply a range of tools, techniques and approaches currently being used in the application of data science.
- A6. Critically analyse innovative data science technologies and implement those technologies efficiently and effectively as an individual or as part of a team.

Teaching, learning and assessment methods used to enable outcomes to be achieved and demonstrated

Core knowledge and understanding is acquired via lectures, tutorials, practical computing sessions, team working and guided independent study. Independent study is used where appropriate resource material is

available and increases as the programme progresses.

Assessment

Assessment methods are specified in each module specification. All learning outcomes in a module are assessed and the type of assessment specified for each outcome. Each module is assessed by examination and/or course work (individual or group). The nature of the course work varies for each module.

Skills and other attributes

Intellectual Skills

A student who is eligible for this award will be able to:

- B1. Represent and explore relationships between algebraic, numerical and graphical forms of representation.
- B2. Model systems in a data science context: conjecture, hypothesis, analysis, inference, conclusion, interpretation, evaluation.
- B3. Apply appropriate problem-solving strategies and select appropriate tools.
- B4. Synthesise a balanced viewpoint from a variety of (potentially contradictory) evidence and perspectives.
- B5. Demonstrate the skills necessary to plan, undertake and report on a project of original research.
- B6. Creatively deploy appropriate tools and techniques for the development of data science applications.

Teaching, learning and assessment methods used to enable outcomes to be achieved and demonstrated

Intellectual skills are developed and applied through class discussion, individual and group practical work, tutorials and course work assignments.

Assessment

Intellectual skills are assessed via formal examinations and through course work assessment.

The final year project, involving a major report and oral presentation, allows a student to demonstrate his/her cognitive skills.

Professional practical skills

A student who is eligible for this award will be able to:

- C1. Model real world situations.
- C2. Use a wide range of appropriate software packages for the analysis/synthesis of information.
- C3. Write and test computer programs.
- C4. Communicate technical issues in non-technical language.
- C5. Plan and manage course/project work.
- C6. Present their work in a professional manner using appropriate I.T. and graphical software.
- C7. Deploy effective data science solutions.

Teaching, learning and assessment methods used to enable outcomes to be achieved and demonstrated

Practical skills are developed throughout the programme, and are reinforced in practical sessions at each level. The basic skills are provided at the lower levels. These are supplemented at higher levels by more advanced tools and techniques. Some of these skills are practised in the placement year.

Specialist software is available in School labs or from specified PCs in the libraries.

Assessment

Assessment is normally by course work and formal, written, timed examination.

The placement year is assessed, by portfolio, on a pass / fail basis.

Transferable / key skills

A student who is eligible for this award will be able to:

- D1. Use information technology, e.g. Internet, for effective information retrieval.
- D2. Apply problem solving skills.

D3. Communicate effectively by written or verbal means.

D4. Plan and manage learning and development.

Teaching, learning and assessment methods used to enable outcomes to be achieved and demonstrated

Key skills are developed throughout the programme in a variety of forms, specifically through a combination of research related coursework, guided independent study and projects, examinations, group work and presentations. Skill 1 is developed through a combination of research-related coursework, guided independent study, and projects. Skill 2 is developed through study of technical methods, modelling exercises, examinations, coursework, and projects. Skill 3 is developed through report writing for coursework and projects, written examinations, teamwork, presentations, and group discussion. Skill 4 is developed via the management of learning tasks and deadlines for coursework and projects.

Assessment

Key skills are assessed as part of coursework (1-4), projects (1-4), written examinations (2, 3) and presentations (3).

Alternative target awards

A student who is eligible for the following awards will be able to:

Bachelor of Science with Honours in Mathematics and Data Science -

A student successfully completing this award will have acquired the subject knowledge and understanding as well as skills and other attributes as detailed above but will not have successfully completed a placement year.

Programme structure - programme rules and modules

Programme rules

The placement year, module 5102APMATH, will follow Level 5 and students will be enrolled on a 480 credit honours sandwich programme. The Level 5 mean for the final award mark will be calculated based upon the 240 credits at Level 5. Students successfully completing the assessment of the placement year are eligible for a Sandwich award.

Students not undertaking a placement year are registered on the non-sandwich version of the programme and will have the opportunity of an additional study year abroad following Level 5. Students will be enrolled on a 480 credit honours with study abroad programme. Of those 480 credits, 120 will be taken via a Level 5 study abroad module 5106APMATH. The modules to be studied in the host institution must be agreed in advance. The Level 5 mean for the final award mark will be calculated based upon the 240 credits at Level 5.

Level 6	Potential Awards on completion	Bachelor of Science with Honours (SW)
Core	Option	Award Requirements
6100MATHS PROJECT (40 credits) 6106STATS MULTIVARIATE ANALYSIS AND DATA MINING (20 credits) 6123COMP ADVANCED AND DISTRIBUTED DATABASES (20 credits) 6124COMP BIG DATA, TOOLS AND ANALYSIS (20 credits) 6126COMP ADVANCED ANALYTICS (20 credits)		120 core credits at level 6 0 option credits at level 6
Level 5	Potential Awards on completion	
Core	Option	Award Requirements
5101STATS STATISTICAL MODELLING (20 credits) 5102COMP DATABASE SYSTEMS (20 credits) 5103MATHS NUMERICAL METHODS (20 credits) 5103STATS PROBABILITY AND RISK (20 credits)		120 core credits at level 5 0 option credits at level 5

5124COMP DATA SCIENCE AND ANALYTICS (20 credits) 5126COMP DATA WAREHOUSING AND MINING (20 credits)		
Level 4	Potential Awards on completion	
Core	Option	Award Requirements
4100COMP INTRODUCTION TO PROGRAMMING (20 credits) 4100STATS DATA EXPLORATION AND ANALYSIS (20 credits) 4101MATHS MATHEMATICAL METHODS (20 credits) 4110MATHS LINEAR ALGEBRA (20 credits) 4117COMP FUNDAMENTALS OF DATA SCIENCE (20 credits) 4123COMP PROBLEM SOLVING FOR DATA SCIENCE (20 credits)		120 core credits at level 4 0 option credits at level 4

Information about assessment regulations

All programmes leading to LJMU awards operate within the University's Academic Framework.
<https://www.ljmu.ac.uk/about-us/public-information/academic-quality-and-regulations/academic-framework>

Opportunities for work-related learning (location and nature of activities)

5102APMATH Sandwich Year Mathematics with Data Science - The aim is to provide students with an extended period of work experience at an approved partner that will complement their programme of study at LJMU. This will give students the opportunity to develop professional skills relevant to their programme of study as well as the attitude and behaviours necessary for employment in a diverse and changing environment.

6123COMP Advanced and Distributed Databases – This module provides modern database modelling experience, thus developing real hands-on experience of distributed database developments.

6126COMP Advanced Analytics – This practical module generates effective analytical modelling experience, thus developing real hands-on experience of data science applications.

Criteria for admission

A/AS Level

112 UCAS points to include 2 A-levels or Double Award (to include A2 Maths grade C or above)

BTEC National Diploma

BTEC Extended Diploma

To the value of 112 UCAS points

BTEC Diploma / 90 Credit Diploma / Subsidiary Diploma /Certificate

To the value of 112 UCAS points when combined with other qualifications. Must include appropriate Mathematical content.

Irish Leaving Certificate

Applicants should have or expect to obtain a total of 112 UCAS points overall, including appropriate Mathematical content.

Scottish Higher

Applicants should have or expect to obtain a total of 112 UCAS points overall, including appropriate Mathematical content.

International Baccalaureate

Applicants should have or expect to obtain a total of 112 UCAS points overall, including Higher Level Maths at grade 5.

Higher national diploma

Pass with Maths at Level 3

Other

In addition to 112 UCAS points applicants should have five GCSEs at grade C or above including GCSE Mathematics grade C and English Language grade C or equivalent.

Mature entry

Without the necessary qualifications but relevant experience are encouraged to apply and may be requested to attend an interview and aptitude test.

Overseas qualifications

Offers will be based on individual qualifications and experience. All applicants should have achieved IELTS 6.0

External Quality Benchmarks

All programmes leading to LJMU awards have been designed and approved in accordance with the UK Quality Code for Higher Education, including the Framework for Higher Education Qualifications in the UK (FHEQ) and subject benchmark statements where applicable.

The University is subject to periodic review of its quality and standards by the Quality Assurance Agency (QAA) Published review reports are available on the QAA website at www.qaa.ac.uk

Programmes which are professionally accredited are reviewed by professional, statutory and regulatory bodies (PSRBs) and such programmes must meet the competencies/standards of those PSRBs.

Support for students and their learning

The University aims to provide students with access to appropriate and timely information, support and guidance to ensure that they are able to benefit fully from their time at LJMU. All students are assigned a Personal Tutor to provide academic support and when necessary signpost students to the appropriate University support services.

Students are able to access a range of professional services including:

- Advice on practical aspects of study and how to use these opportunities to support and enhance their personal and academic development. This includes support for placements and careers guidance.
- Student Advice and Wellbeing Services provide students with advice, support and information, particularly in the areas of: student funding and financial matters, disability, advice and support to international students, study support, accommodation, health, wellbeing and counselling.
- Students studying for an LJMU award at a partner organisation will have access to local support services

Methods for evaluating and improving the quality and standards of teaching and learning

Student Feedback and Evaluation

The University uses the results of student feedback from internal and external student surveys (such as module evaluations, the NSS and PTES), module evaluation questionnaires and meetings with student representatives to improve the quality of programmes.

Staff development

The quality of teaching is assured through staff review and staff development in learning, teaching and assessment.

Internal Review

All programmes are reviewed annually and periodically, informed by a range of data and feedback, to ensure quality and standards of programmes and to make improvements to programmes.

External Examining

External examiners are appointed to programmes to assess whether:

- the University is maintaining the threshold academic standards set for awards in accordance with the FHEQ and applicable subject benchmark statements
- the assessment process measures student achievement rigorously and fairly against the intended outcomes of the programme(s) and is conducted in line with University policies and regulations
- the academic standards are comparable with those in other UK higher education institutions of which external examiners have experience
- the achievement of students are comparable with those in other UK higher education institutions of which the external examiners have experience

and to provide informative comment and recommendations on:

- good practice and innovation relating to learning, teaching and assessment observed by external examiners
- opportunities to enhance the quality of the learning opportunities provided to students

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 he/she takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content, teaching, learning and assessment methods of each module can be found in module and programme guides.