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1. INTRODUCTION

Welcome to Mathematics and Statistics at Lancaster.

This document contains information about our Part I (first-year) subjects MATH100 and MATH110. For a complete list of single-major and combined-major degree schemes involving Mathematics and Statistics, see page 28.

A full-time first-year student is expected to enrol in three Part I subjects, totalling 120 credits, consistent with the degree scheme to which they were admitted and for which they are properly qualified. For instance, a student who enters to study for a combined degree in Accounting, Finance and Mathematics would study

- MATH100 Mathematics (40 credits),
- AC.F100 Introduction to Accounting and Finance (40 credits) and
- ECON102 Principles of Economics B (40 credits).

We offer the following Part I subjects in Mathematics and Statistics.

**MATH100 and MATH110** These subjects are intended for students who have Mathematics at A level or a similar qualification. They are designed to provide the foundation for a degree in Mathematics and Statistics, and to cover the material required to support another subject. MATH100 covers the core methods, while MATH110 covers further topics.

MATH100 and MATH110 consist of the following modules.

<table>
<thead>
<tr>
<th>Weeks</th>
<th>MATH100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>MATH101 Calculus</td>
</tr>
<tr>
<td>6-10</td>
<td>MATH102 Integration</td>
</tr>
<tr>
<td>11-15</td>
<td>MATH103 Matrix Methods</td>
</tr>
<tr>
<td>16-20</td>
<td>MATH104 Probability</td>
</tr>
<tr>
<td>21-25</td>
<td>MATH105 Statistics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weeks</th>
<th>MATH110</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>MATH111 Numbers and Relations</td>
</tr>
<tr>
<td>6-10</td>
<td>MATH112 Discrete Mathematics</td>
</tr>
<tr>
<td>11-15</td>
<td>MATH113 Calculus and Geometry</td>
</tr>
<tr>
<td>16-20</td>
<td>MATH114 Series and Functions</td>
</tr>
<tr>
<td>21-25</td>
<td>MATH115 Differential Equations</td>
</tr>
</tbody>
</table>

**Prerequisites** MATH102, MATH113, MATH114 and MATH115 each require MATH101. MATH105 requires MATH104. MATH102 is recommended for MATH113 and MATH115.

**MATH140** This subject is intended for Engineering and Science students; see the Engineering Part I Handbook for details. Some students may take a mixture of MATH140 and MATH100 modules as a minor subject, consisting of MATH141-3 and MATH104-105; this cannot lead to qualification for Part II Mathematics.
2. CHOICE OF MODULES

In the following, MATH100 refers to the five modules MATH101-105, and MATH110 refers to the five modules MATH111-115.

1. Students intending to major in any of the following degree schemes must take a double Part I in Mathematics, consisting of MATH100 and MATH110.
   - Mathematics, Mathematics with Statistics, Statistics
   - The Study Abroad variants of the previous three degree schemes
   - Financial Mathematics
   - Computer Science and Mathematics
   - Mathematics and Philosophy

2. Theoretical Physics with Mathematics students take MATH101-104 and MATH111-115.

3. Combined Majors must take MATH100, except for Mathematics and Languages students, who may instead take MATH101-103 and MATH114-115.

   However, all combined majors are strongly encouraged to take a double Part I in Mathematics (MATH100 and MATH110) if possible.

4. Environmental Mathematics students must take MATH100 and MATH113-115.

5. Natural Science students intending to take a theme in Mathematics are required to take either
   - MATH101-103 and MATH114-115, for the Pure Mathematics theme, or
   - MATH100, for the Statistics theme.

6. Minors in Mathematics should bear in mind the necessary prerequisites for Part II courses. Common ones include the following.
   - MATH210 Real Analysis requires MATH101 and MATH114;
   - MATH220 Linear Algebra requires MATH103.

7. Other students with a grade A in A-level Mathematics or equivalent are recommended to take MATH100.

Change of modules

Students who wish to change from the modules for which they have enrolled should consult one of the Part I Directors of Studies, and they should also inform the Part I Coordinator. This is necessary to ensure correct registration for University examinations.
Progression to Part II Mathematics

Students who have taken MATH100, or MATH101-103 and MATH114-115, may be allowed to register for Part II Mathematics if they have performed sufficiently strongly in Part I and undertake extra preparatory work that will be specified by the Department. You should consult one of the Part I Director of Studies as early as possible if you want to consider this.
3. DEPARTMENTAL CONTACTS

Part I Coordinator Georgina Moran, Room B3, Fylde College
Telephone (01524) 5-93960. E-mail: g.moran@lancaster.ac.uk

Part I Director of Studies Dr Alexander Belton, Room B4, Fylde College
Telephone (01524) 5-92371. E-mail: a.belton@lancaster.ac.uk

Part I Director of Studies Dr Bernd Schulze, Room B11, Fylde College
Telephone (01524) 5-92173. E-mail: b.schulze@lancaster.ac.uk

The Part I Directors of Studies are available for consultation on any problems that might arise in connection with Part I Mathematics, such as choice of modules or other Part I subjects, absence, illness and difficulty with work.

Head of Teaching (not Lent Term) Dr Amanda Turner, Room B33a, Fylde College
Telephone (01524) 5-93948. E-mail: a.g.turner@lancaster.ac.uk

Head of Teaching (Lent Term) Dr Alexander Belton, Room B4, Fylde College
Telephone (01524) 5-92371. E-mail: a.belton@lancaster.ac.uk

The Head of Teaching is also available for consultation when the Part I Directors of Studies are unavailable.

Academic Officer (Plagiarism) Dr Gabor Elek, Room B2, Fylde College
Telephone (01524) 5-94746. E-mail: g.elek@lancaster.ac.uk

Head of Department Professor Andrey Lazarev, Room B7, Fylde College
Telephone (01524) 5-92156. E-mail: a.lazarev@lancaster.ac.uk

Study Abroad Director Professor Stephen Power, Room B26, Fylde College
Telephone (01524) 5-93958. E-mail: s.power@lancaster.ac.uk

Natural Sciences Coordinator Dr Anthony Nixon, Room B59, Fylde College
Telephone (01524) 5-94282. E-mail: a.nixon@lancaster.ac.uk

Equality and Diversity Representative Dr Nadia Mazza, Room B39, Fylde College
Telephone (01524) 5-93961. E-mail: n.mazza@lancaster.ac.uk

Departmental Administrator Helen Shaw, Room B66, Fylde College
Telephone (01524) 5-93963. E-mail: h.shaw@lancaster.ac.uk

Part II Coordinator Julia Tawn, Room B3a, Fylde College
Telephone (01524) 5-92397. E-mail: julia.tawn@lancaster.ac.uk

The Department Office (Room B3, Fylde College) arranges workshop groups, keeps records and so forth.

The noticeboard for Part I information is outside the Department Office.

Web pages with information about the Department are at http://www.lancaster.ac.uk/maths.
4. LECTURE AND WORKSHOP TIMES AND PLACES

All times below are given using the twenty-four hour clock. For example, 2pm is written as 1400.

**MATH100**
Tuesday 1000 George Fox LT1  
Wednesday 1100 George Fox LT1  
Thursday 0900 George Fox LT1  
Friday 1200 George Fox LT1

**MATH111-114**
Monday 1100 Bowland Main LT  
Tuesday 1400 Bowland Main LT  
Wednesday 0900 Faraday LT  
Thursday 1500 Faraday LT

**MATH115**
Monday 1100 Bowland Main LT  
Tuesday 1500 Faraday LT  
Wednesday 0900 Faraday LT  
Thursday 1500 Bowland Main LT

**Workshops for MATH100** are held on Thursdays at 1200, 1300, 1400, 1600 and 1700, and on Fridays at 0900 and 1000.

**Workshops for MATH110** are held on Fridays at 1300 and 1500.

Note that you attend only one of these groups each week for each module, but attendance is compulsory and closed monitored. Absences are recorded on your permanent record.

Rooms for lectures and workshops are subject to change. You should regularly check your online timetable and the Moodle VLE (see Web Resources, p.12) for any alterations.
5. COMPUTER LABS AND PROBLEM-SOLVING CLASSES

LAB100 is a practical laboratory course which introduces students to the power of computers in modern Mathematics and Statistics, and supports the academic aims of MATH100. Any first-year students taking MATH101-104, including Theoretical Physics with Mathematics or the Statistics theme of Natural Sciences, also take LAB100; those taking only MATH101-103, including the Pure Mathematics theme of Natural Sciences, take LAB100 up to the end of Week 15.

The course introduces the software package R, and uses it to demonstrate basic mathematical programming techniques, such as producing plots, looping, conditional statements, writing functions and generating random numbers. These techniques are used to carry out basic calculations, matrix algebra and calculations in probability (from Week 16).

LAB100 begins in Week 6 with an introductory lecture and continues until Week 20. There are also computer lab sessions in Weeks 21-25 relating to MATH105, but they are organised and assessed as part of MATH105. You will not have a timetabled slot for LAB100; video lectures will be available online (via the Moodle VLE; see Web Resources, p.12) and any assistance that you need can be obtained during weekly drop-in sessions. These will be held in computer Lab A1, which is near the main entrance to the Engineering Building. Please note that you will need your library card to gain access.

LAB100 Quizzes. LAB100 is assessed via weekly online quizzes, which can be accessed via the Moodle VLE.

LAB110 is a computer-based group project which runs in parallel with MATH114-115 in Weeks 16-25. All first-year students taking all of MATH110 must also take LAB110.

More precisely, each group of students (typically 3-5) is given the task of writing two computer programs, one during Weeks 16-20 and another during Weeks 21-25. These programs must solve a specified mathematical problem relating to one of the previous MATH modules, using the software package R.

There will be an introductory lecture in Week 13 and you will be required to attend an introductory lab session in Week 14. Subsequently it is up to each group to decide when to work on the projects. Drop-in sessions will be arranged to provide assistance with programming.

Problem Solving is a course intended to help you make the transition from A-level to university mathematics. It runs parallel with MATH111-113. All first-year students taking all of MATH110 must also take Problem Solving.

You will be required to enrol for classes (one 50-minute class each week) in Weeks 1-4 and 6-9. Each class will consist of about 15 students, supervised by one of the department's lecturers. In contrast to the weekly workshops for MATH100 and MATH110, there will be a small number of problems, often as few as one per week. These problems will not come with a set method which you can apply to find the answer, so you will have to try to find an answer yourself. Communication of your thinking will also be an important aspect of the course, and as part of the course you will give a short presentation (on a solution to one of the problems, or on revision material) to your group.

There will be no problem solving classes in Weeks 5 and 10. Assessment will take place in Weeks 11-15. Further details of the assessment will be published on the course website on Moodle. The mathematical prerequisites are a familiarity with basic trigonometry.
6. TEACHING AND LEARNING

Lectures

Lectures are the basic method of transmitting the content of the course. The test of good lecture notes is that you can use them afterwards, to help complete workshop exercises and assessed coursework, and to revise for examinations.

Feel free to ask questions, even if you are not sure whether your question is ‘silly’; almost always it turns out that there are other students who need the same question answered. Lectures can become something of a monologue if students are inhibited about asking questions or pointing out mistakes (yes, lecturers have been known to make mistakes).

You should always work carefully through the relevant parts of the lecture notes before attending each week’s workshop. This is a good use of your time, because you will find out exactly what needs to be done. Lecture notes generally contain examples or results related to the workshop exercises.

None of the mathematics modules assumes knowledge of material from A-level Further Mathematics; much of this material is incorporated in MATH100 and MATH110.

Books

Although the lectures are intended to contain all the material for the course and you are not required to purchase any books, you should use textbooks to supplement your understanding and to see alternative presentations of the subject matter. On occasion you may wish to use books to revise A-level topics. You may find a book which suits your particular way of learning better than the lectures. Copies of most of the relevant books (see the recommendations given with the Syllabuses, below) are available from the University Library; where a book proves to be popular, multiple copies are kept. Most Mathematics and Statistics books are in the Yellow Zone on B floor; some texts are kept in the Short Loan Section. Even if you feel that the lectures and examination papers provide everything you need, books can broaden your horizons. The online library catalogue is at http://www.lancaster.ac.uk/library.

Printed course notes

Printed course notes will be handed out in the first lecture of each module. Some sets of notes have gaps, which are to be filled in during lectures. At the end of each module all students should ensure that they have a complete copy of the notes and all other course materials that have been circulated. The notes and other course materials are made available in PDF format from the module web pages on Moodle.

Problem sheets and workshops

Each week you must attend a workshop for each of the mathematics modules that you are taking.

The main purpose of the workshop is to help you work through a set of exercises on a problem sheet that will be circulated electronically beforehand (on Moodle) and given out in paper form at the beginning of the workshop. There will be tutors present to assist you if required. Do not be
shy to ask for help — the workshop is a good opportunity to get further explanation for anything with which you are having difficulty. You will benefit from attempting more questions than those strictly required for assessment (see below): it is only by doing mathematics that you learn it. The problems presuppose acquaintance with the material covered in lectures. At school or college you probably did many exercises of every type to help you understand each new topic; here you will usually see only one or two of each type, so it is especially important to attempt them all. Model solutions are circulated via Moodle after each workshop; reading these is a good way to learn, but only after you have made your own attempts.

Note that workshops are not restricted to talking about the latest problem sheet; their purpose is to help you along with the course in any way needed. So even if you feel hopelessly behind or thoroughly lost, do not be tempted to skip the workshop; it is there for such as you. You should also bear in mind that, under University regulations, attendance at workshops is compulsory. A register of attendance is taken at each workshop, and a permanent record is kept. Repeated defaulters will be contacted and asked to explain themselves; continued absences may lead to disciplinary action.

**Weekly assessed exercises**

In weeks 1-4 of each module, the problem sheets will also contain two sections of exercises for assessment. One section of assessed exercises will consist of quiz-type questions which require short answers to be submitted online; there will be a link on Moodle allowing you to do this (see Web Resources, p.12). The other section will consist of exercises that typically require longer written solutions, which will be marked by your group tutor; these solutions must be submitted in your tutor’s pigeonhole in the Mathematics and Statistics department, near the bridge to the Postgraduate Statistics Centre. These solutions should be clearly written in ink, and each page should have your name and your tutor’s name at the top.

Submission deadlines for assessed exercises are as follows. In exceptional circumstances, lecturers may vary these times.

- 1700 on Tuesday for tutor-assessed exercises for MATH100 modules
- 1700 on Wednesday for tutor-assessed exercises for MATH110 modules
- The end of Wednesday (2359) for all online-assessed exercises

Solutions to the first sets of assessed exercises are due in Week 2. In the first week of each module in MATH100 there may also be a set of revision exercises on mathematical methods.

Your group tutor will mark your solutions to the tutor-assessed exercises and return them during the following workshop, together with some feedback; make sure to ask your tutor when you feel there is something you have not understood properly. The tutor may emphasize such matters as clarity and accuracy of presentation, which need to be taken much more seriously as you advance in mathematics. You should keep your marked coursework as it is useful when you revise for exams.

Lecturers are often asked how long students should spend on their weekly problem sheets and other study (extra workshop questions, further reading etc.). This depends on the topic and an individual’s working speed: a rough guide is 3-5 hours per week, for each module. Students are expected to work for around 80 hours on an 8-credit module.
Lecturers have office hours during which you can come to discuss questions about the course. Such discussions are more profitable if you have thought about the questions in advance.

Your marks from the weekly online-assessed and tutor-assessed exercises will each contribute a total of 10% to your overall module mark; see the tables on p.13 for further details about the various contributions to module marks.

**Penalties for late submission of coursework**

If you are ill, or have some other good reason for missing work, then you should let your group tutor know promptly. If coursework is submitted after the appropriate deadline and without an agreed extension, 10% of the maximum mark available will be deducted. However, where coursework is submitted after the work in question has already been marked and handed back to other students, it will received a mark of zero.

**Plagiarism**

Plagiarism occurs whenever a student appropriates the writings or results of another and dishonestly presents these as if they were the student’s own work; it may also be committed by failing to distinguish between common knowledge and knowledge that should be attributed to others. All forms of plagiarism are considered to be serious academic offences. All assessed work, including coursework, tests, examinations, project work and dissertations, must be the student’s own work. The student should acknowledge assistance given, including that from fellow students or supervisors, and specify the major sources involved, whether textbooks, websites or other sources.

To copy from a textbook or another student’s work, and present it as if it were one’s own, is plagiarism. It is important to distinguish copying from consulting textbooks or discussing problems with others, as the latter are valuable and legitimate techniques of study.
7. WEB RESOURCES

In order to access the University computer network and your university email, you will need a university IT account. You should have set up this account before coming to Lancaster; if you haven't, or should you need any help with University computer issues throughout the year, you should contact the ISS Service Desk in the Learning Zone, either by calling 01524 5-10987 or by email to iss@lancaster.ac.uk.

Many of the key Web Resources you will need to help with your studies can be accessed via links from the Student Portal at https://portal.lancaster.ac.uk. Useful links include those to your individual timetable and the Moodle VLE (Virtual Learning Environment). The latter can also be accessed directly at https://modules.lancaster.ac.uk/my and includes further links to the following.

- Individual module web pages. These pages are updated regularly as a module progresses and typically contain completed versions of the lecture notes and specimen solutions to workshop questions and assessed exercises.

- Links to submit your solutions to the weekly online assessments and LAB100 quizzes.

- End-of-module questionnaires (a good way to provide feedback and let us know what you thought about a module).

The Student Registry web pages can be accessed via the Student Portal or found directly at http://www.lancaster.ac.uk/registry/. These pages contain information about general University procedures and policies.
8. ASSESSMENT AND EXAMINATIONS

For those taking LAB100, LAB110 or Problem Solving (see p.8), assessment in the modules MATH102-104, MATH114-115 and MATH111-113, respectively, is made up as follows.

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAB100 quizzes (102-104) / LAB110 project (114-115) / Problem Solving (111-113)</td>
<td>5%</td>
</tr>
<tr>
<td>Weekly assessed exercises</td>
<td>20%</td>
</tr>
<tr>
<td>End-of-module test</td>
<td>25%</td>
</tr>
<tr>
<td>Examination</td>
<td>50%</td>
</tr>
</tbody>
</table>

In all other modules, the assessment will be based upon the following.

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly assessed exercises</td>
<td>20%</td>
</tr>
<tr>
<td>End-of-module test</td>
<td>30%</td>
</tr>
<tr>
<td>Examination</td>
<td>50%</td>
</tr>
</tbody>
</table>

**End-of-module tests**

Tests will last 40 minutes and usually take place during the final lecture of the module being assessed. If you do not sit the test then you will score zero, unless you have good reason for missing it. If you consider that you have a good reason for being absent, you should contact one of the Part I Director of Studies promptly. Going away on holiday is **not** a good reason. Guidelines in case of illness can be found in Section 9 on p.17.

Scripts will be returned by the group tutors.

**Examinations**

Examinations for all modules take place in the second half of the Summer Term. Modules are paired together in 2-hour blocks, with the examination for each module being of one hour's duration.

You should attempt all questions on each exam. The marks available for each question will be indicated on the question paper.

Students are responsible for ensuring that they are registered for the correct examinations, and they should ask the Part I Coordinator in case of doubt.

**Past examination papers**

Papers from previous years are available in the Library and from the University web pages, [http://www.lancaster.ac.uk/sbs/registry/Exams/PastPapers/PastPapers.htm](http://www.lancaster.ac.uk/sbs/registry/Exams/PastPapers/PastPapers.htm). The solutions to past examination papers are not provided by the department.

**Return of marks**

The department aims to return marks for all assessment as quickly as possible. For weekly assessed exercises and end-of-module tests, marks will typically be returned within one or two weeks. In all cases students can expect marks within four weeks of submission or completion.
Qualification for Part II

Aggregation scores

In the department, marks are first calculated as percentages, and then converted into the university’s aggregation scores. For each module, aggregation scores are computed for coursework, for the examination and for the module overall. The aggregation scores for modules are then averaged to obtain the aggregation scores for the subject; see below for some examples.

The following table can be used to convert ranges of percentage marks into ranges of aggregation scores.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Aggregation score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 to 100</td>
<td>15 to 24</td>
<td>M1</td>
</tr>
<tr>
<td>50 to 59</td>
<td>12 to 14.7</td>
<td>M2</td>
</tr>
<tr>
<td>45 to 49</td>
<td>10.3 to 11.7</td>
<td>M3</td>
</tr>
<tr>
<td>40 to 44</td>
<td>9.0 to 10.2</td>
<td>Pass</td>
</tr>
<tr>
<td>0 to 39</td>
<td>0.0 to 8.8</td>
<td>Fail</td>
</tr>
</tbody>
</table>

Part I progression

To proceed to Part II, each student must pass all three Part I subjects and also obtain M grades in those subjects that the student intends to study in Part II.

(P) A student passes in a subject if the aggregation score is greater than or equal to 9.

(M) A student has an M (majorable) grade in a subject if the aggregation scores satisfy all of the following conditions.

i. The overall score is greater than or equal to 10.3;
   
   ii. the coursework score is greater than or equal to 9;
   
   iii. the examination score is greater than or equal to 9.

The precise requirements to qualify for Part II in each of the degree schemes involving Mathematics and Statistics are as follows.

- Students intending to major in Mathematics, Mathematics with Statistics, Statistics, Financial Mathematics, Computer Science and Mathematics or Mathematics and Philosophy must obtain M grades in both MATH100 and MATH110.

- Theoretical Physics with Mathematics students must obtain M grades in both MATH110 and MATH101-104 combined with PHYS115.

- Combined majors must obtain an M grade in MATH100; however, those Mathematics and Languages students who take MATH114-115 instead of MATH104-105 must obtain an M grade in the combination of MATH101-103 and MATH114-115. For combined majors taking MATH110 as an optional third subject, then a pass in MATH110 is acceptable, together with an M grade in MATH100.

- Natural Science students intending to take a theme in Mathematics and Statistics must obtain an M grade in MATH100, or an M grade in the combination of MATH101-103 and MATH114-115.
For the three Study Abroad degree schemes, the following extra rules apply. To proceed to Part II of the scheme, the student must achieve all of the following at the first sitting.

i. the overall aggregation score in MATH100 is greater than or equal to 15;
ii. the overall aggregation score in MATH110 is greater than or equal to 15;
iii. the overall aggregation score in the third subject is greater than or equal to 12.

Students who enter a Study Abroad degree scheme and who do not meet these conditions may qualify to proceed to another degree scheme according to the above rules.

Here is a more detailed example of how the individual module aggregate scores are combined to obtain the overall aggregate scores. Suppose that four MATH100 students have obtained the following aggregate scores:

<table>
<thead>
<tr>
<th></th>
<th>MATH 101</th>
<th>MATH 102</th>
<th>MATH 103</th>
<th>MATH 104</th>
<th>MATH 105</th>
<th>AVERAGE</th>
<th>OVERALL AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will</td>
<td>COURSEWORK</td>
<td>8.7</td>
<td>11.6</td>
<td>12.0</td>
<td>9.3</td>
<td>9.9</td>
<td>10.3</td>
</tr>
<tr>
<td></td>
<td>EXAM</td>
<td>9.3</td>
<td>11.5</td>
<td>10.7</td>
<td>8.2</td>
<td>8.8</td>
<td>9.7</td>
</tr>
<tr>
<td>Xena</td>
<td>COURSEWORK</td>
<td>15.0</td>
<td>12.0</td>
<td>11.7</td>
<td>15.3</td>
<td>13.5</td>
<td>13.5</td>
</tr>
<tr>
<td></td>
<td>EXAM</td>
<td>9.0</td>
<td>8.2</td>
<td>6.3</td>
<td>8.6</td>
<td>7.4</td>
<td>7.9</td>
</tr>
<tr>
<td>Yves</td>
<td>COURSEWORK</td>
<td>22.2</td>
<td>22.0</td>
<td>20.6</td>
<td>19.7</td>
<td>22.0</td>
<td>21.3</td>
</tr>
<tr>
<td></td>
<td>EXAM</td>
<td>11.5</td>
<td>11.4</td>
<td>8.8</td>
<td>6.8</td>
<td>12.0</td>
<td>10.1</td>
</tr>
<tr>
<td>Zak</td>
<td>COURSEWORK</td>
<td>8.3</td>
<td>9.3</td>
<td>9.6</td>
<td>7.9</td>
<td>7.9</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>EXAM</td>
<td>12.0</td>
<td>15.6</td>
<td>15.2</td>
<td>12.4</td>
<td>13.8</td>
<td>13.8</td>
</tr>
</tbody>
</table>

Then they would all have passed MATH100, but only Yves would obtain an M grade. (Will fails to meet the requirement that his overall average is at least 10.3, while Xena and Zak have not achieved an average of at least 9 in their exams and coursework, respectively.)

When processing coursework and examination results, the Department may moderate results and interpret raw marks in accordance with University Regulations and academic principles.

The results are usually communicated to candidates in mid July.

**Resits**

Students who do not obtain the required grade will be offered the opportunity to take resits in the modules in which they have not achieved such a grade. A resit normally consists of a new examination paper taken in late August, but may alternatively consist of an extra piece of coursework that needs to be submitted by late August. Resit exam papers are in the style of the June exams. Under exceptional circumstances, such as illness, failures may be condoned; that is, the student is not required to resit.
End-of-module tests

During any set tests, other than university examinations, the following rules will apply unless the lecturer indicates otherwise.

- All tests are closed book and no programmable devices will be allowed. This means that only pen or pencil and a basic calculator (with its memory cleared) are permitted at the seats. In particular, candidates must not bring with them any paper, notes, books, laptop computers or mobile telephones. All answers to the test must be written on special paper handed out at the beginning of the test.
- No conversation is permitted within the test room, other than to ask the invigilator specific and test-related questions.
- If students need to leave the room to use the toilet during the test, then they must raise their hand and seek permission from the invigilator. No more than one candidate will be allowed to leave the room temporarily during the test at any one time.
- Not all test rooms will have visible clocks and hence students should bring their own watches.
- Students must not leave the test room permanently during the first quarter of the test or the last ten minutes.
- All students must stop writing when instructed by the invigilator. Failure to do so may result in immediate penalties being imposed.
- Students must not talk to each other until papers have been collected from all students.
- If students break any of these guidelines, or are caught copying or using any unauthorised material in the test, then they may be given a zero mark for the test. The department reserves the right to take further action as appropriate.
- Adapted arrangements may be provided where necessary for students with physical disabilities, specific learning difficulties or chronic medical conditions. The arrangements may involve extra time, the use of question papers in an alternative format and other appropriate support.
- Invigilators will announce when 10 minutes of the test remain.

For regulations for examinations, please read the Undergraduate Assessment Regulations, which are available at http://www.lancaster.ac.uk/registry/.

Calculators

For those Mathematics and Statistics examinations where the use of calculators is permitted, you will be issued with a standard Casio FX-85GT PLUS Scientific Calculator; this will be provided in the examination venue before the start of the exam. If you would like to familiarise yourself with this model, sample calculators may be tried out in the department office. Personal calculators are not permitted for Mathematics and Statistics examinations, but may be used for other assessments during the year, including end-of-module tests (if calculators are allowed).
9. ILLNESS AND MITIGATING CIRCUMSTANCES

If you are absent from any part of your studies due to illness you should let the Part I Coordinator know and complete the online Self Certification form; see the link below.

Medical evidence, such as a doctor's medical certificate, will normally be required for an absence of more than one week, or any absence during a test or examination.

Further information on the procedure for reporting absence from studies can be found at http://www.lancaster.ac.uk/sbs/welfare/absence.html.

If you believe your assessment has been adversely affected by any personal circumstances that should be taken into account, the department will require appropriate evidence to be presented. The Part I Directors of Studies and Part I Coordinator can provide advice about what is appropriate.

If the Mitigating Circumstances Committee determines that good cause has been demonstrated as to why a student's performance has been adversely affected, that student may be allowed to take a resit examination as their first sitting, with no fees applied. Such cases may include, for example, illness or family issues.

10. INTERVIEWS

Once a term, each student will be asked to make an appointment to see one of the Part I Directors of Studies for a short and informal interview. These interviews will be used to discuss progress as well as providing students with an opportunity to raise any other issue they may have.

Interviews will typically be held around the middle of each term. Sign-up sheets will be posted on the Part I notice board and students will be notified by email closer to the time. Students not attending interviews and performing poorly will be reported to Registry, who may take further action.
11. SYLLABUSES

MATH101 Calculus – Professor G Blower

Syllabus

• Arithmetic of complex numbers
• Functions of a real variable and their graphs
• Polynomials
• Rational functions and partial fractions
• Exponential and hyperbolic functions
• Compositions and inverses
• Induction
• Sequences and limits
• Differentiation; Product and Chain rules
• Maxima and minima
• Taylor series
• Complex exponentials and trigonometric functions
• Definite integrals as areas;
• Fundamental theorem of calculus
• Integration by parts and substitution

Aims

To provide the student with an understanding of functions, limits, and series, and a knowledge of the basic techniques of differentiation and integration.

Description

The purpose of this module is to study functions of a single real variable. Some of the topics will be familiar from A-level; others will be studied more thoroughly in subsequent modules. The module begins by introducing examples of functions and their graphs, and techniques for building new functions from old. We then consider the notion of a limit and introduce the main tools of calculus. The derivative measures the rate of change of a function and the integral measures the area under the graph of a function. The rules for calculating derivatives are obtained from the definition of the derivative as a rate of change. Taylor series are calculated for functions such as sin, cos and the hyperbolic functions. We use Taylor series to define complex exponential functions which are useful for integration. We then introduce the integral and review techniques for calculating integrals. We learn how to add, multiply and divide polynomials, and introduce rational functions and their partial fractions. Rational functions are important in calculations, and we learn how to integrate rational functions systematically. The exponential function is defined by means of a power series which is subsequently extended to the complex exponential function of an imaginary variable, so that students understand the connection between analysis, trigonometry and geometry. The trigonometric and hyperbolic functions are introduced in parallel with analogous power series, so that students understand the role of functional identities. Such functional identities are later used to simplify integrals and to parametrize geometrical curves.

Bibliography

MATH102 Integration – Dr P Levy

Prerequisite: MATH101 Calculus

Syllabus

- Complex polynomials and complex roots
- Integration of rational functions
- Improper integrals
- Integration over infinite ranges
- Simpson’s rule
- Functions of two or more real variables
- Partial derivatives
- Curves in the plane
- Implicit functions
- The chain rule for differentiating along a curve
- Stationary points for functions of two real variables
- Double and repeated integrals
- Cavalieri’s slicing principle
- Volumes

Aims

Students should gain an understanding of partial derivatives and their use in classifying stationary points of functions of two variables, and an ability to calculate double integrals over simple regions in the plane.

Description

This course extends ideas of MATH101 from functions of a single real variable to functions of two real variables. The notions of differentiation and integration are extended from functions defined on a line to functions defined on the plane. Partial derivatives help us to understand surfaces, while repeated integrals enable us to calculate volumes. We investigate complex polynomials and use the De Moivre’s theorem to calculate complex roots.

In mathematical models, it is common to use functions of several variables. For example, the speed of an airliner can depend upon the air pressure and temperature, and the direction of the wind. To study functions of several variables, we introduce rates of change with respect to several quantities. We learn how to find maxima and minima. Applications include the method of least squares.

Bibliography

Calculus books often contain helpful diagrams and worked examples on integration. See chapters 8 and 14 of:

Syllabus

- Matrices: addition and multiplication, transpose and inverse
- Simultaneous linear equations
- Reduction to echelon form by elementary row operations
- Elementary matrices
- Determinants: expansions about a row or column
- Elementary row and column operations on determinants
- Properties of determinants
- Linear transformations of Euclidean space
- The matrix of a linear transformation
- Non-singular linear transformations
- Eigenvectors and eigenvalues
- The characteristic equation

Aims

The aim of this module is to give an introduction to the theory of matrices together with some basic applications. These are needed for later courses, such as linear algebra, and they are also of practical use for applications to geometry.

Description

This module consists of two main parts. In the first part we introduce the basic concepts from matrix theory. In particular, we learn the essential techniques that are needed for the applications, such as arithmetic rules, row operations and computation of determinants by expansion about a row or a column. The second part of the module covers a notable range of applications of matrices, such as solving systems of simultaneous linear equations, linear transformations, characteristic equation, eigenvectors and eigenvalues.

Bibliography

MATH104 Probability – Professor D Leslie

Syllabus

- The axioms of probability
- Conditional probability
- Independence
- Discrete random variables
- Expectation, mean and variance
- The binomial, Poisson and geometric distributions

Aims

- To provide an introduction to probability theory for discrete distributions.
- To introduce students to some simple combinatorics, set theory and the axioms of probability.
- To make students aware of the different probability models used to model varied practical situations.

Description

Probability theory is the study of chance phenomena; the concepts of probability are fundamental to the study of statistics. The course will emphasise the role of probability models which characterise the outcomes of different types of experiment that involve a chance or random component. The course will cover the ideas associated with the axioms of probability, conditional probability, independence, discrete random variables and their distributions, expectation and probability models.

No previous exposure to the subject will be assumed.

Bibliography

There are many good elementary books on probability theory. In particular, look at:

Prerequisite: MATH104 Probability

Syllabus

- Data collection and summary
- Modelling discrete data
- Continuous distributions
- Modelling continuous data

Aims

To enable students to achieve a solid understanding of the broad role that statistical thinking plays in addressing scientific problems in which the recorded information is subject to systematic and random variations. Specifically, by the end of the module, students should be able to select and formulate appropriate probability models, to implement the associated statistical techniques, and to draw clear and informative statistical conclusions for a range of simple scientific problems.

Description

The module begins with a brief overview of the place of statistics in science and in society, and then turns to the presentation and summary of data. Probability models for discrete data introduced in MATH 104 are revised, and the choice of a suitable model to describe a real dataset is then discussed. Models for continuous random variables are then introduced and their properties are derived. Modelling strategies are then extended from the case of discrete data to that on continuous observations.

Students will learn how to

1. select appropriate probability models which have variations which are consistent with the mechanisms that generated the data,
2. fit the probability model to the data by estimating unknown features of the probability model,
3. assess whether the fitted probability model agrees with the data, and
4. provide answers to scientific questions reflecting the uncertainty in the data.

Students will obtain experience in implementing this general strategy for statistical investigation by application to real data sets.

The module will be supported by weekly lab sessions and workshops as well as lectures. The module will also be supported by the statistical software package R, which students will be introduced to through LAB100, and which will be the basis of weekly lab sessions. The strategic understanding and software experiences developed in this module are skills used in all the subsequent statistical modules of the degree.

Bibliography

MATH111 Numbers and Relations – Dr N J Laustsen

Syllabus

- Logic: truth tables, methods of proof (direct, contraposition, contradiction), simple examples of mathematical proofs
- Number theory: division with remainder; highest common factors and the Euclidean algorithm; lowest common multiples; prime numbers; the Fundamental Theorem of Arithmetic and the existence of infinitely many prime numbers; applications of prime factorization
- Congruences: definition; solving congruences; the Chinese Remainder Theorem
- Relations: equivalence relations; the sum and product of two congruence classes; constructions of number systems
- Polynomials: the division algorithm; highest common factors and the Euclidean algorithm

Aims

To introduce students to logic and mathematical proofs; to state and prove fundamental results in number theory; to generalize the notion of congruence to that of an equivalence relation and explain its usefulness; to generalize the notion of a highest common factor from pairs of integers to pairs of real polynomials.

Description

University mathematics has a rather different feel from that encountered at school; the emphasis is placed far more on proving general theorems than on performing calculations. This is because a result which can be applied to many different cases is clearly more powerful than a calculation that deals only with a single specific case.

For this reason we begin by taking a look at the language and structure of mathematical proofs in general, emphasizing how logic can be used to express mathematical arguments in a concise and rigorous manner.

We then apply these ideas to the study of number theory, establishing several fundamental results such as Bezout's Theorem on highest common factors and the Fundamental Theorem of Arithmetic on prime factorizations.

Next, we introduce the concept of congruence of integers. This, on the one hand, gives us a simplified form of integer arithmetic that enables us to answer with ease certain questions which would otherwise seem impossibly difficult; and on the other it leads naturally to the abstract idea of an equivalence relation which has applications in many areas of mathematics.

Finally, we show how the idea of a highest common factor can be generalized from the integers to polynomials.

Bibliography

MATH112 Discrete Mathematics – Dr J Grabowski

Syllabus

- Introduction to set notation
- Manipulation of sets: inclusion, intersection, union, complements
- Inclusion-exclusion
- Countability
- Functions and composition
- Injectivity, surjectivity and bijectivity
- Invertibility of functions
- Selecting and counting elements from finite sets
- The pigeonhole principle
- Generating functions
- Recurrence relations
- Graphs and trees
- Isomorphism, planarity, traversing and colouring of graphs

Aims

- To introduce the basic ideas and notations involved in describing sets and functions between them.
- To formalize the idea of the size of a set and what it means for a set to be finite, countably infinite or uncountably infinite.
- To provide tools to carry out counting arguments from first principles and introduce techniques such as generating functions and methods to solve recurrence relations.
- To introduce the notion of a graph and demonstrate how one can tell graphs apart.

Description

Many mathematical questions involve counting. For example, if you dine with four friends around a circular table, how many meals can you have before you must repeat the seating arrangement? For finite sets, we can say that one is bigger than another if it contains more elements. What about infinite sets: are some infinite sets bigger than others? This module provides the tools to answer these questions and many other counting problems, such as those involving recurrence relations (e.g. the Fibonacci numbers). As well as counting objects, we might be interested in connections between them, which leads to the study of graphs and networks – collections of nodes joined by edges. There are many applications of this theory to designing or understanding properties of systems such as the infrastructure powering the Internet, social networks such as Facebook, the London Tube network, and the whole world ecosystem, one massive biological network.

Bibliography

MATH113 Calculus and Geometry – Dr B Schulze

Prerequisite: MATH101 Calculus: MATH102 Integration is recommended

Syllabus

- Geometric vectors
- Parameters for curves and surfaces
- Curve length and surface area
- Gradient vectors and geometrical applications
- Chain rule II for partial derivatives
- Constrained maxima
- Change of variable for double integrals
- Fourier series

Aims

To supplement the calculus taught in MATH101 and MATH102 and to introduce vectors and vector calculus, with an emphasis on the geometry of two- and three-dimensional real space.

Description

The main focus of this course is vectors in two- and three-dimensional space. We start off with the definition of vectors and we see some applications to finding equations of lines and planes. We then consider some different ways of describing curves and surfaces via equations or parameters, and we use partial differentiation to determine tangent lines and planes, as well as using integration to calculate the length of a curve.

In the second half of the course, we study functions of several variables. When attempting to calculate an integral over one variable, we often substitute one variable for another more convenient one; here we will see the equivalent technique for a double integral, where we have to substitute two variables simultaneously. We also investigate some methods for finding maxima and minima of a function subject to certain conditions.

At the end, we introduce Fourier series, which are basic to the study of periodic phenomena such as waves.

Bibliography

MATH114 Series and Functions – Dr R Hillier

Prerequisite: MATH101 Calculus

Syllabus

- Limits of sequences and functions
- Sums of series, convergence tests
- Continuity and differentiation of functions
- Applications of the intermediate-value theorem and the mean-value theorem
- Iterative methods

Aims

To provide an introduction to the analysis of real sequences, series and functions of a single real variable. The central concept is that of a limit. Simpler results are justified fully from the definitions; where the proofs are longer, they are deferred to the second-year analysis course MATH210.

Description

This module provides an introduction to analysis, the branch of mathematics which treats important processes such as differentiation and integration. It will enhance familiarity with standard functions, including the exponential and the logarithm, and will focus on the proper definition of notions such as the derivative of a function and the sum of a series; it is essential for advanced uses of calculus to tighten up the intuitive ideas used when introducing the subject. Convergence of sequences and series will be considered thoroughly and standard tests introduced. Power series will be used to define various functions, including familiar trigonometric ones, and to analyse their properties. Key concepts will be applied to derive efficient methods to obtain accurate numerical solutions to problems.

Bibliography

The following are ordered roughly by their level of sophistication, with Hart being a gentler introduction than Bartle and Sherbert. All are available from the University Library.

MATH115 Differential Equations – Professor S C Power

Prerequisite: MATH101 Calculus; MATH102 Integration is recommended

Syllabus

- First-order differential equations: integrable, separable, linear, homogeneous, Bernoulli, with linear coefficients
- Second-order differential equations: reduction of order, linear homogeneous and inhomogeneous with constant coefficients, Cauchy-Euler
- Initial-value problems
- Higher-order differential equations
- Differential operators; Laplace transforms

Aims

- To provide techniques for the solution of first-order differential equations and second-order linear differential equations.
- To solve a range of differential equations which model physical phenomena, such as bacterial-population growth, tumour expansion and oscillating systems subject to forcing and friction.
- To give an introduction to the Laplace-transform method.

Description

A vast number of naturally occurring phenomena are modelled by differential equations, for which solutions are required to explain the behaviour of these phenomena. This course, which should be particularly useful for science students, sets about obtaining solutions to a number of standard types of differential equation.

After we explore the nature of differential equations and their solutions, and how they arise, we solve some elementary types of first-order differential equation. These include equations with separable variables, and homogeneous and linear equations. Applications are given to population-growth models and models for tumour growth.

Complete solutions of linear second-order differential equations with constant coefficients are obtained, and applications given to damped oscillation and resonance.

The more sophisticated method of solution by Laplace transforms is introduced.

Bibliography


Chapter 14 of the first book covers most of the course. The second is an excellent presentation of the subject, which goes far beyond the contents of this module. Both books are available from the University library.
12. SINGLE-MAJOR AND COMBINED-MAJOR DEGREE SCHEMES

Single-major schemes

G100  BSc  Mathematics
G101  MSci Mathematics
G103  MSci Mathematics (Study Abroad)

G1G3  BSc  Mathematics and Statistics
G1GJ  MSci Mathematics and Statistics
G1GH  MSci Mathematics with Statistics (Study Abroad)

G300  BSc  Statistics
G303  MSci Statistics
G301  MSci Statistics (Study Abroad)

Combined-major schemes in the Faculty of Science and Technology

GG14  BSc  Computer Science and Mathematics
GG1K  MSci Computer Science and Mathematics
GF19  BSc  Environmental Mathematics
F3GC  BSc  Theoretical Physics with Mathematics
F3G1  MSci Theoretical Physics with Mathematics
F3G5  MSci Theoretical Physics with Mathematics (Study Abroad)

Combined-major schemes with the Management School

NG41  BSc  Accounting, Finance and Mathematics
GL11  BSc  Economics and Mathematics
GN13  BSc  Financial Mathematics
GN1H  MSci Financial Mathematics
NG21  BSc  Management Mathematics

Combined-major schemes with the Faculty of Arts and Social Sciences

GR11  BA  French Studies and Mathematics
GR12  BA  German Studies and Mathematics
GR14  BA  Spanish Studies and Mathematics
GV15  BA  Mathematics and Philosophy
13. GENERAL INFORMATION

Questionnaires

In order to monitor the student response to courses, the department asks students to complete an online questionnaire at the conclusion of each module they take. A link to the questionnaire will appear on Moodle at the appropriate time. Your feedback is much appreciated.

Student Year Representatives

A number of students are elected from each year to act as representatives of Mathematics and Statistics students. The representatives have the right and responsibility to attend department meetings, and generally to advise the department of any student concerns.

Staff-student consultative committee

This committee comprises the student Year Representatives, the Directors of Studies and the Head of Teaching. The committee considers any teaching issues raised by either by students, lecturers or tutors. Meetings are chaired by a postgraduate student, and are usually held in the third week of each module.

Mathematics and Statistics Society (MASS)

This is a friendly, student-run society which organises social events, talks on interesting mathematical topics and the weekly Maths Café, where you can get extra help with your weekly assignments and discuss areas of interest. Further information about the society is available at Freshers Fair and will be posted on the department notice boards.

Computing facilities

Several computer laboratories on campus are available for student use. The ISS Service Desk in the Learning Zone can provide information about opening times and rules for using the laboratories. See the section on Web Resources, p.12, for details on computer registration.

Alan Talbot memorial prize

This prize commemorates one of the founding professors of the department, and is awarded to the student who is deemed to have performed best in Part I Mathematics. It may be shared. The prize takes the form of a book token.

Term Dates 2014–15

<table>
<thead>
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<th>Term</th>
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<tr>
<td>Michaelmas Term</td>
<td>3rd October 2014 to 12th December 2014</td>
</tr>
<tr>
<td>Lent Term</td>
<td>9th January 2015 to 20st March 2015</td>
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<tr>
<td>Summer Term</td>
<td>17th April 2015 to 26th June 2015</td>
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Student Based Services

If you experience any difficulties during your time at Lancaster University, Student Based Services can often help. They offer a range of services including counselling, advice on financial support and advice on health and general welfare.

Student Based Services are also responsible for Disability Support. They provide an array of information and advice on support services to meet all students learning needs, especially with regard to assessment and examinations. You should contact Student Based Services, the Department Equality and Diversity Representative or one of the Part I Directors of Studies if you consider that you require special arrangements for tests and examinations, wish to get advice on matters such as dyslexia, or have medical concerns that might impact on your studies.

The first point of contact for Student Based Services is at The Base helpdesk, which may be found next to reception in University House. They may also be contacted by telephone on 01524 5-92525 or via the web at http://www.lancaster.ac.uk/sbs/.

Lancaster University Students’ Charter

Central to the mission of Lancaster University is a strong and productive partnership between students and staff. The University and the Students’ Union (LUSU) have worked together to produce a Students’ Charter to articulate this relationship and the standards to which the University and its students aspire.

http://www.lancaster.ac.uk/current-students/student-charter/