Getting Started

Welcome

This week you begin your undergraduate mathematical studies. Mathematics is a far richer subject than you can begin to imagine, but in a few years time I think you will agree. It is very likely that you will find your studies challenging, rewarding, satisfying, thrilling, beautiful, difficult and at times perhaps seemingly impossible — but you'll soon overcome that.

So what do some of the greats say about the subject? I leave you with some of their words (referenced where found):

"..there must surely be something to be said for a study which did not begin with Pythagoras and will not end with Einstein, but is the oldest and youngest of all."

G. H. Hardy (Inaugural Lecture, Oxford, 1920)

"I really love my subject."

J. J. Sylvester (J. Gallian, 2006, p. 88)

"The purpose of computation is insight, not numbers."

R. Hamming (c. 1950s)

"Mathematics, rightly viewed, possesses not only truth, but supreme beauty..."

B. Russell (Mysticism and Logic, Chapter 4)

A.G. Curnock
Director of Undergraduate Studies

Mission Statement

Mathematics is central to our understanding of the world in which we live, to our control of our environment, and to the organisation of our society. It underpins science, technology, medicine, economics and government. The preservation and propagation of mathematics is essential if civilization is to flourish. But this is a requirement that goes far beyond the simple recording and transmission of techniques of calculation and analysis. If Society is to benefit from mathematics, it must nurture a mathematical culture, by promoting a pervasive understanding of the mathematical way of thought and by supporting the study of mathematics for its own sake.

Those who teach mathematics at every level must be able to see beyond the horizons set by the problems at hand, otherwise they will convey no more than the means of mechanical execution. Without a broader appreciation of their subject, they will not pass on the understanding that is required for creativity, nor will they instil a proper appreciation of the beauty and universality of the mathematical ideas.

The mission of the Mathematical Institute is the preservation and expansion of mathematical culture. Our goals are to extend our own horizons through research at the highest level; to support the propagation and exploitation of mathematical ideas through publication and by reaching out to the public; to train our students, graduate and undergraduate, in the practice of mathematics; and to educate them in the ways of mathematical thinking. By these means, and by teaching those who will themselves carry forward our mission, we seek to extend the benefits of mathematical understanding.

Using this Handbook

This **handbook** is intended as a guide and reference for you throughout your Mathematics course at Oxford. It supplements the material printed in the **Examination Regulations**. The **handbook** read in conjunction with its supplements defines the syllabus, provides you with information to help you understand the processes and procedures of the Faculty and about the Mathematical Institute and the other facilities such as libraries and computers to which you have access. Additionally it will give you details of how you will be assessed and how your examinations will be classified. You are supplied with the **handbook** at the beginning of your course and will be informed by your tutors when you should collect supplements to it - such as the **synopses of lecture courses** for each year of your course. All this material is published on the Mathematical Institute website.

The **handbook** also gives you some information about colleges in relation to the way your Mathematics course works.

This is primarily the Course Handbook for the single subject Mathematics courses. Much of what is said is also relevant to the Mathematics parts of the joint courses (Mathematics & Computer Science, Mathematics & Philosophy and Mathematics & Statistics). However, students on the joint courses should also consult the handbooks designed specifically for these courses.
The handbook, and other information about the Mathematics & Computer Science course, can be found on the Computing Laboratory website.
The handbook, and other information about the Mathematics & Philosophy course, can be found on the Mathematical Institute website.
The handbook, and other information about the Mathematics & Statistics course, can be found on the Statistics Department website.

Other Paperwork

The general regulations describing the examination structure are published by the University in the **Examination Regulations**, sometimes called "The Grey Book", which is the authority on matters concerning University examinations and their conduct. In 2008–09 this book should be published on the University website. Amendments to the syllabus and course structure are carefully regulated by the University. If changes are made which affect you then you will be informed. There is a long-standing convention that the syllabus cannot be changed to your disadvantage once you have started studying for the examination concerned, provided that you take your examinations at the normal time.

With this **handbook** we publish for each year of the course **lecture synopses**. The **synopses** reflect the intended content of the corresponding lecture courses, although the lecturer may include material which enhances the syllabus but which does not form part of the syllabus for the examinations. For Honour Moderations and Part A we also publish a formal **syllabus** which is the examinable content.

At the start of each year the Mathematics Faculty produces the syllabus for that year's examination and synopses of lectures: you should obtain these, usually from the Mathematical Institute - your college tutors will advise you when to do so - for each year of your course as appropriate. They are also available electronically from http://www.maths.ox.ac.uk/current-students/undergraduates/handbooks-synopses/.

You should note that, as part of the **lecture synopses**, supporting **reading lists** are issued.

Each term you may receive through your college tutor a copy of the **lecture list**

giving the titles, times, and places of all the lectures being given in Mathematics courses that term. **These lecture lists are also available electronically from http://www.maths.ox.ac.uk/notices/lecture-lists/**.

For certain courses (e.g., the first-year Maple course) you will be provided with a **guide** to that course.

Many—probably all—students will provide themselves with copies of **examination papers** from previous years. Those for the years up to and including 1999 can be obtained from the Examination Schools, and those from 2000 can be accessed at http://www.oxam.ox.ac.uk/. Unofficial versions of papers are also on the Mathematical Institute Website at http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers. Some students buy examination papers from their predecessors. A word of caution: these papers do not define the examination syllabus and most older papers will have been set on a different syllabus! As well as using them as a source of exercises, you may want to look at them in conjunction with the corresponding **examiners' report**: for the years up to and including 1999 these are deposited in college libraries; and from 2000 are posted on the Mathematical Institute website at http://www.maths.ox.ac.uk/notices/exam-reports/.

In addition to these subject-specific guides you will also receive in one form or another, but probably as a **college handbook**, detailed guidance about your own college's regulations and requirements. You will also receive **Essential Information for Students** (the **Proctors' and Assessor's Memorandum**). This is also available electronically: http://www.admin.ox.ac.uk/proctors/info/index.shtml.

How to Study

Although there are many ways of organising your time and arranging your study, the considered advice of one successful mathematician is clear: "[You] would be wise to find out what the usual methods are and give them a prolonged trial before finally committing [your]self. There can be powerful illusions on such points . . . ".[1]

You are strongly recommended to read the notes *How do Undergraduates do Mathematics?* prepared by Charles Batty with the assistance of Nick Woodhouse. These are available for purchase at the Mathematical Institute or can be downloaded from the Maths website at:
http://www.maths.ox.ac.uk/files/study-guide/index.shtml.

You may also like to see what is said in another place; it is recommended that you visit Dr Körner's homepage at http://www.dpmms.cam.ac.uk/∼twk/ and read his advice on *How to listen to a Maths Lecture*.

Email

You will be allocated a college email account. Important information about your course will be sent to this account. If you do not plan to read it regularly you should ensure that you arrange for mail to be forwarded to an account which you do read regularly. You are asked to bear in mind that lost email is the students' responsibility should they choose to forward email to a system outside the university.

For remote access to the University's restricted site you will need to use the University's VPN service. See the Maths Institute's IT Notices page

http://www.maths.ox.ac.uk/help/faqs/undergrads

[1] J E Littlewood, *The Mathematician's Art of Work*, in *Littlewood's Miscellany*, CUP.

Useful 'Web' addresses

Mathematical Institute
http://www.maths.ox.ac.uk/

Statistics Department
http://www.stats.ox.ac.uk/

Computing Laboratory
http://web.comlab.ox.ac.uk/

Philosophy Centre
http://www.philosophy.ox.ac.uk/

Lecture timetables
http://www.maths.ox.ac.uk/notices/lecture-lists/

Information about remote access to the University restricted pages (VPN service)
http://www.maths.ox.ac.uk/help/faqs/undergrads

Maple information - access
http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/undergraduate_maple_server

Archive of past exam papers 2000–2008
http://www.oxam.ox.ac.uk/

Unofficial archive of past exam papers 1991–2008
http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers/

Examiners' reports 2000-2008
http://www.maths.ox.ac.uk/notices/exam-reports/

How do Undergraduates do Mathematics? Notes by Charles Batty
http://www.maths.ox.ac.uk/files/study-guide/index.shtml

Dr Körner's homepage(for advice on How to listen to a Maths Lecture).
http://www.dpmms.cam.ac.uk/∼twk/

Information on the Joint Consultative Committee for Undergraduates
http://www.maths.ox.ac.uk/current-students/undergraduates/jccu

General

Comments or suggestions for matters which might be amended or which might usefully be covered in subsequent editions of this booklet would be welcome. They should be sent to the Director of Undergraduate Studies in the Mathematical Institute, or emailed to `academic.administrator@maths.ox.ac.uk`.

If you require this handbook in a different format, please contact the Academic Administrator in the Mathematical Institute: `academic.administrator@maths.ox.ac.uk` or `(6)15203`.

Contents

Part I
The Mathematics Courses

1 Aims and Structure

1.1 The Courses

The University offers two single-subject courses in Mathematics, and six joint courses:

MMath	Mathematics	4-year
BA	Mathematics	3-year
MMathComputer Science	Mathematics & Computer Science	4-year
BA	Mathematics & Computer Science	3-year
MMath/Phil	Mathematics & Philosophy	4-year
BA	Mathematics & Philosophy	3-year
MMath	Mathematics & Statistics	4-year
BA	Mathematics & Statistics	3-year

There are also two courses:

MComputer Science	Computer Science	4-year
BA	Computer Science	3-year

which share some of the first year with Mathematics & Computer Science.

This is the **Course Handbook** for the single-subject courses in Mathematics — as you progress through the course additional information and supplements will be provided. Much of what is said is also relevant to the Mathematics parts of the joint courses; see below in Appendix A.

1.2 Aims of the Courses

The programme aims:

- to provide, within the supportive and stimulating environment of the collegiate university, a mathematical education of excellent quality through a course which attracts students of the highest mathematical potential;

- to provide a learning environment which, by drawing on the expertise and talent of the staff, both encourages and challenges the students (recognising their different needs, interests and aspirations) to reach their full potential, personally and academically;

- to provide students with a systematic understanding of core areas and some advanced topics in mathematics, an appreciation of its wide-ranging applications, and to offer the students a range of ways to develop their skills and knowledge.

- to lay the foundations for a wide choice of careers and the successful long-term pursuit of them, particularly careers requiring numeracy, modelling and problem-solving abilities;

- to lay the foundations for employment as specialist mathematicians or in research through the study in depth of some of a broad range of topics offered;

and for students taking the 4-year MMath (Hons):

- to provide the foundations for graduate study through a research degree at a leading university either in the UK or overseas.

1.2.1 Programme outcomes with Teaching, Learning and Assessment Strategies

By the end of this degree programme, students will have attained the following "Outcomes", that is, they will have developed knowledge and understanding of the following.

Part I. Specialised Mathematical Knowledge	
1. The core areas of mathematics including the principal areas of mathematics needed in applications.	In the first four terms of the programme there are lectures on algebra, analysis, differential equations, probability, and mathematical methods, supported by college-based tutorials.
2. Some of the principal areas of application of mathematics.	In the first year there are lectures on dynamics, probability, statistics, and mathematical models, supported by college-based tutorials; together with further options later in the course.
3. The correct use of mathematical language and formalism in mathematical thinking and logical processes.	Example in lectures in the first two years, practice in weekly problem sheets, with critical feedback by college tutors, tutorial discussion, printed and electronic notes of guidance.
4. The basic ideas of mathematical modelling.	Lectures on mathematical models in the first year, supported by practice in work for college tutorials, together with further options later in the course.
5. Some of the processes and pitfalls of mathematical approximation.	Examples on problem sheets and Maple in first year.
6.Techniques of manipulation and computer-aided numerical calculation.	Practice in work for college tutorials and Maple practical work in the first year.
7. The basic ideas of a variety of pure and applied areas of specialisation.	A choice of lecture courses, supported by college tutorials or small classes in the second part of the second year.
8. Several specialised areas of mathematics or its applications, the principal results in these areas, how they relate to real-world problems and to problems within mathematics (including, in the four-year course, problems at the frontiers of current research).	Lectures in the third year and fourth years delivered by lecturers actively engaged in research, together with supporting problem classes conducted by subject specialists.

Assessment strategies Formative assessment (feedback is given but marks do not necessarily count towards your classification) on a weekly basis by marking of tutorial and class work, and on a termly basis by college collections (college examinations at the beginning of term) or assessed vacation assignments. Summative assessment (with a final mark which is used in your classification) by four three-hour written papers at the end of year one, assessment of two computer projects in year one, by two three-hour 'breadth papers' in year two designed to test, through bookwork and unseen problems, breadth of understanding across the whole syllabus for the year; and two three-hour 'depth papers', designed to test understanding in depth through further questions on bookwork and more substantial unseen problems. In years three and four, summative assessment is by a combination of one and a half- or three-hour subject papers on bookwork and unseen problems (the usual form of assessment in year three), extended essays, dissertations, practical work, projects, and mini-projects.

1.2.2 Students will have the opportunity to develop the following skills during the course

Part II. Intellectual skills
1. The ability to demonstrate knowledge of key mathematical concepts and topics, both explicitly and by applying them to the solution of problems.
2. The ability to comprehend problems, abstract the essentials of problems and formulate them mathematically and in symbolic form so as to facilitate their analysis and solution.
3. Grasp how mathematical processes may be applied to problems including, where appropriate, an understanding that this might give only a partial solution.
4. The ability to select and apply appropriate mathematical processes.
5. The ability to construct and develop logical mathematical arguments with clear identification of assumptions and conclusions.
6. The ability to use computational and more general IT facilities as an aid to mathematical processes and for acquiring any further information that is needed and available.
7. The ability to present mathematical arguments and conclusions from them with clarity and accuracy, in forms suitable for the audiences being addressed.
8. Students who have focussed on pure mathematics will have skills relating particularly to rigorous argument and solving problems in generality, and facility with abstraction including the logical development of formal theories and the relationships between them.
9. Students who have focussed on physical applied mathematics will have skills relating particularly to formulating physical theories in mathematical terms, solving the resulting equations analytically or numerically, and giving physical interpretations of the solutions.

Teaching and learning opportunities and assessment strategies These skills are acquired through lectures, classes, tutorials, practical classes, studying recommended textbooks and through work done for projects, extended essays and dissertations and oral presentations.

They are assessed formatively during tutorials and classes and summatively in the examination processes each year.

Part III. Mathematics related practical skills	Teaching and Learning opportunities
1. Calculating fluently and accurately in abstract notation.	Practised throughout the course in problem work for tutorials and classes.
2. Use of mathematics computer packages	Lectures, Maple practical classes and informal practice sessions supported by demonstrators in the first year; use of Maple and other packages where appropriate in problems and lectures in later years (e.g. Matlab).

Assessment strategies The first element is assessed summatively (with a final mark) in the examination processes each year and the second element is assessed summatively (with a final mark) in the Maple projects in the first year and practical work undertaken in later years in for example Statistics, Mathematical Physics and Computer Science. Formatively (feedback is given but marks do not necessarily count towards your classification) during tutorials, classes and in college collections.

Part IV. General skills	Teaching and Learning opportunities
1. To analyse and solve problems, and to reason logically and creatively.	Weekly mathematical problem sheets with tutorial or class support, often requiring significant development of ideas beyond material found in lectures and books.
2. Effective communication and presentation orally.	Weekly tutorial and class assignments; requirement to defend written work in tutorials, and presentation of solutions in classes. Presentation of project work.
3. The ability to learn independently.	A learning process that requires students to put together material from a number of sources, including lectures, tutorials, text- books, and electronic sources, largely in their own time.
4. Independent time management.	Requirement to produce substantial amounts of written work against strict tutorial and class deadlines; necessity to balance academic and non-academic activities without continuous oversight.
5. To think critically about solutions and to defend an intellectual position.	Discussion and criticism in tutorials.
6. Collaboration	Tutorial groups are encouraged by the tutorial system to work together, to share ideas and to develop the practice of crediting others for their contributions.
7. Use of information technology.	Compulsory practical work; extensive use of the network for distributing teaching materials and for communication.
8. Language skills.	The opportunity is available in the third year to study a foreign language.

Assessment strategies The tutorial system provides formative assessment of elements (1-5). There is summative assessment of element (2) in the yearly examinations and of element (7) in the assessment of first-year computer projects and second- and third-year practicals. The language option does not contribute to final class, but successful completion will be recorded on student transcripts.

Further information about the programme outcomes and the teaching, learning and assessment strategies may be found in the programme specification. This is available online at http://www.maths.ox.ac.uk/teaching-staff/programme-specifications.

1.3 Overall Course Structure

The degree programmes listed in 1.1 are structured so as to share certain lectures and supporting classes, and to share certain examination papers. The first-year courses, in particular, have been constructed so that it is sometimes possible to move from one course to another. Such a change needs the permission of your college, and if you think you may want to change course you should consult your college tutor as soon as possible.

There are formal University examinations at the end of the first, second, third, and (where relevant) the fourth year of the course. (As mathematics is a progressive subject, later examinations, by implication, cover earlier core work!)

The first year examination is called Honour Moderations, and the first year is usually referred to as 'Mods'. The second-year examination is called Part A, the third-year examination is called Part B and the fourth-year examination is called Part C.

Teaching is normally through structured lecture courses, supported by classes, and, where appropriate, practical work; and through tutorials. In the third and fourth years, there may be some reading courses involving prescribed reading and group meetings.

Assessment is normally by written examination, although there is an element of coursework in certain subjects and some of the third and fourth year options are assessed by projects or extended essays. Further details can be found in the supplements that you will receive as you progress through each year of the course. Normally papers for full units are of three hours duration, except where coursework is involved.

2 Background

The courses are provided in the context of a large collegiate university, with over 18,000 students.

2.1 Some Facts and Figures

The following facts about the Mathematics students may be of interest:

- offers made for October 2008 were 260; being 177 for the single subject courses, 30 for *Mathematics & Computer Science*, 24 for *Mathematics & Philosophy*; 29 for *Mathematics and Statistics*
- of these 176 were men and 84 Women.
- the last-examined fourth year numbered 136; being 95 in *Mathematics*, 8 in *Mathematics & Computer Science*, 19 in *Mathematics & Philosophy* and 14 in *Mathematics & Statistics*;

- prospective Mathematics students and their teachers can accurately forecast grades, so there is a high degree of self-selection; despite this there are almost 4 applicants per place;
- few drop out or fail, almost none later than the first year;
- for degree results please see sections 5.2 and 5.3 of Part VI;
- the most recent available results on first employment for mathematics students are: Study only 50%, Work only 27% and Study and work 20% (including 6% in Education, 12% in Chartered Accountancy, 12% in Investment banking, 6% in other financial services), Unemployed 3% (all figures are approximate).

2.2 Academic Staff

2.2.1 The Posts

Most established Mathematics University postholders are based in the Mathematical Institute, the Department of Statistics, or the Computing Laboratory; a few in Philosophy, Social Studies, and Physics.

The most recent research ratings (the 2001 'RAE') were: Applied Mathematics 5, Computer Science 5, Pure Mathematics 5*, Statistics 5*. A number of members of the Institute are Fellows of the Royal Society or hold EPSRC Advanced Fellowships.

In addition to those in established posts there are about 24 postdoctoral fellows and associates in the departments and colleges. Other contributors to the Faculty's teaching programme include about a dozen college lecturers. Doctoral students assist as teaching assistants (TAs).

In the next section we list the current members of the Faculty of Mathematics. Details can be found on the web about members of the Computing Laboratory (http://www.comlab.ox.ac.uk/people/), Statistics Department (http://www.stats.ox.ac.uk/people) and Philosophy Centre (http://www.philosophy.ox.ac.uk/the_faculty).

2.2.2 Faculty of Mathematics

ACHESON D J Dr Jesus College
ALLWRIGHT D Dr Mathematical Institute
ASHBOURN J M A Dr St Cross College
BAKER R Dr Mathematical Institute
BALL J M Prof Sir Mathematical Institute
BATTY C J K Prof St John's College
BIRCH B J Prof Mathematical Institute
BREWARD C J W Dr Mathematical Institute
CANDELAS P Prof Mathematical Institute
CAPDEBOSCQ Y Dr Mathematical Institute
CHAPMAN S J Prof Mathematical Institute
CHRUSCIEL P Prof Mathematical Institute
COLLINS M J Prof University College
COLLINS P J Dr St Edmund Hall
CURNOCK A G Dr Mathematical Institute
DANCER A S Dr Mathematical Institute
DAY W A Dr Hertford College
DEHAYE P Dr Merton College
DELLAR P Dr Corpus Christi College
DE LA OSSA X Dr Mathematical Institute
DORAN B R Dr Linacre College
DRUTU C Dr Exeter College
DU SAUTOY M P F Prof Mathematical Institute

DYSON J Dr Mansfield College
EARL R A Dr Mathematical Institute
EDWARDS C M Dr Queen's College
EDWARDS D A Dr Mathematical Institute
EKERT A K Prof Mathematical Institute
ERBAN R Dr Mathematical Institute
ERDMANN K Dr Mathematical Institute
ETHERIDGE A M Prof Magdalen College
FARMER C L Prof Mathematical Institute
FLYNN E V Prof New College
FOWLER A C Dr Mathematical Institute
GAFFNEY E A Dr Brasenose College
GIANSIRACUSA J H Dr Magdalen College
GILES M B Prof Mathematical Institute
GILLOW K Dr Computing Laboratory
GOLDREI D C Dr Mansfield College
GRABOWSKI J E Dr Keble College
GRANT I P Prof Mathematical Institute
HAMBLY B M Dr St Anne's College
HANNABUSS K C Dr Balliol College
HAUSEL T Dr Mathematical Institute
HAYDON R G Prof Brasenose College
HEATH-BROWN D R Prof Mathematical Institute
HENKE A Dr Mathematical Institute
HITCHIN N J Prof Mathematical Institute
HODGES A P Dr Wadham College
HOWELL P D Dr University College
HOWISON S D Prof Mathematical Institute
ILHAN A Dr Mathematical Institute
ISAACSON D R Dr Philosophy
JIN H Dr Mathematical Institute
JOHNSTON H Dr St Hugh's College
JONES-PARRY T Mr Mathematical Institute
JOYCE D D Prof Lincoln College
KIRCHHEIM B Prof Mathematical Institute
KIRWAN F C Prof Balliol College
KNIGHT R W Dr Worcester College
KOENIGSMANN J Dr Lady Margaret Hall
KRAMKOV Prof Mathematical Institute
KRISTENSEN J Dr Magdalen College
LACKENBY M Prof St Catherine's College
LAUDER A G B Dr Hertford College
LEESE R A Dr St Catherine's College
LENNOX J C Prof Green College
LINGWOOD R J Dr Continuing Professional Development
LOTAY J Dr University College
LUKE G L Dr Mathematical Institute
LYONS T J Prof Mathematical Institute
MAINI P K Prof Mathematical Institute
MASON L J Prof St Peter's College
MCDIARMID C J H Prof Corpus Christi College
MELCHER C Dr Lincoln College
MONOYIOS M Dr Lady Margaret Hall
MOROZ I M Dr Mathematical Institute

NELSON G Dr St Anne's College
NEUMANN P M Dr Queen's College
NIETHAMMER B Prof St Edmund Hall
NORBURY J Dr Lincoln College
OCKENDON H Dr Mathematical Institute
OCKENDON J R Prof Mathematical Institute
OLIVER J Dr Mathematical Institute
ORTNER C Dr Merton College
PENROSE R Prof Sir Mathematical Institute
PORTER M Dr Somerville College
PRIESTLEY H A Prof Mathematical Institute
PRIOR C R Dr Trinity College
QIAN Z Dr Exeter College
REISINGER C Dr St Catherine's College
RIORDAN O Dr St Edmund Hall
ROAF D J Dr Exeter College
ROOSE T Dr Mathematical Institute
ROUQUIER R A M Prof Mathematical Institute
SCATAGLINI-BELGHITAR G Dr Balliol College
SCOTT A D Prof Merton College
SCREATON G R Dr University College
SEGAL D Prof All Souls College
SEGAL G B Dr All Souls College
SEREGIN G Prof St Hilda's College
SMITH L A Dr Pembroke College
SPARKS J Dr Mathematical Institute
STEDALL J A Dr Queen's College
STEWART W B Dr Exeter College
STIRZAKER D Dr St John's College
STOY G A Dr Lady Margaret Hall
SZENDROI B Dr St Peter's College
TARRES P M Dr St Hugh's College
THOMAS J T Dr Merton College
TILLMANN U L Prof Mathematical Institute
TOD K P Prof St John's College
TSOU S T Dr Mathematical Institute
TOWERS M J, St Hugh's College
VAUGHAN-LEE M R Prof Christ Church
VINCENT-SMITH G F Dr Oriel College
WATERS S Dr St Anne's College
WATSON A Dr Department of Educational Studies
WELSH D J A Prof Mathematical Institute
WHITTAKER R Dr Mathematical Institute
WILKINS C A Dr
WILSON J S Prof University College
WILSON R J Prof Keble College
WOODHOUSE N M J Prof Mathematical Institute
XU Z Dr Mathematical Institute
ZHOU X Prof Mathematical Institute
ZILBER B Prof Mathematical Institute

2.3 The Departments

2.3.1 The Mathematical Institute

The Mathematical Institute is a focus for mathematical activity in Oxford. The members of the Mathematical Institute include more than 120 graduate students as well as professors, readers, other members of staff and academic visitors. There are at least 5 statutory chairs in Pure Mathematics and at least 4 statutory chairs in Applied Mathematics. Many other academics hold the title of professor. The Mathematical Institute, as the mathematics department is known, incorporates the Oxford Centre for Industrial and Applied Mathematics, as well as the Centre for Mathematical Biology and the newly established Oxford Centre for Collaborative Applied Mathematics. Whilst it is usual for mathematics departments in Britain to be split into departments of Pure and Applied Mathematics, the unitary Oxford structure, which encourages numerous strong interactions between the different groups, is regarded as a major factor in the continued high reputation enjoyed by Oxford Mathematics.

Research is carried out in a wide variety of fields including algebraic, differential and general topology, group theory, representation theory and other branches of algebra, number theory, mathematical logic, functional analysis, harmonic analysis, algebraic and differential geometry, differential equations, probability theory and its applications, combinatorial theory, global analysis, mathematical modelling, financial mathematics, stochastic analysis, mathematical biology, ecology and epidemiology, continuum mechanics, elasticity, applied and fluid mechanics, magnetohydrodynamics and plasmas, atomic and molecular structure, quantum theory and field theory, relativity and mathematical physics, applied analysis and materials science.

You may find out more about the Institute by visiting the website:
http://www.maths.ox.ac.uk/.

2.3.2 The Department of Statistics

The Department of Statistics provides a focus for Statistics within the University, and has numerous links with outside scientific and industrial concerns.

You may find out more about the Department by visiting the website:
http://www.stats.ox.ac.uk/.

2.3.3 The Computing Laboratory

Oxford University Computing Laboratory is one of the world's leading centres for the study, development and exploitation of computing technology.

You may find out more about the Computing Laboratory by visiting the website:
http://www.comlab.ox.ac.uk/.

3 The First Year

The first year course is run as a joint venture with the Statistics Department.

In the first year there are no optional topics. The **syllabus** is given in Part V-1 of this handbook and is covered in lectures whose content has been carefully planned. This is the official syllabus for the Honour Moderations Examinations for 2009. They form a coordinated programme which avoids unnecessary duplication but ensures full and careful coverage, and which will allow you to prepare for the examinations. The **lecture synopses** are in a separate booklet. **Reading lists** are given alongside the synopses.

3.1 The Lecture Courses

The lecture courses in the first year are as follows:

Michaelmas Term

Introduction to Pure Mathematics	5 lectures
Introduction to Complex Numbers	2 lectures
Reasonings and Proofs	3 lectures
Linear Algebra I	14 lectures
Geometry I	7 lectures
Analysis I	14 lectures
Calculus of One Variable	6 lectures
Dynamics	16 lectures
Probability I	8 lectures
Calculus of Two or More Variables	10 lectures

Hilary Term

Linear Algebra II	8 lectures
Introduction to Groups, Rings and Fields I	8 lectures
Analysis II	16 lectures
Probability II	8 lectures
Statistics	8 lectures
Fourier Series and Two Variable Calculus	16 lectures
Partial Differential Equations in Two Variables and Applications	16 lectures

Trinity Term

Introduction to Groups, Rings and Fields II	8 lectures
Geometry II	8 lectures
Analysis III	8 lectures
Calculus in Three Dimensions and Applications	16 lectures

3.2 The Maple Course

In addition to the written papers for Moderations, students reading Mathematics or Mathematics & Statistics are required to follow a compulsory computing course "Exploring Mathematics with Maple". This course has been devised to acquaint mathematicians with the use of computers as an aid to learning about mathematics, and to give access to a useful mathematics package software tool.

The course is computer-based and so you must be a registered user of the University (Herald) network. You will be allocated an account before the course begins. Practicals are done in the teaching laboratory in the Department of Statistics on South Parks Street.

Access to the Department of Statistics during normal working hours is by using your University Card.

Further details are available at
http://www.stats.ox.ac.uk/about_us/it_information/restrictedaccess/undergraduate_maple_server

Undergraduates may also use college computers where these are available; with appropriate software supplied by colleges it is possible to log-on to your University (Herald) account, and run Maple from a college machine. Undergraduates may also obtain a free license to run Maple on their own computers. See your College Senior Maths Tutor for this. Using your student ID number we will register all first year students here in the department to use Maple on your own computers. By accepting a copy of Maple from the Department you are stating your agreement that this version is for your own personal use alone, in order that your use is covered by our departmental license.

The course is divided into two parts, one part in each of Michaelmas and Hilary Terms. The Michaelmas Term work consists of preparatory work. Four practicals of two hours each are timetabled. There are people available to help.

In Hilary Term you work on two Maple projects. These must be your own unaided work; you will be asked to make a declaration to that effect when you submit them. The marks are communicated to the Moderators, who will take them into account.

It is important to observe the deadlines for submitting Maple projects. Failure to meet the deadlines may mean that the work will not be taken into account. For 2008/2009 the deadlines are:

- **1st project: 12.00 noon on Friday of week 5**
- **2nd project: 12.00 noon on Friday of week 8**

The work for these projects must be your own unaided work.

Students transferring into Mathematics from any other subject will still be expected to submit two Maple projects (or to suffer the lack of marks as a consequence).

Students who do not have their own computer or whose college has limited computing facilities may, with permission, use the small computing facility in Dartington House. You need to ask about this - please contact the Academic Assistant, Helen Lowe if this concerns you. (loweh@maths.ox.ac.uk).

Plagiarism : the University and Mathematical Institute regard plagiarism as a serious issue.

Any attempt to submit another's work as your own or to make use of published sources without explicit reference to them will be regarded as an infringement of University's code concerning academic integrity. Your attention is drawn to the *Proctors' and Assessor's Memorandum,* Section 9.5, "Conduct in Examinations" which covers all forms of assessment. See also **Part VII section 3** for further information.

Candidates who miss the above deadlines may ask their college to apply to the Chairman of Mathematics for permission to submit late. Where there is a valid reason, the Chairman would normally approve the late submission without penalty. Where it is deemed that there is no valid reason the Chairman of Mathematics will advise the Moderators to apply a penalty of at least 5% of the marks.

3.3 Changing Course

Normally your college will have admitted you to study a specific course. Permission will therefore be needed for change to another course, including changes between the single-subject and joint Mathematics courses. These courses are, however, structured so as to make some changes feasible, particularly during the first year. Again, your college tutors will be able to give you advice, and you may find it helpful to

talk to students reading the course. If you are given permission to change course, then you will have to catch up on the work missed.

4 Three or Four Years

When you applied you will have been advised to assume that you are taking the four year course, and to inform your LEA accordingly. This precaution should be taken for funding reasons. At the beginning of your third year you should decide, taking into account the advice of your college tutors, whether you should choose the three- or four-year course. You will be asked to register this choice.

In making your choice you will have to consider the information about the two courses in this **handbook**, and also your preferred career. You may also like to get the views of those in your college on their experience of the courses. The options for the fourth year of the **MMath** course contain more advanced material and your performance in tutorials and classes and on examinations in earlier years will need to be taken into consideration.

We appreciate that students may change their plans and we allow some flexibility in changing between the three- and four- year programme without making any charge to students. Your college tutor will be able to advise you further. All students are registered on the MMath (4 year) versions of each course. If you subsequently decide to change to the BA (3 year) option you must inform your college office who will in turn inform central administration and the departments. You will normally be required to decide which route you wish to take in the third year of your course. Please be aware that any change to your course may impact the level of your maintenance funding and the time taken to receive your student loan (you are advised to contact Student Finance http://www.direct.gov.uk/en/EducationAndLearning/UniversityAndHigherEducation/StudentFinance/index.htm for further enquiries). Please note also that if you intend to change option you are strongly advised to do so before you take Year 3 examinations.

4.1 Three- or Four-year course

You should register your intention to take either the three-year course or the four-year course during your third year. You are advised to discuss the right course of action for you with your college tutor, who will also advise you how to register. Any student whose performance in the second and third year examination together falls below **lower second standard** will not be permitted to proceed to the fourth year.

5 The Second, Third and Fourth Years

In the second, third and fourth year of your course many options are available. These vary a little from year to year depending on faculty interests and current research interests. The list below shows the options available in the academic year 2008-9. You will receive information on the options, year by year, when it becomes available.

5.1 The Second Year (Part A)

The second year course will consist of three compulsory subjects (core material);
Algebra,
Analysis,
Differential Equations

followed by a number of options:

Introduction to Fields,
Group Theory,
Number Theory,
Integration,
Topology,
Multivariable Calculus,
Calculus of Variations,
Classical Mechanics,
Electromagnetism,
Fluid Dynamics and Waves,
Probability,
Statistics,
Numerical Analysis

The compulsory core is studied in Michaelmas Term. The options are studied in Hilary, and the first half of Trinity Term. Most students take 9 or 10 options but your college tutor will advise.

The Mathematical Institute is responsible for the delivery of all units except for those on Probability & Statistics, which are the responsibility of the Department of Statistics, and those in Numerical Analysis, which are the responsibility of the Computing Laboratory.

5.2 The Third and Fourth years (Parts B and C)

A student will take the equivalent of four 32-hour units in the third year of either H or M level; those continuing to the fourth year will be expected to take the equivalent of three M level 32-hour units in that year.

The units and half units will be designated H-level (aimed at the third year undergraduates) or M-level (aimed primarily at the fourth year or M.Sc. students).

5.3 Pathways

Formal details of which combinations of units you may offer in the examinations will be published by the University in the **Examination Regulations**. The **lecture synopses** will describe recommended 'background courses'. It should be noted that you may choose a course even though you have not done the background courses, but the lecturers and examiners will lecture and examine on the hypothesis that you have the background. If you wish to take a course and you have not taken the recommended background courses then you are advised to consult your college tutors who may be able to help and advise you on alternative background reading.

5.4 Making Choices

Your college tutors will be able to give you advice. Some preliminary work in the libraries, looking at the books recommended in the **reading lists** may also help.

Past papers, and **examiners' reports** may give some of the flavour. When making your choice you should consider not only options which you find interesting and attractive, but also the terms in which lectures and classes are held. Ideally, your work in Michaelmas and Hilary Terms should be spread evenly.

5.4.1 Part B Units and Half Units

MATHEMATICS DEPARTMENT UNITS AND HALF UNITS

- B1 Logic and Set Theory
  - B1a Logic — MT (half unit)
  - B1b Set Theory — HT (half unit)
- B2 Algebra — MT & HT (whole unit)
  - B2a Introduction to Representation Theory — MT (half unit)
  - B2b Group Theory — HT (half unit)
- B3 Geometry
  - B3a Geometry of Surfaces — MT (half unit)
  - B3b Algebraic Curves — HT (half unit)
- B4 Analysis
  - B4a Banach Spaces — MT (half unit)
  - B4b Hilbert Spaces — HT (half unit, cannot be taken unless B4a is taken)
- B568 Introduction to Applied Mathematics
- B5 Applied Analysis
  - B5a Techniques of Applied Mathematics — MT (half unit)
  - B5b Applied Partial Differential Equations — HT (half unit)
- B6 Theoretical Mechanics
  - B6a Viscous Flow — MT (half unit)
  - B6b Waves and Compressible Flow — HT (half unit)
- B7.1/C7.1 Quantum Mechanics, Quantum Theory and Quantum Computers
  - B7.1a Quantum Mechanics — MT (half unit)
  - C7.1b Quantum Theory and Quantum Computers — HT (half unit, cannot be taken unless B7.1a is taken)
- B7.2/C7.2 Relativity
  - B7.2a Special Relativity and Electromagnetism — MT (half unit)
  - C7.1b General Relativity — HT (half unit, cannot be taken unless B7.2a is taken)
- B8 Topics in Applied Mathematics
  - B8a Mathematical Ecology and Biology — MT (half unit)

- B8b Nonlinear Systems — HT (half unit)

- B9 Number Theory
  - B9a Galois Theory — MT (half unit)
  - B9b Algebraic Number Theory — HT (half unit, cannot be taken unless B9a is taken)
- B10 Martingales and Financial Mathematics
  - B10a Martingales Through Measure Theory — MT (half unit)
  - B10b Mathematical Models of Financial Derivatives — HT (half unit)
- B11 Communication Theory — MT (half unit)
- B12 Applied Probability — MT (half unit)
- B21 Numerical Solutions to Differential Equations
  - B21a Numerical Solution of Differential Equations I — MT (half unit)
  - B21b Numerical Solutions of Differential Equations II — HT (half unit)
- B22 Integer Programming — HT (half-unit)
- BE "Mathematical" Extended Essay (whole unit)

Some fourth year options are offered to third year students:

- C3.1 - Geometry: Topology and Groups and Algebraic Topology
  - C3.1a Topology and Groups — MT (half unit: M-level)
  - C3.1b Algebraic Topology — HT (half unit: M-level)
- C5.1a Methods of Functional Analysis for PDEs — MT (half unit: M-level)

OTHER MATHEMATICAL UNITS AND HALF UNITS

- O1 History of Mathematics — MT & HT (whole unit)
- OBS1 Applied Statistics — MT & HT (whole unit)
- OBS2 Statistical Inference
  - OBS2a Foundations of Statistical Inference — MT (half unit)
  - OBS2b Further Statistical Inference — MT (half unit cannot be taken unless OBS2a is taken)
- OBS3 Stochastic Modelling
  - B12a Applied Probability — MT (half unit)
  - OBS3b Statistical Lifetime Models — HT (half unit, cannot be taken unless B12a is taken)
- OBS4 Actuarial Science — MT & HT (whole unit)
- OCS1 Functional Programming, Design and Analysis of Algorithms — MT & HT (whole unit)
- OCS3a Lambda Calculus and Types — MT (half unit)
- OE Extended Essay in a topic closely related to Mathematics (whole unit)

OTHER NON-MATHEMATICAL UNITS AND HALF-UNITS

- N1 Undergraduate Ambassadors' Scheme — (MT, HT) (half-unit)
- N101 History of Philosophy from Descartes to Kant (MT) (whole unit)
- N102 Knowledge and Reality (MT) (whole unit)
- N122 Philosophy of Mathematics (MT) (whole unit)

5.4.2 Part C Units and Half Units

MATHEMATICS DEPARTMENT UNITS AND HALF-UNITS:

- C1.1 Model Theory and Godel's Incompleteness Theorems
  - C1.1a Gödel's Incompleteness Theorems — MT (half unit)
  - C1.1b Model Theory — HT (half unit)
- C1.2 Analytic Topology and Axiomatic Set Theory
  - C1.2a Analytic Topology — MT (half unit)
  - C1.2b Axiomatic Set Theory — HT (half unit)
- C2.1 Lie Algebars and Representation Theory of Symmetric Groups
  - C2.1a Lie Algebras — MT (half unit)
  - C2.1b Representation Theory of Symmetric Groups — HT (half unit)
- C3.1 Topology and Groups and Algebraic Topology
  - C3.1a Topology and Groups — MT (half unit)
  - C3.1b Algebraic Topology — HT (half unit)
- C4.1 Functional Analysis and Banach and C* Algebras
  - C4.1a Functional Analysis — MT (half unit)
  - C4.1b Banach and C* Algebras — HT (half unit)
- C5.1 Methods of Functional Analysis
  - C5.1a Methods of Functional Analysis for Partial Differential Equations — MT (half unit)
  - C5.1b Fixed Point Methods for Nonlinear Partial Differential Equations — HT (half unit)
- C5.2b Calculus of Variations — HT (half unit)
- C6.1 Solid Mechanics — MT (half unit)
- C6.2 Elasticity and Plasticity — HT (half unit)
- C6.3 Perturbation Methods and Applied Complex Variables
  - C6.3a Perturbation Methods — MT (half unit)
  - C6.3b Applied Complex Variables — HT (half unit)
- C6.4 Topics in Fluid Mechanics — MT (half unit)

- C7 Mathematical Physics
  - C7.1b Quantum Theory and Quantum Computers — HT (half unit)
  - C7.2b General Relativity — HT (half unit)
- C7.4 Theoretical Physics — MT and HT (whole unit)
- C8.1 Mathematics and the Environment and Mathematical Physiology
  - C8.1a Mathematics and the Environment — MT (half unit)
  - C8.1b Mathematical Physiology — HT (half unit)
- C9.1 Analytic Number Theory and Elliptic Curves
  - C9.1a Analytic Number Theory — MT (half unit)
  - C9.1b Elliptic Curves — HT (half unit)

  C10.1 Stochastic Differential Equations and Brownian Motion in Complex Analysis
  - C10.1a Stochastic Differential Equations — MT (half unit)
  - C10.1b Brownian Motion in Complex Analysis — HT (half unit)
- C11.1 Graph Theory and Probabilistic Combinatorics
  - C11.1a Graph Theory — MT (half unit)
  - C11.1b Probabilistic Combinatorics — HT (half unit, cannot be taken unless C11.1a is taken)
- C12.1a Numerical Linear Algebra — MT (half unit)
- C12.1b Continuous Optimization — HT (half unit)
- C12.2a Approximation of Functions — MT (half unit)
- C12.2b Finite Element Methods for Partial Differential Equations — MT (half unit)
- Dissertations — half unit or whole unit

OTHER UNITS

MS STATISTICS

- MS1b Statistical Data Mining — HT (half unit)
- MS2a Bioinformatics and Computational Biology — MT (half unit)
- MS2b Stochastic Models in Mathematical Genetics — HT (half unit)
- MS3b Lévy Processes and Finance — HT (half unit)

COMPUTER SCIENCE: Half Units

- CCS1 Categories, Proofs and Processes — MT (half unit)
- CCS3 Quantum Computer Science — HT (half unit)
- CCS4 Automata, Logics and Games — HT (half unit)

PHILOSOPHY

- Rise of Modern Logic — MT (whole unit)

6 The Long Vacation

6.1 International Summer Exchanges

The Mathematical, Physical and Life Sciences Division have set up international summer exchanges with Princeton University and the California Institute of Technology. This would operate as a student exchange: a student from the Mathematical Institute would take the place of an American student, who in turn would come to Oxford.

Any student who is interested in such a summer exchange, to take place in summer 2009, would need to have the outline of a project that would be completed at the overseas institution. This work would not be formally assessed, but if in the following term, the student wished to register for an extended essay or dissertation on a similar or related topic, then this vacation work could form the background work for an assessed piece of written work.

Project outlines should be submitted to the Chairman of the Mathematics Teaching Committee by week 2 of Trinity Term 2009. Every effort will be made to find supervisors and exchange partners at both institutions. Students would need to be self-financing.

6.2 Summer Projects

1. EPSRC vacation bursaries
   The Engineering and Physical Sciences Research Council scheme started in the summer of 2006. In 2007 the MPLS Division received 10 studentships and 15 in 2008. Attached to each student award was a weekly stipend of £180 payable for ten weeks to enable students to conduct a project that would not normally be part of the undergraduate programme. Topics related to the Roberts's shortage areas (this includes Maths, Stats and OR) were specifically targeted. The emphasis is for undergraduates to receive first-hand positive and practical experience of research. A review of the 2007 scheme is found at: http://www.epsrc.ac.uk/PostgraduateTraining/VacationBursaries/default.htm

2. Welcome Trust Bursaries
   Further information is available at
   http://www.wellcome.ac.uk/Funding/index.htm

3. Nuffield Science bursaries
   Further information is available at
   http://www.nuffieldfoundation.org/go/grants/nsbur/page_412.html

4. BBSRC vacation bursaries
   The Biotechnology and Biological Sciences Research Council also fund vacation awards, for projects in Mathematical Biology.
   http://www.bbsrc.ac.uk/funding/studentships/vacation_bursaries.html

5. News International Placement Scheme
   The News International Benefaction includes a scheme which allows some students to have a short period of work experience with newspapers in the News International Group. Further information is available at
   http://www.english.ox.ac.uk/events/NI%20Application%20Form.pdf

Project titles vary from year to year. Please see https://www.maths.ox.ac.uk/current-students/undergraduates/projects for examples of vacation project titles.

Part II
Teaching and Learning

1 Lectures

All official lectures are advertised in the termly **lecture list** for Mathematical Sciences. Copies of the lecture list are distributed at the beginning of each term by college tutors. The lecture list is also posted on the Mathematical Institute's website at http://www.maths.ox.ac.uk/notices/lecture-lists/, and on the University website at http://www.admin.ox.ac.uk/pubs/lectures/. In addition, the term's lecture list and each week's timetable with details of lecture rooms are posted on the electronic notice board in the Mathematical Institute.

Lectures are usually timetabled to last an hour. So that you have time to get to lectures in different locations, there is a convention that undergraduate lectures begin a few minutes after the scheduled time and finish five minutes before the end of the hour. In the first three years students will attend around 8-10 hours of lectures per week. In the fourth year students attend 6 hours of lectures per week on average.

Most students find it helpful to take fairly complete notes of lectures. The normal lecturing style in the Faculty is intended to make this possible, and all the main points should be presented visually as well as orally.

If you have a disability or special needs, which affect your ability to take notes of lectures, please contact the Disability Services, your college tutor and the Academic Administrator in the Mathematical Institute (contact details in Appendix C). Please also see the Departmental Disability Statement at Appendix G.

2 Problem Sheets

All lectures in Mathematics are supported by **problem sheets** compiled by the lecturers. These available for downloading from the Mathematical Institute website. Most students prefer to print their own copies, although they can be printed by the department by prior arrangement. Many college tutors use these problems for their tutorials; others prefer to make up their own problem sheets. In Part B and Part C, problem sheets will be used for the classes run in conjunction with the lectures.

Many of the books recommended in the **reading lists** contain exercises and worked examples; **past papers** and **specimen papers** are another source of such material, especially for revision.

When you tackle problem sheets your tutor wants to see how you think about a proof. Using references is important but do not simply copy out a proof. Put something of how you see things in it. At the end of each problem sheet give a list of references you have used and say which has been used in each question. This is a way of developing the use of citation and referencing.

3 Tutorials

In addition to lectures, students also have tutorials. How these are organised will vary from college to college and subject to subject. For example in your first and second years you might have two (one-hour) tutorials each week, with between one and three other students. You will be set some work to do for each tutorial and in the tutorial you will discuss this work and will probably have an opportunity to ask about any difficulties you may experience. In order to get the best out of a tutorial

it is very important that you are well prepared. You should have done the work and handed it in if this is expected (even if you have not been able to solve every problem). It is also a good idea to make a note of anything you want to ask about. Be sure to arrive on time.

4 Classes

Each 16-hour lecture half unit in the subjects of Part B will usually be supported by classes run under the Intercollegiate Class Scheme rather than by tutorials in college. Students will generally attend four $1\frac{1}{2}$ classes for each Part B half unit. Most Part C half units will be supported by classes, though some may be run as reading courses. Students usually attend seven 1 hour classes for each Part C half unit.

Classes will usually consist of between five and twelve students from a number of different colleges and are run by a class tutor and a teaching assistant. Occasionally, for instance as an alternative to restricting student numbers taking an option, classes will be run in larger groups; but students and their tutors will be advised well in advance if this is to be the case. The course lecturer provides suitable **problem sheets**, and provides specimen solutions to the class tutors and teaching assistants. Students hand in their solutions in advance and these are marked by the teaching assistants; at each class, some of the problems will be gone through in detail, and there will be an opportunity to take up with the class tutor and teaching assistant any particular difficulties. The class tutors report to colleges through the intercollegiate class database on your performance throughout the term.

You will receive information about the organisation of these classes from your college tutor.

Most colleges also run classes, especially to help with pre-examination revision. College tutors will explain their own arrangements.

5 Practicals

For some of the units there is a component of compulsory practical work. The arrangements for this will be explained by the course lecturer; your college tutor will also advise. Those who run the practical sessions will also give advice on how the work is to be written-up.

6 Feedback

There is plenty of opportunity, both formal and informal, for you to comment on the course. The informal ways are through the members of the Faculty who teach you in classes, lectures and tutorials and also through your personal tutors in college. All of these members of the Faculty will encourage you to make your views known to them and will give you ample opportunity to comment on syllabus content and any other issues about the delivery of the course.

A written questionnaire is handed out by each lecturer, who gives time in the lecture for students to complete it. A similar monitoring of the intercollegiate classes takes place termly.

Once the termly questionnaire results are processed, each course lecturer receives the comments and statistical analysis from their own course and in addition consolidated information is made available to relevant committees for discussion, and where necessary, action. One of the key committees which considers this information is the *Joint Consultative Committee for Undergraduates*,(JCCU) and the

action taken as a result of questionnaire comments is made known to your representatives through this channel. This Committee deals with matters over the whole range of Mathematics, Computer Science and Statistics courses.

We welcome your input and feel that you have an important contribution to make. Please use this opportunity and take the time to fill in the questionnaires at the end of lecture courses. A specimen questionnaire form is given in Appendix D. **Questionnaires can also be downloaded from the web.**

We have some formal channels of communication with you. When the Director of Undergraduate Studies or the Department wishes to consult you about policies or inform you of action taken following requests from the JCCU, you will be advised via e-mail to look at the JCCU website. Minutes of the JCCU meetings taken by your student representatives, reports and feedback on student requests can also be found here. See

http://www.maths.ox.ac.uk/current-students/undergraduates/jccu.

7 Responsibility

This whole section has described the *Teaching* arrangements for the course. But of course the important thing is *Learning*. The University and the Colleges will provide facilities and resources to assist your learning. The course lecturers, class tutors, and college tutors will do all they can to help and encourage you to learn. But the responsibility for learning is a personal one.

8 History of Mathematics

You are encouraged to read around your subject, particularly to read some of the history of its development. We include here a short list of books that have been recommended by tutors for you to dip into at various times during your time at Oxford.

J Fauvel & J Gray, *The History of Mathematics, a reader*, Macmillan (1987)
J Fauvel, R Flood & R Wilson, *Oxford figures: 800 years of the mathematical sciences*, OUP (2000)
E M Fellmann, *Leonhard Euler*, Birkhäuser (2007)
M Kline, *Mathematics in Western Culture*, Penguin (1972)
V Katz, *A History of Mathematics: An Introduction* Second Edition, Addison-Wesley (1998)
D Struik, *A Concise History of Mathematics*, Dover Paperback, (1946)
M Kline, *Mathematical Thought from Ancient to Modern Times*, OUP (1972)
Heinrich Dörrie, *100 Great Problems of Elementary Mathematics*, Dover (1965)
Ioan James, *Remarkable Mathematicians, from Euler to von Neumann*, CUP (2002)
J Stedall, *Mathematics Emerging: A Sourcebook 1540 – 1900* (OUP, 2008).

Part III
Resources

1 Books

Do not think that a complete set of lecture notes for a course removes the need to consult textbooks. You will need constant access to books in the course of your studies, for clarifying points made in lectures, completing arguments given partially, doing things in different ways, helping with problems and so on. The **reading lists** issued alongside the **lecture synopses** are revised annually, and contain a range of suggestions, including alternatives and suggestions for further reading.

To make best use of a book, you need your own copy so think seriously of buying at least the books with the highest recommendations—your college tutor will be able to advise you on which to buy. Often you will be able to buy such books from your predecessors in your college, or through the virtual second-hand Bookstall run by MURC. Second-hand copies are also available in Blackwell's second-hand department but they sell out rapidly. Amazon also sells second-hand books.

2 Libraries

The main source of borrowed books is your **College Library** which you should get to know as soon as possible. It is general practice for college libraries to purchase the books which appear in the **reading lists** for every Mods, Part A and Part B course. In practice college libraries also provide a good selection of the books listed as 'further reading' for these courses, and indeed a wider selection of background and alternative reading, particularly books which have not been recommended because they have gone out of print.

College libraries frequently have a number of copies of popular books and are often responsive to requests for new purchases, but *they do need to be asked*. Different colleges have different mechanisms for these requests; again your college tutor will be able to advise you.

The other source of books to borrow is the **Radcliffe Science Library** in Parks Road. This library is associated with the **Bodleian** and you need to be registered with the **Bodleian** to use it. When you arrive in Oxford you will be required to sign a declaration promising to obey the library rules and you will then be given a combined reader's card/University Card. This will give you access to any part of the **Bodleian Library** and any of its dependent libraries.

3 IT

The University is committed to making sufficient computer facilities available to junior members to cover their course-work requirements.

All students will also be automatically allocated a University e-mail account and may register for further services at Oxford University Computing Services. (See 4.1 below). A number of important notices will be sent to you via email. It is important to check your account frequently.

Colleges have PCs (and in some cases Macs), mostly networked, for the use of junior members. Many colleges have students' rooms wired with ethernet points to enable students to connect their own PCs to the network.

As everywhere, there is concern for computer security and anyone opening an account must agree to abide by the local rules. At Oxford there is a University disci-

plinary procedure enforcing the rules, so that breaches of them involve the Proctors with all the sanctions and penalties available to them.

Note that some webpages (e.g. the webpage with class details) are NOT available from outside the Oxford network. If you are regularly using a computer outside the Oxford network, you need to set up VPN. Instructions on how to do this can be found at:

http://www.maths.ox.ac.uk/help/faqs/undergrads

4 Other

4.1 Computing Services

Your computing requirements will be supported primarily by the departmental and college IT staff; certain facilities of the central computing services are available when appropriate.

Oxford University Computing Services are located at 13 Banbury Road and offer facilities, training and advice to members of the University in all aspects of academic computing. The central services are based on a number of main computer systems together with core networks reaching all departments and colleges. You can find more information at

http://www.oucs.ox.ac.uk/

4.2 The Language Centre

The *Language Centre* provides resources and services for members of the University who need foreign languages for their study, research or personal interest.

Language courses in eight languages, the Language Library (consisting of over 13,000 audio and video cassettes with accompanying textbooks in over 100 languages) and its study area (computer-based learning resources and audio/video study rooms) are available free of charge to junior members of the University pursuing a course. Those in possession of a University Card must present it when they register at the Centre. Prospective users without a University Card must present a letter from their College or Departmental Administrator indicating their status within the University. You can find more information at

http://www.lang.ox.ac.uk/

There may be an opportunity for students who have studied some French (particularly those who have studied to GCSE level but not to A-level) to take a course in the third or fourth year. This will not count towards your degree class but may be recorded on your transcript or CV.

4.3 Careers

Careers guidance is provided by the *Careers Service*, and at a personal level by college tutors. Careers advisers carry out guidance interviews with students, discussing with them their skills and aspirations. The Careers Service also provides training in writing applications, interview techniques and analysis of transferable skills. In addition the Careers Service provides information about occupations and employers and advertises work experience opportunities.

Members of the Faculty who have taught you are usually willing to provide support and references. The Careers Service provides a link-person, who has expertise in areas where mathematicians are often in demand, for example, in finance careers. College tutors are regularly updated on Careers Service activities.

In addition to its general programme, the Careers Service runs an annual 'Jobs for Mathematicians' half-day, in collaboration with the Mathematical Institute. At this event there are talks from alumni currently working in jobs suitable for mathematicians. The event also helps students consider their transferable skills. You can find more information at http://www.careers.ox.ac.uk.

The Mathematics Undergraduate Representation Committee (MURC) has set up an emailing list for careers and studentship information. If you wish to receive such information you should sign up. You can do this by sending a blank message to `murc-jobs-join@maths.ox.ac.uk`. The system will confirm your request and once that is completed you will be registered to receive careers information.

4.4 University Lectures

University lectures in all subjects (although not *classes*) are open to all students. A consolidated **lecture list** is available on the University website at: http://www.maths.ox.ac.uk/notices/lecture-lists/. Further information can be found at http://www.admin.ox.ac.uk/pubs/lectures/

The seminars and colloquia given in the Mathematical Institute, often by mathematicians of international repute, are announced on the departmental notice boards; although usually aimed at faculty and research students, all interested in the subject are welcome to attend.

4.5 Study Skills

Much of the advice and training in study skills will come in the regular tutorial and class teaching your college arranges for you. In these sessions, and in preparation for them, you will develop your powers of expression and argument. There is also good advice in Prof. Batty's "How do Undergraduates do Mathematics?" http://www.maths.ox.ac.uk/files/study-guide/index.shtml available in paper copy from reception in the Mathematical Institute, and electronically on the website. The *Projects Committee* gives guidance on the choice and preparation of extended essays and dissertations.

4.6 Special Needs

Specialised advice and assistance is available for dyslexic, blind/partially sighted, and other disabled students from the University Disability Office http://www.admin.ox.ac.uk/eop/ or disability@admin.ox.ac.uk or 01865 (2)80459.

If you experience difficulties with your course because of a disability then you should discuss this with your college tutors. Some colleges have a specific member of staff who assists students with welfare difficulties. Please also see the Mathematical Institute Departmental Disability Statement, appended at G.

Part IV
Organisation and Representation

1 Mathematical, Physical & Life Sciences Division

The Mathematics courses are overseen by the Mathematical, Physical & Life Sciences Division. The responsibility for the delivery of the courses has been placed on various departments in the division.

2 The Departments

Members teaching undergraduate mathematics tend to belong to one of three departments: the Mathematical Institute, the Department of Statistics, and the Computing Laboratory. These departments provide most of the facilities for the courses. In Section 2.3 of Part I, there is a description of the general activities of the departments.

The Mathematical Institute acts as the focus of activity in Mathematics. It houses the Whitehead Library (for research in Mathematics - not an undergraduate library).

The Institute contains lecture theatres and seminar rooms in which undergraduate lectures and classes are given after the first year. (First-year lectures are delivered in the lecture theatre in the University Museum.) The Maple course demonstration sessions are held in the Statistics Department computing laboratories. Many lecture notes may be downloaded from the department's website together with problem sheets, additionally lecture notes are sold at the Reception desk. Most matters concerned with the administration of the mathematics courses are dealt with in the Institute—for example the production of synopses, lecture timetables and lecture notes. If you have any comments relating to departmental provision, please contact the Academic Administrator in the first instance (contact details in Appendix C.)

3 The Faculties

The University staff in each department, and main college teachers in the subject areas, are grouped together in a Faculty. The faculties provide a broad consultative framework which ensures that the views of all teaching staff are taken into account when decisions about admissions, syllabus, teaching and examining are made.

4 Colleges

The relationship between the University and colleges is a complicated one. As you already know, colleges make their own decisions on admissions, and the academic and personal well-being of undergraduates is largely the concern of the colleges. Courses, syllabuses and lectures are planned and put on by the University, and examinations are set and marked by the University. Tutorial teaching is done by the colleges, and there are increasing numbers of inter-collegiate classes.

In your college there will be one or more subject tutors who will jointly guide your studies. This will involve arranging tutorials, usually done in meetings at the beginning of term, and discussing and advising on choice of options. In the first instance, any work-related questions can be taken to one of these tutors. You

may hope to find, as many people do, that your relationship with one or other of your subject tutors is good enough that you can take most other, non-work-related, questions to them also. However, for the times when this is not the case, many colleges have a separate system of student advisers or personal tutors. You will need to see how things are organised in your own college.

Colleges also differ between themselves in other additional provisions: some have book grant or book loan schemes to assist you to acquire books; some have good provision of junior members' computing facilities; in some, time is devoted to "study-skill sessions" which aim to assist new students in making the adjustment to the academic demands of university life. Again, you will need to see how it works in your college.

5 Representation

5.1 MURC

The Mathematics Undergraduate Representative Committee (informally known as MURC) is a student body representing the interests of mathematics, computer science and statistics students. It consists of a representative from each college, elected by undergraduates in these subjects of the college. It holds regular meetings to discuss issues connected with academic organisation of the course such as lectures, examinations and syllabus content. It is the forum which allows undergraduates, through their representatives to raise issues connected with their course, and it is important for colleges to elect a representative to the committee.

The views of this committee are channelled to the faculties and departments through the *Joint Consultative Committee with Undergraduates*. This joint committee meets regularly once a term and discusses any matters that the MURC representatives wish to raise; in addition it has to consider matters relating to the synopses and proposed changes in syllabus.

The membership of the Joint Consultative Committee is twelve members of MURC appointed by MURC and representatives of the Faculties of Mathematics, of Computation and of Statistics. The committee is chaired by the Director of Undergraduate Studies; the Secretary is an undergraduate member of the committee. The statistical feedback from the questionnaires is sent to a designated undergraduate member of MURC (the Questionnaire Representative) for consideration by MURC and it is also discussed by the Joint Consultative Committee. This committee is available for consultation by the Departments, and by the Divisional Board, on any matter which relates to the undergraduate courses.

The Chairperson and Secretary of MURC also attend meetings of the Faculty of Mathematics, and the Chairperson attends meetings of the Mathematics Teaching Committee.

5.2 MURC Activities and Facilities

The programme of MURC activities and facilities is displayed on the MURC notice board beside the Institute lecture rooms. Information can also be found on the MURC website, http://www.maths.ox.ac.uk/∼murc

During the year, open days for prospective Mathematics students are run by the Mathematics Faculty in collaboration with MURC.

5.3 OUSU

Undergraduate representation at University (as opposed to subject or college) level is coordinated through *OUSU*, the Oxford University Student Union. Details of

these arrangements can be found in **Essential Information for Students** (the **Proctors' and Assessor's Memorandum**). Contact details for OUSU can be found in Appendix C.

5.4 College

College procedures for consultation, monitoring, and feedback vary; you will receive from your college details of these.

5.5 The Invariants

The Invariants is Oxford's student mathematics society, with the aim of introducing its members to a wide selection of mathematically-linked topics.

Meetings are held on Tuesdays at 8.00pm at the Mathematical Institute. These usually involve an informal talk on mathematics, followed by refreshments and the chance to talk to the guest speaker. No in-depth knowledge of mathematics is required, since all speakers are asked to make their talks accessible.

Recent talks have been on subjects as diverse as 'Magic Squares', 'How to Build With Lego', and 'Applied Maths in the Real World'.

In addition to the weekly meetings, *The Invariants* also host a number of social events, including a Christmas party and an annual formal dinner.

Anyone interested should come to the first meeting, which is free, to find out more.

5.6 The Proctors and Academic Appeals

In the rare case of any student wishing to make an appeal against an examination result, the appeal is usually made via the college to the Proctors' Office. However, students should be aware that they have the right to take certain matters to the Proctors directly (see Part II). Contact details can be found in Appendix C.

Part V
Syllabus and Lecture Synopses

You will be issued with the syllabus in supplement to your handbook. We have just completed the process of revising the syllabus; you will be issued with sections each year.

1 Moderations

For examination in 2009; this will be supplied with your **handbook**.

2 Part A

For examination in 2010, will be supplied in 2009.

3 Part B

For examination in 2011, will be supplied in 2010.

4 Part C

For examination in 2012 (if applicable), will be supplied in 2011.

Part VI
Assessement and Examinations

As well as a medium of instruction, the tutorial is a personally tailored form of continuous assessment, and both you and your tutor will have a very good idea of how you are getting on. In the first two years tutors will also organise college examinations, called *collections*, from time to time and usually at the start of each term; these are not to be confused with the University's *public* examinations which qualify you for your degree.

For the undergraduate degrees in Mathematics you will sit examinations each year in Trinity Term, called *public examinations* because they are organised by the University, rather than privately by your college.

1 Preparation

Your tutor will advise you about revision and practice. As well as any consolidation work done after the end of term, it is usual to spend much of Trinity Term revising work for that year's examination.

In subjects which have been taught in previous years, past examination papers are a good guide to the sort of examination question that you might be set. These can be found on the web at
http://www.maths.ox.ac.uk/current-students/undergraduates/examinations/past-papers

Please note that the syllabus for the examination may have changed, and is certainly not determined by what appeared in past papers. Your tutor will be able to give you advice on how relevant particular past papers are.

2 Entering for University Examinations

In years 1 and 2, examination entry is automatic. When you register online at the beginning of the year, you will be entered for the examinations, which consist of compulsory core papers only. In years 3 and 4 your college arranges examination entry, which involves the submission of a form from the college to the University giving details of the optional papers which you are sitting.

A timetable will be issued and sent to your college a few weeks before the examination. This will give you details of where and when each of the written papers will happen. Your college will pass on your timetable together with a randomly allocated *candidate number* which you will use to identify your scripts, instead of your name and college.

Before the examinations you will receive at least one *notice to candidates* from the examiners which will let you know the details of the examination procedure.

3 Procedure for Written Examinations

First and second year examinations are likely to be at Ewert House in Summertown. Third and fourth year examination are likely to be in the Examination Schools on the High Street. Different papers happen in different rooms around the building as detailed in the entrance hall. You must wear full academic dress (sub fusc and gown) and be carrying your cap to attend public examinations and you must bring your University Card with you.

You are strongly advised to allow plenty of time to reach the examination room. Desks are identified by your name and college, with the desks in alphabetical order

of names, but you will need to know your candidate number so that you can write this (and *not* your name) on your answer booklet. The question paper will be on your desk when you go into the examination. You should check that it is the paper you have entered for, and you should read carefully the instructions on the cover, but you may not open it until told to do so.

You will be provided with booklets of A4 paper in which to write your answers. You must write in ink, rather than pencil, though you may use pencil for any graphs and diagrams. Please answer each question or section in a new booklet as indicated on your examination question paper. Rough working should be crossed through.

4 First Public Examination

The three- and four-year courses have the same University examination, Honour Moderations in Mathematics, at the end of the third term of the first year. There are no lectures in the second half of this term to give you extra time to prepare for the examination. The examination consists of four papers, each of three hours duration: Pure Mathematics I, Pure Mathematics II, Applied Mathematics I, Applied Mathematics II. Each paper has eight questions, and you will be instructed to submit answers to no more than five questions. No books or tables may be taken into the examination room. Calculators are not normally permitted, you should follow instructions in notices sent to you by the Chairman of Examiners regarding calculators. The Moderators (Examiners in Moderations) will also take into account the marks awarded for your work on the Maple projects. The Moderators give **Advice to Candidates** on their marking conventions and how they identify and reward excellence; see Appendix B for more information which contains an extract from our examination conventions.

4.1 Examination Results

On the strength of your performance in Mods, you will be classified (in the First, Second or Third Class) or given a Pass or failed. The percentages in each category for recent years were:

	First	Second	Third	Pass	Fail
2001	30.0%	58.9%	6.3%	2.1%	2.6%
2002	29.0%	58.5%	8.7%	0.0%	3.8%
2003	30.1%	59.6%	6.2%	1%	3.1%
2004	29.5%	51.5%	9.0%	7.0%	3.0%
2005	30%	53%	12%	3%	2%
2006	37%	45%	11%	3%	4%
2007	31%	57%	6%	4%	3%
2008	37%	57%	3%	0%	3%

The Examiners will provide you, through your college, with University Standardised Marks for each paper. These describe, paper by paper your performance on the examination and are the marks which will appear on your transcript. See Appendix B for further information on how the examiners determine the class from these paper marks.

4.2 Re-sits

Those who fail Mods or were unable to sit the examination because of illness or other urgent and reasonable cause may, at the discretion of their college, enter for the Preliminary Examination in Mathematics. The Preliminary Examination is an

unclassified examination which candidates either pass or fail and consists of two papers taken in the following September.

5 Second Public Examination

5.1 Part A

The three- and four-year courses have the same University examinations Mathematics Part A, at the end of the third term of the second year. Part A is not classified, but the results will be carried forwards to the classification at the end of the third year (see below).

5.2 Part B

At the end of the third term of your third year you will take Part B. The formal details of which combination of papers you may offer in the examination will be published by the University in the **Examination Regulations**. In total you must take the equivalent of eight papers. The Examiners give **Advice to Candidates** on their marking conventions etc.

On the basis of your performance in the examination you will be classified (First, Upper Second, Lower Second, Third Class) or given a Pass or failed. Recent statistics for the BA degree are:

	First	Upper Second	Lower Second	Third	Pass	Fail
2001	19.8%	56.9%	12.1%	6.9%	4.3%	0%
2002	20.5%	53.8%	14.5%	10.3%	0%	0.9%
2003	22.8%	50.4%	21.3%	1.6%	3.1%	0.8%
2004	25.7%	48.5%	17.8%	5.0%	1.0%	2.0%
2005	27.1%	50.0%	17.1%	5.7%	0%	0%
2007	35.88%	46.47%	14.71%	2.35%	0.59%	0%
2008	34.19%	47.74%	14.19%	3.23%	0.65%	0%

Please refer to https://www.maths.ox.ac.uk/notices/exam-reports/ for the most up-to date statistics.

5.3 Part C

If you take the MMath course, the second and third year will be very similar to the BA and you will also take Part C at the end of your fourth year .

The **Examination Regulations** and amendments published in the University Gazette will give full details.

You will receive a class at the end of Part B (as above) and a separate class for Part C. Recent statistics for the MMath degree are:

	First	Upper Second	Lower Second	Third	Pass	Fail
2001	53.7%	27.8%	14.8%	1.9%	1.9%	0%
2002	47.6%	38.1%	14.3%	0%	0%	0%
2003	50.0%	35.1%	9.5%	5.4%	0%	0%
2004	54.4%	29.4%	11.8%	2.9%	1.5%	0%
2005	44.7%	47.4%	5.3%	2.6%	0%	0%
2006	58.43%	34.83%	6.73%	0%	0%	0%
2007	45.8%	42.2%	10.8%	2.4%	0%	0%
2008	46.32%	47.37%	6.32%	0%	0%	0%

Please refer to https://www.maths.ox.ac.uk/notices/exam-reports/ for the most up-to date statistics.

5.3.1 Examination Results

The Examiners will provide you, through your college, with a letter setting out your performance on each paper in University Standardised Marks.

5.3.2 Repeats and Re-sits

For details of the regulations concerning repeats see the relevant sections of the **Examination Regulations**. Your college tutor will also be able to give advice about these very infrequently used procedures.

6 Projects, Dissertations, Extended Essays

Third year students may write an extended essay, equivalent to one unit or 32 lectures.

Fourth-year students may write a half-unit or a full-unit dissertation.

Projects give students the opportunity to develop valuable skills - collecting material, explaining it, expanding it clearly and persuasively, and using citations. Some students show their absolute abilities better on a sustained piece of exposition rather than on solving problems set in a three-hour examination paper.

Note the revised penalties regarding late submission of project work.

Dissertation and extended essays must be submitted to the Chairman of Examiners c/o the Examination School, High Street, Oxford by the deadline published in the synopses. You will also need to complete a declaration of authorship form. An example of this is given in Appendix I

Dissertations and extended essays will be assigned USMs according to the same principles as Mathematics papers. In arriving at these marks, the relative weights (for BE Essays and Dissertations) given to content, mathematics, and presentation will be 25%, 50% and 25%, respectively. For OE Essays on historical, statistical, computer-related or similar topics the examiners will assign 75% for content and 25% for style and presentation. However, the content should have substantial connections with mathematics. Here is a brief explanation of these terms:

Mathematics: proofs and assertions should be correct, and the mathematics should be appropriate for the level of study. In applied topics, the derivation of the model should be properly justified.

Content: the examiners are looking for some of your own thoughts and contributions: you must do more than rehash text books and lecture notes; you should use original sources; you must not plagiarise.

Presentation: the mathematics must be clear and well laid out; the English should be clear and grammatically correct; sources should be properly acknowledged, references should be properly cited. Give some thought to notation, choice of typeface, and numbering of equations and sections. Do not fail to number the pages. Be sure to supply complete and accurate references for all the sources used in completing the project, and be sure to cite them properly in the text.

Excellent brief advice on mathematical writing is to be found on the London Mathematical Society website http://www.lms.ac.uk/publications/documents/writing.pdf

All projects are independently, blind, double-marked. The examiners oversee the reconciliation of the two marks in consultation with the assessors.

Students are invited to give an informal presentation of their work to their supervisor before the end of Hilary Term. Although not formally assessed this provides useful feedback to the student and is part of the learning process.

Further details are given in the project guidelines which are available online at http://www.maths.ox.ac.uk/current-students/undergraduates/projects.

7 Examination Regulations

You should always check with the current **Examination Regulations**, which can be consulted on the University website.

8 Prizes

The following prizes are available for undergraduate students. These are awarded by the Examiners, and no application is necessary.

Part B

- Gibbs Prizes of £400 and a proxime accessit prize of £200 or two equal prizes of £300 at the discretion of the Examiners.
- Gibbs Mathematics Prize of £100 for Mathematics and Philosophy candidates.
- 2 Junior Mathematical prizes of £200 each.
- IMA Prize of a year's free membership.

Part C

- A single Gibbs Prize of £400 or two equal Gibbs Prizes of £200, at the discretion of the examiners.
- Gibbs Mathematics Prize of £100 for Mathematics and Philosophy candidates.
- Junior Mathematical Prize of £200.
- IMA Prize of a year's free membership.

Part VII
University Regulations and Codes

1 The Proctors

The following is quoted from **Essential Information for Students** (the **Proctors' and Assessor's Memorandum**):

"The Proctors and Assessor are available if students wish to consult them in confidence for help, information, or advice about University matters or any other matters outside the sphere of their college advisers. Such requests may be on individual matters or on behalf of a club, society, or any other group of members of the University".

The duties of the Proctors and Assessor are now mainly:

- ensuring that regulations designed to maintain the orderly working of the University are implemented (this means that they play a major part in seeing that University examinations are conducted properly and fairly, and in enforcing student discipline);
- investigating any complaints by any member of the University (the Proctors have the power to summon any member of the University before them to help in their enquiries);
- serving on University committees (so that they can obtain wide experience of the University's administration, take part in decision-making, and provide feedback to colleges and student representatives).

2 Paperwork

The Proctors and Assessor have produced a booklet called **Essential Information for Students** which will be given to you by your college. This contains general information about health and welfare matters; the Student Union; accommodation; sport and recreation; transport; personal safety and security. It provides a source of information about the University's academic support services including the University Language Centre and Careers Services. The booklet also gives the University's formal, statutory rules and requirements in relation to Conduct of Examinations, Harassment, Freedom of Speech and explains complaints and appeals procedures. It is important for you to read this booklet in conjunction with the **handbook** for your course.

2.1 Regulations for Candidates in University Examinations

Students should refer to the **Examination Regulations,** for the full regulations regarding examinations. For example, Parts 9 - 18, and 20 relates to the conduct of examinations and Part 19 gives the *Proctorial's Disciplinary Regulation for Candidates in Examination.*

In stated in these regulations: (1) 'examination' includes where the context so permits the submission and assessment of a thesis, dissertation, essay, or other coursework which is not undertaken in formal examination conditions but counts towards or constitutes the work for a degree or other academic award; and (2) 'examination room' means any room designated by the University's Clerk of the Schools or approved by the Proctors as a place for one or more candidates to take an examination.

It is a student's responsibility to be aware of University guidance of these matters.

3 Plagiarism

The University and Department employ a series of sophisticated software applications to detect **plagiarism** in submitted examination work, both in terms of copying and collusion. It regularly monitors on-line essay banks, essay-writing services, and other potential sources of material. It reserves the right to check samples of submitted essays for plagiarism. Although the University strongly encourages the use of electronic resources by students in their academic work, any attempt to draw on third-party material without proper attribution may well attract severe disciplinary sanctions.

Below is the University definition of what constitutes Plagiarism. All cases would be regraded as a serious disciplinary matter and could result in your being suspended or being sent down.

3.1 What is plagiarism?

Plagiarism is the copying or paraphrasing of other peoples work or ideas into your own work without full acknowledgement. All published and unpublished material, whether in manuscript, printed or electronic form, is covered under this definition.

Collusion is another form of plagiarism involving the unauthorised collaboration of students (or others) in a piece of work.

Cases of suspected plagiarism in assessed work are investigated under the disciplinary regulations concerning conduct in examinations. Intentional or reckless plagiarism may incur severe penalties, including failure of your degree or expulsion from the university.

3.2 Why does plagiarism matter?

It would be wrong to describe plagiarism as only a minor form of cheating, or as merely a matter of academic etiquette. On the contrary, it is important to understand that plagiarism is a breach of academic integrity. It is a principle of intellectual honesty that all members of the academic community should acknowledge their debt to the originators of the ideas, words, and data which form the basis for their own work. Passing off anothers work as your own is not only poor scholarship, but also means that you have failed to complete the learning process. Deliberate plagiarism is unethical and can have serious consequences for your future career; it also undermines the standards of your institution and of the degrees it issues.

3.3 What forms can plagiarism take?

- Verbatim quotation of other peoples intellectual work without clear acknowledgement. Quotations must always be identified as such by the use of either quotation marks or indentation, with adequate citation. It must always be apparent to the reader which parts are your own independent work and where you have drawn on someone elses ideas and language.

- Paraphrasing the work of others by altering a few words and changing their order, or by closely following the structure of their argument, is plagiarism because you are deriving your words and ideas from their work without giving due acknowledgement. Even if you include a reference to the original author

in your own text you are still creating a misleading impression that the paraphrased wording is entirely your own. It is better to write a brief summary of the authors overall argument in your own words than to paraphrase particular sections of his or her writing. This will ensure you have a genuine grasp of the argument and will avoid the difficulty of paraphrasing without plagiarising. You must also properly attribute all material you derive from lectures.

- Cutting and pasting from the Internet. Information derived from the Internet must be adequately referenced and included in the bibliography. It is important to evaluate carefully all material found on the Internet, as it is less likely to have been through the same process of scholarly peer review as published sources.

- Collusion. This can involve unauthorised collaboration between students, failure to attribute assistance received, or failure to follow precisely regulations on group work projects. It is your responsibility to ensure that you are entirely clear about the extent of collaboration permitted, and which parts of the work must be your own.

- Inaccurate citation. It is important to cite correctly, according to the conventions of your discipline. Additionally, you should not include anything in a footnote or bibliography that you have not actually consulted. If you cannot gain access to a primary source you must make it clear in your citation that your knowledge of the work has been derived from a secondary text (e.g. Bradshaw, D. Title of Book, discussed in Wilson, E., Title of Book (London, 2004), p. 189).

- Failure to acknowledge. You must clearly acknowledge all assistance which has contributed to the production of your work, such as advice from fellow students, laboratory technicians, and other external sources. This need not apply to the assistance provided by your tutor or supervisor, nor to ordinary proofreading, but it is necessary to acknowledge other guidance which leads to substantive changes of content or approach.

- Professional agencies. You should neither make use of professional agencies in the production of your work nor submit material which has been written for you. It is vital to your intellectual training and development that you should undertake the research process unaided.

- Autoplagiarism. You must not submit work for assessment which you have already submitted (partially or in full) to fulfil the requirements of another degree course or examination.

3.4 Not just printed text!

The necessity to reference applies not only to text, but also to other media, such as computer code, illustrations, graphs etc. It applies equally to published text drawn from books and journals, and to unpublished text, whether from lecture handouts, theses or other students essays. You must also attribute text or other resources downloaded from web sites.

All matters relating to plagiarism are taken very seriously and would lead to a Disciplinary matter.

See for example, The Proctors and Assessor booklet **Essential Information for Students** Section 9, also available on-line at
http://www.admin.ox.ac.uk/proctors/info/pam/section9.shtml

4 Code on Harassment

The Mathematical Institute has appointed two senior members who may be consulted in connection with the University's Code on Harassment. Details are posted in reception in The Mathematical Institute.

5 Disabilities and Equal Opportunities

The University is committed to making arrangements where appropriate to enable students with disabilities to participate fully in student life. Please see the University's Equal Opportunities Statement below, and the Mathematics Departmental Disability Statement in Appendix G.

6 University Equal Opportunities Statement: students

The University of Oxford and its colleges aim to provide education of excellent quality at undergraduate and postgraduate level for able students, whatever their background. In pursuit of this aim, the University is committed to using its best endeavours to ensure that all of its activities are governed by principles of equality of opportunity, and that all students are helped to achieve their full academic potential. This statement applies to recruitment and admissions, to the curriculum, teaching and assessment, to welfare and support services, and to staff development and training.

6.1 Recruitment and admissions

Decisions on admissions are based solely on the individual merits of each candidate, their suitability for the course they have applied to study (bearing in mind any requirements laid down by any professional body), assessed by the application of selection criteria appropriate to the course of study. Admissions procedures are kept under regular review to ensure compliance with this policy.

We seek to admit students of the highest academic potential. All colleges select students for admission without regard to marital status, race, gender, ethnic origin, colour, religion, sexual orientation, social background or other irrelevant distinction.

Applications from students with disabilities are considered on exactly the same academic grounds as those from other candidates. We are committed to making arrangements whenever practicable to enable such students to participate as fully as possible in student life. Details of these arrangements can be found in the University's Disability Statement, and information will be provided on request by colleges or by the University Disability Co-ordinator.

In order to widen access to Oxford, the University and colleges support schemes which work to encourage applicants from groups that are currently under-represented. The undergraduate Admissions Office can provide details of current schemes.

None of the above shall be taken to invalidate the need for financial guarantees where appropriate.

6.2 The curriculum, teaching and assessment

Unfair discrimination based on individual characteristics (listed in the statement on recruitment and admissions above) will not be tolerated. University departments, faculties, colleges and the central quality assurance bodies monitor the curriculum,

teaching practice and assessment methods. Teaching and support staff have regard for the diverse needs, interests and backgrounds of their students in all their dealings with them.

6.3 Welfare and Support Services

Colleges have the lead responsibility for student welfare and can provide details of arrangements made to support their students. The University, in addition, provides for all students who require such support:

a counselling service;

childcare advice;

disability assessment and advice, and

a harassment advisory service.

Further details of these services are included in the Proctors' and Assessor's handbook 'Essential Information for Students', which is updated annually.

6.4 Staff Development and Training

The University, through its Institute for the Advancement of University Learning, will provide appropriate training programmes to support this equal opportunities statement.

6.5 Complaints

A candidate for admission who considers that he or she has not been treated in accordance with this equal opportunities policy, should raise this with the college concerned (or department in the case of graduate admission). Students in the course of their studies may use the student complaints procedure, and should, in the first instance, lodge their complaint with the Proctors, who will advise on the procedure to be followed thereafter. The Committee on Diversity and Equal Opportunity monitors complaints made by students.

7 Safety

You are urged to act at all times responsibly, and with a proper care for your own safety and that of others. Departmental statements of safety policy are posted in all departments, and you must comply with them. Students should note that they (and others entering onto departmental premises or who are involved in departmental activities) are responsible for exercising care in relation to themselves and others who may be affected by their actions.

They should also note that in the Institute accidents should be reported immediately to the Administrator, presently in Room F13, telephone 73542, who keeps the accident book. First aid boxes are located in the hallway on each floor.

Each lecture theatre has its own regulations for procedures to be followed in the case of fire or other emergency; you are urged to familiarise yourself with the proper escape routes. The escape routes from the Mathematical Institute lecture and seminar rooms, where most of your lectures will be held, are set out in the emergency exit procedure which is displayed in the Mathematical Institute. In the case of evacuation of the lecture theatre give heed to the instructions of the lecturer.

Part VIII
Information for International Students

1 Contacts

International Students Advisory Service (tel:(2)70105)
Examination Schools, High Street, Oxford
email: `international.office@admin.ox.ac.uk`, website: `www.admin.ox.ac.uk/io`

Oxford University Language Centre (tel:(2)83360)
email: `admin@lang.ox.ac.uk`, website: `www.lang.ox.ac.uk`

Oxford University Student Union - International Students Officer
email: `international@ousu.org`

2 Language Skills

One of the most important things you can do is to continue to develop your language skills. Students whose first language is not English often feel shy about making minor grammatical mistakes and this can hold you back from fully participating and making friends within the group of home students. Seek extra help, for example the Language Centre runs English for academic studies courses (http://www.lang.ox.ac.uk/eas/index.html).

Why are language skills fundamental? Of course this will help you follow lectures and tackle problem sheets but it goes much deeper than this. The way students study here in Oxford and in the UK, involves something we call "academic good practice". This means we encourage students to discuss Mathematics and lecture courses outside of formal contact hours. Working together can be beneficial, but you must work on problem sheets on your own. Always write up your work using your own words. Reading books and lecture notes is very important, but when you write out a proof or an argument your tutors want to see how you think about it. Your understanding is central to this. From what you write and the way you write it, your tutor will be able to gauge the way you will be tutored and how best you will be supported.

Making friends amongst your peers from your home country is always a natural reaction to living in another culture. That is fine for a month or two while you get used to Oxford, but do not let it stop there. Make friends from other backgrounds, other cultures, other faiths and who speak other languages. Understanding British culture takes quite a long time. We probably seem a little cold and aloof. This is never intended. Stop, smile, speak to one of us and in time you will breakdown barriers. The influence you can have on helping home students and all of us understand your culture can only enrich us all. Will you do that?

3 Dictionaries

Your college tutor will advise you here but sometimes the Proctors will approve use of a dictionary during examinations. It is vital that nothing is written in the dictionary, apart from your name and college.

4 Examinations

Examinations in Oxford and more generally in the UK are conducted in a very formal way. You must write using a pen (a pencil is only allowed for diagrams). Your dress is formal (sub-fusc and a gown). You must not communicate with any candidate once you are in the examination hall; to do so is a disciplinary offence.

5 Assessed Work

Read section VII on plagiarism very carefully. It is assumed that whenever you submit a piece of work it is your own unaided work. This includes your problem sheets, your Maple projects, any project, extended essay or dissertation. You must state references you use to help you in any piece of assessed work; always give a bibliography.

6 Lectures: How to get the best out of your lectures

Always take notes during each lecture. This helps you follow the arguments and examples. More than this, it helps you know and recall the theory. Write up your notes carefully after a lecture. Read references and make extra notes on any topic you are unclear on, or you want to understand more fully.

7 Involvement in College Life

Get involved. Participate. Become a mathematics representative for your college on the Mathematics Undergraduate Representative Committee (MURC). This will help you to make lots more friends.

Part IX
Appendices

A The Joint Courses

A.1 Mathematics & Statistics

This handbook applies to the first year in Mathematics and Statistics, which is shared with the single-subject degree. For other details about the course please see the separate handbook and Statistics Department website.

A.2 Mathematics & Computer Science

This is a brief overview of the course; for more details please see the separate handbook and Computing Laboratory website.

Mathematics & Computer Science is a three-year or four-year course intended to equip the future computer scientist with the fundamental understanding and practical skills needed by potential leaders of a demanding profession. It is a training in logical thought and is a good preparation for many occupations. The course concentrates on the areas in which mathematics and computing are most relevant to each other. It places emphasis on the bridges between hardware and software, and between theory and practice.

A.3 Computer Science

There is a separate handbook for this course, and information can be found on the Computing Laboratory website.

A.4 Mathematics & Philosophy

This is a brief overview of the first year of the course; for more details please see the separate handbook.

Mathematics & Philosophy is a three-year or four-year course intended for those who would like to combine the development of their mathematical skills with the study of philosophy. There is a natural bridge in the philosophy of mathematics, as well as in logic. The latter has always been reckoned a part of philosophy, and over the last hundred years it has developed as a branch of mathematics.

There is an examination at the end of the first year, called Honour Moderations in Mathematics & Philosophy. This consists of four three-hour papers. Two of these papers, 'Pure Mathematics I' and 'Pure Mathematics II' also form part of the Mathematics courses. The lectures (and in most colleges the tutorials and classes) on the topics covered by these papers are the same as those attended by those sitting Honour Moderations in Mathematics; the examination papers are identical. The third paper is 'Elements of Deductive Logic'; candidates prepare for this paper by studying formal logic and its application to the analysis of English sentences and inferences, using the logical symbols and tableau rules of Hodges' *Logic*. There are university lectures and college-based classes or tutorials. The fourth paper is called 'Introduction to Philosophy' and for this paper students read certain prescribed texts by Descartes and Frege, and are required in the examination to show knowledge of both authors. There are university lectures on each author, and college tutorials.

B Examination Conventions

The formal procedures determining the conduct of examinations are established and enforced by the University Proctors. For the Mathematical Institute examination conventions are set out in this course handbook and in additional supplements. These conventions are a guide to the examiners and candidates but the regulations set out in the Examination Regulations have precedence. The examiners are nominated by the Nominating Committee in the Mathematical Institute and those nominations are submitted for approval by the Vice-Chancellor and the Proctors. Formally, examiners are independent of the Department and of those who lecture courses. However, for written papers in Mathematics, examiners are expected to consult with course lecturers in the process of setting questions.

The paragraphs below give an indication of the conventions to which the examiners usually adhere, subject to the guidance of the appointed external examiners, and other bodies such as the Teaching Committee in the Mathematical Institute, the Mathematical, Physical and Life Sciences Division, the EPSC and the Proctors who may offer advice or make recommendations to examiners. It must be stressed that to preserve the independence of the examiners, candidates are not allowed to make contact directly about matters relating to the content or marking of papers. Any communication must be via the Senior Tutor of your college, who will, if he or she deems the matter of importance, contact the Proctors. The Proctors in turn communicate with the Chairman of Examiners.

B.1 Moderations

All Mathematics candidates take four papers, viz.

1. Pure Mathematics I (PMI)
2. Pure Mathematics II (PMII)
3. Applied Mathematics I (AMI)
4. Applied Mathematics II (AMII)

and submit two Maple projects.

The first two papers are also taken by candidates in *Mathematics & Philosophy*. Each paper has eight questions and candidates may submit answers to at most five questions. Each question is marked out of 20 marks and is divided into two or three parts. The marks for each part will be given on the examination paper.

The format of Papers Applied Mathematics I and Applied Mathematics II changed slightly in 2007/08 (this was to enable Maths & Computer Science candidates to answer questions on probability).

The paper **Applied Mathematics I** is divided into two sections: (i) Calculus of one variable and dynamics, and (ii) Calculus of two or more variables and probability. There will be four questions set on each section and candidates instructed that they should not submit answers to more than five questions in all and not more than three questions from either section.

The paper **Applied Mathematics II**, as in previous years, contains questions on Fourier Series and 2 variable calculus, PDEs, calculus of 3 variables but will also contain a question on statistics.

Marks for each individual examination will be reported in university standardised form (USM): 70+ a first class mark, 50-69 a second class mark, 40-49 a third class mark, 30-39 a pass mark, and *below* 30 a fail mark. Examiners may recalibrate the

raw marks to arrive at university standardised marks reported to candidates. The standardised marks for written papers and marks for Maple projects (MM) will be averaged according to the following two formulae:

$$Av_1 = \frac{PMI + PMII + AMI + AMII + \frac{1}{4}MM}{4\frac{1}{4}},$$

$$Av_2 = \frac{PMI + PMII + AMI + AMII}{4},$$

rounded up to a whole number.

Classes will be awarded according to the following conventions:

First : $Av_1 \geq 70$

Second : $50 \leq Av_1 < 70$

Third : $40 \leq Av_1 < 50$ and $Av_2 \geq 40$

or

$40 \leq Av_2 < 50$;

Pass : $30 \leq Av_2 < 40$;

Fail : $Av_2 < 30$.

In addition to this, it should be noted that no student shall be awarded a Pass or Honours unless they score at least 30 on each paper.

A 'Preliminary Examination' is set for candidates who fail moderations or who, for some good reason, are unable to sit Moderations.

The Preliminary Examination consists of two papers; one in Pure Mathematics and one in Applied Mathematics. This is an unclassified examination. To pass the examination a student must achieve a USM of at least 40 on each of the two papers and demonstrate understanding of sufficient breadth to satisfy the Examiners.

B.2 Qualitative description of examination performance for the various classes for each paper

First Class: the candidate shows excellent skills in reasoning, deductive logic and problem-solving. He/she demonstrates an excellent knowledge of the material, and is able to use that innovatively in unfamiliar contexts.

Upper Second Class: the candidate shows good or very good skills in reasoning, deductive logic and problem-solving. He/she demonstrates a good or very good knowledge of much of the material.

Lower Second Class: the candidate shows adequate basic skills in reasoning, deductive logic and problem-solving. He/she demonstrates a sound knowledge of much of the material.

Third Class: the candidate shows reasonable understanding of at least part of the basic material and some skills in reasoning, deductive logic and problem-solving.

Pass: the candidate shows some limited grasp of basic material demonstrated by the equivalent of an average of one meaningful attempt at a question on each unit of study. A stronger performance on some papers may compensate for a weaker performance on others.

Fail: little evidence of competence in the topics examined; the work is likely to show major misunderstanding and confusion, coupled with inaccurate calculations; the answers to questions attempted are likely to be fragmentary only.

B.2.1 Advice from Examiners

The following is typical of recent letters of **Advice to Candidates** sent out by the Examiners and Moderators. It is offered here as a 'specimen', to give you an idea of how the Moderations examinations will be organised.

Arrangements for the examination:

Papers will be sat in the Ewert House, Summertown, starting at either 9.30 or 2.30. You will be allowed to enter a few minutes before this time to get settled; in particular, I hope to allow extra time for you to find your places before the first paper, but in any case, apart from any latecomers, the examination will not start until everyone is seated. You may remove your gown, jacket and tie, but you must put them on again before leaving your desk at the end of the examination. There will be an area near the entrance where coats and bags must be left; you may take one transparent pencil case containing personal items, and writing equipment into the examination area, and these may be inspected. In particular, you may not take in mobile phones, books, diaries, notebooks or any paper, nor may you take in any food or drink unless it is medically required and approved by the Proctors - the Moderators will have been informed in these cases. **Calculators will not be allowed.**

You should note that you are required to remain in the examination hall until at least 30 minutes have elapsed from the actual start. If you arrive late you will not receive extra time to make up for this and if you are more than 30 minutes late, you will be allowed to enter, but your late arrival will be reported and your script may not be marked.

Desks will be grouped by subject, and this will be clearly indicated; seating within each subject will be in alphabetical order, with desks having your name on them. You should try to remember your examination candidate number since this is the only identification that you are permitted to write on your scripts; however, there is a master list in case you have forgotten, but you will then have to wait at the end of the examination before handing in your script. The examination paper and answer booklets will be on your desk before you are allowed in. There are no questions visible on the front of the examination paper, and you may not open it until told to. The paper in the answer booklets is unlined.

- **On papers A, B and D you should submit answers to no more than five questions. On paper C there will be two sections and you should submit answers to no more than five questions in all, with no more than three questions from section (i) and no more than three questions from section (ii)**
- **Begin each question in a new answer booklet**
- **Hand in your answers in numerical order**

- **Write the numbers of all the questions to be marked on the front answer booklet.**
- **If you answer fewer than five questions you must submit an empty answer booklet for each unanswered question, so that you still submit at least five booklets in total.** (For example, if you answer three questions you should also submit two empty answer booklets with your candidate number on the front page.)
- **Cross out all rough working and any working you do not want to be marked. If you have used separate answer booklets for rough work please cross through the front of each such answer booklet and attach these answer booklets at the back of your work.**

You are reminded also of the rule that you may not write in pencil, except to draw diagrams.

If you have been given permission by the Proctors to use a dictionary, you should show it to me at the beginning of the examination. It must then remain in the examination hall until the end of the entire examination, and you should hand it to the Moderator invigilating at the end of each paper. DO NOT WRITE ANYTHING OTHER THAN YOUR NAME IN YOUR DICTIONARY.

Make sure that every booklet has your number on it. At the end on the examination, you will be told to stop writing, and should do no more than complete the line you are writing. **Please ensure that you have written the numbers of the five (or fewer) questions that you want marked on the front answer booklet, that you have crossed through any working that you do not want to be marked.** You should then hand in scripts as directed by the invigilators.

If you wish to leave the examination hall at any time during the examination, to attend the lavatory or obtain a drink of water, raise your hand and wait for an invigilator to escort you out. Similarly, if you feel unwell, or wish to leave the examination early, wait for an invigilator to come, but then ask to see the Moderator present since only he can record your incapacity or early departure. You will not be permitted to leave the examination hall because of illness and then return, on more than one occasion during a single examination. You will not be allowed to leave during the last 30 minutes of a paper, except in the case of illness, to avoid disruption to other candidates or to the orderly collection of scripts. Candidates in Mathematics and Philosophy will be instructed on the number of questions to be attempted on Philosophy papers.

B.3 Late Submission of or Failure to Submit Coursework

Late Submission of or Failure to Submit Mathematics Coursework

The Examination Regulations stipulate specific dates for submission of the required pieces of coursework to the Examiners (this includes History of Mathematics coursework, Undergraduate Ambassadors Scheme coursework, Extended essays and Dissertations). Rules governing late submission and any consequent penalties are set out in the 'Late Submission of Work' sub-section of the 'Regulations for the Conduct of University Examinations' section of the Examination Regulations 2008, 2007, 2006 & 2005, respectively on pages 45, 45, 45 & 44.

Late submission of coursework for Mathematics examinations will normally result in the following penalties:

- With permission from the Proctors under clause (2) of para 16.8, page 45, no penalty.
- With permission from the Proctors under clauses (3) + (4) of para 16.8, a penalty of a reduction in the mark for the coursework in question of at least 5 USMs (or at least 5% of the maximum mark available for the piece of work); the exact penalty to be set by the Examiners with due consideration to the advice given in the document 'Academic Penalties for Late Submission of a Thesis or Other Exercise: Proctors Notes for Guidance', dated 1/11/06.
- Where the candidate is not permitted by the Proctors to remain in the examination he or she will be deemed to have failed the examination as a whole.
- Where no work is submitted or it is proffered so late that it would be impractical to accept it for assessment the Proctors may, under their general authority, and after (i) making due enquiries into the circumstances and (ii) consultation with the Chairman of the Examiners, permit the candidate to remain in the examination. In this case the Examiners will award a mark of zero for the piece of coursework in question.

B.4 Finals

B.4.1 Classification in the Mathematics Degrees

Each candidate will receive a numerical mark on each paper in each Part of the examination in the University standardised range 0-100, such that

- a First Class performance (on that paper) is indicated by a mark of 70 to 100;
- an Upper Second Class performance (on that paper) is indicated by a mark of 60 to 69;
- a Lower Second Class performance (on that paper) is indicated by a mark of 50 to 59
- a Third Class performance (on that paper) is indicated by a mark of 40 to 49;
- a Pass performance (on that paper) is indicated by a mark of 30 to 39;
- a Fail performance (on that paper) is indicated by a mark of 0 to 29.

In order to arrive at such University standardized marks (or USMs) for each paper, the examiners will mark and assess papers in the ways described below.

Part A

The Examination Papers
There are four papers in Part A, all of 3 hours. In the order in which they will be taken, these are AC1, AC2, AO1 and AO2. Questions on AC1 and AO1 are shorter and will be marked out of 10, while questions on AC2 and AO2 are longer and will be marked out of 25. There will be 9 questions on paper AC1 and candidates should attempt them all. There will be 9 questions on paper AC2 and candidates may hand in answers to at most 5, from which the best 4 answers will be counted towards the mark for this paper. There will be 19 questions on paper AO1, 1 for each 8 lecture course and 2 for each 16 lecture course, and candidates may hand in answers to at most 10, from which the best 9 answers will be counted towards the mark for this paper. There will be 19 questions on paper AO2, distributed among the courses as in AO1, and candidates may hand in answers to at most 5, from

which the best 4 marks will be counted towards the mark for this paper.

Marking of Papers
Mark schemes for questions out of 10 will aim to ensure that the following qualitative criteria hold:

- 9-10 marks: a completely or almost completely correct answer, showing good understanding of the concepts and skill in carrying through arguments and calculations; minor slips or omissions only.

- 5-8 marks: a good though not complete answer, showing understanding of the concepts and competence in handling the arguments and calculations.

Mark schemes for questions out of 25 will aim to ensure that the following qualitative criteria hold:

- 20-25 marks: a completely or almost completely correct answer, showing excellent understanding of the concepts and skill in carrying through the arguments and/or calculations; minor slips or omissions only.

- 13-19 marks: a good though not complete answer, showing understanding of the concepts and competence in handling the arguments and/or calculations. In this range, an answer might consist of an excellent answer to a substantial part of the question, or a good answer to the whole question which nevertheless shows some flaws in calculation or in understanding or in both.

Parts B and C The Examination Papers
Where not otherwise stated, the syllabus and form of the papers for each unit and half unit is defined by the lecture synopsis.

Examinations for whole unit papers are of **three hours duration** and half unit papers are of **one and a half hour duration**. The rubrics are given below - note these are revised for 2008/09 and are the same for Parts B and C.

There are three questions in each half unit. For a whole unit paper the rubric states "candidates may submit answers to as many questions as they wish: the best two from each section will count". For a half unit paper the rubric states "candidates may submit answers to as many questions as they wish: the best two will count".

Analysis of marks

Part A At the end of the Part A examination, a candidate will be awarded a University standardised mark (USM) for each of the four papers. The Examiners will recalibrate the raw marks to arrive at the USMs reported to candidates.
The Examiners aim to ensure that all papers and all subjects within a paper are fairly and equally rewarded, but if in any case a paper, or a subject within a paper, appears to have been problematical, then the Examiners may take account of this in calculating USMs.
The USMs awarded to a candidate for papers in Part A will be carried forward into a classification for Part B as described below.

Part B
The Board of Examiners in Part B will assign USMs for full unit and half unit

papers taken in Part B and may recalibrate the raw marks to arrive at University standardised marks reported to candidates. The full unit papers are designed so that the raw marks sum to 100, however, Examiners will take into account the relative difficulty of papers when assigning USMs. In order to achieve this, Examiners may use information on candidates' performances on the Part A examination when recalibrating the raw marks. They may also use other statistics to check that the USMs assigned fairly reflect the students' performances on a paper.
The USMs awarded to a candidate for papers in Part B will be aggregated with the USMs from Part A to arrive at a classification.

Part C
The Board of Examiners in Part C will assign USMs for full unit and half unit papers taken in Part C and may recalibrate the raw marks to arrive at university standardised marks reported to candidates. The full unit papers are designed so that the raw marks sum to 100, however, Examiners will take into account the relative difficulty of papers when assigning USMs. In order to achieve this, Examiners may use information on candidates' performances on the earlier Parts of the examination when recalibrating the raw marks. They may also use other statistics to check that the USMs assigned fairly reflect the students' performances on a paper.
The USMs awarded to a candidate for papers in Part C will be aggregated to arrive at a classification for Year 4.

Aggregation of marks for award of Part B in 2009 onwards
All successful candidates will be awarded a classification at the end of three years, after the Part B examination. This classification will be based on the following rules (agreed by the Mathematics Teaching Committee).

We are adopting a *Strong Paper rule* for classification in 2009 and onwards.

By the *nth class strong paper rule* we mean that for a candidate to be classified at the nth class standard, at least 3 papers from Parts A and B must lie in the nth class and at least one of these is at Part B. For example, for a First class award, a candidate would need at least 3 of their whole unit paper USMs to be first class marks (with at least 1 first class whole unit at Part B) together with a weighted average score of parts A and B over 70.

In effect we are looking at a *marks profile.*
The Part A USMs are given a weighting of 2, and the Part B USMs a weighting of 3 for a full unit and 1.5 for a half unit.

Let $AvUSM-PartA\&B = Average\ weighted\ USM\ in\ Parts\ A\ and\ B\ together$ (rounded up to a whole number);

Classes are determined as follows in conjunction with the qualitative class descriptors.

- First Class: $AvUSM - PartA\&B \geq 70$ and the first class strong paper rule satisfied.
- Upper Second Class: $AvUSM - PartA\&B \geq 70$ and not satisfying the first class strong paper rule **OR** $70 > AvUSM - PartA\&B \geq 60$ and the upper second strong paper rule satisfied.
- Lower Second Class: $70 > AvUSM - PartA\&B \geq 60$ and not satisfying the upper second strong paper rule **OR** $60 > AvUSM - PartA\&B \geq 50$ and the lower second strong paper rule satisfied.

- Third Class: $50 > AvUSM-PartA\&B \geq 40$ **OR** $60 > AvUSM-PartA\&B \geq 50$ and not satisfying the lower second strong paper rule

- Pass: $40 > AvUSM - PartA\&B \geq 30$

- Fail: $AvUSM - PartA\&B < 30$

[Note: Half unit papers count as half a paper when determining the average USM, or determining the number of strong papers.]

BA in Mathematics
All candidates who wish to leave at the end of their third year and who satisfy the Examiners may supplicate for a classified BA in Mathematics at the end of Part B based on the above classification.

MMath in Mathematics in 2009 and onwards
In order to proceed to Part C, a candidate must minimally achieve lower second standard in Part A and Part B together.

Candidates successfully studying for a fourth year will receive a separate classification based on their University standardised marks in Part C papers, according to the following rules (agreed by the Mathematics Teaching Committee).

Let $AvUSM - PartC = Average\ USM\ in\ Part\ C$ (rounded up to a whole number)
Classes are determined as follows in conjunction with the qualitative class descriptors.

- First Class: $AvUSM - PartC \geq 70$

- Upper Second Class: $70 > AvUSM - PartC \geq 60$

- Lower Second Class: $60 > AvUSM - PartC \geq 50$

- Third Class: $50 > AvUSM - PartC \geq 40$

A 'Pass' will not be awarded for Year 4. Candidates achieving:

$$AvUSM - PartC < 40,$$

may supplicate for a BA with the classification obtained at the end of Part B.

[Note: Half unit papers count as half a paper when determining the average.]

Candidates leaving after four years who satisfy the Examiners may supplicate for an MMath in Mathematics, with two associated classifications; for example:
MMath in Mathematics: Years 2 and 3 together - First class; Year 4 - First class.

Note that successful candidates may supplicate for one degree only - either a BA or an MMath. The MMath is doubly classified but a candidate will not be awarded a BA degree and an MMath degree.

Qualitative Class Descriptors

The average USM ranges used in the classifications reflect the following descriptions:

- First Class: the candidate shows excellent skills in reasoning, deductive logic and problem-solving. He/she demonstrates an excellent knowledge of the material, and is able to use that innovatively in unfamiliar contexts.
- Upper Second Class: the candidate shows good or very good skills in reasoning, deductive logic and problem-solving. He/she demonstrates a good or very good knowledge of much of the material.
- Lower Second Class: the candidate shows adequate basic skills in reasoning, deductive logic and problem-solving. He/she demonstrates a sound knowledge of much of the material.
- Third Class: the candidate shows reasonable understanding of at least part of the basic material and some skills in reasoning, deductive logic and problem-solving.
- Pass: the candidate shows some limited grasp of basic material demonstrated by the equivalent of an average of one meaningful attempt at a question on each unit of study. A stronger performance on some papers may compensate for a weaker performance on others.
- Fail: little evidence of competence in the topics examined; the work is likely to show major misunderstanding and confusion, coupled with inaccurate calculations; the answers to questions attempted are likely to be fragmentary only.

B.4.1 Advice from Examiners

You will receive advice from the Examiners before each part of your finals examination, giving more information. Notices from Examiners in previous years can be found on the Mathematical Institute website.

C Contact Points

C.1 Mathematical Institute

Director of Undergraduate Studies Dr Audrey Curnock
email: curnock@maths.ox.ac.uk

Faculty Chairman Professor Charles Batty (tel: (2)77375)
email: charles.batty@sjc.ox.ac.uk

Academic Administrator Ms Charlotte Rigdon (tel: (6)15203)
email: academic.administrator@maths.ox.ac.uk

Deputy Academic Adminstrator Mr Yan Chee Yu (tel: (6)15206)
email: yuy@maths.ox.ac.uk

Graduate Studies Assistant Mrs Margaret Sloper (tel:())
email: sloper@maths.ox.ac.uk

Academic Assistant Mrs Helen Lowe (tel: (6)15204)
email: loweh@maths.ox.ac.uk

Academic Assistant Miss Sandy Patel (tel:())
email: patels@maths.ox.ac.uk

C.2 Faculty of Statistics

Chairman of Academic Committee Dr Neil Laws (tel: (2)72875)
email: winkel@stats.ox.ac.uk

Academic Administrator Ms J Boylan (tel: (2)72860)
email: boylan@stats.ox.ac.uk

C.3 Faculty of Computer Science

Chairman of Teaching Committee Dr G Lowe (tel: (2)73841)
email: Gavin.Lowe@comlab.ox.ac.uk

Academic Administrator Mrs C O'Connor (tel: (2)73863)
email: Christine.OConnor@comlab.ox.ac.uk

C.4 Projects Committee

Chairman Prof R Heath-Brown
email: rhb@maths.ox.ac.uk

C.5 Careers Service

Enquiries (tel: (2)74646)

Mathematics Link Mrs A Bird (tel: (2)74654)
email: alison.bird@cas.ox.ac.uk

C.6 MURC

General
webpage: http://www.maths.ox.ac.uk/ ∼murc

Chairperson Julia Steinberg St Hilda's College
email: julia.steinberg@st-hildas.ox.ac.uk

C.7 Invariants

President Sean Ledger, St John's College
email: sean.ledger@sjc.ox.ac.uk

C.8 General

Disabilities Office (tel: (2)89840)
email: disability@admin.ox.ac.uk

Counselling Service (tel: (2)70300)

Proctors' Office (tel: (2)70090)
email: proctors.office@proctors.ox.ac.uk

Equal Opportunities Officer (tel: (2)89821)
email: equal.opportunities@admin.ox.ac.uk

Accessible Resources Acquisition and Creation Unit (tel: (2)83861)
email: ruth.harris@ouls.ox.ac.uk

Oxford University Student Union, Vice President (Welfare) (tel: (2)88450)
email: welfare@ousu.org

D Questionnaires

On the next page is a specimen of the Questionnaires used to monitor the effectiveness of the teaching. The system is described above in Section II.6. Your comments will be stored on our database and used by lecturers to inform their future teaching. We urge you to fill in the questionnaires **for every course you take**, and hope that you will take the opportunity to **make constructive criticisms** which will help us in our teaching.

E Policy on Intellectual Property Rights

The University of Oxford had in place arrangements governing the ownership and exploitation of intellectual property generated by students and researchers in the course of, or incidental to, their studies. These arrangements are set out in the University's *Statutes* 2000 (page 121 refers) under which the University claims ownership of certain forms of intellectual property which students may create. The main provisions in the *Statutes* are as follows.

Section V. Of intellectual property generated by students

1. Subject to clause 2 below and to the provisions of the Patents Act 1977, and unless otherwise agreed in writing between the student concerned and the University in relation to any particular piece of intellectual property, the University claims ownership of the following forms of intellectual property; in the case of (*c*), (*d*), (*e*) and (*f*) (and(*g*) as it relates to (*c*)-(*f*)) the claims are to intellectual property devised, made, or created but students in the course of or incidentally to their studies:

(*a.*) works generated by computer hardware or software owned or operated by the University;

(*b.*) films, video's, multimedia works, typographical arrangements, and other works created with the aid of University facilities

(*c.*) patentable and non-patentable inventions;

(*d.*) registered and unregistered designs, plant varieties, and topographies;

(*e.*) university-commissioned works not within *(a)*, *(b)*, *(c)* or *(d)*;

(*f.*) databases, computer software, firmware, courseware, and related material not within *(a)*, *(b)*, *(c)* *(d)*, or *(e)*, but only if they may reasonably be considered to possess commercial potential; and

(g.) know-how and information associated with the above

2. Not withstanding clause 1 above, the University shall not assert any claim to the ownership of copyright in:

(*a.*) artistic works, books, articles, plays, lyrics, scores, or lectures, apart from those specifically commissioned by the university

(*b.*) audio or visual aids to the giving of lectures; or

(*c.*) computer-related works other than those specified in clause 1 above .

3. For the purpose of clauses 1 and 2 above:

(*a.*) a 'student' is a person reading and registered for a degree, diploma, or certificate of the University;

(*b.*) 'commissioned works' are works which the University has specifically requested the student concerned to produce, whether in return or a special payment or not. However save as may be separately agreed between the University Press and the student concerned, works commissioned by the University Press in the course of its publishing business shall not be regarded as 'works commissioned by the University'.

F Email - Important information for students in Mathematics and Mathematics & Statistics

You will be allocated a college email account. Important information about your course will be sent to this account. If you do not plan to read it regularly you should ensure that you arrange for mail to be forwarded to an account which you do read regularly. You are asked to bear in mind that lost email is the students' responsibility should they choose to forward email to a system outside the university.

G Mathematical Institute Departmental Disability Statement

The Institute will do everything within its power to make available its teaching and other resources to students and others with disabilities to ensure that they are not at a disadvantage. In some cases, this may require significant adjustments to the building and to teaching methods. Those with disabilities are encouraged to discuss their needs with the Academic Administrator [tel: 01865 273530, email academic.administrator@maths.ox.ac.uk] at the earliest possible opportunity.

The Executive Committee is responsible for the department's disability policy.

The Academic Administrator will notify those directly involved with teaching and scheduling lectures. For instance, students with visual impairment might have lectures in rooms with whiteboards; students who are hard of hearing might have their lectures scheduled in a room with an induction loop. In some instances, it may be possible for lecturers to provide students with lecture notes, even when they are not posted on the Mathematical Institute website.

H Mathematical Institute Complaints - Complaints within the Department

Undergraduates with a complaint should first normally discuss it with their college tutor.

If the concern or complaint relates to teaching or other provision **made by the faculty/department** then the student should raise it with the Director of Undergraduate Studies (Dr A. G. Curnock). Within the faculty/department the officer concerned will attempt to resolve your concern/complaint informally and as speedily as possible.

Students may also contact their student representatives for informal support on MURC and the Joint Consultative Committee for Undergraduates.

In thinking about causes of concern/complaint, please bear in mind that the first step if at all possible is to raise the matter that is troubling you with the person who is immediately responsible. If this is difficult, then many sources of advice are available within colleges, within faculties/departments and from bodies like OUSU or the Counselling Service, which have extensive experience in advising students. General areas of concern about provision affecting students as a whole should, of course, continue to be raised through Joint Consultative Committees via student representation on the faculty/department's committees.

If your concern or complaint relates to teaching or other provision **made by your college**, then you should raise it with your tutor or with one of the college officers, e.g. Senior Tutor. Your college will also be able to explain how to take your complaint further if you are dissatisfied with the outcome of its consideration.

In the rare instances where you are dissatisfied with the outcome of a complaint, and all other avenues listed above have been explored, then you may take your concern further by making a formal complaint to the University Proctors. A complaint may cover aspects of teaching and learning (e.g. teaching facilities, supervision arrangements etc), and non-academic issues (e.g. support services, library services, university accommodation, university clubs and societies, etc.) A complaint to the Proctors should be made only if attempts at informal resolution have been unsuccessful.

Further information can be obtained from the Proctors Memorandum.

I Declaration of Authorship Form