Programme Specification for BSc Mathematics Joint Honours

1.	Awarding institution/body	University of Worcester
2.	Teaching institution	University of Worcester
3.	Programme accredited by	N/A
4.	Final award	BSc (Hons)
5.	Programme title	Mathematics
6.	Pathways available	Joint
7.	Mode and/or site of delivery	Standard taught programme, onsite at University of Worcester
8.	Mode of attendance	Full-time and part-time study
9.	UCAS Code	Biology and Mathematics CG11, Computing and Mathematics GI11, Education Studies and Mathematics GX13, Geography and Mathematics FX83, Physical Education and Mathematics GX15 Psychology and Mathematics GC18
10.	Subject Benchmark statement and/or professional body statement	2007 QAA Subject benchmark statement for Mathematics, Statistics and Operational Research and the draft (2015) QAA Subject benchmark statement for Mathematics, Statistics and Operational Research (currently under review)
11.	Date of Programme Specification preparation/ revision	April 2015, July 2015 (PAT)

12. Educational aims of the programme

Mathematics is available as a Joint Honours course where every effort has been made to design the content of the modules so that they include (but are not limited to) examples of problems which may be experienced in students' other subjects. The overall aim is to provide a modern practice-based course in mathematics and statistics, which develops the logical and analytical problem solving skills required for the practical application of a range of mathematics and statistics methods and modelling techniques, using of a range of modern software.

In particular the programme aims to:

- develop the skills and knowledge relating to the practical application of mathematics and statistics, when applied to solving real problems or analysing real data sets in a typical work or research related environment using modern software that will enhance students' employability opportunities;

- offer a stimulating curriculum that provides a sound theoretical foundation in core areas of mathematics and statistics, and provides an opportunity to study a broad range of mathematical and statistical methods and techniques appropriate for a Joint Honours mathematics graduate;

- develop intellectual abilities in abstract reasoning, logical deduction, logical argument and problem solving;

- enable students to develop a range of subject-specific skills and knowledge and transferable skills to prepare them for the many and varied areas of employment relevant to graduates in mathematics, or for postgraduate study or research;

- offer a curriculum that allows flexible choice to study additional advanced topics in either mathematics or statistics so as to allow students to pursue a curriculum that is relevant to their second Joint Honours subject or their career aspirations.

The intended learning outcomes of the programme and associated examples of the learning, teaching and assessment methods used to achieve these are listed in the table below.

13. Intended learning outcomes and learning, teaching and assessment methods

Knowledge and understanding: *On successful completion of the course, students will be able to:*	*Examples of learning, teaching and assessment methods used:*
K1 demonstrate a detailed conceptual knowledge and understanding of key areas of mathematical and statistical methods appropriate for a Joint Honours mathematics graduate; K2 identify and describe a range of mathematical and statistical methods, models and techniques, and explain how to apply them to solve real problems and analyse real data sets; K3 select and apply a range of mathematical and statistical computing software, and interpret the results of mathematical and statistical analyses.	• the programme develops both the theoretical and practical aspects in a sequential nature, building on layers of understanding and skill development over time; • the development of theoretical knowledge and understanding is, for most modules, achieved via a regular programme of lectures, seminars and problem solving classes, which will include student interaction, discussion and will often include student-led presentations; • practical skills will be developed by guided PC lab-based sessions at Level 4 and more open-ended PC-lab based investigations at Levels 5 and 6; • support is provided by interactive learning resources available on the VLE, through guided private study throughout the programme and via academic tutors particularly at Level 4 in relation to reviewing students' portfolio progress; • assessment is by a variety of means, including individual and group-based projects, oral presentations, poster presentations, PC lab-based assessment tasks and end of module examinations, which are all supported by regular formative feedback.
Cognitive and intellectual skills: *On successful completion of the course, students will be able to:*	*Examples of learning, teaching and assessment methods used:*
C1 demonstrate skills in abstract reasoning, logical deduction, logical argument and problem solving; C2 comprehend problems and formulate them mathematically in order to develop mathematical and/or statistical models or analyses and demonstrate how and when they can be applied; C3 identify the limitations of any models or analyses employed, as well as being able to describe the assumptions on which they are based and the possible consequences of their violation;	• in order to allow sufficient time to develop students' cognitive and intellectual skills, the programme has been designed so that students have 4-hours of contact per week for each module (for 24 weeks for a 30 credit module or 12 weeks for a 15 credit module); • arguments will be developed in lectures and seminars in specific contexts, which will then be supported by smaller group activities such as working on paper based problems and PC lab-based activities to allow students to work on problem-solving activities; • the lectures, seminars and problem solving classes are complimented, for most modules, with practical PC lab-based sessions to develop the practical application of the

C4 evaluate the appropriateness of any software used to the mathematical or statistical problems being addressed.	methods being studied and to develop the skills in formulating and developing mathematical and statistical models which is a key theme of the programme; • smaller more well-defined problems are considered at Level 4, progressing to larger less-well defined problems in less familiar contexts at both Levels 5 and 6; • peer-support, will be encouraged through both informal contacts and also peer-feedback within the context of student-led seminar presentations.
Practical skills relevant to employment: *On successful completion of the course, students will be able to:* P1 demonstrate highly developed skills in numeracy and be comfortable with numerate concepts and arguments; P2 assess problems logically, approach them analytically and be able to apply their skills and knowledge to new unfamiliar problems; P3 demonstrate skills and expertise in the use of a range of modern software relevant to the practical application of mathematics and statistics; P4 be aware of and sensitive to the ethical or legal issues relating to the collection and management of data.	***Examples of learning, teaching and assessment methods used:*** • most modules will have PC lab-based sessions where the use of modern software will be practiced extensively; • software to be used will include, for example, Matlab, Maple, R, and SPSS; as well as software commonly found in the workplace such as Excel, Word and Powerpoint; • all students will be encouraged to take the Level 6 independent study module to further develop their practical skills in this respect; • expert speakers from both industry, as well as other academic staff from outside of mathematics at the university with contextual expertise, have agreed to offer seminar talks of relevance to the practical application of their knowledge and skills.
Transferable skills: *On successful completion of the course, students will be able to:* T1 communicate effectively both orally and in writing, in order to formulate, solve and report their solution to problems and analyses to both technical and non-technical audiences; T2 work effectively as a member of a team; T3 utilise time management and organisational skills including meeting deadlines, prioritising tasks and organising schedules.	***Examples of learning, teaching and assessment methods used:*** • the Induction process aims to introduce students to several aspects of learning and study, for example time management related to assignment hand-in dates and working as a team; • the programme contains a range of approaches to learning, teaching and assessment designed to encourage students to learn both as individuals and as a member of a team; • Several modules involve formal group work including assessment of a written report; • some modules at Level 4 include opportunities for students to solve smaller problems in groups and present their solution to the class; • opportunities for formative feedback via presentations are provided along with several opportunities for each student to undertake a summative assessment to demonstrate these skills;

	• other modules at Level 5 will continue to develop student's investigation and communication skills, so that these are sufficiently well developed for undertaking their independent study at Level 6.

14. Assessment Strategy

The overall purpose of the assessment regime is to enable students to:
- demonstrate the acquisition and development of analytical, practical and intellectual skills commensurate with study at Levels 4, 5 and 6 of the 2008 Framework for Higher Education Qualifications (FHEQ), the2007 QAA Subject benchmark statement for Mathematics, Statistics and Operational Research and the draft (2015) QAA Subject benchmark statement for Mathematics, Statistics and Operational Research which is currently under review;
- gain experience in working individually and as part of a team and to communicate the results of their analyses both orally and in written reports;
- receive continuous, regular and appropriate feedback throughout the module/ course.

The programme's assessment strategy has been considered within the context of UW's Learning, Teaching and Assessment Strategy and Assessment Policy

Assessments for the individual modules have been designed to enable students to demonstrate that they have successfully met the learning outcomes. Each module outlines the nature of the assessment and the respective weighting of each assessment item, as well as a detailed assessment brief and assessment criteria. Emphasis is placed both on the development of the underlying theory and the logical and analytical problem solving skills. The styles of each assessment takes into account a myriad of factors, including learning outcomes, content of the module and teaching and learning styles. Other aspects of the programme of particular emphasis include:

1. Facilitating student presentations within seminars and problem classes;
2. Peer feedback on student presentations;
3. PC lab-based work in most modules to practice the formulation and solution of problems using mathematical and statistical packages and other software commonly found in the workplace;
4. Regular group work and projects to practice the development of team-working skills;
5. Scheduling of summative assessments during the year;
6. Where possible, anonymous marking strategy is used.

The programme has also been designed to align with the University's Curriculum Design Policy, i.e. to "reflect the institution's values, goals and mission, that provide an excellent experience for students to learn, discover and fulfil their academic potential, and offer opportunities for students to be 'co-creators' in the learning experience, whilst also securing appropriate academic standards."

Formative assessment also plays a key part in the learning and teaching strategy for the course. A range of opportunities for formative assessment and feedback have been designed into the course. Particular examples include:

1. The requirement of students to maintain portfolios of their work in the Level 4 modules and the use of these within the academic tutoring process;
2. Students being required to complete regular problem sheets with model solutions being provided for each question and feedback provided whenever possible;

3. Immediate feedback on student-led presentations in class in Level 4 modules;
4. Peer assessment and marking of presentations, group report and posters in Level 5 modules;
5. Student-led discussions in seminars in Level 6 modules;

15.   Programme structures and requirements

This course is available in full-time or part-time mode and has been designed to offer a balance of theory and practice in mathematics and statistics. The emphasis is on the development of logical and analytical problem solving skills required for the practical application of a range of mathematics and statistics methods and modelling techniques, using of a range of modern software. The programme is also structured so that students can develop these skills in relation to contexts relevant to students' second Joint Honours subject.

The course is cumulative in nature in that much of the material at Level 4 is developed further at Level 5 before then being applied in more specialised areas at Level 6. At Level 4 the course provides an opportunity to cover the theoretical underpinning in both mathematics and statistics, but will also expose students to the practical application of mathematics and statistics to problem solving, modelling and data analysis. At Level 5 all students will continue to develop the theoretical foundation. In addition students can choose whether to concentrate more time on the applications of problem solving, modelling and data analysis in either a mainly mathematical modelling or statistical modelling context. This is to allow choice at Level 5 to be aligned with whatever may be most relevant to their second Joint Honours subject. For example, students studying Computing and Mathematics may wish to choose Mathematical Modelling at Level 5, whereas students studying Mathematics and Psychology may wish to choose Statistical Modelling at Level 5. This choice does then have some impact on which modules can then be studied at Level 6.

The Course team felt this flexibility of choice is important to allow a student to either study further advanced mathematics topics or further advanced statistics topics at Level 6 to fulfil their academic potential, and to also allow them to pursue a curriculum that is relevant to their second Joint Honours subject or their career aspirations.

Award map for BSc (Hons) Mathematics

Course Title: **BSc (Hons) Mathematics**	Date of preparation: **April 2015**
Note: this course is only available as a Joint Honours programme with Joint and Minor pathways	

Level 4					
Module Code	**Module Title**	**Credits** (Number)	**Status** (Mandatory (M) Designated (D) or Optional (O))	**Pre-requisites** (Code of Module required)	**Co-requisites/ exclusions and other notes***
MATH1101	Mathematical Foundations	30	M	None	None
MATH1103	Introduction to Probability and Statistics (Semester 1)	15	M	None	None
MATH1102	Introduction to Applied Mathematical Modelling (Semester 2)	15	M	None	None

Joint Honours Requirements at Level 4: Joint Honours students must take all 60 credits from the table above.

Level 5						
Module Code*	**Module Title**	**Credits** (Number)	**Status** (Mandatory (M) or Optional (O))		**Pre-requisites** (Code of Module required)	**Co-requisites/ exclusions and other notes***
			JH	Min		
MATH2101	Analysis and Linear Algebra	30	M	O	MATH1101	None
MATH2102	Mathematical Modelling	30	O	O	MATH1101 and MATH1102	None
MATH2103	Statistical Modelling	30	O	O	MATH1101 and MATH1103	None

Joint and Minor Honours Requirements at Level 5
Students following Joint Honours pathways can adjust their studies at level 5 to take more modules in one subject or can maintain an equally balanced programme of modules in each subject. The precise award title (Joint Hons or Minor Hons) depends on the total number of credit achieved in each subject at levels 5 and 6 – for further information see the table at the end of this document.

Joint Pathway Requirements at Level 5
Joint pathway students must take exactly 60 credits from the table above to include MATH2101 and one of MATH2102 or MATH2103

Minor Pathway Requirements at Level 5
Minor Pathway students must take at least 30 credits and no more than 60 credits from the table above to include at least one of MATH2101 and/or MATH21103.

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Level 6

Module Code	Module Title	Credits (Number)	Status (Mandatory (M) or Optional (O))		Pre-requisites (Code of Module required)	Co-requisites/ exclusions and other notes*
			JH	Min		
MATH3103	Abstract Algebra	15	O	O	MATH2101	None
MATH3105	Differential Equations	15	O	O	MATH2101and MATH2102	None
MATH3106	Optimisation	15	O	O	MATH2101 and MATH2102	None
MATH3107	Advanced Statistical Modelling in Sport	15	O	O	MATH2103	None
MATH3108	Statistics in Medicine and Health	15	O	O	MATH2103	None
MATH3109	Multivariate Statistics	15	O	O	MATH1103 and MATH2101	None
MATH3101/3102	Mathematics Project	30	O	O	MATH 2101 and one of MATH2102 or MATH 2103	None

Joint and Minor Honours Requirements at Level 6
Students following pathways in two subjects can adjust their studies at level 6 to take more modules in one subject or can maintain an equally balanced programme of modules in each subject.   The precise award title (Joint Hons or Minor Hons) depends on the total number of credit achieved in each subject at levels 5 and 6 – for further information see table overleaf.

Joint Pathway Requirements at Level 6
Joint pathway students must take 45, 60 or 75 credits (to make at least 105 credits over levels 5 and 6 in the subject, and no more than 135 credits over levels 5 and 6 in the subject), from the table above.
Joint pathway students who choose to take their Independent Study (Mathematics Project) in this subject, must also take at least 30 credits from the table above (excluding MATH3101/3102).
Joint pathway students must take either, the Mathematics Project in this subject, or the Independent Study (equivalent) in their other joint subject, or take JOIN3001/2 or JOIN3013 where an Independent Study covers both joint subjects.

Minor Pathway Requirements at Level 6
Minor pathway students must take either 30 or 45 credits from the table above excluding MATH3101/3102.

Credit requirements for awards involving two subjects

In determining whether an award derived from two subjects is Joint Honours (subject 1 **and** subject 2) or Major/Minor Honours (subject 1 **with** subject 2) credits taken in each subject at levels 5 and 6 will count as follows:

Subject 1	Subject 2	Award
120	120	Joint Hons
135	105	Joint Hons
150	90	Major/minor Hons
165	75	Major/minor Hons
180	60	Major/minor Hons

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16.   QAA and Professional Academic Standards and Quality

The award is located at level 6 of the FHEQ. The learning outcomes for the programme and individual modules, along with the learning, teaching and assessment strategies have been developed with reference to the UK Quality Code for Higher Education, the 2007 QAA Subject benchmark statement for Mathematics, Statistics and Operational Research and the draft (2015) QAA Subject benchmark statement for Mathematics, Statistics and Operational Research (currently under review).

17.   Support for students

Our fundamental approach to student support is centred on the need to motivate and inspire our students.

17.1 Student Induction
Our induction process consists of activities designed to provide students with an introduction to the course and an opportunity to meet their academic tutor as well as getting to know each other.

The following are examples of activities that are being considered for inclusion in the Induction for 2015:

- A discussion of how to study and thrive on a maths degree;
- What are calculus linear algebra;
- Resources in the library and online mathematics and statistics resources;
- What mathematics have you studied before arriving at university;
- Setting up a Mathematics Society and a Maths Arcade*;
- Talks on employability and careers;
- Team-working activities;
- Visit to HIVE library;
- Meeting with module leaders, tutors and Academic Advisors;
- Hands-on sessions on UoW computer systems and available software;
- Talks by Registry, ILS, librarians, student services;
- Student Union activities.

* Since mathematics as a subject is new at the University, we intend to support the first cohort of students to seek an IMA grant to set up a new Mathematics Society (**WOR**cester **M**athematics **S**ociety or WORMS). In addition we anticipate supporting the first cohort of students to set-up a weekly Maths Arcade drop-in session. This is an innovative activity aimed at supporting students who might be struggling more with their mathematics studies, but at the same time aims to stretch the more able learners. The idea behind the Maths Arcade drop-in is that it is run by students for students, but staff are also available to also offer tutorial support in a mathematically themed social environment.

17.2   Personal Academic Tutoring
Each student has a nominated Personal Academic Tutor to provide academic advice and guidance, personal development planning and pastoral support as appropriate. The Academic Tutor plays a significant role in enhancing the student's academic and personal experience of studying. Key aspects of the role include:

- Assisting students to make the transition to studying in higher education;
- Helping students to understand the requirements of their course;
- Supporting students to take responsibility for their own learning;

- Helping students to make the most of learning resources and other forms of support available;
- Supporting students in academic, professional and career related planning and development;
- Advising and guiding students on issues or problems that arise while they are at University;
- Supporting students for whom there may be particular challenges;
- Meeting students on a regularly scheduled basis. Individual meeting will be held throughout the academic year, and the Academic Tutor will provide group meeting times during Worcester and/or Induction Weeks;
- Tutors will advise students on individual course options, module selection and academic planning.

At Level 4, students will be required to compile a portfolio consisting of solutions to weekly problems and practical exercises. They will be encouraged and supported to show that they are marking and reviewing their own work based on model solutions that are made available during the module. The overall portfolio will be reviewed periodically by the academic tutor (or a nominated member of the course team where the academic tutor is not mathematics-based), in order to help the student assess their progress.

17.3 Worcester Weeks
The academic year includes two *Worcester Weeks* where the normal timetable has been altered to enable a range of alternative learning activities to be scheduled. These are an integral part of the learning experience. During these weeks, students will be engaged in planned, structure learning activities, which can be a combination of 'taught' time, directed learning activities, time to develop employability skills or individual study.

The following are just some of the examples of activities that are being considered for future Worcester Weeks:

- Careers in mathematics and statistics and /or visits to employers of mathematicians and statisticians;
- Visits to places of historical interest in mathematics and statistics;
- Forecasting competition;
- Organising a conference;
- Presentation skills;
- Searching for vacancies;
- CV clinic;
- Finding and applying for Graduate Internships.

17.4 Support Processes and Mechanisms
The following have been put in place to provide support for undergraduate students within the Institute of Science and the Environment.

- Induction programme including inputs from Student Services;
- Module outlines include module code, module title, level, planned teaching activities, attendance requirements, assessment brief, assessment criteria and reading lists;
- Library, IT, Media and Print support is provided by Information Learning Services (ILS) staff through an Information Desk and Study Guides;
- Student representation on Course Management Committee to address course-wide opportunities for enhancement;
- Access to details of module availability, registration and results via the student online learning environment (SOLE page);

- A range of support services, including finance, Student Services (Firstpoint), and accommodation advice;
- Student and academic support, representation and social networking via the Students' Union;
- Equal Opportunity via the Disability and Dyslexia Service, which implements codes of practice in relation to disability, racial and other forms of discrimination and also provides practical support and guidance for students with learning difficulties;
- Career Services offer one-to-one drop-in advice and information and publishes career events, activities and job opportunities;
- A Virtual Learning Environment – VLE to provide module-specific material, documents, activities and networking, as well as a more general announcements and updates.
- (A full list of services can be found in the Course Handbook)

The University is also considering the potential to develop a Mathematics and Statistics Help Service (MASH) at Worcester, which would also provide an obvious significant area of further support for students on the course.

18.   Admissions

Admissions Policy
The University aims to be accessible and is committed to widening participation and encouraging diversity in the student population. Hence we actively encourage and welcome people from the widest range of economic and cultural backgrounds and value the contribution of mature learners who may be able to use their work experience as evidence of prior learning. However evidence of mathematics attainment at least equivalent to A Level will be required for admission to the course.

Entry requirements
The course is intended for people who wish to study mathematics along with a second subject. Since mathematics is a subject which builds incrementally in complexity from GCSE to A Level (or equivalent) and beyond, it is a typical requirement for students onto the course that they have as a minimum an A Level at Grade C in mathematics, although a grade at A or B is preferable.

The University's standard minimum entry requirements apply: 4 GCSEs (Grade C or above) plus 120 Tariff points from minimum of 2 and maximum of 3½ A Levels or equivalent Level 3 qualifications. See UW Admissions Policy for other acceptable qualifications.

The current UCAS Tariff requirements for entry to this course are published on the University's website and in the prospectus.

Admissions procedures
Full-time applicants apply through UCAS
Part-time applicants apply directly to University of Worcester (UW)

Admissions/selection criteria
The decision to offer a place will be based on a candidate's prior attainment in mathematics at A Level (or equivalent) and their demonstrated enthusiasm for the subject, commitment to study and the academic capability to succeed on the Course.

19. **Methods for evaluating and improving the quality and standards of teaching and learning**

Mechanisms for review and evaluation of teaching, learning and assessment, the curriculum and outcome standards include
- Module feedback;
- Annual Course Evaluation Report completed by Course Leader;
- Periodic Review including external scrutiny;
- Peer teaching observation;
- External Examiners' Reports;
- Academic staff annual appraisal;
- Staff Development Away Days and other events;

Mechanisms for gaining student feedback on the quality of teaching and their learning experience:
- Course Management Committee
- Module feedback, including module feedback questionnaires and online questionnaires
- Meetings with module tutors and academic tutor
- National Students Survey
- Induction, exit and other ad hoc surveys
- StARs (Student Academic Representatives)

Feedback to students concerning decisions, changes and action points will be provided by direct feedback from the student representatives, the minutes of the Course Management Committee meeting and the Annual Evaluation Report.

20. **Regulation of assessment**

The course operates under the University's Undergraduate Regulatory Framework

Requirements to pass modules
- Modules are assessed using a variety of assessment activities which are detailed in the module specifications.
- The minimum pass mark is D- for each module.
- Students are required to submit all items of assessment in order to pass a module, and in some modules, a pass mark in each item of assessment may be required.
- Full details of the assessment requirements for a module, including the assessment criteria, are published in the module outline.

Submission of assessment items
- Students who submit course work late but within 5 days of the due date will have work marked, but the grade will be capped at D- unless an application for mitigating circumstances is accepted.
- Students who submit work later than 5 days but within 14 days of the due date will not have work marked unless they have submitted a valid claim of mitigating circumstances.
- For full details of submission regulations see Undergraduate Regulatory Framework.

Retrieval of failure
- Students are entitled to resit failed assessment items for any module that is awarded a fail grade, unless the failure was due to non-attendance.
- Reassessment items that are passed are graded at D-.
- If a student is unsuccessful in the reassessment, they have the right to retake the module (or, in some circumstances, take an alternative module).

Requirements for Progression

- Students at Level 4 may be permitted to progress to Level 5 when they have passed at least 90 credits at Level 4.
- Students at Level 5 may be permitted to progress to Level 6 when they have passed at least 90 credits at Level 5.
- A student who fails 90 credits or more due to non-submission will be required to withdraw from the University.
- Students who pass less than 90 credits but have submitted all items of assessment will be required to retake modules.

Requirements for Awards

Award	Requirement
CertHE	Passed 120 credits at Level 4 or higher
DipHE	Passed a minimum of 240 credits with at least 90 credits at Level 5 or higher
Degree (non-honours)	Passed a minimum of 300 credits with at least 90 credits at Level 5 or higher and a minimum of 60 credits at Level 6
Degree with honours	Passed a minimum of 360 credits with at least 90 credits at Level 5 or higher and a minimum of 120 credits at Level 6

Classification

The honours classification will be determined by whichever of the following two methods results in the higher classification.

Classification determined on the profile of the best grades from 60 credits attained at Level 5 and the best grades from 120 credits at Level 6. Level 5 and Level 6 grades count equally in the profile.

Classification determined on the profile of the best grades from 120 credits attained at Level 6 only.

For further information on honours degree classification, see the Undergraduate Regulatory Framework.

21. **Indicators of quality and standards**

The University underwent a QAA Institutional Audit in March 2011. The audit confirmed that confidence can be placed in the soundness of the institution's current and likely future management of the academic standards of its awards and the quality of the learning opportunities available to students. The audit team highlighted several aspects of good practice, including the student academic representative (StARs) initiative, the proactive approach which supports the student experience for disabled students, the comprehensiveness of the student online environment (SOLE), the wide range of opportunities afforded to students to enhance their employability, the institution's commitment to enhancement, and the inclusive approach to working with its collaborative partners.

The mathematics course team have significant experience of teaching mathematics and statistics at undergraduate level. Between them they have been engaged in and are still engaged in teaching and learning projects relating to mathematics and statistics. In addition they have experience of providing mathematics and statistics advice and support to students of all abilities, with the course leader being a significant contributor to the work of the sigma-network (www.sigma-network.ac.uk), which is a national network

promoting excellence in the provision of mathematics and statistics support. The course leader is also the national lead for the statstutor project (www.statstutor.ac.uk) which is an online resource in statistics aimed at supporting students with teaching and learning of statistics in higher education.

The mathematics course team also have experience of either working in industry or engaging with partners from industry on work-based projects relating to the application of mathematics and statistics. This has enabled the development of a good network of contacts that have contributed to the development of the mathematics course and who have also agreed to contribute to providing a work-based context to parts of the course through invited guest seminars or projects.

22.   Graduate destinations, employability and links with employers

Graduate destinations

There is a strong national demand for graduates with Mathematics, with plentiful evidence that skills in mathematics and statistics are critical to the success of the British economy, particularly in science, engineering and manufacturing. Initially mathematics is being offered as a Joint Honours degree with six subjects including Biology, Computing, Education Studies, Geography, Physical Education and Psychology. The demand for graduates with well-developed problem solving and analytical skills in all of these areas is clear.

Graduates in mathematics are employed in many areas including:

- Finance, banking and accountancy.
- Actuary and insurance;
- Teaching (there is also a continuing shortage of well qualified mathematics teachers which will continue with the introduction of the new post-16 core maths curriculum).
- Science and Engineering.
- Government departments and Defence.
- Pharmaceutical and health industries.
- Research and Development.
- Sports modelling, betting and trading professions.
- Logistics, planning and market research.
- IT and computing.
- etc.

The starting salaries for mathematics graduates are also amongst the highest of all the graduate disciplines[1] and were ranked 9th (behind *Medicine*, *Dentistry*, *Economics*, *Veterinary Science* and some specific forms of *Engineering*) out of 59 subject areas at £24,296 against an average of £21,762.

Student employability

- The course is inherently about developing logical and analytical problem solving skills, which are required in many areas of employment.
- Most modules will have PC lab-based sessions where the use of software relevant to the application problem solving and data analysis will be practiced extensively. This

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[1] HESA 2010-11. Published April 2013

includes for example, Matlab, Maple, R, and SPSS, as well as software commonly found in the workplace such as Excel, Word and Powerpoint.

- Students will be encouraged to become student members of the Royal Statistical Society (RSS) and Institute of Mathematics and its Applications (IMA) where appropriate and to engage with those organisations.
- There are many opportunities for students to practice and develop their skills in working as a team, presenting and communicating their work in writing.
- Expert speakers from both industry, as well as other academic staff from outside of mathematics at the university with contextual expertise, have agreed to offer seminar talks of relevance to the practical application of their knowledge and skills.
- All students will also be encouraged to take the Level 6 mathematics project module to further develop their practical skills in this respect. Where appropriate this will be based around a real work-based project.
- Both the induction and the Worcester Weeks will include activities designed to develop the students' skills at searching for and applying for employment, preparing a CV, undertaking interviews and having the opportunity to talk to employers about careers in mathematics and statistics.
- Discussions have also taken place with existing students at Worcester University, including postgraduate students studying the PGCE Mathematics course at the University, and current undergraduates who had studied mathematics to A Level, to seek their views on the new course curriculum proposal.

Links with employers

With regard to regional employers, discussions about the course have involved companies such as QinetiQ, AVL, Worcester Bosch, Yamazaki Mazak, SLR Consulting and Malvern Instruments. In addition discussions about the course have involved larger national companies such as British Gas and Rolls Royce. In addition the course team have particular links with companies involved in space planning such as CPB Projects, and a number of companies that employ mathematical and statistical modellers in the sports modelling and trading industries and discussions have taken place with Smartodds, Sporting Index, Black Swan Partners and Sports Trading Network, .

These discussions were facilitated through:
- meetings in person with local employers;
- attendance by the course leader at an Employers' Forum organised by the IMA (Institute of Mathematics and its Applications) held at Rolls Royce, Derby, which included round table discussions of the skills required by mathematics graduates in the workplace;
- email correspondence with employers located outside of the region.

Senior staff members at these organisations are very supportive of the introduction of the degrees not least because they can often see employment opportunities for the graduates. The areas of mathematics proposed in the curriculum match those that these employers value. Many of these employers have agreed to offer seminar presentations about the use of mathematics in the employment context, careers talks, to attend the final year poster day planned as part of the independent studies module and to consider the possibilities for real projects to be undertaken through students' independent study. This network of employer contacts, both local and national, will also inform the continued development of the mathematics Joint Honours courses.

contained in this document is reviewed by the University and may be checked by the [Quality Assurance Agency for Higher Education](#).