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1 General Information

Welcome to the Department of Mathematical Sciences. About 1,200 undergraduates take modules provided by the Department. This booklet has been written for students taking Level 1 mathematics modules and who do not wish to progress to higher level mathematics modules. Separate literature is available for students who may wish to study level 2 mathematics modules in later years.

This booklet contains information specific to your programme of study within the Department. For information concerning general University regulations, examination procedures etc., you should consult the Faculty Handbooks (www.dur.ac.uk/faculty.handbook/) and the University Calendar, which provide the definitive versions of University policy. The web address of the Teaching and Learning Handbook, which contains information about assessment procedures, amongst other things, is www.dur.ac.uk/teachingandlearning.handbook/.

You should keep this booklet for future reference. For instance, prospective employers might find it of interest.

An on-line version of this booklet may be found at http://www.maths.dur.ac.uk/teaching/ and then clicking on the appropriate year

1.1 The Department

Besides undergraduate teaching, the Department has a second main function — research. Just like you, lecturers and tutors are building on their existing expertise and trying to solve mathematical problems. Together with various administrative tasks, it is their main occupation outside the classroom. One difference, however, is that the problems you are asked to tackle should actually be solvable! The important thing is that Mathematics in Durham is living, developing and growing — and you are joining in.

1.2 Useful Contacts

The first point of contact for issues referring to a particular course or module should be the relevant lecturer. For more general questions or difficulties you are welcome to consult the Course Director, your Adviser (if you have one) or Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk).

For issues involving University registration for mathematics modules, please see the Registration Co-ordinator.

Head of Department:
Prof. M. Goldstein (CM207, michael.goldstein@durham.ac.uk)
Registration Co-ordinator:
Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk)
Director of Support Teaching:
Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk)

For each Joint Honours degree there is a designated member of staff from each participating department whom you may contact if you wish to discuss any aspect of your joint degree course. The relevant contacts in the Department are as follows:
Joint degrees with Physics:
Prof. P. R. W. Mansfield (CM210, p.r.w.mansfield@durham.ac.uk)
Joint degree with Chemistry:
Dr D. J. Smith (CM231a, douglas.smith@durham.ac.uk)
Joint degree with Education:
Dr V. E. Hubeny (CM306, veronika.hubeny@durham.ac.uk)

We may also wish to contact you! Please keep the Mathematics Office informed of your current term-time residential address and e-mail address.

1.3 Course Director

The Auxiliary Level 1 Mathematics Modules Course Director is:
Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk).
The Course Director is responsible for overseeing the academic progress of students taking these modules. If at any time you would like to discuss aspects of your course, or if there are questions about the Department that this booklet leaves unanswered, please contact the Course Director.

1.4 Consultation with Members of Staff

If you have any questions on the subject or are experiencing difficulties with a particular lecture course, you should consult the member of staff giving the course as soon as possible. The consultation may be:

- immediately after the lecture,
- by calling on the lecturer concerned in his or her office,
- by email.

For general issues with your studies, please contact the Course Director or Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk)

1.5 Change of Registration

If after your initial registration, you wish to change to, or from, a mathematics module you must see Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk). Any such change must be completed during the first four weeks of Michaelmas term.

1.6 Staff-Student Consultation

The Board of Studies has two Staff-Student Consultative Committees ((A) for Honours Mathematics and Natural Sciences and (B) for Auxiliary level 1 modules) to provide an effective means of communication between staff and students.

The Committees first meet in the Michaelmas Term. They have student representatives from each year (each module for Committee (B) and if you have issues you wish to raise, you should contact your year (or module) representatives.

The Staff-Student Consultative Committees also seek feedback from all students on all aspects of Mathematics courses by way of a questionnaire during the penultimate week of Michaelmas
and Epiphany terms. These are considered by the lecturers concerned, the Head of Department and the members of the Department’s Monitoring Committee. The Staff-Student Consultative Committees report to the Board of Studies, the main decision-making body of the Department, and play an active role in promoting high quality teaching in the Department. There are also student representatives to the Board of Studies, who act in an advisory capacity and also provide direct feedback to the student body.

Summary results of the questionnaires and minutes of the Staff-Student Committees are posted on the relevant noticeboards (first floor corridor of the Department).

If you have concerns about teaching which are not covered by these meetings and questionnaires, contact can be made directly with the Staff-Student Consultative Committee Chairmen:
Prof. S. F. Ross (CM218, s.f.ross@durham.ac.uk) for Committee (A).
Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk) for Committee (B).

1.7 Students with Special Needs

The University is committed to full compliance with the aims of the Special Educational Needs and Disability Act 2001. Once a student has been accepted for a course of study, the University accepts a responsibility to ensure appropriate provision for that student throughout his/her course. Students with disabilities can expect to be integrated into the normal University environment. They are encouraged and helped to be responsible for their own learning and so achieve their full academic potential.

Durham University Service for Students with Disabilities (DUSSD) aims to provide appropriate care and support for all Durham students with a disability, dyslexia, medical or mental health condition which significantly affects study. DUSSD can advise you and organise special academic facilities if you have a disability and need some help. They will try to provide whatever support is necessary to enable you to study effectively and to make full use of your opportunities at University. This help will be specific and appropriate to you and relevant to the courses you choose.

Special arrangements and facilities may well be required by disabled students when taking examinations. These might include extra reading time or a separate quiet room and are intended to minimise the effects of disability, which are often exacerbated by examination conditions. DUSSD organises all the requisite examination concessions for hearing-impaired, visually-impaired and dyslexic students. DUSSD also makes recommendations to departments for students with other disabilities who have regular support from the Service.

Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk) is the Departmental Disability Representative (DDR) and is the person to be contacted regarding any concerns, requirements or problems in studying in the department.

For further advice, or to obtain a copy of the University’s Disability Statement, please contact Durham University Service for Students with Disabilities (DUSSD), Pelaw House, Leazes Road, Durham, DH1 1TA, Tel: 0191 334 8115 (Voice and Minicom), Email: disabilities.service@durham.ac.uk.
1.8 Illness and Absence

If you miss tutorials or fail to hand in written work because of illness you must ask your College to inform the Department. If this work is summatively assessed (i.e., counts towards your final mark for a module), you must complete a self-certification of illness form.

If your academic performance is significantly affected by illness or other difficulties at any time, you should obtain documentary evidence as described in the Learning and Teaching Handbook of the University of Durham. The relevant section is: 6.3.16 Student Absence and Illness. This is accessible on-line under the address www.dur.ac.uk/learningandteaching.handbook/3.16.pdf and contains links to downloadable self-certification forms and requests for a doctor’s certificate.

A member of the Department is liaising with the Colleges regarding illness and absences related to illness. Feel free to contact her if you feel it might be beneficial for you to discuss matters within the department.

Liaison officer (Colleges - Dept of Mathematical Sciences):
Mrs F. Giblin (Maths Office, f.l.giblin@durham.ac.uk)

If you miss tutorials or fail to hand in written work for other reasons you should contact the Director of Support Teaching, Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk), as soon as possible.

1.9 Course Information

Term time in Durham is Michaelmas (10 weeks), Epiphany (9 weeks) and Easter (9 weeks). There are 22 teaching weeks, and the last seven weeks are dedicated to private revision, examinations and registration for the subsequent academic year.

Timetables giving details of places and times of your commitments are available on Departmental web pages and noticeboards in the first floor corridor of the Department. It is assumed that you read them!

You may access your own Maths timetable at www.maths.dur.ac.uk/teaching/ and then clicking on the ‘My Maths timetable’ link.

Also, teaching staff often send you important information by e-mail to your local '@dur.ac.uk' address, and so you should scan your mailbox regularly (see below).

Note that in October it takes time to sort out groups for tutorials and practicals, and so these classes start in week 2.

1.10 Computers, ICT and DUO

You are expected to use the internet — i.e., e-mail and the World-Wide Web (WWW) — and facilities are provided by the Information Technology Service (ITS). You should take advantage of ITS instruction courses to make sure that you have a basic acquaintance with computers. The web-address is www.dur.ac.uk/ITS.

The Maths Department web-address is www.maths.dur.ac.uk and a valuable link is ‘Teaching’. Here besides lecture and tutorial timetables you will find material provided by lecturers. For this they may use ‘Durham University Online’ (DUO).
DUO is a virtual learning environment which is a collection of on-line resources including links to web pages, lecture notes and exercise sheets/solutions, communication tools like email and assessment features such as formative quizzes. Your login area on DUO is where you can access all on-line course materials offered by your lecturers.

Soon after your registration details have been entered onto the University’s student records system (Banner), you will automatically be enrolled by the Learning Technologies Team at the IT Service on the DUO courses related to the mathematics modules that you are taking. Details of how to logon to the DUO system are given at [duo.dur.ac.uk](http://duo.dur.ac.uk) and in the IT Service publication ‘Computing at Durham’. Individual lecturers will inform you about its use for their courses from time to time during the year. The Department will also make use of the Announcements area in DUO to pass on important information to you so please get into the habit of logging in every day.

### 1.11 Private Study

‘An undergraduate module with effect from October 1998 is defined as a study unit comprising 200 hours of SLAT (Student Learning Activity Time) per annum and lasts one academic year’ (University of Durham Teaching and Learning Handbook). The total ‘contact time’ that a student spends in lectures, tutorials, etc. amounts to around 30% of the total SLAT. You would be wise to plan how best to use the remaining 70% (140 hours for a 20-credit module, i.e., 6.4 hours per week of a 22-week academic year per 20-credit module). Your adviser will be able to help you with this. This time is allocated within the module to be spent, not only in preparing submitted work (e.g. essays, assessed problems), but in private study of the lecture course material and in revision. You are advised to organise your time in such a way that you are able to devote a number of hours each week to reviewing your lecture notes, reading around the subject and working through exercises extra to those which have been set by the lecturer. By so doing you will be developing your study and personal management skills and be giving yourself the best opportunity to gain a firm understanding of the topics as they unfold. By attending to any difficulties or misconceptions you have as the course progresses you will be in an excellent position at the end of the course to make the most of your revision time. Planning and preparation are the key to reducing examination stress. It was within this framework that the University developed PDPs (Personal Development Plans) which is a structured and supported process which will enable you to reflect on the mathematical process and to discover, at a personal level, the best way for you to learn the mathematics you are taught. To find out more visit [duo.dur.ac.uk](http://duo.dur.ac.uk).

### 1.12 Books and Libraries

The main collection of mathematics books, including all the texts recommended in this booklet, is housed in the University Library. Each College has its own library.

Here are a few books which convey the excitement of modern mathematics — a good way to spend your book tokens! —


For mathematical sites on the Internet, visit [www.yahoo.co.uk/Science/Mathematics/](http://www.yahoo.co.uk/Science/Mathematics/)
1.13 Student Records

Your Department record file contains some or all of the following:

- Your UCAS form,
- Annual Department registration forms,
- Your plagiarism forms,
- Annual examination results,
- Copies of letters received from you and sent to you.

Lists of student names are used in the preparation of registers for tutorials, practicals and examples classes and in the examinations. All such Departmental computer files are registered under the Data Protection Act. Each student’s marks for all examinations and assessed work are confidential to the members of the Board of Examiners of the Department; aggregate marks are known to the members of the Faculty Board of Examiners, College Principals and Senior Tutors, the Examinations Department, and the individual student.

1.14 Smoking and Mobile Phones

Please note that (i) smoking is not allowed in any University building, and (ii) mobiles must always be switched off in teaching rooms.
Durham University Mathematical Society, affectionately known as MathSoc, provides an opportunity for maths students (or anyone with an interest in maths) to meet away from lectures. We arrange a variety of events throughout the year, such as bowling, bar crawls, paintballing, a Christmas meal, and the highlight of the year - a trip to see Countdown being filmed! So you should find something to interest you.

MathSoc also helps to arrange guest lectures in a wide range of aspects of maths such as Geometry and Spectrum and Twistor Theory. These are at a level such that anyone with an interest in maths can enjoy them and they will hopefully inspire an interest in a part of maths you may not have seen before.

We have our own website (www.durham.ac.uk/mathematical.society), where you will find all the most up-to-date information about the society. Here you will also find our second-hand book list, which has many of the books needed for courses for much cheaper than you will find them in the shops.

If you would like any more information about either the society itself, or advice on any other aspect of the maths course for example module choices for next year, feel free to get in touch with any of the exec listed below, or via the society email address (mathematical.society@durham.ac.uk) TO JOIN:

Come see our stand at the freshers fair or email at any time it costs only 6 for life membership or 3 for a year

This year’s Exec. is:
- President - Caspar de Haes (c.c.j.de-haes@durham.ac.uk)
- Treasurer - Sarah Kane (s.a.kane@durham.ac.uk)
- Secretary - Jennifer Avery (jennifer.avery@durham.ac.uk)
- Social Secretary - Chloe Green (chloe.green@durham.ac.uk)
- Publicity Officer - Matthew Palmer (m.i.palmer@durham.ac.uk)

1.16 Disclaimer

The information in this booklet is correct at the time of going to press in May 2009. The University, however, reserves the right to make changes without notice to regulations, programmes and syllabuses. The most up-to-date details of all undergraduate modules can be found in the Faculty Handbook on-line at www.dur.ac.uk/faculty.handbook/.
2 Examinations and Assessment

2.1 Collections
The main exams take place in May/June each year. Also in each first-year Maths module there are short compulsory class tests in January immediately following the Christmas vacation. These are called ‘Collections’, and further details will be published in December. Timetables for the May/June exams appear in Feb/March.

2.2 University Assessment Process

Full details of the University procedures for Examinations and Assessment may be found in the Learning and Teaching Handbook (www.dur.ac.uk/learningandteaching.handbook/).

2.3 Board of Examiners

The Board of Examiners is responsible for all assessment of Mathematics courses.
Chair: Prof. A. Taormina (CM302, anne.taormina@durham.ac.uk)
Deputy Chair: Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk)
Secretary: Dr H. Gangl (CM108, herbert.gangl@durham.ac.uk)

2.4 Plagiarism, Cheating and Collusion

Working with your fellow students is perfectly acceptable, but joint work should be declared as such. The University has a strict policy against plagiarism and other forms of cheating, a statement of which may be found in the Teaching and Learning Section in Volume I of your Faculty’s Undergraduate Handbook.

Plagiarism includes
- The verbatim copying of another’s work without acknowledgement.
- The close paraphrasing of another’s work by simply changing a few words, or altering the order of the presentation, without acknowledgement.
- Unacknowledged quotation of phrases from another’s work.
- The deliberate and detailed presentation of another’s concept as one’s own.

Cheating includes
- Communication with or copying from any other student during an examination.
- Communication during an examination with any person other than a properly authorised invigilator or another authorised member of staff.
- Introducing any written or printed material into the examination room unless expressly permitted by the Board of Examiners in Mathematical Sciences or course regulations.
- Introducing any electronically stored information into the examination room, unless expressly permitted by the Board of Examiners in Mathematical Sciences or course regulations.
- Gaining access to unauthorised material during or before an examination.
- The provision or assistance in the provision of false evidence or knowledge or understanding in examinations.

Collusion includes
- The collaboration, without official approval, between two or more students in the preparation and production of work which is ultimately submitted by each in an identical, or substantially similar, form and/or represented by each to be the product of his or her individual efforts.
• The unauthorised co-operation between a student and another person in the preparation and production of work which is presented as the student’s own.

2.5 Academic Progress Notice (APN)

The department’s APN Manager is:
Dr. S. Borgan (CM208, sharry.borgan@durham.ac.uk).
The APN Manager manages the APN process in the department and is responsible for monitoring your academic progress.
The APN Manager will, if necessary, contact you concerning missed compulsory commitments. If you persistently miss these, without good cause, then an APN will be requested, this would a very serious matter, as it could result in you being required to withdraw from the University.

For level 1 the compulsory commitments for APN purposes are:
1. The written assignments for each module.
2. Tutorials / Problems Classes / Computer Practical Classes / Seminars for each module
3. Tests and Collections exams for each module

2.6 Monitoring of Work

Under the general regulations of the University with regard to the Academic Progress Notice (APN), you are required to complete written work to a standard satisfactory to the Chairman of the Board of Studies. In practice this means that you will be required to hand in written work on time at a standard of grade C or better (see table below). To encourage this, your performance is monitored by the APN Manager.

Formative assessment of coursework occurs at all Levels, while summative continuous assessment of coursework occurs for the auxiliary Level I Mathematics modules.

The purpose of formative and summative continuous assessment of coursework is to help the student at each stage of the learning process. It is designed to encourage effort all year long and provides manageable milestones, in preparation for the summative assessment of end of year examinations. Course lecturers provide problems of an appropriate standard and length to the students, as well as assessment templates (model solutions) to the markers.

Each script is returned to the student with the grade written on it. The interpretation of grades is as in the table below.

The returned scripts should indicate clearly where errors and gaps in arguments occur, and the nature of errors. They should give brief indications as to the approach required, bearing in mind that model solutions for all set problems will be provided to students by lecturers shortly after the marking has occurred. The lecturer makes relevant model solutions available to students via the course webpage or/and Durham On-Line (DUO) shortly after they have submitted their assignments.

Remark: Grades D/E or a failure to hand in work is a demerit. If say 4 questions of equal standard are set and 2 are answered very well and 2 are not tackled at all then there is close to 50% attainment, resulting in grade C.

1 ‘Summative’ assessment counts towards the overall mark for the module. ‘Formative’ assessment does not.
2 MATH1031, MATH1541, MATH1551, MATH1561, MATH1571, MATH1711
In all cases, performance at marked written work can provide useful evidence for the Board of Examiners if examination performance is adversely affected by illness or other circumstances.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Equivalent Mark</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≥ 80%</td>
<td>Essentially complete and correct work</td>
</tr>
<tr>
<td>B</td>
<td>60%—79%</td>
<td>Shows understanding, but contains a small number of errors or gaps</td>
</tr>
<tr>
<td>C</td>
<td>40%—59%</td>
<td>Clear evidence of a serious attempt at the work, showing some understanding, but with important gaps</td>
</tr>
<tr>
<td>D</td>
<td>20%—39%</td>
<td>Scrappy work, bare evidence of understanding or significant work omitted</td>
</tr>
<tr>
<td>E</td>
<td>&lt;20%</td>
<td>No understanding or little real attempt made</td>
</tr>
</tbody>
</table>

2.7 Submission of Formative Work

Students are required to submit work before the deadline for submission. No credit is given for late work unless there is a prior arrangement with the lecturer.

2.8 Submission of Summative-Assessed Work

Students are required to submit work before the deadline for submission. They will be informed clearly of the deadline for a given piece of work — the submission dates will be displayed on Departmental noticeboards (first floor corridor) and module webpages where appropriate.

If a student, for whatever reason, believes he/she is unable to submit a major piece of summative assessed work by the due deadline, he/she should submit a written request for an extension to the Head of Department well in advance of the due deadline and explain his/her reasons, providing supporting evidence where appropriate. The Head of Department will have to consider whether in his/her view the grounds offered by the student are sufficient to warrant an extension to the original deadline. Normally the only grounds on which an extension will be granted are where circumstances beyond the control of the student have prevented submission.

If an extension is granted then the new deadline will be made clear to the student, in writing, and the procedures with regard to meeting the new deadline should be those outlined in this policy statement. If a student is not granted an extension, and fails to submit a piece of summative assessed work by the due deadline, the work will not be marked and a mark of zero will be recorded.

2.9 Calculators

Calculators are needed for some Maths modules and in the corresponding examinations. In the interest of fairness, the Board of Studies in Mathematical Sciences has decided that only the simplest scientific types are allowed. In particular, you are not allowed to take to an examination any calculator which is programmable, can display graphics, has facilities for text storage or communications or can evaluate integrals or solve linear equations.

For details follow the links ‘Teaching > Exam info’ from the Department’s home-page.
2.10 Examinations and Progression

Details of examination papers structure may be found by following the links ‘Teaching > Exam info’ from the Department’s home-page.
In addition to any continuous assessment component (accounting for 10% of the final mark), each module is examined by a three-hour paper in May/June (accounting for 90% of the final mark). These papers normally allow a choice of six questions from eight.

For all degrees, you must satisfy the University rules on progression. You should refer to your Faculty’s First-Year Undergraduate Handbook in the section ‘Introduction to the University’s Modular Undergraduate Degree Scheme’ for the precise rules for progression from Year 1 to Year 2. Flowcharts have been designed to help you understand the implications of the progression regulations. They may be found at [www.dur.ac.uk/faculty.handbook](http://www.dur.ac.uk/faculty.handbook) by following the link ‘Student survival guide > Flowchart of Progression Regulations’. You will be eligible to proceed to the second year if you obtain at least 40% in each of your six modules. As a first or second-year student, you have the opportunity to retake, in August/September of the same year, the components of the modules for which your overall mark was less than 40%.

Exam results (pass or fail) are available to you on-line at the end of the penultimate week of the Easter term.

Departmental examinations (called ‘Collections’) are compulsory and held at the beginning of the second term on the first term’s work. An exception is Mathematics for Engineers and Scientists (MATH1551) for which Collections are held in the last week of the first term. These provide you and the Department with a valuable guide to your progress during the first term.

The final degree awarded depends on your performance in each of your subsequent years, and details may be found in the University Final Honours Handbook, Core - Volume II.

2.11 Illness and Examinations

If your academic performance is significantly affected by circumstances beyond your control – for instance, illness or bereavement – at any time during your programme of study, and especially in the period leading up to or during the examination period, you might wish to bring these mitigating circumstances to the attention of the Board of Examiners.

The Board of Examiners has discretion to take mitigating circumstances into account when making a final decision on a student’s progression to the next year of study or on his/her class of degree. Students must inform the Board of Examiners before they meet, using the Mitigating Circumstances form, which can be obtained from Colleges or downloaded from [http://www.dur.ac.uk/resources/learningandteaching.handbook/Section6/a6.04.pdf](http://www.dur.ac.uk/resources/learningandteaching.handbook/Section6/a6.04.pdf). Supporting evidence such as a doctor’s certificate, or other evidence from an independent professional such as a counsellor or members of DUSSD, should be submitted with the form if available and appropriate.

Students considering claiming Mitigating Circumstances are advised to read Section 6 of the Learning and Teaching Handbook of the University of Durham, accessible on-line under the address [http://www.dur.ac.uk/learningandteaching.handbook/6/](http://www.dur.ac.uk/learningandteaching.handbook/6/)
The relevant section is:
6.3.16.4. Evidence for Boards of Examiners.
3 Teaching and Learning

The classroom part of most Mathematics modules is a sequence of 50-minute lectures, usually supplemented by tutorials and/or practicals.

Lectures show you the details of the subject and help you to absorb the language and pick up the emphasis. They are an important collective experience, giving a skeleton for you to flesh out through your own independent study and work.

If you are used to close supervision by a schoolteacher who tells you all that you need to know and goes over material repeatedly till you grasp it, then the university style of teaching and learning seems alien at first.

In lectures new ideas come thick and fast, building on each other, and you find that to keep up you must take charge yourself and organise your life to work consistently on your own. This involves using Library and online resources and, most importantly, actually doing mathematics — i.e., carrying out calculations and solving problems.

However, you quickly adapt — you use textbooks, and you ask questions to lecturers and tutors (they encourage them). You prioritize commitments and (very valuable!) you learn to benefit from discussions with fellow students. In fact you develop as an active learner in place of a passive pupil, and start to enjoy your new maturity.

Attendance at lectures is not formally monitored, although few people succeed without their guidance. However, all lecturers set problems to be attempted and handed in for correction and grading, and performance in this most important aspect is monitored (see the next section). So is tutorial and practical attendance. If you miss out then you will soon be asked to account for yourself.

Tutorials are for work in a small group, where you deal with exercises and problems set by the lecturer, and with ideas and issues arising from the lectures. The written work and the tutorial discussions together promote the valuable skill of communicating detailed ideas clearly. And this is where you get regular feedback on your progress.

3.1 Independent Learning

One of the Department’s goals in your education is to try and make you an independent learner by the time you leave university. We also recognise that some students:

- find the transition from school to university difficult;
- enjoy the choice and opportunity to specialise as they progress through their degree.

In order to assist in this transition we front load tutorial support in the first-year and release this resource in later years to allow for choice and specialisation. In all modules the lecturer sets problems for students to attempt. In the first and second years students have a tutor for each module. In the third and fourth years the lecturer performs the role of tutor. Our open-door policy means that if you have any question then you are encouraged to ask the person who performs the tutors role. In fact we encourage students to bring classmates when difficulties are discussed.
3.2 The Modules

Here is some brief information concerning those modules which will not lead on to higher level mathematics modules. In particular, you will find below the pre-requisites needed, as well as the excluded combinations of modules. A more detailed description, together with syllabuses, is given later in the booklet. Each module is a single module, which may be taken by students of any Faculty who have at least the stated pre-requisite qualification or equivalent.

All modules described below have a continuous assessment component for homework. The rule applied is the following: from the 100 marks available, ten marks are deducted for each missing /unsatisfactory/late assignment beyond a threshold set by the lecturer (and subject to non-negativity).

**Data Analysis, Modelling and Simulation (MATH1711):** This module has a pre-requisite qualification of grade C at A-level Mathematics. Continuous assessment accounts for 10% of the final mark. The first term material coincides with that of Statistics (MATH1541), so that the module may not be taken before, with or after MATH1541. There are two lectures and one-and-a-half tutorial/practical hour per week.

**Discrete Mathematics (MATH1031):** This module has a pre-requisite qualification of grade C at A-level Mathematics. Continuous assessment accounts for 10% of the final mark. There are two lectures and one tutorial per week.

**Mathematics for Engineers and Scientists (MATH1551):** This module has a normal pre-requisite qualification of grade C at A-level Mathematics. Honours Engineering students take this module in the first year. Continuous assessment accounts for 10% of the final mark. Core Mathematics A (MATH1012), Core Mathematics B1 (MATH1051), Core Mathematics B2 (MATH1041), Single Mathematics A (MATH1561) and Single Mathematics B (MATH1571) may not be taken before, with or after this module. There are three lectures per week and a fortnightly tutorial.

**Single Mathematics A (MATH1561):** This module has a normal pre-requisite qualification of grade C at A-level Mathematics. Continuous assessment accounts for 10% of the final mark. Core Mathematics A (MATH1012), Core Mathematics B1 (MATH1051), Core Mathematics B2 (MATH1041) and Mathematics for Engineers and Scientists (MATH1551) may not be taken before, with or after this module. There are three lectures and one tutorial per week.

**Single Mathematics B (MATH1571):** This module has a normal pre-requisite qualification of grade C at A-level Mathematics. Continuous assessment accounts for 10% of the final mark. Single Mathematics A (MATH1561) must be taken alongside this module, although other co-requisites or previous knowledge may be acceptable. Core Mathematics A (MATH1012), Core Mathematics B2 (MATH1041) or Mathematics for Engineers and Scientists (MATH1551) may not be taken before, with or after this module. There are three lectures and one tutorial per week.

**Statistics (MATH1541):** This module has a pre-requisite qualification of grade C at A-level Mathematics. Continuous assessment accounts for 10% of the final mark. The first term material coincides with that of Data Analysis, Modelling and Simulation (MATH1711) so that the module may not be taken before, with or after this module. There are two lectures and one-and-a-half tutorial/practical hour per week.

*Note:* If you have a grade A at A-level Mathematics you might consider taking Core Mathematics...
A rather than Single Mathematics A. Core Mathematics A is a double module which is taken by Honours Mathematicians and many Natural Scientists, and it could widen the choice of modules available to you next year. If you are considering taking Core Mathematics A please ask for the First-Year Mathematics booklet. Advice will also be available during registration.

3.3 Booklists and Descriptions of Courses

The following pages contain brief descriptions of the modules available to you.

Each module description is followed by a list of recommended books and a syllabus. For some modules you are advised to buy a particular book, indicated by an asterisk; for others a choice of titles is offered or no specific recommendation is given.

There are also suggestions for preliminary reading and some time spent on this during the summer vacation may well pay dividends in the coming year.

Syllabuses, timetables, handbooks, exam information, and much more may be found at www.maths.dur.ac.uk/teaching/, or by following the link ‘teaching’ from the Department’s home page (www.maths.dur.ac.uk).

The syllabuses are intended as guides to the modules. No guarantee is given that additional material will not be included and examined nor that all topics mentioned will be treated.
3.3.1 DATA ANALYSIS, MODELLING AND SIMULATION – MATH1711 (41 lectures)

Mr D. A. Wooff / Dr U. Picchini

Term 1 - Data Analysis: Lectures for the first term of the module coincide with the Statistics module (MATH1541) and provide an introduction to data analysis. The topics to be covered are: sources of data, descriptive statistics, exploration of relationships between two or more variables, and a selection of more advanced techniques.

Term 2 - Modelling and Simulation: The second term deals with problems arising in deterministic modelling, allowing us to predict the behaviour of physical systems (or to learn that the behaviour is unpredictable). For instance biological systems modelling populations with diseases which also experience birth and death.

Computers will be used for some demonstrations and for practical classes. The software will be R for Windows and Maple for Windows.

There are two lectures and an average of 1.5 hours of computing practicals and problems classes per week. Weekly problems may be taken from the exercise sheets and for practicals. There will be a Collection examination in January. All these form an integral part of the module.

Recommended Books

Purchase of a book is not necessary. However, background reading is strongly recommended. Much of the material covered in first term lectures may be found in [1]. Many other introductory statistics texts cover most of the basic techniques addressed. Note that various formulae and methods may differ slightly from book to book, and from lecture material to books. The latter two references cover material for the second term. Other books may be recommended when appropriate.


Calculators

Approved electronic calculators are allowed in the examinations.
Outline of course Data Analysis, Modelling and Simulation

Aim: The module is a first course in practical data analysis and computer modelling. The emphasis of the module is upon the understanding of real-life statistical and mathematical problems, and develops the basic concepts and methods by example.

Term 1 (20 lectures)

Sources of Data: Controlled experiments. Randomisation. Observational studies. Ethical practice.

Descriptive Statistics: Displaying distributions: stem and leaf plots, histograms. Notation; summation formulae. Describing and summarising distributions: location (mode, mean, median, percentiles); spread (variance, inter-quartile range); boxplots. Standardisation. Measurements and errors: outliers (link from boxplots), bias, randomness, chance errors, (informally) central tendency. Normal curve; areas under Normal curve; assessing Normality. Misleading graphs.


Methods for More than Two Variables: Least squares and multiple regression; two way tables, mean polish and median polish.

Data Analysis Topics: Chosen from the following: non-linear least squares, smoothing, transformations, design of experiments.

Terms 2 & 3 (21 lectures) Smoothing Data: (2): Least-squares, solving normal equations from first principles with data errors.


Continuous Models (6): Chemical reactions, continuous population problems, first-order ordinary differential equations, Euler’s method, mechanical models (2nd-order systems), phase portraits, equilibria, stability, phase paths and isoclines.

Stochastic Models (5): Random walks and Monte-Carlo quadratures, problems like Buffon’s needle.
3.3.2  DISCRETE MATHEMATICS – [MATH1031] (41 lectures)

Dr S. Borgan

This module introduces a wide variety of topics, all of them about things which are discrete (like the integers) rather than continuous (like the real numbers). We will often ask ‘how many?’; these counting problems can be simple to state, using ordinary language, but surprisingly difficult to solve, needing both careful common sense and some specific techniques. The second term of the course is mostly about graphs. These are not the familiar graphs of functions, but networks - like for example railway lines and stations.

Many of the problems you will tackle cannot be done by any standard method, so you must learn to explain your thinking clearly, in some suitable combination of words, symbols and diagrams. Of course this skill will be very useful for other modules, and the rest of your life.

Discrete Maths has some of its origins in mathematical puzzles and games, but now finds many and varied applications, usually in setting up structure or organising something. It is fundamental to computer science.

There are two lectures and one problems class per week. Problems are set weekly to be handed in and there is a compulsory examination (Collections) in January to see how you are going on. In May/June there is a 3-hour written examination.

Recommended Books

There is no required text, but any of these might be helpful or interesting.

Grimaldi is perhaps the most comprehensive.

Tucker also covers most of the material.

Graham, Knuth and Patashnik is a mine of interesting information and examples, written in a very chatty style.

Wilson’s book is excellent for the graph theory part of the course and goes well beyond.

Marcus is very good on the non-graph theory parts of the course.


Calculators

Approved electronic calculators are allowed in the examinations.
Outline of course

Discrete Mathematics

**Aim**: To provide students with a range of tools for counting discrete mathematical objects. To provide experience of a range of techniques and algorithms in the context of Graph Theory, many with every day applications.

**Term 1** (20 lectures)

**Principles of Counting**: Arrangements and permutations, selections and combinations, mathematical induction, combinatorial vs arithmetical proof. Pigeonhole principle, inclusion - exclusion.

**Recurrence Relations and Generating Functions**: Recurrence relations, generating functions, partitions.

**Terms 2 & 3** (21 lectures)

**Graphs**: Basic concepts (paths circuits, connectedness etc.) Euler paths, maze algorithms. Planar graphs, Euler’s theorem, the Platonic graphs. A brief introduction to graph colouring, the Six Colour Theorem. Greedy algorithm.

This module is intended to supply the basic mathematical needs for students in Engineering and other sciences.

There will be a short online diagnostic test to be completed during the first week. This test is based on a wide range of maths A-level material. The purpose is to help you brush-up on any material you have forgotten or did not cover in great detail at A-level (not everyone has the same mathematical background.) It does not count in any way towards your final mark for this module. Note that there are also revision classes during the first two weeks of term where you can practise problems and ask questions.

There are 3 lectures each week and fortnightly tutorials. The tutorials start in Week 3. Problems will be set to be handed in each week and there is a Collection examination in December to test your understanding of the first term material. All these form an integral part of the module.

**Recommended Books**

Students should buy either the two books by Stroud or the book by Stephenson.


If you are not too confident about the mathematics module then the books by Stroud will provide you with much support throughout the module. Students have found these books very helpful in previous years. You will probably already know some of the material in the first book. Stephenson is a more concise text but should also prove useful for parts of the second year mathematics module for Engineering students.

You may also like to refer to: (all paperbacks)


**Calculators**

The use of electronic calculators is forbidden in examinations.
Outline of course

Mathematics for Engineers and Scientists

**Term 1** (28 lectures)

**Elementary Functions** (Practical): Their graphs, trigonometric identities and 2D Cartesian geometry: To include polynomials, trigonometric functions, inverse trigonometric functions, $e^x, \ln x, x, \sin(x+y)$, sine and cosine formulae. Line, circle, ellipse, parabola, hyperbola.

**Differentiation** (Practical): Definition of the derivative of a function as slope of tangent line to graph. Local maxima, minima and stationary points. Differentiation of elementary functions. Rules for differentiation of sums, products, quotients and function of a function.

**Integration** (Practical): Definition of integration as reverse of differentiation and as area under a graph. Integration by partial fractions, substitution and parts. Reduction formula for $\int \sin^n x \, dx$.

**Complex Numbers**: Addition, subtraction, multiplication, division, complex conjugate. Argand diagram, modulus, argument. Complex exponential, trigonometric and hyperbolic functions. Polar coordinates. de Moivre’s theorem. Positive integer powers of $\sin u, \cos u$ in terms of multiple angles.

**Differentiation**: Limits and Continuity. L’Hopital’s rule. Leibniz rule. Tangents, normals. Newton-Raphson method for roots of $f(x) = 0$. Power series, Taylor’s and MacLaurin’s theorem, and applications.


**Terms 2 & 3** (34 lectures)

**Partial Differentiation**: Functions of several variables. Chain rule. Level curves and surfaces. Gradient of a scalar function. Normal lines and tangent planes to surfaces. Local maxima, minima, and saddle points.

**Integration**: Areas, volumes, length of arc, area of a surface of revolution, centre of gravity, second moments of area, moments of inertia. Cylindrical and spherical coordinates. Numerical integration: rectangular, trapezoidal and Simpson’s rules.

3.3.4 SINGLE MATHEMATICS A – [MATH1561](62 lectures)

Prof. P. E. Dorey / Prof. A. Taormina / Prof. S. F. Ross

The module follows on from A-level, although certain A-level topics may be covered afresh. There are three lectures and one tutorial per week. Problems are set to be handed in each week and there is a compulsory practice examination (Collections) in January to see how you are getting on. It is important to do the written work conscientiously throughout the year both to prepare yourself for the examination and because there is continuous assessment for written work. The material consists of important basic ideas and techniques in calculus and linear algebra which have applications in a huge variety of areas of science and mathematics.

**Recommended Books**

Course notes will be available for purchase (price £2) though examples considered in the lectures may not be included in these notes.

The recommended books for the course are:


The first covers the material in the first term, while the latter covers terms 2 & 3 of Single A and virtually everything in Single B. These books are strongly recommended.

Many other books contain useful material covering parts of the course. They can be useful sources for further worked examples and problems. A few suggestions are:


**Calculators**

Approved electronic calculators are allowed in the examinations.
Outline of course

**Term 1** (30 lectures)

**Diagnostic Test** (1)

**Elementary Algebra and Basic Functions** (5): Elementary algebra: Simple algebraic manipulations. Roots of \( ax^2 + bx + c = 0 \) by completion of the square. Binomial theorem. Basic functions and elementary calculus: definition of standard functions (trigonometric, exponential, log, and hyperbolic functions).

**Limits and Differentiation** (4): Real numbers versus rational numbers; limits, continuity, differentiability. Basic methods of differentiation.

**Integration** (9): Basic methods of integration including substitution, integration by parts, partial fractions, reduction formulae. Line integrals and arc length.


**Complex Numbers** (7): Addition, subtraction, multiplication, division, complex conjugate, modulus, arguments, polar form. Argand diagram, de Moivre’s theorem, \( e^{i\theta} \), positive integral powers of sin and cos in terms of multiple angles, complex exponential, trigonometric and hyperbolic functions. Roots of unity, solutions of simple equations in terms of complex numbers.

**Terms 2 & 3** (32 lectures)

**Taylor’s theorem** (7): Taylor polynomials, Taylor’s theorem with Lagrange form of the remainder, applications to simple numerical approximations, application to L’Hopital’s rule. Convergence of Taylor series. Taylor series of \( 1/(1+x) \), \( e^x \), \( \cos x \), \( \sin x \), \( \ln(1+x) \).


This module follows on from A-level mathematics, although many topics will be covered afresh. There are three lectures and one tutorial per week. Problems are set to be handed in each week and there is a compulsory examination (Collections) in January. These are all integral parts of the module.

In the first term we will discuss vector algebra and some applications to mechanics and geometry, ordinary differential equations – their classification and solutions, and Fourier analysis – the representation of functions as linear superpositions of sines and cosines.

In the second and third terms we cover functions of several variables, partial differential equations, and probability. The ideas of differentiation and integration extended to functions of two or more variables give rise to partial derivatives and multiple integrals. A partial differential equation expresses a relationship involving a function of two or more variables and some of its partial derivatives. Wave motion is one of the many phenomena described by partial differential equations; an example is vibration of a stretched string, such as a guitar string. The Fourier analysis discussed in the first term will be used in this context. The final part of the module provides an introduction to probability and statistics.

Recommended Books

First Term: Ordinary differential equations, vector methods and Fourier analysis can be found in most books on mathematical methods, for example:


The chapter on probability in James covers this section of the course. The Schaum outline book S. Lipschutz, Probability provides lots of examples on fundamental concepts. An alternative, wonderful, but deeper book, which progresses to a significantly higher level, is W. Feller, Introduction to Probability Theory and its Applications, Vol. I, Wiley.

Calculators

The use of electronic calculators is forbidden in the examinations.
Outline of course

**Single Mathematics B**

**Term 1** (30 lectures)

**Diagnostic test**

**Vectors:** Scalars and vectors. Bases and components. \( \mathbf{i}, \mathbf{j}, \mathbf{k} \) notation. Vector algebra. Equations of line and planes. Scalar and vector products and their geometrical meaning, length and orthogonality. Triple products. Derivatives with respect to scalars: velocity, acceleration forces, moments, angular velocity. Two-dimensional polar coordinates, spherical and cylindrical polar coordinates.

**Ordinary Differential Equations:** Properties of the experimental function. First order: \( y' = \lambda y \), separable, homogeneous, Bernoulli’s, linear equations. Second order: linear equations with constant coefficients, superposition, complementary functions and particular integrals. Applications to particle dynamics, using Newton’s Laws of Motion (constant force, harmonic oscillator with damping).

**Fourier Analysis:** Periodic functions, orthogonality of trigonometric functions, Fourier representation and coefficients. Odd and even functions. Mention of complex form.

**Terms 2 & 3** (32 lectures)

**Partial Differential Equations:** Physical examples of functions of several variables (e.g. temperature, potentials). Preliminary discussion of partial differentiation and change of variables. Simple examples of partial differential equations. Methods of solution: change of variables, separation of variables. Vibrating string (finite and infinite length) as example, harmonic modes of oscillation, D’Alembert’s solution (if time).

**Functions of Several Variables:** *(The aim is to develop techniques of multivariable calculus with special emphasis on two and three dimensions)* Continuity, partial differentiation, composite functions, change of variables, chain rule. Surfaces, maxima and minima, gradient of scalar function. Taylor’s theorem for two variables up to second order. Multiple integrals of functions of several variables, simple examples of area and volume integrals. Statement of Green’s theorem in the plane.

**Introduction to Probability and Statistics:** Chance experiments, sample space, random variables, independence, probability distributions, expectation and variance, application to experimental errors.
Statistics attempts to make evaluations concerned with uncertainty and numerical conjectures about perplexing questions. The focus of the course is upon the understanding of real-life statistical problems. The first term’s lectures coincide with those for the Data Analysis, Modelling and Simulation module (MATH1711), and develop the basic concepts, with an emphasis on using computer packages for exploratory data analysis. In term 2 we address mainly inferential techniques.

No prior statistical knowledge is assumed. Students are required to have an A-level (with grade ‘C’ at least) in a mathematics subject which may or may not be statistics, or an equivalent qualification.

There are two lectures per week and three other hours (a mixture of tutorials, problems classes, and computer practicals) per fortnight. Problems are set weekly to be handed in for assessment. There will be a Collection examination in January.

**Recommended Books**

Purchase of a book is not necessary. However, background reading is strongly recommended.

Some of the material covered in first term lectures may be found in [1], and this also provides good background for second term lectures. Many other introductory statistics texts cover most of the basic techniques addressed. Note that various formulae and methods may differ slightly from book to book, and from lecture material to books.


**Calculators**

Approved electronic calculators are allowed in the examinations.
Aim: The module is designed to be a first statistics course. The emphasis is upon the understanding of real-life statistical problems, and develops the basic concepts and statistical methods by example.

Term 1 (20 lectures)
Sources of data: Controlled experiments. Randomisation. Observational studies. Ethical practice.
Descriptive statistics: Displaying distributions: stem and leaf plots, histograms. Notation; summation formulae. Describing and summarising distributions: location (mode, mean, median, percentiles); spread (variance, inter-quartile range); boxplots. Standardisation. Measurements and errors: outliers (link from boxplots), bias, randomness, chance errors, (informally) central tendency. Normal curve; areas under Normal curve; assessing Normality. Misleading graphs.
Methods for more than two variables: Least squares and multiple regression; two way tables, mean polish and median polish.
Data analysis topics: Chosen from the following. Non-linear least squares, smoothing, transformations, design of experiments.

Terms 2 & 3 (21 lectures)
Introduction to confidence intervals and hypothesis testing: Generating confidence intervals. Basic ideas about hypothesis testing, type I and type II errors. Significance tests. P values. Sensible statistical reporting.
Methods for categorical data: Fitting hypothesized frequencies to data. Fitting hypothesized probability distributions to data. Chi-square tests of homogeneity. Chi-square tests of independence.
Distribution-free methods: Spearman’s rank correlation coefficient. Mann-Whitney-Wilcoxon test, exact and approximate. Wilcoxon signed rank test, exact and approximate.