Programme Information & PLOs

Title of the new programme – including any year abroad/ in industry variants

BSc in Mathematics

Level of qualification

Please select:	Level 6

Please indicate if the programme is offered with any year abroad / in industry variants	**Year in Industry** Please select Y/N	No
	Year Abroad Please select Y/N	Yes

Department(s):
Where more than one department is involved, indicate the lead department

Lead Department	Mathematics
Other contributing Departments:	

Programme Leader

Dr Ian McIntosh

Purpose and learning outcomes of the programme

Statement of purpose for applicants to the programme

With a BSc degree in Mathematics from York, you will have developed your mathematical skills to be able to confidently analyse complex or unfamiliar problems using mathematical principles. Throughout the degree your core mathematical skills (calculus, algebra, probability and statistics) will be developed to a high level of sophistication, and your reasoning skills will be sharpened, as you are guided to use mathematics in deeper and more interesting ways. You will develop other skills which will be valuable throughout your career, such as computer programming and the ability to write on technical subjects with clarity and precision. We pride ourselves on being a friendly and inclusive department with high-quality teaching provided in a relaxed atmosphere. You will experience a variety of ways of learning and working, through lectures, small group seminars, group and individual projects, under the careful guidance of our dedicated staff, all of whom are engaged in current research and many of whom are world leaders in their field.
In the final year you will use your knowledge, understanding and skills to write a dissertation on a topic of your own interest, under the supervision of an expert mathematician. By the end you will have knowledge of an important subject with many applications in the modern world, and have one of the most sought-after qualifications by key employers. Our excellent programme is accredited by the Institute of Mathematics and Its Applications (IMA).
With York's reputation as a top university, this makes a BSc degree in Mathematics at York an outstanding choice.

Programme Learning Outcomes

Please provide six to eight statements of what a graduate of the programme can be expected to do.
Taken together, these outcomes should capture the distinctive features of the programme. They should also be outcomes for which progressive achievement through the course of the programme can be articulated, and which will therefore be reflected in the design of the whole programme.

PLO	On successful completion of the programme, graduates will be able to:
1	use the language of mathematics and confidently identify those problems that can be analysed or resolved by standard mathematical techniques. This includes the ability to apply those techniques successfully in the appropriate context.
2	recognise when an unfamiliar problem is open to mathematical investigation, and be able to adapt and/or synthesise a range of mathematical approaches (including abstraction or numerical approximation) to investigate the problem
3	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical nature, and be able to justify the mathematical principles they choose for such a critique
4	conduct a study into a specialised area, by researching material from a variety of sources, and synthesise this material into a well-organized and coherent account.
5	communicate complex mathematical ideas clearly in writing, at a level appropriate for the intended audience, and also be able to provide an effective summary of these ideas for non-specialists
6	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.

Programme Learning Outcome for year in industry (where applicable)

For programmes which lead to the title 'with a Year in Industry' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year in industry b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year in industry by alteration of the standard PLOs.

n/a

Programme Learning Outcome for year abroad programmes (where applicable)

For programmes which lead to the title 'with a Year Abroad' – typically involving an additional year – please provide either a) amended versions of some (at least one, but not necessarily all) of the standard PLOs listed above, showing how these are changed and enhanced by the additional year abroad or b) an additional PLO, if and only if it is not possible to capture a key ability developed by the year abroad by alteration of the standard PLOs.

have confidence in being able to adapt to the demands of working for an extended period in a foreign country, which include working in another language and navigating another culture.

i) Why the PLOs are considered ambitious or stretching?

Each PLO represents a challenge to the student to develop existing skills to a higher level. Through each stage the level of challenge is raised, as more depth or complexity is encountered. In studying mathematics each stage builds naturally on the attainments of the previous one, as foundational ideas are developed into fully fledged theories or methodologies.

ii) The ways in which these outcomes are distinctive or particularly advantageous to the student:

The outcomes identify six basic areas, which can be summarised as: technique, adaptability, critical thinking, scholarship, communication and digital literacy. When possessed together they give each student the abilities and understanding to function in any environment where the precision and clarity of mathematical thinking are valuable.

iii) How the programme learning outcomes develop students' digital literacy and will make appropriate use of technology-enhanced learning (such as lecture recordings, online resources, simulations, online assessment, 'flipped classrooms' etc)?

All students will learn some programming and have to use mathematical typesetting for written projects and for presentations. The project work in all three years develops their skills with using the internet for literature search and review. A number of modules include the opportunity to use mathematics software (such as R, Maple and MatLab).

iv) How the PLOs support and enhance the students' employability (for example, opportunities for students to apply their learning in a real world setting)?
The programme's employability objectives should be informed by the University's Employability Strategy:

http://www.york.ac.uk/about/departments/support-and-admin/careers/staff/

The PLOs cover a list of skills which are desired by employers: analytical reasoning, confidence with high level mathematics, clarity of communication, flexible thinking, the ability to learn complex ideas quickly and precisely, and digital literacy.

vi) How will students who need additional support for academic and transferable skills be identified and supported by the Department?

For first year students regular "drop-in" academic support sessions are scheduled into the timetable, as optional support for all first year students. The Mathematics Society runs weekly "Coffee and Caculus" sessions in the Department's social space (Topos) during Autumn and Spring term. These sessions are an opportunity for later year students to help first year students, but also a place where all years can come together to work in groups on weekly homework. Mathematical Skills 1 & 2 have optional timetabled drop-in sessions (fortnightly) during Spring term to help with the written assignments (particularly the use of LaTeX). Specific student needs related to disability are identified through statements of needs, with the oversight of the department's Disability Coordinator and each student's academic supervisor.

vii) How is teaching informed and led by research in the department/ centre/ University?

The vast majority of teaching staff are active in research, and through lectures, tutorials and seminars communicate the influence foundational ideas have on making progress in research. Students also explicitly connect with the principles of research through projects (in Math Skills 1 & 2, and the final year dissertation) as well as having the option to choose modules which connect to relatively recent research in their final year.

Stage-level progression

Please complete the table below, to summarise students' progressive development towards the achievement of PLOs, in terms of the characteristics that you expect students to demonstrate at the end of each year. This summary may be particularly helpful to students and the programme team where there is a high proportion of option modules.

Note: it is not expected that a position statement is written for each PLO, but this can be done if preferred (please add information in the 'individual statement' boxes). For a statement that applies across all PLOs in the stage fill in the 'Global statement' box.

Stage 0 (if your programme has a Foundation year, use the toggles to the left to show the hidden rows)

Stage 1

On progression from the first year (Stage 1), students will be able to:	*Global statement*

PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8

competently use foundational mathematical techniques	adapt foundational techniques to unfamiliar situations	create and critique elementary mathematical reasoning and understand the importance of sound reasoning	produce, in collaboration with others, a well-researched survey of some elementary idea or foundational tool in mathematics	communicate elementary mathematical ideas clearly and concisely	use computers for (a) elementary mathematical typesetting to produce a written report and slides for presentation (b) elementary statistical analysis.		
Stage 2							
On progression from the second year (Stage 2), students will be able to:			*Global statement*				
PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
confidently perform calculations, or use methods, which require the combination of several foundational techniques, and identify which of those techniques is appropriate.	recognize when some foundational techniques can be applied outside the standard context, and put together two or more techniques to analyse a problem.	reproduce, with understanding and some insight, important examples of logical reasoning or mathematical argument, and create their own arguments for similar situations	independently perform a literature survey of a renowned or noteworthy mathematical idea, method or process.	write clearly and concisely, with an appropriate balance between mathematics and English, about well-understood mathematical ideas	write basic programmes in Java, typeset using LaTeX and understand how to search for technical information digitally		
Stage 3							
(For Integrated Masters) On progression from the third year (Stage 3), students will be able to:			*Global statement*				
PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8
Individual statements							

Programme Structure

Module Structure and Summative Assessment Map

Please complete the summary table below which shows the module structure and the pattern of summative assessment through the programme.

'Option module' can be used in place of a specific named option. If the programme requires students to select option modules from specific lists these lists should be provided in the next section.

From the drop-down select 'S' to indicate the start of the module, 'A' to indicate the timing of each distinct summative assessment point (eg. essay submission/ exam), and 'E' to indicate the end of the module (if the end of the module coincides with the summative assessment select 'EA') . It is not expected that each summative task will be listed where an overall module might be assessed cumulatively (for example weekly problem sheets).

If summative assessment by exams will be scheduled in the summer Common Assessment period (weeks 5-7) a single 'A' can be used within the shaded cells as it is understood that you will not know in which week of the CAP the examination will take place.

Stage 0 (if you have modules for Stage 0, use the toggles to the left to show the hidden rows)																															
Stage 1																															
Credits	**Module**		**Autumn Term**										**Spring Term**										**Summer Term**									
	Code	**Title**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
30	MAT00001C	Calculus	S										A													E	A					
20	MAT00010C	Algebra	S										A													E	A					
10	MAT00011C	Mathematical Skills 1: Reasoning and Communication	S										A									EA		A								
20	MAT00004C	Introduction to Probability and Statistics	S									EA	A																			
20	MAT00005C	Real Analysis												S												E	A					
20	MAT00003C	Introduction to Applied Mathematics												S												E	A					
Stage 2																															
Credits	**Module**		**Autumn Term**										**Spring Term**										**Summer Term**									
	Code	**Title**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
40	MAT00034I	Applied Mathematics	S										A													E	A					
40	MAT00032I	Pure Mathematics	S										A													E	A					
40	MAT00005I	Probability & Statistics	S										A													E	A					
10	MAT00027I	Mathematical Skills 2	S									A										E	A									
10	MAT00026I	Linear Algebra	S									E	A																			
10	MAT00033I	Vector Calculus	S									E	A																			
10	MAT00024I	Functions of a Complex Variable												S								E					A					
Stage 3																															
Credits	**Module**		**Autumn Term**										**Spring Term**										**Summer Term**									
	Code	**Title**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

10		Autumn - List A	S									E	A																		
10		Spring - List B												S								E						A				
20		Autumn/Spring - List C	S							A											A		EA					A				
40	MAT00004H	BSc Final Year Project	S									A														EA				A		

Stage 4

Credits	Module		Autumn Term										Spring Term										Summer Term									
	Code	Title	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10

Optional module lists

If the programme requires students to select option modules from specific lists these lists should be provided below. If you need more space, use the toggles on the left to reveal ten further hidden rows.

Option List A	Option List B	Option List C	Option List D	Option List E	Option List F	Option List G	Option List H
Bayesian Statistics MAT00003H	Formal Languages and Automata MAT00002H	Numerical Analysis MAT00041H					
Introduction to Dynamical Systems MAT00011H	Differential Geometry MAT00006H						
Introductory Fluid Dynamics MAT00012H	Electromagnetism MAT00007H						
Mathematical Finance I MAT00015H	Galois Theory MAT00008H						
Generalised Linear Models MAT00017H	Lebesgue Integration MAT00013H						

Number Theory MAT00023H	Mathematical Finance II MAT00016H						
Quantum Mechanics I MAT00024H	Survival Analysis (H Level) MAT00018H						
Special Relativity MAT00028H	Multivariate Analysis MAT00021H						
Algebraic Number Theory MAT00029H	Quantum Mechanics II MAT00025H						
Stochastic Processes MAT00030H	Cryptography MAT00034H						
Statistical Pattern Recognition MAT00031H	Applications of Nonlinear Dynamics MAT00036H						
Metric Spaces MAT00037H	Biological Fluid Dynamics (H Level) MAT00039H						
Partial Differential Equations (H Level) MAT00040H	Topology MAT00044H						
Character Theory MAT00046H	Time Series MAT00045H						
	Applied Complex Analysis MAT00048H						
	Intermediate Fluid Dynamics MAT00051H						

Management and Admissions Information

This document applies to students who commenced the programme(s) in:	2017/18

Interim awards available Interim awards available on undergraduate programmes (subject to programme regulations) will normally be: Certificate of Higher Education (Level 4/Certificate), Diploma of Higher Education (Level 5/Intermediate), Ordinary Degree and in the case of Integrated Masters the Bachelors with honours. Please specify any proposed exceptions to this norm.

Certificate of Higher Education (Level 4/Certificate), Diploma of Higher Education (Level 5/Intermediate), Ordinary Degree.

Admissions Criteria

TYPICAL OFFERS
A levels AAA/AAB
IB Diploma Programme
36/35 points including HL 6
in essential subjects
BTEC Extended Diploma
DDD (may vary for
combined programmes)

Length and status of the programme(s) and mode(s) of study

Programme	Length (years)	Status (full-time/part-time) Please select	Start dates/months (if applicable – for programmes that have multiple intakes or start dates that differ from the usual academic year)	Mode				
				Face-to-face, campus-based		Distance learning		Other
BSc in Mathematics BSc in Mathematics with a Year in Europe	3/4	Full-time	n/a	Please select Y/N	Yes	Please select Y/N	No	n/a

Language(s) of study

English.

Language(s) of assessment

English.

Programme accreditation by Professional, Statutory or Regulatory Bodies (PSRB)

Is the programme recognised or accredited by a PSRB		
Please Select Y/N:	Yes	if No move to next Section if Yes complete the following questions

Name of PSRB

The programme is accredited by the Institute of Mathematics: it meets the educational requirements for Chartered Mathematician (CMath) designation when followed by subsequent training and experience in employment to obtain equivalent competencies to those specified by the Quality Assurance Agency (QAA) for taught master's degrees. In addition, Level 6 mathematical finance modules carry the possibility of some exemption from Institute of Actuaries professional examinations, subject to performance at an appropriate level.

Are there any conditions on the approval/ accreditation of the programme(s)/ graduates (for example accreditation only for the full award and not any interim award)

Additional Professional or Vocational Standards

Are there any additional requirements of accrediting bodies or PSRB or pre-requisite professional experience needed to study this programme?

Please Select Y/N:	No	if Yes, provide details

(max 200 words)

University award regulations

The University's award and assessment regulations apply to all programmes: any exceptions that relate to this programme are approved by University Teaching Committee and are recorded at the end of this document.

Are students on the programme permitted to take elective modules?

(See: https://www.york.ac.uk/media/staffhome/learningandteaching/documents/policies/Framework%20for%20Programme%20Design%20-%20UG.pdf)

Please Select Y/N:	Yes	The Mathematics with a Year in Europe degree involves a full academic year at one of the Department's Erasmus / Socrates partner universities. It is additional to the three years at York, taking place between Stages 2 and 3.

Careers & Placements - 'With Placement Year' programmes

Students on all undergraduate and integrated masters programmes may apply to spend their third year on a work-based placement facilitated by Careers & Placements. Such students would return to their studies at Stage 3 in the following year, thus lengthening their programme by a year. Successful completion of the placement year and associated assessment allows this to be recognised in programme title, which is amended to include 'with Placement Year' (e.g. BA in XYZ with Placement Year'). The Placement Year also adds a Programme Learning Outcome, concerning employability. (See Careers & Placements for details).

In exceptional circumstances, UTC may approve an exemption from the 'Placement Year' initiative. This is usually granted only for compelling reasons concerning accreditation; if the Department already has a Year in Industry with criteria sufficiently generic so as to allow the same range of placements; or if the programme is less than three years in length.

Programme excluded from Placement Year?	No	If yes, what are the reasons for this exemption:

Study Abroad (including Year Abroad as an additional year and replacement year)

Students on all programmes may apply to spend Stage 2 on the University-wide North America/ Asia/ Australia student exchange programme. Acceptance onto the programme is on a competitive basis. Marks from modules taken on replacement years count toward progression and classification.

Does the programme include the opportunity to undertake other formally agreed study abroad activities? All such programmes must comply with the Policy on Study Abroad

https://www.york.ac.uk/staff/teaching/procedure/programmes/design/__

Please Select Y/N:	No	

Additional information

Transfers out of or into the programme

ii) Transfers into the programme will be possible? (please select Y/N)	Yes	

Additional details:

Students may transfer to the MMath Mathematics programme at any time during Stages 1 and 2, subject to satisfactory academic progress and LEA agreement. Students on the MMath Mathematics programme may transfer to the BSc Mathematics programme at any time during Stages 1 and 2. At the end of Stage 2, students who fail to achieve the progression requirements for Stage 3 of the MMath programme will automatically be transferred to Stage 3 of the BSc Mathematics programme. Requests to transfer between the BSc Mathematics programme and the various combined Mathematics programmes are dealt with on an individual basis and are normally only permitted in Stage 1.

ii) Transfers out of the programme will be possible? (please select Y/N)	Yes	

Additional details:

Students may transfer to the MMath Mathematics programme at any time during Stages 1 and 2, subject to satisfactory academic progress and LEA agreement. Students on the MMath Mathematics programme may transfer to the BSc Mathematics programme at any time during Stages 1 and 2. At the end of Stage 2, students who fail to achieve the progression requirements for Stage 3 of the MMath programme will automatically be transferred to Stage 3 of the BSc Mathematics programme. Requests to transfer between the BSc Mathematics programme and the various combined Mathematics programmes are dealt with on an individual basis and are normally only permitted in Stage 1.

Exceptions to University Award Regulations approved by University Teaching Committee

Exception Please detail any exceptions to University Award Regulations approved by UTC	**Date approved**

Date on which this programme information was updated:

29/06/17

Please note:

The information above 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 they take full advantage of the learning opportunities that are provided.

Detailed information on the learning outcomes, content, delivery and assessment of modules can be found in the module descriptions.

The University reserves the right to modify this overview in unforeseen circumstances, or where the process of academic development, based on feedback from staff, students, external examiners or professional bodies, requires a change to be made. Students will be notified of any substantive changes at the first available opportunity.

Programme Map

Please note: the programme map below is in interim format pending the development of a University Programme Catalogue.

Programme Map: Module Contribution to Programme Learning Outcomes

This table maps the contribution to programme learning outcomes made by each module, in terms of the advance in understanding/ expertise acquired or reinforced in the module, the work by which students achieve this advance and the assessments that test it. This enables the programme rationale to be understood:

· Reading the table vertically illustrates how the programme has been designed to deepen knowledge, concepts and skills progressively. It shows how the progressive achievement of PLOs is supported by formative work and evaluated by summative assessment. In turn this should help students to understand and articulate their development of transferable skills and to relate this to other resources, such as the Employability Tutorial and York Award;

· Reading the table horizontally explains how the experience of a student at a particular time includes a balance of activities appropriate to that stage, through the design of modules.

Stage	Module		Programme Learning Outcomes							
			PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
			use the language of mathematics and confidently identify those problems that can be analysed or resolved by standard mathematical techniques. This includes the ability to apply those techniques successfully in the appropriate context.	recognise when an unfamiliar problem is open to mathematical investigation, and be able to adapt and/or synthesise a range of mathematical approaches (including abstraction or numerical approximation) to investigate the problem	use logical reasoning as a basis for the critical analysis of ideas or statements which have a mathematical nature, and be able to justify the mathematical principles they choose for such a critique	conduct a study into a specialised area, by researching material from a variety of sources, and synthesise this material into a well-organized and coherent account.	communicate complex mathematical ideas clearly in writing, at a level appropriate for the intended audience, and also be able to provide an effective summary of these ideas for non-specialists	create mathematical documents, presentations and computer programmes by accurately and efficiently using a range of digital technologies.	#REF!	#REF!
Stage 1	Algebra MAT00010C	Progress towards PLO	competently use the standard algebra of vectors, matrices and related objects	adapt the standard algebraic tools to problems slightly outside the standard format	justify the steps and methods used in algebraic arguments		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 1	Calculus MAT00001C	Progress towards PLO	competently use the standard methods of differential and integral calculus	adapt standard calculus tools to problems slightly outside the standard format	justify the steps in the solution of calculus problems, or their application		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 1	Mathematical Skills 1 MAT00011C	Progress towards PLO	achieve competence in working with sets, functions, logic and methods of proof	adapt the standard concepts of set theory and logic to problems slightly outside the standard format	practice different methods of mathematical reasoning	find relevant resources, understand their content and contribute towards the group report as a collaborative effort in exposition	practice and develop written and oral communication skills	use LaTeX to create a short written report, and prepare slides for a presentation.		

		By working on (and if applicable, assessed through)	lecture material and exercises, with feedback through marked work and the tutorials, and assessed by course work and examination	exercises and with feedback through marked work and the tutorials, and assessed by course work and examination	lecture material and exercises, with feedback through marked work and the tutorials, and assessed by course work and examination	their contribution to the group project (3-4 students per group), as assessed by the written project.	the production of the group project and group presentation talk, as assessed through the written project (8-10 pages) and the group talk (12-15 minutes).	the written report and the presentation slides for the group project in Spring term, with the support of lectures and drop-in support classes, and as assessed by the written project and the presentation slides.		
Stage 1	Introduction to Probability and Statistics MAT00004C	Progress towards PLO	understand and use standard probability theory and its relation to statistical analysis, and be able to do elementary statistical modelling and analysis	apply the standard methods from the module in unfamiliar situations	explain the reasoning behind the standard methods of statistical analysis using their theoretical foundations		present clear and concise solutions to exercises	confidently use the statistical package R for elementary data analysis		
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work	the data analysis examples with the support of the computer practicals		

Stage 1	Introduction to Applied Mathematics MAT00003C	Progress towards PLO	understand and practice the use of mathematical methods to formulate and solve standard problems in elementary applied mathematics	adapt a range of methods to create and investigate applied mathematical models beyond the standard examples	analyse the reasoning behind the core dynamics of a mathematical model		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 1	Real Analysis MAT00005C	Progress towards PLO	competently use the standard methods of real analysis to work with sequences, series and functions	adapt the standard analytic tools to problems slightly outside the standard format	justify the logical steps in the proofs of analytic results		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination.		exercises, with the support of seminars and formative feedback through marked work			

Stage 2	Applied Mathematics MAT00034I	Progress towards PLO	work confidently with the mathematical aspects and foundational ideas in the application of mathematics to modern physics: Newtonian gravity, special relativity, classical and quantum mechanics, waves and fluids	apply a variety of mathematical tools and physical principles to be able to model unfamiliar situations and analyse the consequences of such models	understand and be able to justify the thought processes behind the choice of one or other mathematical tool, or the reasoning and assumptions underlying a particular mathematical model		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Pure Mathematics MAT00032I	Progress towards PLO	understand the language of abstract mathematics and work confidently with the ideas which form the basis of abstract algebra, number theory and geometry	recognize and be able to put into practice the principles of abstract mathematics in unfamiliar settings	reproduce, with understanding, central arguments used in algebra, number theory and geometry, and be able to adapt these to similar situations		present coherent, clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Probability & Statistics MAT00035I	Progress towards PLO	work confidently with a range of statistical tools (both analytically and numerically), statistical inference concepts and techniques, and be able to use probability theory to model a variety of random processes	apply the statistical methods and the framework of applied probabilistic modelling to unfamiliar situations	understand and be able to explain when it is appropriate to use statistical methods or models amongst those covered in the syllabus		present clear and concise solutions to exercises	building on the skills developed in Introduction to Probability and Statistics, write code in the statistical package R for the statistical analysis of data sets		
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work	example data sets with the support of example classes		

Stage 2	Mathematical Skills 2 MAT00027I	Progress towards PLO	understand the basics of scientific computing and be able to write functional code for some standard algorithms	apply the methods of numerical analysis to unfamiliar problems	critically analyse their own computer code	investigate, independently after some initial guidance, the literature on a mathematical process or focussed area of research	write coherent documentation of their programming project, or write a report (8-10 pages) which gives a clear account of one of three optional topics in mathematics	write an elementary programme using Java, and, building on the skills developed in Mathematical Skills 1, typeset a written report which includes a short literature survey		
		By working on (and if applicable, assessed through)	lecture material and supported by laboratory practice sessions	practical exercises, with the support of laboratory classes and as assessed through the programming assignment	the programming exercises, supported by laboratory practice sessions	either the programming project or the mathematical topic project, as assessed by the submitted report.	either the programming project or the mathematical topic project, as assessed by the submitted report.	the coding exercises in Autumn term (and the Spring term for students of the programming pathway), and the written report in the Spring term.		
Stage 2	Linear Algebra MAT000026I	Progress towards PLO	use the standard methods of basic linear algebra and matrix theory, and their theoretical justification through abstract algebra	apply basic linear algebra and matrix theory to a range of unfamiliar situations	prove standard results in abstract linear algebra		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 2	Vector Calculus MAT00033I	Progress towards PLO	use the standard methods of multi-variable differential and integral calculus to work with functions of many variables and vector fields	apply these standard methods to problems which require a level of interpretation to set up the application			present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination			exercises, with the support of seminars and formative feedback through marked work			
Stage 2	Functions of a Complex Variable MAT00024I	Progress towards PLO	understand and use the standard methods of complex analysis for functions of one complex variable	apply complex analysis to solve problems in applied real analysis, where their use provides quick and powerful solutions	decide when certain methods from complex analysis can, or cannot, be applied and give a justification for this decision		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination	exercises and with formative feedback through marked work and the seminars, and assessed by examination	lecture material and exercises, with the support of seminars and formative feedback through marked work, and assessed by examination.		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Differential Geometry MAT00006H	Progress towards PLO	understand and be able to calculate the standard geometric properties of curves and surfaces	decide which geometric properties can be evaluated given different representations of a curve or surface	justify the steps made in differential geometric arguments		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Algebraic Number Theory MAT00029H	Progress towards PLO	understand what is meant by "Algebraic Number Theory" and will be well-versed in many of the standard techniques	recognise various problems in algebraic number theory and apply the techniques they have learnt to solve them (e. g., factorisation of algebraic integers or ideals; identification of prime and irreducible elements in rings of integers)	justify the steps made in algebraic and number-theoretic arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Character Theory MAT00046H	Progress towards PLO	understand and be able to calculate the standard algebraic constructions (group algebras and character tables) attached to a finite group using clear and precise notation	decide which approach is appropriate (e.g. module or character theoretic) to problems in representation theory	follow logical steps in arguments and justify those steps		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture note and exercise sheet material	lecture notes, exercise sheets and previous exams (and ideally making up small exercises of one's own)	exercises from exercise sheets and and past exam papers		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Cryptography MAT00034H	Progress towards PLO	understand and be able to work with some of the mathematical underpinnings of modern cryptography	apply their current mathematical knowledge to new areas (namely certain cryptographic systems)	follow the reasoning as to why a primality test or a factorisation algorithm works		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Formal Languages and Automata MAT00002H	Progress towards PLO	understand the concept and be able to calculate the languages associated with finite state automata	decide which languages are of a nature that allows them to be described via automata, or other finitary processes	analyse the logic behind the Pumping Lemma, allowing them one way of determining when a language is not regular		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Galois Theory MAT00008H	Progress towards PLO	understand and be able use symmetry in the solution of polynomial equations and the correspondence that reconstructs fields and their subfields inside groups of symmetry	see how their algebraic foundations can be applied to solve specific problems (in particular, the algebraic solutions of equations and the construction using ruler and compass of specific objects)	follow the reasoning behind the construction of the Galois group of a field extension and the correspondence between its subgroups and intermediate fields		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Lebesgue Integration MAT00013H	Progress towards PLO	understand and be able to calculate the Lebesgue integral of simple functions	decide which properties define a null set and be able to compute the Lebesgue integral of a given function	justify the steps made in defining the Lebesgue integral of a measurable function		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Metric Spaces MAT00037H	Progress towards PLO	understand the notion of an abstract metric space and have a collection of tools to study them	understand how and when the concept of metric can be used to examine unfamiliar problems	comprehend and produce mathematical arguments to support claims concerning properties of metric spaces		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Number Theory MAT00023H	Progress towards PLO	understand and be able to use a wide range of methods from analytic number theory, Diophantine equations and Diophantine approximation	apply their analytic/number theoretic foundations to solve specific problems (eg. counting primes, Waring's problem) and develop new areas (Diophantine approximation)	comprehend and produce mathematical arguments to support claims concerning fundamental properties of numbers. At the end of the module students will (i) understand and appreciate a variety of methods and results in the subject and (ii) be able to tackle a variety of problems competently.		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Topology Mat00044H	Progress towards PLO	understand the notion of topological spaces, invariants and fundamental groups and be able to apply the ideas in an abstract setting.	determine when a given space is a topological space, be able to determine when two spaces are essentially the same and be able to determine what, if any, topological invariants the spaces possess	answer questions and solve problems about topological spaces that require reasoned, solid mathematical arguments		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Introduction to Dynamical Systems MAT00011H	Progress towards PLO	analyse the qualitative features of simple dynamical systems	adapt standard techniques to unfamiliar nonlinear dynamical systems	justify the conclusions of a qualitative analysis of a nonlinear system		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Applied Complex Analysis MAT00048H	Progress towards PLO	confidently apply tools and techniques of complex analysis in a variety of standard problems, including evaluation of contour integrals and the solution of differential equations	adapt the methods of complex analysis to unfamiliar problems	justify the steps made in application of complex analytic methods		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination.	lecture material and exercises, with the guidance and support of seminars		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Applications of Nonlinear Dynamics MAT00036H	Progress towards PLO	analyse the qualitative features of simple dynamical systems in an applied context	tackle unseen problems in models of real-life biological, chemical, or mechanical dynamical systems by various mathematical approaches	justify the conclusions of a qualitative analysis of a dynamical systems problem		present clear and concise solutions to exercises, including the results of mathematical reasoning and the qualitative discussion of the implications and validity of mathematical models			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars and examples classes, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Biological Fluid Dynamics (H Level) MAT00039H	Progress towards PLO	apply fluid dynamics techniques to a set of problems in biology	adapt standard applied mathematics techniques to unfamiliar fluid dynamics problems in biology	justify the conclusions of a qualitative analysis of a biological fluid dynamics problem	conduct, independently or in groups, studies on the context or analysis of biological fluid dynamics problems	present clear written or seminar presentations of worked exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback during short presentations in seminars	exercises, with the support of seminars and formative feedback on marked work and presentations			
Stage 3	Electromagnetism MAT00007H	Progress towards PLO	students will be able to apply vector calculus techniques to Maxwell's equations across a range of standard electromagnetic phenomena	students will be able to apply their theoretical understanding of electromagnetism to a range of phenomena, selecting the appropriate technique and applying it to an unfamiliar problem	students will work through a range of intriguing electromagnetic phenomena, including apparent paradoxes which require clear argument and new theory for their resolution		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Introductory Fluid Dynamics MAT00012H Intermediate Fluid Mechanics MAT00051H	Progress towards PLO	students will be able to apply basic fluid dynamics techniques to unfamiliar fluid dynamical problems	students will be able to adapt standard techniques to unfamiliar fluid dynamical problems	students will be able to justify the conclusions of a qualitative analysis of a fluid dynamics problem		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Partial Differential Equations (H Level) MAT00040H	Progress towards PLO	students will be able to use various techniques for analysing and solving partial differential equations	students will be able to adapt standard techniques to unfamiliar partial differential equations	students will be able to justify the conclusions of a qualitative analysis of a partial differential equation		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Numerical Analysis MAT00041H	Progress towards PLO	students will be able to apply numerical approximation techniques to a range of standard mathematical problems	students will be provided with a range of approximation techniques that can be used in unfamiliar application problems	students will be able to justify which particular numerical method is appropriate in a given context, and in which sense the approximation error is small		students will be able to communicate mathematical arguments in Numerical Analysis in writing	implement the numerical methods in practice by means of computer packages (such as Maple or Excel) and/or programming languages (such as Java).		
		By working on (and if applicable, assessed through)	lecture materials, computer practicals, assessed computer-based coursework, as well as being assessed in the examination	lecture materials, computer practicals	lecture materials, computer practicals, written coursework, and as assessed through examination		assessed written coursework	lecture material, computer practicals, coursework		

Stage 3	Quantum Mechanics I MAT00024H Quantum Mechanics II MAT00025H	Progress towards PLO	students will be able to understand how the language of mathematics and mathematical techniques are used to solve standard problems in quantum mechanics	students will be able to tackle unseen problems in quantum mechanics by various mathematical approaches	students will be able to examine critically some applications of quantum mechanical principles		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Special Relativity MAT00028H	Progress towards PLO	understand how the language of mathematics and mathematical techniques are used in the formulation of the theory of special relativity and be able to derive some of its intriguing physical implications	apply the theoretical understanding of special relativity to a range of phenomena occurring in spacetime, selecting the appropriate technique and applying it to an unfamiliar problem	work through a range of intriguing relativistic phenomena, including apparent paradoxes which require clear argument and coherent application of the theory of special relativity for their resolution		present clear and concise solutions to exercises, which includes careful discussion of the application of the mathematics of special relativity to the description of physical situations such as length contraction, time dilation, relativity of simultaneity, etc.			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Bayesian Statistics MAT00003H	Progress towards PLO	students will be able to perform a Bayesian analysis of simple statistical models with a conjugate prior distribution, including derivation of the posterior distribution and simulation from the posterior predictive distribution	students will be able to recognize statistical problems which require the application of the Bayes' rule; and to apply the Bayesian inferential approach to unfamiliar simple statistical models	students will be able to interpret numerical summaries of the posterior and predictive distributions, produced by simulation methods		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	Generalised Linear Models MAT00017H	Progress towards PLO	students will be able to correctly formulate a generalised linear model and use it appropriately in the context of data analysis	students will be able recognise when generalised linear models do not fit the available data and adapt their modelling strategy as appropriate	students will be able to conduct inference using the appropriate tools and be aware of the corresponding assumptions and their consequent limitations		present clear and concise solutions to exercises	students will be able to use the statistical programme R to perform data analysis in the GLM context.		
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars and practical sessions, through feedback on marked work and as assessed through examination	theoretical and practical exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars and practical sessions, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work	example data sets in exercises with the support of computer practical classes		
Stage 3	Mathematical Finance I MAT00015H	Progress towards PLO	students will be able to analyse portfolio selection and simple investment strategies	students will be able adapt standard techniques to unfamiliar portfolio optimisation and also forward contracts and options	students will be able to justify the conclusions of a quantitative analysis of portfolio under risk restrictions and also obtain arbitrage constraints in investment strategies		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Mathematical Finance II MAT00016H	Progress towards PLO	students will be able to analyse the quantitative features of pricing and hedging options	students will be able adapt standard techniques to unfamiliar option pricing and hedging problems	students will be able to justify the conclusions of a quantitative analysis of pricing and hedging options		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Multivariate Analysis MAT00021H	Progress towards PLO	students will be able to analyse the quantitative features of multivariate data	students will be able adapt standard techniques to unfamiliar multivariate data	students will be able to justify the conclusions of a qualitative analysis of a multivariate data set		present clear and concise solutions to exercises	students will be able to use statistical package R to analyse multivariate data by various techniques		

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practicals, and through feedback on marked work, and as assessed through examination	exercises, with the guidance and support of practicals, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of practicals, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work	examples with the support of computer practical classes		
Stage 3	Statistical Pattern Recognition MAT00031H	Progress towards PLO	students will acquire a range of pattern recognition techniques that can be applied to real world data analysis, particularly classification problems	students will be able to identify and apply the most appropriate techniques to particular problems	students will be able to justify the conclusions of a qualitative analysis of a multivariate data set		present clear and concise solutions to exercises	apply pattern recognition techniques using the statistical package R.		
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises in seminars and computer practicals	lecture material and exercises, with the guidance and support of practicals, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work	example data sets in exercises with the support of seminars and examples classes		

Stage 3	Stochastic Processes MAT00030H	Progress towards PLO	students will be able to formulate and analyse mathematical models that take account of the stochastic (random) fluctuations that are always present in the real world. They will acquire a range of mathematical techniques and approximations that can be used to make analytic predictions from stochastic models	students will be able adapt standard techniques to unfamiliar stochastic dynamical systems	students will be able to justify the arguments behind using stochastic models and recognize the difference with deterministic models of behaviour		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and through feedback on marked work, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Survival Analysis (H Level) MAT00018H	Progress towards PLO	understand and be able to use the standard statistical techniques of survival analysis	apply the methods of survival analysis to unfamiliar data sets	explain the criteria for using the statistical models which apply to survival analysis		present clear and concise solutions to exercises			

		By working on (and if applicable, assessed through)	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination.	exercises, with the guidance and support of practical sessions, and through feedback on marked work	lecture material and exercises, with the guidance and support of practical sessions, and through feedback on marked work, and as assessed in the examination		exercises, with the support of seminars and formative feedback through marked work			
Stage 3	Time Series MAT00045H	Progress towards PLO	students will be able to analyse the quantitative feature of time series models	students will be able to adapt standard techniques to unfamiliar time series models	students will be able to justify the conclusions of a quantitative analysis of a time series model		present clear and concise solutions to exercises			
		By working on (and if applicable, assessed through)	lecture material and exercises, with guidance and support of seminars, and through feedback on marked work, and as assessed through examination	exercises, with guidance and support of seminars, and through feedback on marked work, and as assessed through examination	lecture material and exercises, with the guidance and support of seminars, and as assessed through examination		exercises, with the support of seminars and formative feedback through marked work			

Stage 3	BSc Final Year Project MAT00004H	Progress towards PLO		adapt and apply the mathematics learned during the degree to some challenging topic outside the BSc degree syllabus	justify the reasoning and/or choice of methods used in the mathematics relevant to the project topic	conduct an independent study into a specialised area of mathematics, by researching material from a variety of sources, and synthesize this material into a well-organized and coherent account.	communicate complex mathematical ideas clearly in writing at the final year BSc level, and also be able to present an effective poster summary of these ideas for non-specialists	building on the skills developed in Mathematical Skills 1 & 2, prepare a long, well-structured, technical document involving mathematical typesetting (which may include figures), with proper use of a referencing protocol. They will also be able to prepare a digital master for a poster summarising their project.		
		By working on (and if applicable, assessed through)		material found in the literature, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation, with the support of the project supervisor and as assessed by the dissertation	the project dissertation (30-35 pages) and the poster, with the support of the project supervisor and the lectures on writing mathematics, as assessed by the writing assignments and the dissertation	preliminary assignments which develop an appreciation of layout for documents and a poster, the use of structure, the inclusion of figures. This is supported by practical classes, with feedback on assignments, and assessed through assignments, the final project and the poster.		