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Last updated: 02 August 2017.
Whilst every effort has been made to ensure that the information contained in this document is accurate, details are subject to change.

**Term Dates**

**Academic Year 2017-2018**

**Michaelmas Term:** 6 October 2017 to 15 December 2017  
**Lent Term:** 12 January 2018 to 23 March 2018  
**Summer Term:** 20 April 2017 to 29 June 2018

**Exam Periods**

All Part II exams occur during the Summer Term (Weeks 21 – 30). Typically they occur between Weeks 23 and 28. NOTE: exams may be scheduled on a Saturday.

**MATH390 Project Skills**

**Students who will begin Year 3 in 2017/18 should note that the module MATH390 begins in Summer Term prior to Year 3, during Weeks 26-30 of 2016/17. See page 26 for details.**

**Students who will begin Year 2 in 2017/18 will instead take MATH240 in Michaelmas Term 2017/18, and MATH390 will cease to exist.**
Points of Contact

Academic Staff

The following is a list of key members of academic staff who are relevant to Part II undergraduate students. Also, each student is allocated an Academic Advisor who will hold termly interviews; see Page 9 for more about Academic Advisors.

Year 2 Director of Studies (Michaelmas & Summer): Dr Nadia Mazza, Room B41, Fylde College Telephone (01524) 5-93961. E-mail: n.mazza@lancaster.ac.uk

Year 2 Director of Studies (Lent): Professor David Towers, Room B5, Fylde College Telephone (01524) 5-93890. E-mail: d.towers@lancaster.ac.uk

Year 2 Director of Studies: Dr Gareth Ridall, Room B61, Fylde College Telephone (01524) 5-92302. E-mail: g.ridall@lancaster.ac.uk

Year 3 Director of Studies: Dr Paul Levy, Room B24a, Fylde College Telephone (01524) 5-93780. E-mail: p.d.levy@lancaster.ac.uk

Year 3 Director of Studies: Dr Rebecca Killick, Room B32, Fylde College Telephone (01524) 5-92940. E-mail: r.killick@lancaster.ac.uk

Year 4 Director of Studies: Dr Robin Hillier, Room B60, Fylde College Telephone (01524) 5-94907. E-mail: r.hillier@lancaster.ac.uk

Natural Science Coordinator (Year 2): Dr Łukasz Grabowski, Room B39, Fylde College Telephone (01524) 5-93444. E-mail: lukasz.grabowski@lancaster.ac.uk

Natural Science Coordinator (Years 3 & 4): Dr Anthony Nixon, Room B43, Fylde College Telephone (01524) 5-94695. E-mail: a.nixon@lancaster.ac.uk

Head of Department: Dr Alexander Belton, Room B55, Fylde College Telephone (01524) 5-92371. E-mail: a.belton@lancaster.ac.uk

Head of Undergraduate Teaching: Dr Mark MacDonald, Room B12, Fylde College Telephone (01524) 5-93955. E-mail: m.macdonald@lancaster.ac.uk

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

Academic Employability Champion: Dr Derek Kitson, Room B6a, Fylde College Telephone (01524) 5-94914. E-mail: d.kitson@lancaster.ac.uk

Equality and Diversity Officer: Dr Amanda Turner, Room B54, Fylde College Telephone (01524) 5-93948. E-mail: a.g.turner@lancaster.ac.uk

Assessment Officer: Dr Daniel Elton, Room B6, Fylde College Telephone (01524) 5-93890. E-mail: d.m.elton@lancaster.ac.uk

External Examiners: Professor David Applebaum – University of Sheffield (Pure Mathematics) Professor Emma McCoy – Imperial College, London (Statistics) Dr Alan Kimber – University of Southampton (Year 4 Statistics)

(Note: Students should not contact External Examiners directly, but in the first instance raise any issues with the Assessment Officer or Head of Undergraduate Teaching.)
Administrative Office Support

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

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

**Undergraduate Administrative Assistant:** Alison Bradley, Room B4c, Fylde College.  
Telephone (01524) 5-93953.  
E-mail: a.r.brady@lancaster.ac.uk

The **Department Office** is open for general enquiries, Room B3/B3a, Fylde College.  
Telephone (01524) 5-93960 / (01524) 5-92397.

**Departmental Administrator:** To be confirmed.

**Noticeboard** for class information etc. in the area of the homework pigeon holes Fylde College.

**Web pages** for information about the Department are at http://www.lancaster.ac.uk/maths/

**Module information/timetables** https://portal.lancaster.ac.uk/student_portal#myarea

**Online Courses Handbook** http://www.lusi.lancaster.ac.uk/CoursesHandbook/

**SharePoint** http://centralinfo.lancs.ac.uk/sites/maths/student/default.aspx
General Information

Lectures and workshops

Lectures are the basic method of transmitting the content of this course. Workshops take place weekly in small groups, each one under the supervision of a tutor; these are an important part of the course. Attendance at workshops/tutorials is compulsory; it will be monitored and kept on your permanent record. A medical note will be required for missed work submission and absence for more than 2 weeks.

Printed course notes

Printed notes are provided for most modules. Some of these notes have gaps, which are filled in during lectures. At the end of each module all students should ensure that they have a complete copy of the course notes and any other course materials that have been circulated. The notes are available in pdf format from the course web pages on Moodle: https://modules.lancaster.ac.uk

Coursework

Each week you will be asked to hand in, to your workshop group tutor, solutions to certain questions relating to the course material seen in lectures. The pigeonholes for this purpose are opposite B4c in the Mathematics and Statistics department. Solutions should be clearly written, and each page should have your name at the top. The tutor will return the marked assignments at the tutorial or workshop, together with any feedback.

Tutorial or workshop groups will consist of about 15 students, and each group has a tutor who is responsible for marking the assignments. The tutor will return the marked assignments at the tutorial or workshop, together with any comments on the exercise. Clarity and accuracy of presentation are important in Mathematics and Statistics.

Students benefit from attempting more questions than those strictly required: it is only by trying to do Mathematics that one learns it. The problems presuppose acquaintance with the material covered in lectures.

In addition, many modules have a weekly assessment component consisting of an online quiz. For modules with project components, work will normally be returned to you within 4 weeks of submission excluding university closure periods.

Late coursework

The Lecturer will state the deadline before which coursework should be submitted. Where coursework is submitted after the said deadline and without an agreed extension it will receive a penalty of one full grade if it is less than three days late and zero (non-submission) thereafter. Where the third day after the deadline falls on a weekend, students will have until 10 am on Monday to hand in without receiving further penalty. Where coursework is submitted after the work in question has already been marked and handed back to other students involved, it shall be awarded zero. No mark will be given if the student hands in after the answers to the homework have been published.

Books

Although the lectures are intended to contain all the material required, you should use textbooks to supplement your understanding and to see alternative presentations of the subject matter. Copies of most of the relevant books (see the recommendations given in the Module Catalogue) 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 AQN section on A floor; some texts are kept in the Short Loan Section. The online library catalogue is at http://www.lancaster.ac.uk/library/

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 (as long as calculators are allowed).

Illness/Mitigating circumstances

If you are ill, or have some other good reason for missing a single coursework, or a small amount of class time, you should let your Academic Tutor, Director of Studies or the Part II Coordinator know promptly. Absences should also be logged online (using the Absence Notification link in the Online Student Services section of your Student Portal).

You need to make a claim for mitigating circumstances if you want the Department to take into account any illness or other good reason which has resulted in you missing a significant amount of coursework or an examination, or if you feel your performance in coursework or an examination has been negatively affected by adverse circumstances.

Claims for mitigating circumstances need to be supported by appropriate evidence. For a medical condition affecting performance this will normally mean a report completed by an appropriate professional who should comment on how the medical condition concerned would be likely to have affected your ability to prepare for or carry out the assessment(s) in question. Medical certificates that merely confirm attendance at a clinic are unlikely to be considered sufficient. The Assessment Officer can provide advice about mitigating circumstances and, in particular, what evidence might be appropriate.

Claims for mitigating circumstances, together with appropriate supporting evidence, should be submitted to the Part II Coordinator. This should be done as early as possible and certainly by the end of the examinations period in May/June.

All cases will be reviewed by the Mitigating Circumstances Committee. In cases where good cause has been demonstrated the Committee may propose a number of actions as appropriate to the case. Examples of such actions include the extension of a deadline, or the opportunity to resit an examination or coursework as if it were a first attempt (for which there will be no fee and the marks will not be capped). However students should note that it is not possible to change the marks obtained for any assessment.

Mitigating circumstances are generally not an appropriate means to deal with chronic medical issues or other relevant long-standing personal circumstances. Such cases are better handled via appropriate support arrangements, such as an integrated learning plan or alternative assessment arrangements.

Contact Time

Lancaster University has a set of minimum commitments on academic contact, see:-

https://gap.lancs.ac.uk/ASQ/Policies/Documents/Academic-Contact-Policy.pdf

These commitments indicate the amount of contact time with your tutors that you should typically expect on an annual basis if you take traditionally taught modules, i.e. delivered entirely by lectures / seminars / practicals / workshops etc. However, it should be noted that your actual experience
will vary due to your module choices, for example dissertation units and modules with a large proportion of blended learning (i.e. using online resources) typically have less face-to-face contact and a greater amount of independent study.

For six out of eight Year 2 modules in this department, every two weeks will consist of 5 hours of lectures as well as two hours of workshops. Additionally, every module will have a 2 hour scheduled revision session prior to the exam. So a student who takes all eight second year mathematics modules should have a combined total of 296 contact hours for the whole year.

Typically, this department offers approximately 215 contact hours in Year 3, and 180 contact hours in Year 4.

Lecturers for each module will offer weekly office hours for additional assistance.

**Academic Advisors**

Every student is assigned to an academic tutor for the duration of their degree. They will arrange a meeting with you in intro-week of your first year, and termly thereafter. Your advisor can provide help with module choices, monitor and advise on your progress, support your career planning, and sign-post you to services available elsewhere in the university. They are also available for consultation on any problems that might arise in connection with your course, such as choice of modules, absence, illness, difficulty with work etc.

If you are unsure who your academic advisor is, then just ask any member of the administrative staff, and they will be happy to let you know.

**Independent Learning**

The department outlines the independent learning required for each module at the start of the module. A student’s working week consists of 40 hours of study in each term week. So, if you have 10 hours of teaching (contact) time per week our expectation is that you will spend a further 30 hours on private study including reading through and understanding the lecture notes, further reading of published materials, completion of coursework, preparation for exams and tests, etc.

**Video recording of lectures**

Although individual lecturers may choose to have their lectures recorded, this will be done on a case-by-case basis. The department's Undergraduate Teaching Committee believes there are pedagogical reasons for not recording lectures by default. A lecture should be an interactive event, which demands input from both lecturer and students, and not a passive experience.

**Computing**

Several Part II modules in Mathematics and Statistics have associated Computer Laboratory classes and assessment linked to these. Wherever possible the software is open source and students are expected to download it onto their own machines.

Lab A1 (Engineering) is often used for the department laboratory classes, and for individual use when available. Postgraduate students have access to labs in the PSC. There are also several general access computer laboratories available on campus for student use. Computing advice is provided by ISS.
Information on the internet

Useful information, such as timetables, previous examination papers and coursework marks are available online, on the Student Registry website:
https://portal.lancaster.ac.uk

You will need your username and password to access your personal information. There is also a wide variety of useful links for current students available here:
http://www.lancaster.ac.uk/current-students/

LU Portal

LU Portal is your personal home page for Moodle with key information about the modules you are studying, your summative grades, your library reading lists, and also your timetable and exam timetable in an integrated calendar.

Moodle

Moodle provides activities and resources to support your learning. Lecturers utilise Moodle in a wide variety of ways to deliver learning materials (handouts, presentations, bibliographies etc), engage you in active learning (exercises and online tests, discussion spaces and learning logs) and update you with information about your modules.

iLancaster

iLancaster App provides an alternative link into Moodle when on the move, together with other useful information and advice. This is also used to the automatic check-in to lectures and workshops. If you are not able to check-in automatically using the iLancaster App then you are required to sign a register at your workshop. For more about iLancaster, see here:
http://m.lancaster.ac.uk/

Mahara

Mahara is a private and social web space to record and share reflections, start new groups, mashup both external and user generated content, create and publish portfolios and digital CVs to both an internal and external audience.

You will need your University login and password to access our eLearning services. During your study, your department and/or the student learning adviser for your faculty may also direct you to other web-based resources with advice on effective learning skills and strategies.

Communication by e-mail

As part of you joining Lancaster University, you will be allocated a Lancaster email account. Make sure that you activate your account, change your initial password and test your email account. Your email address will include your name then @lancaster.ac.uk.

Your Lancaster email address will be used for all official correspondence from the University. You should check it on a daily basis.
Awards

Second Year Prizes

The *Lloyd Prize in Mathematics* is awarded each year for the best performance by a second year undergraduate who is reading mathematics as a major subject, either alone or in combination with another major subject. The prize consists of books to the value of c. £60.

The *Striding Edge Scholarship* is an award of £500 available for a 2nd year Mathematics (single or combined) major student. The award is made on the basis of academic achievement in year 2, but is intended for students experiencing some financial hardship. Any student who wishes to be considered for this award should contact the Part II Administrator or their Director of Studies before the 31st May of their 2nd year.

Final Year Prizes

The *David Astley Memorial Prize* is awarded to that undergraduate reading for a degree in mathematics with honours, who at the end of his/her final year is judged to have displayed the best combination of breadth of mathematical abilities with clarity of exposition. This prize is now donated by the Department and has been given to the value of £100.

The *IMA Prizes* are 2 prizes to be awarded for outstanding performance in the final year. The prizes give a year’s free membership of the Institute.

The *Royal Statistical Society Prize* is awarded to the best statistician graduate. The prize is one year’s graduate statistician membership of the Royal Statistical Society.

Lancaster Award

At Lancaster we not only value your academic accomplishments, but also recognise the importance of those activities you engage with outside your programme of study. The student experience is enhanced by including extra-curricular activities and, with more graduates than ever before and increasing competition for jobs upon leaving University, these are vital to your future prospects. We want to encourage you to make the very most of your University experience and to leave Lancaster as a well-rounded graduate. We have a wealth of opportunities to get involved in with initiatives such as work placements, volunteering, extracurricular courses, societies and sports. The Lancaster Award aims to encourage you to complete such activities, help you to pull them together in one place and then be recognised for your accomplishments. We want you to stand out from the crowd - the Lancaster Award will help you to do this. For more information see [http://www.lancaster.ac.uk/careers/award/](http://www.lancaster.ac.uk/careers/award/)
Module Enrolment

In October when you arrive, and each subsequent year (normally in April/May) you will be asked to enrol for the individual courses or modules which make up your programme of study. Enrolment will be available online, and you will be advised by email, from Student Registry when enrolment is available. Manual enrolments can be made via the Directors of Studies and the Part II Co-ordinator.

There will be a one hour timetabled advice session towards the end of the Lent Term, primarily for Year 2 students regarding their Year 3 choices. Also you can ask your Director of Studies regarding your academic module options.

Changing your Major or your Modules

You may change your intended major subject at Part II enrolment to any major for which your Part I subjects qualify you. However, any changes are reliant on your achieving a majorable mark in any subject you wish to take as a major. You are still permitted to change your major (Part I subjects and results permitting) at any time before the start of your second year.

If you decide to change your major before Part II enrolment in May you need to discuss this with the department(s) involved and then enrol in the normal way. If you decide after you have enrolled for Part II courses (for example, on receipt of examination results) then you should contact the Student Registry as soon as possible after you receive your results.

Please seek advice from your Director of Studies or the Part II Co-ordinator. Changes in Part II enrolment will only be accepted in the first two weeks of the course module for normal 5 or 10 week modules, and during the first two days for short intensive statistics modules.

You can download a change of major form, or a change of enrolment form, from: http://www.lancaster.ac.uk/sbs/registry/undergrads/forms.htm

Online Courses Handbook

The online courses handbook provides information on all taught undergraduate and postgraduate programmes of study and course modules in any one academic year. This includes syllabuses and pre-requisites.

http://www.lusi.lancaster.ac.uk/CoursesHandbook/
Student support and representation

Lancaster has adopted a student-centred approach in which access to high quality support across a range of areas is provided by different agencies in a way which best meets each student's individual circumstances and needs. This is summarised in the Student Support Policy which can be found at:

http://www.lancaster.ac.uk/about-us/our-principles/student-support/

In addition, during the first year of study, you will be assigned to a named College Advisor. That person can also provide advice and support to you on accessing these services, or upon any other issues you may need help with.

The university also has an academic tutorial system where you will be allocated an academic tutor within your major department who will meet with you on a one to one basis each term. This tutor will be interested in and be knowledgeable about your progress and be in a position to provide academic advice and support.

Student Representatives

Student representatives are elected from each year to act as representative of Mathematics and Statistics students. The representatives have the right to attend Department meetings, and generally advise the Department of any student concerns. There is one meeting per term.

The Staff-student consultative committee comprises the student Year Representatives, an MSc representative, a postgraduate, the Year Directors of Studies and the Heads of Undergraduate and Postgraduate Teaching. The committee considers any teaching issues which are raised at the meeting. Meetings are chaired by a postgraduate student, and are usually held in the weeks 3, 8, 13, 18 and 23. Minutes are posted on the SharePoint web site.

http://centralinfo.lancs.ac.uk/sites/maths/student/sscc/default.aspx

The schedule of meetings can be found here.

http://centralinfo.lancs.ac.uk/sites/maths/default.aspx

Student Feedback

At the end of each module you will be emailed and asked to provide feedback through an online questionnaire. This feedback is then used by us in a number of ways, all of which contribute to our processes for assuring the quality of our teaching. These processes include:

- Consideration by your module organisers and teaching staff when reviewing their courses at the end of the year and planning future developments. The Head of Department also receives and reviews summaries of all module feedback.

- Discussion at the department’s teaching and staff-student committees to identify module strengths and weaknesses, develop proposals for module refinement.

- Analysis within the department’s annual teaching report to identify examples of good practice and areas for improvement; this report is discussed at faculty and university teaching committees.

Module evaluations are uploaded to Moodle, and lecturers respond accordingly.
The NSS is a survey of mostly final year undergraduates in England, Northern Ireland, Wales and the majority of institutions in Scotland. FE colleges with directly funded HE students (i.e. students in their final year of a course leading to undergraduate qualifications or credits) in England and Wales will also participate. The survey is part of the revised system of quality assurance for higher education, which replaces subject review by the QAA, and is designed to run alongside the QAA institutional audit to generate more detailed public information about teaching quality. The NSS is commissioned by the Higher Education Funding Council for England: http://www.hefce.ac.uk/. Ipsos MORI, https://www.ipsos-mori.com/ an independent research company, administers the survey.

**Students’ Charter**

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

You can read the full Charter here:

http://www.lancaster.ac.uk/current-students/student-charter/
Assessment and feedback code of practice

The Quality Assurance Agency for Higher Education defines the following terms:

- **Formative assessment** has a developmental purpose and is designed to help learners learn more effectively by giving them feedback on their performance and on how it can be improved and/or maintained.
- **Summative assessment** is used to indicate the extent of a learner's success in meeting the assessment criteria used to gauge the intended learning outcomes of a module or programme.

The summer examinations are the main summative assessments used in our department. Weekly homework is partially summative, since it counts towards the final grade, but for most modules it should be considered as primarily formative assessment.

In this section we set out a code of good practice regarding undergraduate assessment and feedback within the Department of Mathematics and Statistics at Lancaster University. Below "lecturer" refers to the course convenor of a given module, "tutor" refers to anyone who is grading work for that module, and "student" refers to anyone enrolled in that module.

**Responsibilities of the lecturer**

1. The lecturer should communicate to the students at the start of the module how their final grade will be calculated. The proportion of the grade which comes from coursework, projects, exams, etc., should be stated in the LUSI module catalogue.
2. Lecturers should ensure their formative assessment is designed to promote learning and improve understanding.
3. For weekly assignments, and other multi-question work, the lecturer is expected to state how many marks are allocated to each question well before the due date.
4. For projects, and other student work that is not purely quantitative, it is important for the lecturer to communicate to the students how they will be graded well before the due date.
5. Once work has been collected, the lecturer should provide the students with model solutions and/or a marking scheme before or shortly after the students are given back their graded work. It is also preferable that solutions and/or marking schemes are made available on Moodle.
6. The lecturer should provide their tutors with a marking scheme for any assessed work, to ensure that student work can be graded consistently. It is sometimes sufficient to assign partial marks for individual steps on the model solutions.
7. The lecturer is responsible for resolving any grading inconsistencies between tutors which are brought to their attention.
8. If any inaccuracies are discovered in the model solutions or marking scheme, then the lecturer should promptly distribute a corrected version.
9. When setting the final examination, lecturers should ensure they are assessing the learning outcomes of the module, as they have been stated to the students.

**Responsibilities of the tutors**

1. Tutors should be familiar with the document "Guidelines for tutors" (available on Sharepoint).
2. Tutors are expected to grade work in a timely manner. In particular, weekly coursework should be graded before the weekly workshops, and project feedback should be given to the students within 4 weeks of submission.
3. Tutors should learn and understand the marking scheme and/or guidelines given to them by the lecturer.
4. When giving feedback, tutors should encourage critical reflection by the student.
Responsibilities of the students

1. Students should learn how they are being assessed in each module.
2. Students are expected to consider all feedback given to them by their tutors. If any piece of feedback is unclear, then the student should seek further explanation from their tutor.
3. If grading inconsistencies between students are discovered, then these should be brought to the attention of their tutors. If the issue cannot be resolved after consulting the marking scheme, then it should be brought to the attention of the lecturer.
4. Students are expected to complete an anonymous module evaluation at the end of each module, which provides feedback to the lecturer and the department.

Guidelines for marking schemes

It is important that any summative or formative assessment be consistent and fair between tutors within a module.

Coursework: Most weekly assignments are graded based on their mathematical and notational correctness, but may also be partially graded on their precision of expression, or presentation. Lecturers and tutors may differ in their grading practices. So, in the interests of transparency and fairness, it is recommended that lecturers produce marking schemes and/or grading guidelines for all coursework, so that both the students and the tutors know how work should be graded.

For example, an otherwise correct answer which incorrectly uses a certain piece of mathematical notation may or may not be penalized. Also, the extent to which partial marks are awarded for incorrect answers may differ between lecturers. The purpose of a marking scheme is to clarify these ambiguities.

Examinations: For most modules in our department, the main summative assessment is the examination in summer term. No feedback is given on these examinations, and neither the solutions nor the marking schemes are made public. Past examination papers from previous years (without solutions) can be found on the Student Registry website.

For each of the Year 2 modules (except MATH240, MATH245), the summer exam is worth 85% of the overall grade. In Years 3 and 4, modules without a project or major coursework component have an exam component of 90%. See the LUSI online courses handbook for details of individual modules.

The exam marks are moderated by undertaking a comparative analysis of marking trends to compare individual students’ marks on an individual course with their average mark on all their other courses. If you wish to be informed on any aspect of the regulations regarding exams, please consult Student Registry in University House.

Projects and dissertations: Our department offers several modules which, as part of their assessment, include written projects. Students do not have to use LaTeX for final project work for any module other than MATH240. Like all assessment, it is important that the students are informed of the marking scheme well before the due date. Projects are usually graded with letter grades, and it is often not possible to give a precise numerical grade breakdown. Nevertheless, in the interests of transparency and fairness, it is recommended that the lecturer indicates specific criteria considered during grading.

The following are the project marking guidelines, which are intended to ensure consistency of project grading across the department. The lecturer should specify a set of categories on which the assessment will be based, and the weighting given to each category. Categories can include, for example, Content and Understanding, Organisation and Style, Initiative, etc. For shorter projects, a single category is appropriate. Within each category the lecturer should state specific learning outcomes. A category should be awarded the appropriate letter grade if it meets the requirements of the corresponding descriptor in the table below; if the descriptor is met but there
is particular strength or weakness, a plus or minus should be appended. The overall grade is given by the weighted average of the aggregate scores corresponding to the letter grades in each category.

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Aggr. Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>24</td>
<td>Exemplary range and depth of attainment of intended learning outcomes, secured by discriminating command of a comprehensive range of relevant materials and analyses, and by deployment of considered judgement relating to key issues, concepts and procedures.</td>
</tr>
<tr>
<td>A</td>
<td>21</td>
<td>Conclusive attainment of virtually all intended learning outcomes, clearly grounded on a close familiarity with a wide range of supporting evidence, constructively utilised to reveal appreciable depth of understanding.</td>
</tr>
<tr>
<td>A-</td>
<td>18</td>
<td>Clear attainment of most of the intended learning outcomes, some more securely grasped than others, resting on a circumscribed range of evidence and displaying a variable depth of understanding.</td>
</tr>
<tr>
<td>B+</td>
<td>17</td>
<td>Acceptable attainment of intended learning outcomes, displaying a qualified familiarity with a minimally sufficient range of relevant materials, and a grasp of the analytical issues and concepts which is generally reasonable, albeit insecure.</td>
</tr>
<tr>
<td>B</td>
<td>16</td>
<td>Attainment deficient in respect of specific intended learning outcomes, with mixed evidence as to the depth of knowledge and weak deployment of arguments or deficient manipulations.</td>
</tr>
<tr>
<td>B-</td>
<td>15</td>
<td>Attainment of intended learning outcomes appreciably deficient in critical respects, lacking secure basis in relevant factual and analytical dimensions.</td>
</tr>
<tr>
<td>C+</td>
<td>14</td>
<td>Attainment of intended learning outcomes appreciably deficient in respect of nearly all intended learning outcomes, with irrelevant use of materials and incomplete and flawed explanation.</td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>No convincing evidence of attainment of any intended learning outcomes, such treatment of the subject as is in evidence being directionless and fragmentary.</td>
</tr>
<tr>
<td>C-</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>D+</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>D-</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

**Presentations:** Some modules, such as MATH240, include an oral presentation component. Presentations will be graded using some or all of the following assessment criteria.

An excellent academic presentation is one in which the following components are present.

- There is a clear structure (introduction, main body and conclusion) in which key themes are presented in a logical order.
- Information is accurately extracted and communicated, items for investigation are clearly identified and analysed, tangible conclusions are drawn and arguments are fully supported by relevant evidence or reference to theory.
- Visual material is accurate (no typographic, spelling or grammatical errors), effective in supporting the key messages of the presentation and not distracting.
- The words and terminology used are appropriate for an academic presentation.
- Body language and attitude are appropriate throughout the presentation.
- The pace is appropriate (not too fast and not too slow with appropriate use of pauses), voices are clear (pitch, tone and volume are used effectively to aid audience audibility, interest and understanding) and pronunciation of words and technical terms are correct and clear.
- If there are multiple presenters, then they support each other and do not interrupt others unnecessarily.
- Timing is used to good effect and time limits are not exceeded.
Plagiarism Framework for Mathematics and Statistics

Plagiarism involves the unacknowledged use of someone else’s work and passing it off as if it were one’s own. This includes the following examples.

- Copying or paraphrasing from a source text without acknowledgement. This includes quoting text from a referenced source without distinguishing it with quotation marks or similar. It does not include the statement of standard results, definitions and so forth, which is permissible without attribution.
  1. One single line or a few words. This will not usually be considered an issue.
  2. A whole paragraph or more. This is in general a major offence.
  3. Somewhat less, but several lines. This is poor academic practice and a minor offence.
- Submission of another student’s work or a part thereof.
  1. In the case of weekly coursework students are allowed to work together, but each student should write up separately and not submit the same work.
  2. For a project or a dissertation it is a major offence.
- Directly copying from model solutions made available in previous years. This is taken very seriously as a major offence.
- Reproduction of the same or almost identical work for more than one assessment is, in general, a major offence.
- Submission of purchased work is a major offence.
- Copying computer code from the internet for project work is a major offence.

The level of intent will be taken into consideration; unintentional plagiarism is a minor offence. If there is no intent to gain an unfair advantage, then it is likely due to poor study skills, but the matter will usually still be raised with the student concerned.

Preventing plagiarism

All members of the department involved in teaching are expected to raise awareness and give advice on good study practice, while being clear about expected standards, including referencing and the use of quotations.

All markers are required to act if plagiarism is suspected. Graduate Teaching Assistants will consult the course lecturer on what action to take. The Academic Officer and the Heads of Undergraduate and Postgraduate Teaching can provide guidance if desired.

How suspected plagiarism is handled

In the case of a minor offence, marks will be deducted for poor academic practice and feedback will identify the problem. A meeting with the student will usually be offered, to discuss the matter. The Academic Practice and Support (APS) section of the student’s LUSI record will be updated by a member of admin staff, to note that marks have been lost through poor academic practice. A copy of the relevant material will be passed to the Academic Officer. Students may appeal the judgement to the Academic Officer. Persistent offenders will be referred to their Director of Studies.

Any suspected major offence must be referred to the Academic Officer, and no mark will be recorded until the case is resolved; copies will be made of the material which is under suspicion. The student will be informed that their mark is withheld and that they may appeal to the Academic Officer. An entry will be made in the APS section of the student’s LUSI record to the effect that the case has been referred to the Academic Officer.

This advice is provided to give a better understanding of the university’s Plagiarism Framework.

https://gap.lancs.ac.uk/ASQ/Policies/Pages/PlagiarismFramework.aspx
Assessment regulations and degree classification

For Bachelor's degrees (BSc and BA), a student normally needs to have studied 360 credits over three years, with at least 90 credits at level 6 (that is, from third-year modules). Usually this will be composed of 120 credits from year one (Part I) and 120 credits from each of years two and three (Part II).

For integrated Master's degrees (MSci), a student normally needs to have studied 480 credits over four years, with at least 120 credits at level 7 (that is, fourth-year modules). Usually this will be composed of 120 credits from year one (Part I) and 120 credits from each of years two, three and four (Part II).

Only Part II credits contribute to the final degree classification. Each module contributes to the overall mean in proportion to the number of credits it is worth.

Aggregation score

In October 2011 the university implemented new undergraduate assessment regulations, which are now in place for all undergraduate students. These changes have been introduced to simplify the existing regulations, ensure markers use the full range of available marks across all disciplines and deal with mitigating circumstances in a more transparent way.

The main features are:

- Assessed work which is quantitative will be marked in percentages. These marks will be converted to an aggregation score on a 24 point scale, as described in the table below.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Aggregation score</th>
<th>Letter grade</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>24</td>
<td>A-, A, A+</td>
<td>First</td>
</tr>
<tr>
<td>90</td>
<td>22.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>19.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>65</td>
<td>16.5</td>
<td>B-, B, B+</td>
<td>Upper Second</td>
</tr>
<tr>
<td>60</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>13.5</td>
<td>C-, C, C+</td>
<td>Lower Second</td>
</tr>
<tr>
<td>50</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>10.5</td>
<td>D-, D, D+</td>
<td>Third</td>
</tr>
<tr>
<td>40</td>
<td>9</td>
<td>F</td>
<td>Fail</td>
</tr>
<tr>
<td>20</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Some assessed work, such as project work, will be marked using letter grades. These grades will be converted to an aggregation score on a 24 point scale for the purposes of calculating your overall module results and your final degree class.

- Degree classifications will be based on your overall aggregation score and there will be clear definitions for borderline scores and departmental criteria for considering borderline cases.

- To progress between years, any failed modules must be resat. Only one resit opportunity is permitted.

- To qualify for a degree any modules which you have not passed must be condoned, that is you are given credit for taking them even though you have not achieved a pass mark. Failed module marks may only be condoned above a minimum aggregation score indicating a reasonable attempt has been made.
To be awarded an honours degree, you must attain an overall pass grade and have no more than 30 credits condoned.

The penalty for work submitted late is a reduction of one full grade for up to three days late and zero thereafter.

To see the full undergraduate assessment regulations and a student FAQ with answers to the most common questions relating to how you are assessed and how your overall degree result will be determined go to:

http://www.lancaster.ac.uk/sbs/registry/undergrads/AssessmentRegs.htm

**Resits**

A student who fails any module will have the opportunity of reassessment; for lecture modules, this normally involves taking a resit examination in the same academic year as the first attempt. For modules not in the student's final year, the maximum aggregation score that the student can gain by reassessment is 9. For modules in the student’s final year, the reassessment will only be to gain sufficient credit to qualify for a degree.

When a student resits an examination, the department will submit a resit mark which is the maximum of:

- the original mark;
- the resit examination mark;
- the original coursework mark, with the resit examination mark.

A fee at a rate determined from time to time shall be payable by a student who is given permission to resit any examination or resubmission of dissertation.

In exceptional circumstances students may be allowed to take a re-sit exam as their first sitting with no fees applied. Such cases would include for example illness or family circumstances all would need appropriate signed written evidence.

**Progression Requirements**

In order to progress from Year 2 to Year 3 of a BA/BSc/MSci degree a student must achieve (following any opportunities for reassessment) an overall aggregation score of 9 or above with no more than 30 credits condoned.

If at the end of Year 3 a student enrolled in an MSci degree who does not achieve an overall Part II aggregation score of at least 14.5 will be automatically switched to a BSc degree, graduated, and will not be allowed to progress to Year 4.

Students entering the third year on a Study Abroad MSci scheme are committed to the MSci from then on.

**Condonation**

For students entering Part II prior to 2016/17 the examination board can condone up to 30 credits of failed modules for a classified 3 year degree, and up to 45 credits for a classified 4 year degree, but only if the student has taken reassessment and all of the aggregation scores in the failed modules are greater than or equal to 4 after reassessment.

For students entering Part II in 2016/17 the examination board can condone up to 30 credits of failed modules for a classified 3 year degree, and up to 45 credits for a classified 4 year degree,
but only if the student has taken reassessment and all of the aggregation scores in the failed modules are greater than or equal to 7 after reassessment.

**Examinations**

For most of the **Year 2** modules, the summer exam is worth 85% of the overall grade. In **Year 3**, with the exception of MATH361 and MATH362, most third year MATH modules have an exam assessment component of either 70% or 90%. In **Year 4**, modules without a project or major coursework component have an exam component of 90%. See the online courses handbook for details: [http://www.lusi.lancaster.ac.uk/CoursesHandbook/](http://www.lusi.lancaster.ac.uk/CoursesHandbook/)

Past examination papers from previous years (without solutions) can be found here: [http://www.lancaster.ac.uk/student-based-services/exams-and-assessment/past-papers/](http://www.lancaster.ac.uk/student-based-services/exams-and-assessment/past-papers/)

Model solutions are not provided to examinations, because we wish students to use their own initiative, to learn to work independently and to develop their skills in problem solving. Using your own understanding to produce a solution, assisted by related examples from lecture notes, workshops and assessed exercises, is more valuable and develops mathematical insight far more than rote learning of a fixed method. If, despite your best efforts, the desired solution is still elusive, help may be sought from the lecturer, either during the relevant revision lecture, via email or by arranging a meeting.

**Intercalations**

Sometimes because of medical, financial or personal difficulties students feel they have no alternative but to apply to suspend their studies for a year. Whilst this option can be of benefit to some students, it is not without its drawbacks: one of the major ones being the fact that students are not permitted to claim benefits if they would normally be excluded under the full-time education rules. Intercalating students are regarded as continuing students on the grounds that they intend to resume their studies.

Don’t allow yourself to drift into a situation that ends with intercalation being the only option, because without some assured financial support - a guaranteed job or financial help from your family - you could be left with no source of income.

Do ensure that you seek help early if you are experiencing any problems that may adversely affect your academic work. Speak to someone in the department or any of the various welfare agencies or call into the Base, part of Student Based Services, in University House, who will put you in touch with someone in the Student Registry if necessary.

If personal circumstances mean that you are left with no alternative but to seek a period of intercalation, please contact the Base and your Director of Studies to arrange to discuss your application.

**Withdrawals**

If you feel uncertain about carrying on at Lancaster, it is important that you talk it through with your Director of Studies or one of the other support services such as your personal College Advisor or someone in Student Based Services. Some initial written advice is also available via [http://www.lancaster.ac.uk/sbs/registry/undergrads/withdrawal.htm](http://www.lancaster.ac.uk/sbs/registry/undergrads/withdrawal.htm). It may be, for example, that you need time to adjust to a new and unfamiliar lifestyle.

Should you decide to leave, it is essential that you do not just walk out. You should contact the Student Registry within Student Based Services who will discuss your plans with you and formally approve your withdrawal. The Student Registry will notify Student Finance England to have payment of your loan and tuition fees stopped, as appropriate. If you have any books on loan from the Library or are in possession of any university equipment or property, please make sure that you return these - it will save you and us a lot of unnecessary letters and telephone calls.
In order to safeguard your entitlement to funding for any future course you should seek advice as soon as possible. Full details on this, and information regarding a transfer to another course/college, may be obtained from the Student registry.

Repeated years or repeated courses

A widely held, but incorrect, belief is that you can repeat a year of study if you haven’t done very well, repeat an individual course, or replace a course in which you have done badly with another one. This is not the case. The University’s examination and assessment regulations contain the following statement:

“No student shall be given an unfair advantage over fellow students through being allowed to automatically repeat individual modules, periods of study or a whole programme of study. Exceptional permission to repeat work may be granted by the designated Pro-Vice-Chancellor, the Provost for Student Experience, Colleges and the Library, an Academic Appeal or Review Panel as defined in the chapter on Academic Appeals, the Intercalations Committee or by the Standing Academic Committee in cases where a student’s academic performance has been adversely affected by personal, health or financial problems and where such cases have been properly documented.

No student shall normally be allowed to automatically replace modules in which he or she has failed or performed poorly by taking a different module in order to achieve better marks. Exceptional permission to do so may be granted by the designated Pro-Vice-Chancellor, the Provost for Student Experience, Colleges and the Library, by an Academic Appeal or Review Panel, as defined in the chapter on Academic Appeals, the Intercalations Committee or by the Standing Academic Committee in cases where a student’s academic performance has been adversely affected by personal, health or financial problems and where such cases have been properly documented.”

Degree Classification

At the end of the degree programme a student’s overall mean will be calculated from their module aggregation scores taking into account the relative weightings (credit value) of the modules. That overall mean will then be rounded to one decimal place and be used to determine the class of degree to be awarded as follows:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Aggregation score</th>
<th>Degree class</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.3 to 100</td>
<td>17.5 to 24.0</td>
<td>First</td>
</tr>
<tr>
<td>67.0 to 68.0</td>
<td>17.1 to 17.4</td>
<td>Borderline</td>
</tr>
<tr>
<td>58.3 to 66.7</td>
<td>14.5 to 17.0</td>
<td>2.1</td>
</tr>
<tr>
<td>57.0 to 58.0</td>
<td>14.1 to 14.4</td>
<td>Borderline</td>
</tr>
<tr>
<td>48.3 to 56.7</td>
<td>11.5 to 14.0</td>
<td>2.2</td>
</tr>
<tr>
<td>47.0 to 48.0</td>
<td>11.1 to 11.4</td>
<td>Borderline</td>
</tr>
<tr>
<td>40.0 to 46.7</td>
<td>9.0 to 11.0</td>
<td>Third</td>
</tr>
<tr>
<td>36.0 to 39.6</td>
<td>8.1 to 8.9</td>
<td>Borderline</td>
</tr>
<tr>
<td>0.00 to 35.7</td>
<td>0.0 to 8.0</td>
<td>Fail</td>
</tr>
</tbody>
</table>

If a student’s overall mean falls into one of the borderline ranges defined above, the examining bodies will apply the following rubric for deciding the degree class to be recommended:

(a) For all students, where a student falls into a borderline then the higher award should be given where either half or more of the credits from Part II are in the higher class or the final year average is in the higher class.
(b) For all students on integrated masters programmes, where a student falls into a borderline then the higher award should be given where half or more of the credits from Part II are in the higher class.
(c) Borderline students not meeting either of the criteria described in (a) or (b) above would normally be awarded the lower class of degree unless (d) applies.
(d) That for all students, borderline or not, Examination Boards should continue to make a special case to the Committee of Senate for any student where the class of degree
recommended by the Board deviates from that derived from a strict application of the regulations. Such cases would be based around circumstances pertaining to individual students where these circumstances have not already been taken into account.

Full details of the degree classification regulations are given within the Manual of Academic Regulations and Procedures (MARP) which can be found at:

https://gap.lancs.ac.uk/ASQ/QAE/MARP/Pages/default.aspx

**Conversion between BSc and Msci**

Single majors may change between the three-year BSc and the four-year MSci degree schemes at any time during their second or third year.

In order to continue into the fourth year of the MSci, a Lancaster-based student must obtain an average mark of 14.5 Aggregation Score over all Part II modules (second- and third-year modules) completed by the end of Year 3; any student, who fails to achieve this will instead be considered for the award of a classified BSc at the end of the third year.

For students on Study Abroad schemes, however, a certain level of performance is required in the second year, measured by the average mark over second-year modules: 14.5 Aggregation Score, achieved at the first sitting. Any student who doesn't achieve that will be transferred to a Lancaster based MSci. Students entering the third year on a Study Abroad MSci scheme are committed to the MSci from then on.

Lancaster-based students who withdraw during the fourth year of the MSci, or whose achievement at the end of the year does not qualify them to be awarded an MSci degree, may be awarded a classified BSc degree with Honours, in accordance with the regulations for the corresponding BSc award. The decision on the class of their degree may not be made until the end of the following exam period; however, the student will have access to their university transcript, detailing the marks obtained in the second and third year.

**Complaints procedure**

The University Student Complaints Procedure can be found at

https://gap.lancs.ac.uk/complaints/Pages/default.aspx

This procedure applies to complaints made by current Lancaster University students, or leavers within 3 months of the date of their graduation or withdrawal (the Complaints Coordinator may accept complaints beyond this period if exceptional circumstances apply), in respect of:

- the delivery and/or management of an academic module or programme, or supervised research;
- any services provided by academic, administrative or support services (other than the Students’ Union, who operate their own Complaints Procedure)

This procedure does not apply to complaints relating to:

- decisions of Boards of Examiners (these are governed by the Academic Review and Appeal Procedures)
- suspected professional malpractice (if it is established that misconduct of staff or students has occurred that is governed by other disciplinary procedures or external legal systems, then these procedures will be invoked and the complaint will not be dealt with under the student complaints procedure)
- any suspected potential breach of criminal law.
Careers Information

The department’s careers tutor is listed at the start of this handbook and they can provide you with advice on the types of careers available to you. For more careers information and details of upcoming events, please see the Maths Careers page on Moodle.

Also, the central Careers Service will have department specific sessions in each of your undergraduate years. We strongly advise you to visit Careers regularly so that you can use their expertise to ensure that by the start of your final year you have the necessary work experience, other extra-curricular activities and knowledge of the job market to put together a successful application for your first graduate job. For more information see: http://www.lancaster.ac.uk/careers/

Accreditation and membership of professional societies

Graduates with a single-major degree in Mathematics and/or Statistics are recommended to take advantage of membership of one of the following three professional societies.

- The London Mathematical Society http://www.lms.ac.uk/
- The Royal Statistical Society http://www.rss.org.uk/
- The Institute of Mathematics and its applications http://www ima.org.uk/

The Royal Statistical Society accredits the following degrees.

- BSc Mathematics
- BSc Mathematics with Statistics: for all graduates.
- MSci Mathematics
- MSci Mathematics with Statistics.
- MSci Mathematics (Study Abroad)
- MSci Mathematics with Statistics (Study Abroad).
- BSc Statistics: for all graduates
- MSci Statistics.
- MSci Statistics (Study Abroad).

Graduates of the MSci degrees should have taken the MATH492 Statistics Dissertation in order to be accredited, although those who have taken MATH491 or MATH493 might be eligible for GradStat status on an individual basis depending on what other modules have been chosen.

Graduates of the BSc Mathematics, MSci Mathematics and MSci Mathematics with Study Abroad should have taken at least four Statistics modules in Years 3-4 (totalling 60 credits).

The Royal Statistical Society will also consider individual applications from graduates of BSc or MSci in Mathematics who would need to produce suitable transcripts to gain accreditation.

The Institute of Actuaries grants an exemption from CT3 for students who obtain an average of 60% or more in each of MATH230 and MATH235. http://www.actuaries.org.uk/
Medical conditions and disabilities

You are admitted to the University on your academic record. The University welcomes all students and has an array of support services to ensure no student feels disadvantaged.

This department follows University Policy and strives to make itself an inclusive department. It is possible that you have already had support from the Disabilities Service as part of your admission process. Debbie Hill in the Disabilities Service will continue to provide guidance and support by working with the Department to ensure your learning support needs are met, especially with regards to exams and assessments. There is also financial help that is available

You can contact the Disabilities Service at any time in your time here is you feel you might need advice (for example you might want to be assessed for dyslexia). The person to liaise with in the department with any issue concerning disability, equal opportunities or unfair treatment (including harassment) is listed at the start of this handbook.

If you have any medical concerns or mental health issues that impact on your studies that you would like the Department to take into account you should contact Part II Coordinator, Head of Department or your Part II Director of Studies; for contact details see page 5.

If using the library is an issue because of dyslexia, a disability or medical condition, get in touch with Fiona Rhodes, f.rhodes@lancaster.ac.uk, for advice and help.

Confidentiality: if it is useful for you, do talk in confidence to any of the staff named here, but please remember that you may not be able to access all the support available to you unless we can inform other staff involved in support arrangements.

You may also find it helpful to look at some of the following web pages for local and national background.

Lancaster Disabilities Service:
http://www.lancaster.ac.uk/sbs/disabilities/
You can also easily reach the site above via the alphabetical list on the University home page.

Links to national equalities bodies and organisations:
http://www.equalityanddiversity.co.uk/

Lancaster Equal Opportunities web pages:
http://www.lancaster.ac.uk/hr/equality-diversity/

Safety Officer: for contact details see the start of the handbook.
For YEAR 2 students

The following eight modules are offered in Year 2; each is worth 15 credits.

**Weeks 1-10**
- MATH210 Real Analysis
- MATH220 Linear Algebra II
- MATH230 Probability II
- MATH240 Project Skills

**Weeks 11-20**
- MATH215 Complex Analysis
- MATH225 Abstract algebra
- MATH235 Statistics II
- MATH245 Computational Mathematics

Note that from 2017/18, there are 8 Year 2 modules, each 15 credits, replacing the 6 Year 2 modules of 20 credits. Also note that the 10 credit modules MATH211 and MATH226 are no longer offered.

Any single-major degree scheme requires the student to take all eight of these modules. Students enrolled in a combined major scheme would normally take four of the above modules. See page 30 for more information about the modules required for the various degree schemes.

Short descriptions of modules can be found on page 33. More information about the modules themselves, such as their syllabuses and assessment format can be found online at the Module Catalogue: [http://www.lusi.lancaster.ac.uk/CoursesHandbook/](http://www.lusi.lancaster.ac.uk/CoursesHandbook/)

One important factor when choosing second-year modules is the effect of the decisions taken on the options available in the third year. As a guide, please see page 33 for the expected list of third-year modules next year with their prerequisites. (However, some further changes may occur.)

**MATH240 / MATH390 Project Skills**

Starting in 2017/18, one of the core Year 2 modules will be MATH240 Project Skills, and will take place in Michaelmas and Lent terms. This replaces the module MATH390.

Students who entered Year 2 in 2016/17 will be the last ones to take MATH390, which will run for the last time in the Summer term of 2016/17, and Michaelmas 2017/18. It is important for students enrolled in MATH390 to still be in Lancaster in Summer term of Year 2 (Weeks 26-30), after the Year 2 exams have finished.

For Year 3 students

Any single-major degree scheme requires the student to take eight MATH3xx modules. All Year 3 modules are worth 15 credits. Students enrolled in a combined major scheme would normally take four MATH3xx modules, see page 30 for details.

**Provisional timetable**

The following table gives the provisional timing of these modules.

<table>
<thead>
<tr>
<th>1-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH314</td>
<td>MATH317</td>
<td>MATH313</td>
<td>MATH318</td>
</tr>
<tr>
<td>MATH316</td>
<td>MATH321</td>
<td>MATH319</td>
<td>MATH325</td>
</tr>
<tr>
<td>MATH323</td>
<td>MATH327</td>
<td>MATH322</td>
<td>MATH326</td>
</tr>
<tr>
<td>MATH329</td>
<td>MATH331</td>
<td>MATH334</td>
<td>MATH328</td>
</tr>
<tr>
<td>MATH330</td>
<td>MATH332</td>
<td>MATH345</td>
<td>MATH333</td>
</tr>
<tr>
<td>MATH336</td>
<td>MATH361</td>
<td>MATH361 (13 &amp; 14)</td>
<td>MATH335</td>
</tr>
<tr>
<td>MATH390(project)</td>
<td></td>
<td>MATH362</td>
<td></td>
</tr>
</tbody>
</table>

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MATH390 will not run after 2017/18, as it is being replaced by MATH240.

Some details of these modules are provided on page 33; further details can be found in the LUSI online Courses Handbook [http://www.lusi.lancaster.ac.uk/CoursesHandbook/](http://www.lusi.lancaster.ac.uk/CoursesHandbook/)

However, please note that it is possible that not all of the courses listed above may actually be given. If you enrol in a module that ends up not being given, then you will be informed by the end of Week 25, and you will be asked to change your registration accordingly.

Please note that changes into or out of a module are only allowed up to and including the Friday of the second week of the module concerned.

**Pre-requisites for Third Year options**

The following table lists the pre-requisites for third-year modules.

If you are registered for a 4 year MSci programme, please also see the table of fourth-year modules on page 28 and ensure that your module choices for Year 3 are compatible with the modules you intend to take in year 4.

<table>
<thead>
<tr>
<th>Third-year module</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH313 Probability Theory</td>
<td>MATH210, MATH230 helpful</td>
</tr>
<tr>
<td>MATH314 Lebesgue Integration</td>
<td>MATH210; Excl MATH414</td>
</tr>
<tr>
<td>MATH316 Metric Spaces</td>
<td>MATH210 or MATH211, MATH220</td>
</tr>
<tr>
<td>MATH317 Hilbert Space</td>
<td>MATH210 or MATH211, MATH220; MATH316 helpful</td>
</tr>
<tr>
<td>MATH318 Differential Equations</td>
<td>MATH210 or MATH211</td>
</tr>
<tr>
<td>MATH319 Linear Systems</td>
<td>MATH215, MATH220</td>
</tr>
<tr>
<td>MATH321 Groups and Symmetry</td>
<td>MATH225 or MATH226</td>
</tr>
<tr>
<td>MATH322 Rings, Fields and Polynomials</td>
<td>MATH111, MATH225</td>
</tr>
<tr>
<td>MATH323 Elliptic Curves</td>
<td>MATH225, MATH240</td>
</tr>
<tr>
<td>MATH325 Representation Theory of Finite Groups</td>
<td>MATH220, MATH225 or MATH226, MATH321 recommended</td>
</tr>
<tr>
<td>MATH326 Graph Theory</td>
<td>MATH220</td>
</tr>
<tr>
<td>MATH327 Combinatorics</td>
<td>MATH111, MATH112, MATH220</td>
</tr>
<tr>
<td>MATH328 Number Theory</td>
<td>MATH111; MATH225 helpful</td>
</tr>
<tr>
<td>MATH329 Geometry of Curves and Surfaces</td>
<td>MATH115 or MATH220</td>
</tr>
<tr>
<td>MATH330 Likelihood Inference</td>
<td>MATH235</td>
</tr>
<tr>
<td>MATH331 Bayesian Inference</td>
<td>MATH235</td>
</tr>
<tr>
<td>MATH332 Stochastic Processes</td>
<td>MATH230</td>
</tr>
<tr>
<td>MATH333 Statistical Models</td>
<td>MATH235, MATH330, MATH245/390</td>
</tr>
<tr>
<td>MATH334 Time series analysis</td>
<td>MATH235, MATH330, MATH245/390</td>
</tr>
<tr>
<td>MATH335 Medical Statistics</td>
<td>MATH235, MATH245/390</td>
</tr>
<tr>
<td>MATH336 Multivariate Statistics</td>
<td>MATH220, MATH230, MATH235</td>
</tr>
<tr>
<td>MATH345 Financial Mathematics</td>
<td>MATH230, MATH332</td>
</tr>
<tr>
<td>MATH361 Mathematical Education</td>
<td>None</td>
</tr>
<tr>
<td>MATH362 Mathematical Education Placement</td>
<td>MATH361</td>
</tr>
<tr>
<td>MATH390 Project Skills</td>
<td>MATH210 or MATH220 or MATH230</td>
</tr>
</tbody>
</table>

For the purposes of the regulations on pp.31-33,

- MATH313-329 are Mathematics modules;
o MATH330-345 are Statistics modules;

o MATH361-362 and MATH390 are neither.

**For Year 4 students**

In Year 4 single-major students must take 120 credits, including six 15 credit MATH4xx modules and either a Mathematics or Statistics or Industrial dissertation, worth 30 credits. See page 29 for specific degree scheme requirements. Students enrolled in combined major schemes should also see page 30 for details.

**Provisional timetable**

The following table gives the provisional timing of these modules. Note that the group project, MATH390, for returning Year Abroad students also has to be completed by week 6.

<table>
<thead>
<tr>
<th>1-5</th>
<th>6-10</th>
<th>11-15</th>
<th>16-20</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH414</td>
<td>MATH417</td>
<td>MATH411</td>
<td>MATH412</td>
</tr>
<tr>
<td>MATH416</td>
<td>MATH424</td>
<td>MATH413</td>
<td>MATH425</td>
</tr>
<tr>
<td>MATH423</td>
<td>MATH432</td>
<td>MATH445</td>
<td>MATH440</td>
</tr>
<tr>
<td>MATH426</td>
<td>MATH453</td>
<td></td>
<td>MATH482</td>
</tr>
<tr>
<td>MATH451</td>
<td>MATH454</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH452</td>
<td></td>
<td>MATH463</td>
<td></td>
</tr>
<tr>
<td>(MATH390)</td>
<td></td>
<td>MATH464</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CHIC465</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MATH466</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>MATH491/492/493 Dissertation</td>
<td></td>
</tr>
</tbody>
</table>

Some details of these modules are provided on page 33; further details can be found in the LUSI online Courses Handbook [http://www.lusi.lancaster.ac.uk/CoursesHandbook/](http://www.lusi.lancaster.ac.uk/CoursesHandbook/)

However, please note that **it is possible that not all of the courses listed above may actually be given**. If you enrol in a module that ends up not being given, then you will be informed by the end of Week 25, and you will be asked to change your registration accordingly.

Please note that changes into or out of a module are only allowed up to and including the Friday of the second week of the module concerned.

**Module names, prerequisites and exclusions**

The following table lists the pre-requisites for fourth year modules.

<table>
<thead>
<tr>
<th>Fourth Year Module</th>
<th>Pre-requisites</th>
<th>Exclusions</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH411 Operator Theory</td>
<td>MATH317 or MATH417</td>
<td></td>
</tr>
<tr>
<td>MATH412 Topology and Fractals</td>
<td>MATH210</td>
<td></td>
</tr>
<tr>
<td>MATH413 Probability Theory</td>
<td>MATH210; MATH230 helpful</td>
<td>MATH313</td>
</tr>
<tr>
<td>MATH414 Lebesgue Integration</td>
<td>MATH210</td>
<td>MATH314</td>
</tr>
<tr>
<td>MATH416 Metric Spaces</td>
<td>MATH210; MATH220</td>
<td>MATH316</td>
</tr>
<tr>
<td>MATH417 Hilbert Space</td>
<td>MATH210 or MATH211, MATH220; MATH316 or MATH416 helpful</td>
<td>MATH317</td>
</tr>
<tr>
<td>MATH423 Elliptic Curves</td>
<td>MATH225, MATH390</td>
<td>MATH323</td>
</tr>
<tr>
<td>MATH424 Galois Theory</td>
<td>MATH225, MATH322; MATH321 recommended</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Prerequisites</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>MATH425</td>
<td>Representation Theory of Finite Groups</td>
<td>MATH220, MATH225 or MATH226; MATH321 recommended</td>
</tr>
<tr>
<td>MATH426</td>
<td>Lie Groups and Lie Algebras</td>
<td>MATH220, MATH225, MATH316; MATH113 or MATH329</td>
</tr>
<tr>
<td></td>
<td></td>
<td>helpful; MATH321 or MATH325 helpful</td>
</tr>
<tr>
<td>MATH432</td>
<td>Stochastic Processes</td>
<td>MATH230</td>
</tr>
<tr>
<td>MATH440</td>
<td>Stochastic Calculus</td>
<td>MATH413 or MATH313; MATH332 or MATH432</td>
</tr>
<tr>
<td>MATH445</td>
<td>Financial Mathematics</td>
<td>MATH230, MATH332 or MATH432</td>
</tr>
<tr>
<td>MATH451</td>
<td>Likelihood Inference</td>
<td>MATH235</td>
</tr>
<tr>
<td>MATH452</td>
<td>Generalised Linear Models</td>
<td>MATH330 or MATH451</td>
</tr>
<tr>
<td>MATH453</td>
<td>Bayesian Inference</td>
<td>MATH235</td>
</tr>
<tr>
<td>MATH454</td>
<td>Computationally Intensive Methods</td>
<td>MATH330 or MATH451, MATH331 or MATH453, MATH245/390</td>
</tr>
<tr>
<td>MATH463</td>
<td>Clinical Trials</td>
<td>MATH235, MATH245/390</td>
</tr>
<tr>
<td>MATH464</td>
<td>Principles of Epidemiology</td>
<td>MATH235, MATH245/390</td>
</tr>
<tr>
<td>CHIC465</td>
<td>Environmental Epidemiology</td>
<td>MATH330 or MATH451</td>
</tr>
<tr>
<td>MATH466</td>
<td>Longitudinal Data Analysis</td>
<td>MATH330 or MATH451, MATH333 or MATH452</td>
</tr>
<tr>
<td>MATH482</td>
<td>Financial Risk: Extreme Value Theory</td>
<td>MATH330 or MATH451, MATH332 or MATH432</td>
</tr>
<tr>
<td>MATH491</td>
<td>Mathematics Dissertation</td>
<td>MATH240/390</td>
</tr>
<tr>
<td>MATH492</td>
<td>Statistics Dissertation</td>
<td>MATH240/390</td>
</tr>
<tr>
<td>MATH493</td>
<td>Industrial Dissertation</td>
<td>MATH240/390</td>
</tr>
</tbody>
</table>

For the purposes of the regulations on pp.31-33,

- MATH411-426 are taught MATH4xx Mathematics modules;
- MATH432-482 and CHIC465 are taught MATH4xx Statistics modules;
- MATH491-493 are neither.

**Single-major degree schemes**

The following rules apply to students to begin Year 2 in 2017/18 or later. For students who began Year 2 in 2016/17 or earlier, please see the 2016/17 version of this handbook.

All degree schemes require students to take a total of 120 credits in each year.

All single major degree schemes, including Year Abroad schemes, require students to take all eight 15-credit Year 2 modules: MATH210, MATH215, MATH220, MATH225, MATH230, MATH235, MATH240, MATH245; these are the only MATH2xx modules considered below. In subsequent years there are choices available.

In single-major BSc degrees, up to four 15 credit MATH modules may be replaced by minor courses in other subjects, but in practice the choice may be limited by prerequisites and students would not normally be allowed to take more than 30 non-MATH credits in their final year.

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**BSc Mathematics**
Required modules: All eight MATH2xx modules.

**BSc Mathematics with Statistics**
Required modules: All eight MATH2xx modules, and at least 4 MATH3xx Statistics modules.

**BSc Statistics**
Required modules: All eight MATH2xx modules, and at least 4 MATH3xx Statistics modules.

**MSci Mathematics**
Required modules: All eight MATH2xx modules.

**MSci Mathematics with Statistics**
Required modules: All eight MATH2xx modules; at least 4 MATH3xx Statistics modules; and at least 2 taught MATH4xx Statistics modules.

**MSci Statistics**
Required modules: All eight MATH2xx modules; at least 4 MATH3xx Statistics modules; at least 3 taught MATH4xx Statistics modules; and the dissertation may be either MATH492 or MATH493 with a statistical orientation.

**MSci Study Abroad**
The regulations are as for the appropriate MSci degree, interpreted appropriately. The requirement "At least 4 MATH3xx Statistics modules" will be taken to mean that at least 50% of the modules taken for assessment while abroad should have a significant statistical component.
Combined-major degree schemes

Combined major schemes normally require 60 credits per year from each subject. The Mathematics/Statistics component of the various degrees is as follows.

**BSc Accounting, Finance and Mathematics**

Second Year: MATH220, MATH230, MATH235, MATH245.
Third Year: MATH330, and three other MATH3xx modules, two of which must be Statistics modules.

**BSc Accounting, Finance and Mathematics (Industry)**

Second Year: MATH220, MATH230, MATH235, MATH245.
Third Year: MATH330, and three other MATH3xx modules, two of which must be Statistics modules.

**BSc Computer Science and Mathematics**

Second Year: MATH220 and three other MATH2xx modules.
Third Year: Four MATH3xx modules, excluding MATH362.

**MSci Computer Science and Mathematics**

Second Year: MATH220 and three other MATH2xx (including MATH240, if taking one of MATH491/492/493 in Year 4)
Third Year: Four MATH3xx modules, excluding MATH362.
Fourth Year: Depends on specialism. See the LUSI online handbook for details.

**BSc Economics and Mathematics**

Second Year: MATH220, MATH230, MATH235, MATH245.
Third Year: MATH330 and three other MATH3xx modules, two of which must be Statistics modules.

**BSc Financial Mathematics**

Second Year: MATH210, MATH230, MATH235, and one further MATH2xx module.
Third Year: MATH313, MATH330 and two other Statistics MATH3xx modules.

**BSc Financial Mathematics (Industry)**

Second Year: MATH210, MATH230, MATH235, and one further MATH2xx module.
Third Year: MATH313, MATH330 and two other Statistics MATH3xx modules.

**MSci Financial Mathematics**

Second Year: MATH210, MATH230, MATH235, and one further MATH2xx module. If taking MATH491/492/493, then MATH240 must have been taken in Year 2 or Year 3.
Third Year: MATH313, MATH330 and 2 other Statistics MATH3xx modules.
Fourth Year: Depends on specialism. See the LUSI online handbook for details.

**BA French/German/Italian/Spanish Studies and Mathematics**

Second Year: Four MATH2xx modules.
Final Year: Four MATH3xx modules, excluding MATH362.

**BSc Management Mathematics**

Second Year: MATH220, MATH230, MATH235, MATH245.
Third Year: MATH330 and three other MATH3xx modules, two of which must be Statistics modules.

**BSc Management Mathematics (Industry)**

Second Year: MATH220, MATH230, MATH235, MATH245.
Third Year: MATH330 and three other MATH3xx modules, two of which must be Statistics modules.

**BA Mathematics and Philosophy**

Second Year: MATH210, MATH215, MATH220, MATH225.
Third Year: Four MATH3xx modules, excluding MATH362.

**BSc Theoretical Physics with Mathematics**

Second Year: MATH210, MATH215, MATH220, MATH225.
Third Year: Two MATH3xx modules excluding MATH362

**MSci Theoretical Physics with Mathematics**

Second Year: MATH210, MATH215, MATH220, MATH225.
Third Year: Two MATH3xx modules excluding MATH362.
Fourth Year: Two MATH4xx modules excluding MATH491/492/493.

**Natural Sciences**

These students should consult the Natural Sciences department for details of the particular themes studied.

Minors may take 30 or 60 credits chosen from the available second-year modules, subject to prerequisites and the agreement of their major department.
Module Descriptions

Notice the Year 1 modules changed their order, and therefore the numbers, in 2016/17. The following uses the new numbering. More information about the modules can be found online at the Module Catalogue.

http://www.lusi.lancaster.ac.uk/CoursesHandbook/

MATH210: Real Analysis (15 cr.)
Prereq.: MATH114
The course starts with a recap of limits of sequences and convergence of series. The notion of a limit is then extended to functions, which leads to the analysis of differentiation, including proper proofs of techniques learned at A-level and in MATH114. The Intermediate Value Theorem is now given the respect it deserves and proved from the definitions, and we discover that it has more applications than expected. We turn next to the Mean Value Theorem: earlier results ensure that its proof is now easy, and we show that it, too, has many applications of widely differing kinds. The next topic is new: sequences and series of functions (rather than just numbers); again it has many applications, and is central to more advanced analysis. The notion of integration is then put under the microscope; once it is properly defined (via limits) we show how to get from this definition to the familiar technique of evaluating integrals by reverse differentiation. We describe some applications of integration that are quite different from the ones in A-level before finally turning to Fourier series and some further applications.

MATH215: Complex Analysis (15 cr.)
Prereq.: MATH210
Complex Analysis had its origins in differential calculus and the study of polynomial equations. In this course we consider the differential calculus of functions of a single complex variable and study power series and mappings by complex functions. The integral calculus of complex functions leads to some elegant and important results including the fundamental theorem of algebra. These classical theorems are also used to evaluate real integrals. The course ends with basic discussion of harmonic functions, which play a significant role in physics.

MATH220: Linear Algebra II (15 cr.)
Prereq.: MATH105
The course is concerned with the study of vector spaces, together with their structure-preserving maps and their relationship to matrices. It considers the effect of changing bases on the matrix representing one of these maps, and examines how to choose bases so that this matrix is as simple as possible. It also studies vector spaces in which the concepts of length and angle can be introduced.

MATH225: Abstract Algebra (15 cr.)
Prereq.: MATH220
From your previous mathematical studies, you will be aware of examples of different types of symmetries. As well as geometric symmetries (rotations, reflections, translations), you have also met permutations and linear transformations. The notion of a group is designed precisely to capture the common elements of all of these manifestations of symmetries. We take an abstract approach, where we can prove very general results that we will apply to lots of examples. We will begin the study of abstract groups, looking at their internal structure (subgroups) and how groups can be related by structure-preserving functions (homomorphisms). You have also encountered several different generalizations of "number systems" - the integers, the integers modulo n, polynomials and fields. Just as groups model symmetries, so rings are abstract models for number systems. They have an addition and a multiplication, satisfying most (but not all) of the familiar properties of the examples we have just mentioned. Again we will study the internal structure of rings, their structure-preserving maps and some basic results and fundamental theorems. The examples and results studied here are used and developed further throughout later pure mathematics modules in algebra, analysis, combinatorics and geometry."

MATH230: Probability II (15 cr.)
Prereq.: MATH102, MATH103, MATH105
Probability provides the theoretical basis for statistics and is of interest in its own right. Basic concepts covered in the first year probability module are extended to encompass continuous random variables, with several important continuous probability distributions investigated in detail. We then consider transformations of random variables and groups of two or more random variables; this leads to two theoretical results about the
behaviour of averages of large numbers of random variables, which have important practical consequences in statistics.

**MATH235: Statistics II (15 cr.)**  
*Prereq.: MATH104, MATH105, MATH230*  
Statistics is the science of using observed data to help us understand patterns of population behaviour. Such data may be collected from samples, surveys or designed experiments. In this module we build on the concepts of statistical modelling, parameter estimation and testing introduced in Math105. The first half of the course introduces the linear regression model as a tool to model the relationships between observed variables. For this model we consider parameter estimation and interpretation, model fit and model selection. Next we consider the concept of likelihood-based inference which provides a general method by which the the parameters in a statistical models can be estimated in order to draw conclusions from observed data.

**MATH240: Project Skills (15 cr.)**  
*Prereq.: Student must be majoring in the department of Maths and Stats*  
This module is a prerequisite for third and fourth year modules which have projects. This course aims to teach and enhance skills, including both subject-related and transferable skills, appropriate to Part II students in Mathematics and Statistics. These skills include the preparation of mathematical documents and presentation materials, scientific writing, oral presentations and group work. The module includes components on LaTeX, oral communication skills, scientific writing, a written short project, a written group project, and a group presentation.

**MATH245: Computational Mathematics (15 cr.)**  
*Prereq.: MATH101; MATH102; MATH103; MATH104; MATH105*  
Computers, and in particular, computational methods are playing an increasingly important role in mathematics and statistics. This module explores a range of computational and numerical methods for solving mathematical and statistical problems, focussing both on the theory underpinning the methods and the application of the methods to a variety of problems using R. The module starts by introducing programming within R. The module then moves through numerical solutions of equations, numerical and statistical (Monte Carlo) methods for evaluating integrals and finishes with the numerical solution of ODEs.

**MATH313 Probability Theory (15 cr.)**  
*Prereq.: MATH210; MATH230; Excl MATH413*  
The aim of this course is to develop an analytical and axiomatic approach to the theory of probabilities. The notion of a probability space is introduced and illustrated by simple examples featuring both discrete and continuous sample spaces. Random variables and the expectation are then used to develop a probability calculus, which is applied to achieve laws of large numbers for sums of independent random variables. Lindeberg’s method is used to study the distributions of sums of independent variables. The results are illustrated in applications to random walks and statistical physics, in particular, the Poisson and central limit theorems are proven, with estimation of accuracy of both approximations.

**MATH314 Lebesgue Integration (15 cr.)**  
*Prereq.: MATH210; Excl MATH414*  
The aim of this course is to introduce the Lebesgue integral for functions on the real line. The course features a classical approach to the construction of Lebesgue measure on the line and to the definition of the integral. The bounded convergence theorem is used to prove the monotone and dominated convergence theorems. The results are illustrated in classical convergence problems including Fourier integrals.

**MATH316: Metric Spaces (15 cr.)**  
*Prereq.: MATH210 or 211, MATH220; Excl.: MATH416*  
The course gives an introduction to the key concepts and methods of metric space theory, a core topic for pure mathematics and its applications. It offers a deeper understanding of continuity, leading to an introduction to abstract topology. The course provides firm foundations for further study of many topics including geometry, Lie groups and Hilbert space, and has applications in many others, including probability theory, differential equations, mathematical quantum theory and the theory of fractals.

**MATH317 Hilbert Space (15 cr.)**  
*Prereq.: MATH210 or 211, MATH220; MATH316 helpful; Excl.: MATH417*  
The notion of a norm introduces a generalized notion of ‘distance’ to the purely algebraic setting of vector spaces. This can be done in several quite natural ways, both for vectors of any dimension and for functions.
The more special notion of an inner product generalizes angles at the same time as distances. With these concepts established, geometrical ideas like orthogonality can be seen to apply to much more general spaces than Euclidean spaces of three (or even n) dimensions, notably to infinite dimensional spaces of functions. Hilbert space theory shows, for example, how Fourier series are really another case of expressing an element in terms of a basis, and how orthogonality can be used in finding best approximations to a given function by functions of a prescribed type. Finally, some of the main results of linear algebra generalize very nicely to linear operators between Hilbert spaces.

MATH318: Differential Equations (15 cr.)
Prereq.: MATH210 or MATH211
This module considers questions relating to linear ordinary differential equations. While explicit solutions can only be found for special types of equations, some of the ideas of real analysis allow us to answer questions about the existence and uniqueness of solutions to more general equations, as well as study certain properties of these solutions.

MATH319: Linear Systems (15 cr.)
Prereq.: MATH215, MATH220
Linear systems is engineering mathematics. In the mid nineteenth century, the engineer Watt used a governor to control the amount of steam going into an engine, so that the input of steam reduced when the engine was going too quickly, and the input increased when the engine was going too slowly. Maxwell then developed a theory of controllers for various mechanical devices, and identified properties such as stability. The crucial idea of a controller is that the output can be fed back into the system to adjust the input. Many devices can be described by linear systems of differential and integral equations which can be reduced to a standard (A,B,C,D) model. These include electrical appliances, heating systems and economic processes. The course shows how to reduce certain linear systems of differential equations to systems of matrix equations and thus solve them. Linear algebra enables us to classify (A,B,C,D) models and describe their properties in terms of quantities which are relatively easy to compute. The course then describes feedback control for linear systems. The main result describes the linear controllers that stabilize an (A,B,C,D) system. The course covers graphical methods such as Nyquist and Bode plots.

MATH321: Groups and Symmetry (15 cr.)
Prereq.: MATH225 or MATH226
The study of groups is developed from Math225a. 'Direct products' are used to construct new groups, while any finite group is shown to "factor' into 'simple' pieces. We also consider situations in which a group "acts' on a set by permuting its elements; this powerful idea is used to identify the symmetries of the Platonic solids, and help study the structure of groups themselves.

MATH322: Rings, Fields and Polynomials (15 cr.)
Prereq.: MATH111, MATH225
This module continues the study of commutative rings begun in MATH225. We introduce two new classes of integral domains called Euclidean domains, where we have a counterpart of the division algorithm, and unique factorization domains, in which an analogue of the Fundamental Theorem of Arithmetic holds. We explore how well-known concepts from the integers such as the highest common factor, the Euclidean algorithm, and factorization of polynomials, carry over to this new setting.

MATH323: Elliptic Curves (15 cr.)
Prereq.: MATH225, MATH390 (or MATH240)
The course is an introduction to elliptic curves, an important subject in algebraic geometry. In this module we will learn how curves can be described by algebraic equations, understand and use abstract groups in dealing with geometrical objects, learn some of the notions and the main results pertaining to elliptic curves.

MATH325: Representation Theory of Finite Groups (15 cr.)
Prereq.: MATH220, MATH225 or MATH226, MATH321 recommended
The course is an introduction to the ordinary representation theory of finite groups, including the first steps in character theory. Representation theory of finite groups is an important subject in algebra. The main results are presented together with examples and applications.

MATH326 Graph Theory (15 cr.)
Prereq.: MATH220
Graph theory is a rapidly developing branch of mathematics that finds applications in other areas of mathematics as well as in other fields such as computer science, statistical physics, chemistry and data science. Graphs are mathematical structures used to model pairwise relations between objects. This course
gives an introduction to three fundamental aspects of graph theory: structural graph theory (including graph minors and methods for counting trees), algebraic graph theory (using matrices to deduce properties of graphs) and topological graph theory (planar graphs and non-crossing embeddings on surfaces).

**MATH327: Combinatorics (15 cr.)**  
*Prereq.: MATH111, MATH112, MATH220*  
Combinatorics is the core subject of discrete mathematics which refers to the study of mathematical structures that are discrete in nature rather than continuous (for example graphs, lattices, designs and codes). While combinatorics is a huge subject - with many important connections to other areas of modern mathematics - it is a very accessible one. This course gives an introduction to the fundamental topics of combinatorial enumeration (sophisticated counting methods), graph theory (graphs, networks and algorithms), and combinatorial design theory (Latin squares and block designs). Some important practical applications of the results and methods are also briefly discussed.

**MATH328: Number Theory (15 cr.)**  
*Prereq.: MATH111; MATH225 helpful*  
Number theory is the study of the fascinating properties of the natural number system. How many primes leave remainder 1 when divided by 4, and how many leave remainder 3? Are there short cuts to factorizing large numbers or determining whether they are prime? (And why is this important in cryptography?) Some equations have whole number solutions: how do we find them, count them or catalogue them? The number of divisors of an integer fluctuates wildly, but can we give a good estimation of the “average” number of divisors in some sense?  
To answer such questions about natural numbers, one sometimes has to draw on ideas from algebra and analysis, including rational or complex numbers, groups, integration, infinite series and even infinite products. This course introduces some of the central ideas and problems of the subject, and some of the methods used to solve them, while keeping prerequisites to a minimum. The results are constantly illustrated by exercises and examples involving actual numbers.

**MATH329: Geometry of Curves and Surfaces (15 cr.)**  
*Prereq.: MATH113 or MATH220*  
This module provides an introduction to the subject of differential geometry. Familiar tools from calculus and linear algebra are used to investigate curves and surfaces embedded in three-dimensional space. A number of well-known concepts will be encountered, such as length and area, and some new ideas will be introduced, including the curvature and torsion of a curve, and the first and second fundamental forms of a surface. Students will learn how to compute these quantities for a variety of examples, and in doing so will develop their geometric intuition and understanding.  
In addition to the subject-specific aims, this module is intended to improve students' ability to understand and to develop mathematical arguments, and to present them in a clear and well-structured manner. The module also aims to enhance students' problem-solving abilities.

**MATH330: Likelihood Inference (15 cr.)**  
*Prereq.: MATH235; Excl.: MATH451*  
Statistical inference is the theory of the extraction of information about the unknown parameters of an underlying probability distribution from observed data. Consequently, statistical inference underpins all practical statistical applications, such as those considered in all other third year statistics courses. This course reinforces the likelihood approach taken in MATH235, for single parameter statistical models, and extends this to problems where the probability for the data depends on more than one unknown parameter. The issue of model choice is also considered: in situations where there are multiple models under consideration for the same data, how do we make a justified choice of which model is the 'best'? The approach taken in this course is just one approach to statistical inference: a contrasting approach, Bayesian Inference, is covered in MATH331.

**MATH331: Bayesian Inference (15 cr.)**  
*Prereq.: MATH235; Excl.: MATH453*  
Bayesian statistics provides a mechanism for making decisions in the presence of uncertainty. Using Bayes theorem, knowledge or rational beliefs are updated as fresh observations are collected. The purpose of the data collection exercise is expressed through a utility function, which is specific to the client or user. It defines what is to be gained or lost through taking particular actions in the current environment. Actions are continually made or not made depending on the expectation of this utility function at any point in time. Bayesians admit probability as the sole measure of uncertainty. Thus Bayesian reasoning is based on a firm axiomatic system. In addition, since most people have an intuitive notion about probability, Bayesian analysis is readily communicated.
MATH332: Stochastic Processes (15 cr.)
Prereq.: MATH230; Excl.: MATH432
This course covers important examples of stochastic processes, and how these processes can be analysed.
As an introduction to stochastic processes we will look at the random walk process. Historically this is an important process, and was initially motivated as a model for how the wealth of a gambler varies over time (initial analyses focussed on whether there are betting strategies for a gambler that would ensure he won). We will then focus on the most important class of stochastic processes, Markov processes (of which the random walk is a simple example). Markov processes are defined by the property that the future of the process is independent of the past if we condition on the current state of the process. We will look at how to analyse Markov processes, and how Markov processes are used to model queues and populations.

MATH333: Statistical Models (15 cr.)
Prereq.: MATH235, MATH330, MATH390 (or MATH245)
Generalized linear models (GLMs) may be used to relate a response variable to one or more explanatory variables. The response variable may be classified as quantitative (continuous or discrete, i.e. countable) or categorical (two categories, i.e. binary, or more than categories, i.e. ordinal or nominal). GLMs will be applied in a range of applications in the biomedical, natural and social sciences. R will be used in weekly workshops.

MATH334: Time series analysis (15 cr.)
Prereq.: MATH330, MATH390 (or MATH245)
A wide variety of sequences of observations arising in environmental, economic and scientific contexts come under the heading of time series data. Topics in Time Series and Volatility Modelling will discuss the techniques for the analysis of such data with emphasis on financial applications. In this module students will use R for exploratory data analysis.

MATH335: Medical Statistics (15 cr.)
Prereq.: MATH235, MATH390 (or MATH245)
This course aims to introduce students to the study designs and statistical methods commonly used in health investigations including measuring disease, study design, causality and confounding. Both observational and experimental designs feature and various health outcomes are considered. The course is built around a number of published articles and is structured to provide understanding of the problem being investigated and also the mathematical and statistical concepts underpinning inference.

MATH336: Multivariate Statistics (15 cr.)
Prereq.: MATH220, MATH230, MATH235
This module aims to introduce students to some of the theoretical and practical elements of machine learning and multivariate statistics. The specific focus will be on multivariate data representation/visualisation feature extraction and dimensionality reduction, e.g. through Principal Component Analysis (PCA) multivariate data classification using discriminant analysis and Support Vector Machines (SVMs). Apart from learning the theoretical aspects of the above methods, the students will also learn how to apply them in practice using R.

MATH345: Financial Mathematics (15 cr.)
Prereq.: MATH230, MATH332
The aim is to give a simple introduction to mathematical finance. This includes some financial terminology and the study of European and American option pricing with respect to different models. More precisely, we consider two discrete models, the binomial Model and finite market model, and one continuous model, the Black Scholes model. We also introduce some probabilistic terminology, which is required to study the properties of these models. This includes martingales, stopping times and a brief, non-rigorous introduction to the mathematical theory of Brownian motion.

MATH361: Mathematical Education (15 cr.)
Prereq.: None
This course is designed to give you an opportunity to consider key issues in the teaching and learning of mathematics. Whilst it is an academic study of mathematics education and not a training course for teachers, it does provide an excellent foundation for a PGCE especially in preparing students to write academically. As a learner of mathematics of many years' experience you are well-placed to reflect upon that experience and attempt to make sense of it in the light of theoretical frameworks developed by researchers in the field. Within this course we hope to help you with this process so that as a mathematics graduate you will be able to contribute knowledgeably to future debate about the ways in which your subject is treated within the education system.

MATH362: Mathematical Education Placement (15 cr.)
Prereq.: MATH361
This module will be run as a partnership between the Department of Mathematics and Statistics, University of Cumbria and the Students' Union’s volunteering unit. It will help to enhance students’ employability and will be based on the Students’ Union’s Schools Partnership Scheme, which supports Lancaster students on 10-week placements in local primary and secondary schools. The module will involve classroom observation and assistance, the development of classroom resources, the provision of one-on-one or small group support and possibly the opportunity to teach sections of lessons to the class as a whole.

**MATH411: Operator Theory (15 cr.)**  
**Prereq.:** MATH317 or MATH417  
This module provides an introduction to an important topic in the field of modern analysis. A bounded operator is a generalisation of a matrix or linear transformation, where the underlying space is no longer required to be finite-dimensional. Fundamental ideas from analysis are used to extend well-known algebraic concepts, such as eigenvalues and the adjoint, to the infinite-dimensional setting. Students will encounter important families of operators, including unitary, self-adjoint and non-negative operators. The notion of a function of an operator will be extended from polynomial to continuous functions, provided that the operator is self-adjoint. The course culminates in a generalisation of a familiar result from linear algebra, that any Hermitian matrix can be diagonalised. An appropriate version of this statement is shown to hold for any compact self-adjoint operator. In addition to the subject-specific aims, successful completion of this module will improve students’ abilities to analyse and construct complex mathematical arguments, and to express themselves clearly through written work.

**MATH412: Topology and Fractals (15 cr.)**  
**Prereq.:** MATH210  
Fractals, roughly speaking, are strange and exotic sets in the plane (and in higher dimensions) which are often generated as limits of quite simple repeated procedures. The 'middle thirds Cantor set' in [0,1] is one such set. Another, the Sierpinski sieve, arises by repeated removal of diminishing internal triangles from a solid equilateral triangle. This analysis module will explore a variety of fractals, partly for fun for their own sake but also to illustrate fundamental ideas of metric spaces, compactness, disconnectedness and fractal dimension. The discussion will be kept at a straightforward level and topological ideas of open and closed sets will be discussed in the setting of the Euclidean plane.

**MATH413: Probability Theory (15 cr.)**  
**Prereq.:** MATH210; MATH230; Excl.: MATH313  
The aim of this course is to develop an analytical and axiomatic approach to the theory of probabilities. The notion of a probability space is introduced and illustrated by simple examples featuring both discrete and continuous sample spaces. Random variables and the expectation are then used to develop a probability calculus, which is applied to achieve laws of large numbers for sums of independent random variables. Lindeberg's method is used to study the distributions of sums of independent variables. The results are illustrated in applications to random walks and statistical physics, in particular, the Poisson and central limit theorems are proven, with estimation of accuracy of both approximations.

**MATH414: Lebesgue Integration (15 cr.)**  
**Prereq.:** MATH210; excl MATH314  
The aim of this course is to introduce the Lebesgue integral for functions on the real line. The course features a classical approach to the construction of Lebesgue measure on the line and to the definition of the integral. The bounded convergence theorem is used to prove the monotone and dominated convergence theorems. The results are illustrated in classical convergence problems including Fourier integrals.

**MATH415: Metric Spaces (15 cr.)**  
**Prereq.:** MATH210, MATH220; Excl.: MATH316  
The course gives an introduction to the key concepts and methods of metric space theory, a core topic for pure mathematics and its applications. It offers a deeper understanding of continuity, leading to an introduction to abstract topology. The course provides firm foundations for further study of many topics including geometry, Lie groups and Hilbert space, and has applications in many others, including probability theory, differential equations, mathematical quantum theory and the theory of fractals.

**MATH416: Hilbert Space (15 cr.)**  
**Prereq.:** MATH210 or MATH211, MATH220; MATH316 or MATH416 helpful; Excl.: MATH317
The knowledge gained in Hilbert space will consolidate the student's understanding of linear algebra and enable the student to study applications such as quantum mechanics and stochastic processes. The module shows how to use inner products in analytical calculations, to use the concept of an operator on an infinite dimensional Hilbert space, to recognise situations in which Hilbert space methods are applicable and to understand concepts of linear algebra and analysis that apply in infinite dimensional vector spaces.

**MATH423: Elliptic Curves (15 cr.)**  
**Prereq.:** MATH225, MATH390 (or MATH240); **Excl.:** MATH323  
The course is an introduction to elliptic curves, an important subject in algebraic geometry. In this module we will learn how curves can be described by algebraic equations, understand and use abstract groups in dealing with geometrical objects, learn some of the notions and the main results pertaining to elliptic curves.

**MATH424: Galois Theory (15 cr.)**  
**Prereq.:** MATH225, MATH322; MATH321 recommended  
Galois Theory is, in essence, the systematic study of properties of roots of polynomials. Starting with such a polynomial \( f \) over a field \( k \) (e.g. the rational numbers), one associates a "smallest possible" field \( L \) containing \( k \) and the roots of \( f \); and a finite group \( G \) which describes certain "allowed" permutations of the roots of \( f \). The Fundamental Theorem of Galois Theory says that under the right conditions, the fields which lie between \( k \) and \( L \) are in 1-to-1 correspondence with the subgroups of \( G \). Towards the end of the course we will see two applications of the Fundamental Theorem. The first is the proof that in general a polynomial of degree 5 or higher cannot be solved via a formula in the way that quadratic polynomials can; the second is the fact that an angle cannot be trisected using only a ruler and compasses. These two applications are among the most celebrated results in the history of mathematics.

**MATH425: Representation Theory of Finite Groups (15 cr.)**  
**Prereq.:** MATH220, MATH225 or MATH226; MATH321 recommended; **Excl.:** MATH325  
The course is an introduction to the ordinary representation theory of finite groups, including the first steps in character theory. Representation theory of finite groups is an important subject in algebra. The main results are presented together with examples and applications.

**MATH426: Lie Groups and Lie Algebras (15 cr.)**  
**Prereq.:** MATH220, MATH225, MATH316; MATH113 or MATH329 helpful, MATH321 or MATH325 helpful  
The theory of Lie groups and Lie algebras permeates modern mathematics and theoretical physics and brings together the methods of algebra, geometry and analysis. The course will introduce the notion of a vector field, one-parameter group of linear transformations, the matrix exponential map and its derivative. The notion of an abstract Lie algebra will be studied; it will be shown that the tangent space to a matrix group has the structure of a Lie algebra. We will prove the Baker-Campbell-Hausdorff formula and discuss the correspondence between linear groups and linear Lie algebras.

**MATH432: Stochastic Processes (15 cr.)**  
**Prereq.:** MATH230; **Excl.:** MATH332  
The course aims to show how the rules of probability can be used to formulate simple models describing processes, such as the length of a queue, which can change in a random manner, and how the properties of the processes, such as the mean queue size, can be deduced. By the end of the course the students should be able to use conditioning arguments and the reflection principle to calculate probabilities and expectations of random variables for stochastic processes; to calculate the distribution of a Markov Process at different time points and to calculate expected hitting times; to determine whether a Markov process has an asymptotic distribution and to calculate it; and to understand how stochastic processes are used as models.

**MATH440: Stochastic Calculus (15 cr.)**  
**Prereq.:** MATH413 or MATH313; MATH332 or MATH432  
Stochastic Calculus is a theory that enables the calculation of integrals with respect to stochastic processes. This module begins with the study of discrete-time stochastic processes, in particular defining key concepts such as martingales and stopping times. This leads on to the exploration of continuous-time processes, in particular Brownian motion. The final section covers integration with respect to Brownian motion, and the derivation of Ito's formula, a stochastic analogue of the chain rule. This allows the definition and solution of stochastic differential equations (SDEs), the stochastic analogue to ordinary differential equations (ODEs).

**MATH445: Financial Mathematics (15 cr.)**  
**Prereq.:** MATH230, MATH332 or MATH432 **Excl:** MATH345  
The aim is to give a simple introduction to mathematical finance. This includes some financial terminology and the study of European and American option pricing with respect to different models.
More precisely, we consider two discrete models, the binomial Model and finite market model, and one continuous model, the Black Scholes model. We also introduce some probabilistic terminology, which is required to study the properties of these models. This includes martingales, stopping times and a brief, non-rigorous introduction to the mathematical theory of Brownian motion, including stochastic integration with respect to Brownian motion.

**MATH451: Likelihood Inference (15 cr.)**
**Prereq.: MATH235; Excl.: MATH330**
The student will learn how information about the unknown parameters is obtained and summarized via the likelihood function; be able to calculate the likelihood function for some statistical models which do not assume independent identically distributed data; be able to evaluate point estimates and make statements about the variability of these estimates; understand about the inter-relationships between parameters, and the concept of orthogonality; be able to perform hypothesis tests using the generalised likelihood ratio statistic; use computational methods to calculate maximum likelihood estimates. Find maximum likelihood estimators using the statistical package R.

**MATH452: Generalised Linear Models (15 cr.)**
**Prereq.: MATH330 or MATH451**
To learn techniques for formulating sensible models for set of data that enables to answer question such as how the probability of success of a particular treatment will depend on the patient's age, weight, blood pressure and so on. To introduce a large family of models, called the generalised linear models (GLMs), that includes the standard linear regression model as a special case and to discuss the theoretical properties of these models. To learn a common algorithm called iteratively reweighted least squares algorithm for the estimation of parameters. To fit and check these models with the statistical package R; produce confidence intervals and tests corresponding to questions of interest; and state conclusions in everyday language.

**MATH453: Bayesian Inference (15 cr.)**
**Prereq.: MATH235; Excl.: MATH331**
Bayesian statistics is a framework for rational decision making using imperfect knowledge expressed through probability distributions. Bayesian principles are applied in the fields of navigation, control, automation and artificial intelligence. The aim of decision makers is to make rational decisions that maximise some personal utility function which may represent quantities such as money which are related to wealth of an individual. Within the Bayesian framework, knowledge of the world, (the prior) is updated as fresh observations arrive to yield a posterior distribution which shows the revised knowledge. The evidence for the model is expressed by calculating a marginal likelihood. Future behaviour and the fit of the model are assessed using a predictive distribution. This includes sampling uncertainty and uncertainty of our knowledge. We look at the posterior, the marginal and the predictive distributions for several one parameter conjugate models, and two families of multi-parameter fully conjugate models. We extend range of belief types that can be modelled by using mixtures of conjugate priors. We also explore the use of non-conjugate formulations of models and use Monte-Carlo integration, importance sampling and rejection sampling for calculating and simulating from these distributions.

**MATH454: Computationally Intensive Methods (15 cr.)**
**Prereq.: MATH330 or MATH451, MATH331 or MATH453, MATH390 (or MATH245)**
The first week of the course introduces students to the EM algorithm. The remainder of the course introduces the use of Markov chain Monte Carlo methods as a powerful technique for performing Bayesian inference on complex stochastic models. Weeks 2 and 3 will focus on the Gibbs sampler and the introduction of the Gibbs sampler will be closely integrated with Bayesian modelling techniques such as hierarchical modelling, random effects models, data augmentation and mixture modelling. Weeks 4 and 5 will focus on the generic Metropolis-Hastings algorithm and in particular the random walk Metropolis and independence sampler algorithms. Key MCMC issues such as burn-in, convergence and algorithmic performance will be discussed.

**MATH463: Clinical Trials (15 cr.)**
**Prereq.: MATH235, MATH390 (or MATH245)**
Clinical trials are planned experiments on human beings designed to assess the relative benefits of one or more forms of treatment. For instance, we might be interested in studying whether aspirin reduces the incidence of pregnancy-induced hypertension; or we may wish to assess whether a new immunosuppressive drug improves the survival rate of transplant recipients. Note that treatments may be procedural, for example, surgery or methods of care. This course combines the study of technical methodology with discussion of more general research issues. The course begins with a discussion of the relative advantages and disadvantages of different types of medical studies. The basic aspects of clinical trials as experimental designs are then discussed. This includes a section on definition and estimation of treatment effects.
Furthermore, cross-over trials, concepts of sample size determination, and equivalence trials are covered. The course also gives a brief introduction to sequential trial designs and meta-analysis.

**MATH464: Principles of Epidemiology (15 cr.)**
*Prereq.: MATH235, MATH390 (or MATH245)*
This course introduces students to the basic principles of epidemiology, including its methodology and application to prevention and control of disease. Concepts and strategies used in epidemiologic studies are examined. At the conclusion of the course students should understand the role of epidemiology in preventive medicine and disease investigation, understand and be able to apply basic epidemiologic methods, and be able to assess the validity of epidemiologic studies with respect to their design and inferences.

**CHIC465: Environmental Epidemiology (15 cr.)**
*Prereq.: MATH330 or MATH451*
This course aims to introduce students to the kinds of statistical methods commonly used by statisticians to investigate the relationship between risk of disease and environmental factors. Specifically, the course will cover methods for the analysis of spatial data, including spatial point-process models, spatial case-control methods, spatially aggregated data, point source problems and geostatistics. A number of published studies will be used to illustrate the methods described, and students will learn how to perform similar analyses using the statistical package R.

**MATH466: Longitudinal Data Analysis (15 cr.)**
*Prereq.: MATH330 or MATH451, MATH333 or MATH452*
Longitudinal data arise when a time-sequence of measurements is made on a response variable for each of a number of subjects in an experiment or observational study. For example, a patient's blood pressure may be measured daily following administration of one of several medical treatments for hypertension. Typically, the practical objective of most longitudinal studies is to find out how the average value of the response varies over time, and how this average response profile is affected by different experimental treatments. This module presents an approach to the analysis of longitudinal data, based on statistical modelling and likelihood methods of parameter estimation and hypothesis testing.

**MATH482: Financial Risk: Extreme Value Methods (15 cr.)**
*Prereq.: MATH451 or MATH330, MATH332 or MATH432*
This module will cover topics related to the understanding of special models to describe the extreme values of a financial time series and fitting appropriate extreme value models to data which are maxima or threshold exceedance. The students will be able to use extreme value models to evaluate Value at Risk and understand the impact of heavy tailed data on standard statistical diagnostic tools.

**MATH491, 492, 493 Dissertation (30 cr.)**
*Prereq.: MATH390 (or MATH240), MATH245 required for MATH492/493.*
At the end of Year 3 you will fill in a form stating your mathematical or statistical interests and based on that you will be assigned a dissertation supervisor (member of staff) and a topic. The dissertation may be in mathematics (MATH491), statistics (MATH492), or on an industrial project (MATH493), which is in cooperation with an external industrial partner. This depends on your degree scheme and your choice. During the first term you will meet your supervisor weekly and will be guided into your in-depth study of a specific topic. During the second term you will have to produce a written dissertation on what you have learnt and give an oral presentation. You will hand in your dissertation in the first week after the Easter recess. The grade is based 70% on your final written product, 10% on your oral presentation, and 20% on the initiative and effort that you demonstrated during the entire two terms of the module. Further information is available from the Year 4 Director of Studies and will be communicated to every Year 4 student at the beginning of Term 1.