1 WELCOME AND INTRODUCTION

1.1 Welcome

I am delighted to welcome you as students on behalf of all staff in the Department of Actuarial Mathematics and Statistics at Heriot-Watt University.

The Department of Actuarial Mathematics and Statistics is internationally renowned for teaching and research in these areas, and it was among the first universities in the UK to offer degree programmes in Actuarial Science. I would like to encourage you to explore the opportunities we offer. There are opportunities to spend a year abroad in Canada or Australia or on our campus in Malaysia. There are also opportunities to spend a year on an industrial placement. On your home campus, there are ample opportunities to attend talks and seminars including the annual conference and other events organised by the Students' Actuarial Society.

Once again we are delighted to welcome you as our students, and I very much hope the academic year ahead will be successful, inspiring, and enjoyable for you.

Dr Anke Wiese
Head of Department

1.2 Introduction

This guide provides a reference to degree programme structures and other departmental information for students on Actuarial Mathematics and Statistics (AMS) degrees. It should be read and used in conjunction with the Undergraduate Programme Handbook for The School of Mathematical and Computer Sciences (MACS Guide) available on the MACS organisation section of VISION, which contains more detailed information on University Regulations and procedures. This guide is intended as a summary of AMS Programme Structures, but note that the University Regulations and Programme Structures take precedence in case of any discrepancy between them and the guide.

Information concerning examination timetables, University regulations and other general information can be found on the Academic Registry website at www.hw.ac.uk/registry. Further sources of information are the MACS web site at www.macs.hw.ac.uk/home and the MACS Organisation section on VISION (see Section 2.5.5).
1.3 Programmes Offered

The following undergraduate programmes are offered:

- F723 BSc in Actuarial Science
- F712 BSc in Actuarial Science and Diploma in Industrial Training 1
- F706 BSc in Actuarial Science and Diploma in Industrial Training 2
  (F706 is restricted to a specific placement offered by PwC)
- F771 BSc in Financial Mathematics
- F713 BSc in Statistical Modelling

The degrees may be awarded at honours or ordinary level. Study for an honours degree usually takes four years, and for an ordinary degree, three years. For the programmes that include industrial training, study lasts an additional year because of the year-long work placement.

All the degrees are designed to make it easy in most cases to transfer from one to another during the first two years. In addition, the Heriot-Watt course scheme is compliant with the Scottish Credit and Qualifications Framework (SCQF). This makes credit transfers between Scottish universities easier.
2 KEY INFORMATION

2.1 Key Contacts

Professor Beatrice Pelloni is the Head of the School of Mathematical and Computer Sciences, and Dr Anke Wiese is the Head of the Department of Actuarial and Mathematical Statistics. They are supported by year level Directors of Studies and an experienced team of academic staff.

Directors of Studies 2016/17

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester 1</th>
<th>Semester 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Professor Gavin Gibson <a href="mailto:G.J.Gibson@hw.ac.uk">G.J.Gibson@hw.ac.uk</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dr James Cruise     <a href="mailto:R.J.Cruise@hw.ac.uk">R.J.Cruise@hw.ac.uk</a></td>
<td></td>
</tr>
<tr>
<td>Second</td>
<td>Andrea Sneddon      <a href="mailto:A.E.Sneddon@hw.ac.uk">A.E.Sneddon@hw.ac.uk</a></td>
<td></td>
</tr>
<tr>
<td>Third</td>
<td>Dr Torsten Kleinow  <a href="mailto:T.Kleinow@hw.ac.uk">T.Kleinow@hw.ac.uk</a></td>
<td></td>
</tr>
<tr>
<td>Fourth</td>
<td>John Phillips       <a href="mailto:J.Phillips@hw.ac.uk">J.Phillips@hw.ac.uk</a></td>
<td></td>
</tr>
</tbody>
</table>

2.2 Academic Staff

Students are encouraged to contact directly any member of staff whose lectures they have attended if further help or advice is needed. Staff can also be contacted through the MACS School Office (EM 1.25).

The AMS academic staff for 2016-17 are listed below, together with their offices and telephone extensions (prefix by 451 if calling from outside). E-mail addresses for staff consist of the initials and surname followed by @hw.ac.uk (e.g. A.J.G.Cairns@hw.ac.uk).

Email and telephone contact details for all other Heriot-Watt University staff (and students as well) can be found by using the ‘People Finder’ option on the menu bar of the University’s homepage http://www.hw.ac.uk/.
<table>
<thead>
<tr>
<th>Name</th>
<th>Room</th>
<th>Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor A.J.G. Cairns</td>
<td>CM S.08</td>
<td>3245</td>
</tr>
<tr>
<td>Dr M.C. Christiansen</td>
<td>CM G.18</td>
<td>8211</td>
</tr>
<tr>
<td>Professor D. Clancy</td>
<td>CM S.02</td>
<td>3208</td>
</tr>
<tr>
<td>Dr R. Cruise (1st year Director of Studies – sem. 2)</td>
<td>CM T.27</td>
<td>3741</td>
</tr>
<tr>
<td>Dr F. Daly</td>
<td>CM G.06</td>
<td>3212</td>
</tr>
<tr>
<td>Dr C. Donnelly</td>
<td>CM G.04</td>
<td>3251</td>
</tr>
<tr>
<td>Dr M. Fahrenwaldt</td>
<td>CM F.13</td>
<td>3664</td>
</tr>
<tr>
<td>Professor S. Foss</td>
<td>CM G.07</td>
<td>3238</td>
</tr>
<tr>
<td>Professor G. J. Gibson (1st year Director of Studies – sem. 1)</td>
<td>CM G.03</td>
<td>3205</td>
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<tr>
<td>Professor J. Hansen</td>
<td>CM S.05</td>
<td>3213</td>
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<tr>
<td>Dr T.C. Johnson</td>
<td>CM G.05</td>
<td>8343</td>
</tr>
<tr>
<td>Dr T. Kleinow (3rd year Director of Studies)</td>
<td>CM F.11</td>
<td>3252</td>
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<tr>
<td>Professor A.S. Macdonald</td>
<td>CM T.04</td>
<td>3209</td>
</tr>
<tr>
<td>Mr J. Phillips (4th year Director of Studies)</td>
<td>CM S.06</td>
<td>4376</td>
</tr>
<tr>
<td>Mr G.G. Reid (Exemptions Officer)</td>
<td>CM F.09</td>
<td>3075</td>
</tr>
<tr>
<td>Mr P. Ridges</td>
<td>CM F.13</td>
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</tr>
<tr>
<td>Dr V. Shneer</td>
<td>CM S.07</td>
<td>3902</td>
</tr>
<tr>
<td>Ms A.E. Sneddon (2nd year Director of Studies)</td>
<td>CM S.10</td>
<td>3226</td>
</tr>
<tr>
<td>Mr A.D. Stott</td>
<td>CM T.12</td>
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<tr>
<td>Dr G. Streftaris</td>
<td>CM S.15</td>
<td>3679</td>
</tr>
<tr>
<td>Dr A. Wiese (Head of Department)</td>
<td>CM T.13</td>
<td>3717</td>
</tr>
</tbody>
</table>

### 2.3 Administrative Staff

The Programmes are supported through the School Office. Staff in the office can help with administrative information and procedures such as registration issues, changes of address and many other issues.

- **Location:** EM1.25
- **Phone:** 0131 451 3324
- **Email:** [macs-schooloffice@hw.ac.uk](mailto:macs-schooloffice@hw.ac.uk)

Updating personal information, such as a change of address, is done through the Student Self Service portal: ([http://www.hw.ac.uk/selfservice](http://www.hw.ac.uk/selfservice)).
### 2.4 Significant Dates in the Academic Year

HWU Edinburgh Campus session dates for 2016/2017

<table>
<thead>
<tr>
<th>Dates</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 September 2016 – 2 December 2016</td>
<td>Semester 1</td>
</tr>
<tr>
<td>5 December 2016 – 16 December 2016</td>
<td>Semester 1 exams</td>
</tr>
<tr>
<td>19 December 2016 – 6 January 2017</td>
<td>Semester 1 break</td>
</tr>
<tr>
<td>9 January 2017 – 31 March 2017</td>
<td>Semester 2</td>
</tr>
<tr>
<td>3 April 2017 – 21 April 2017</td>
<td>Semester 2 break</td>
</tr>
<tr>
<td>24 April 2017 – 19 May 2017</td>
<td>Semester 2 exams</td>
</tr>
<tr>
<td>22 May 2017 – 1 September 2017</td>
<td>Summer break</td>
</tr>
<tr>
<td>3 August 2017 – 11 August 2017</td>
<td>Resits</td>
</tr>
</tbody>
</table>

Please refer to the University's websites at [http://www.hw.ac.uk/](http://www.hw.ac.uk/) and [http://www.hw.ac.uk/edinburgh.htm](http://www.hw.ac.uk/edinburgh.htm) which contain detailed information about Heriot-Watt University and the Edinburgh Campus.

### 2.5 Communications

#### 2.5.1 Contact Details

It is essential that the School and the University are kept informed of any changes to students’ contact details, particularly term-time and home addresses. It is the responsibility of the student to ensure that the University has the most up-to-date contact information.

Please inform the University of any changes to personal details to ensure that we hold up-to-date records.

If you wish to change your address, please login to Student Self Service ([http://www.hw.ac.uk/selfservice](http://www.hw.ac.uk/selfservice)).

If you require your name to be changed, please inform the Student Service Centre and provide the appropriate paperwork.

Please note that letters from the University are automatically sent to students’ term addresses as recorded on the student record system, so it is particularly important to ensure address details are kept up to date.
2.5.2 Mail & Notices

Mail (internal and external) for students is delivered to pigeon-holes inside the MACS office (EM1.25). Check yours regularly. Various announcements and notices are posted on VISION (see Section 2.5.5).

2.5.3 Lockers

Lockers are allocated for the duration of each academic year on a first-come, first-served basis. Keys for lockers in the EM Building are available from Mr A. Houston (EM1.31) for a deposit of £10.

2.5.4 E-mail

New students will be issued with instructions on how to set up their e-mail account during enrolment.

Returning students will have continued access to their e-mail.

Please note that students’ Heriot-Watt e-mail addresses are used by academic and administrative staff to send important information throughout the year.

Staff will only use official Heriot Watt e-mail addresses when writing to their students.

Students are expected to check your e-mail regularly (at least once a day) and to ensure that your in-box is regularly cleared.

More information regarding Heriot-Watt’s I.T. facilities and regulations can be found at: http://www.hw.ac.uk/is/.

2.5.5 VISION

Heriot Watt University has a Virtual Learning Environment (VLE) called VISION. Each of your courses will have a space on the VLE and your lecturers will use this space to post class materials, such as reading lists, details of assignments or announcements of revision sessions. You may also be required to use VISION to upload your work through Turnitin, a plagiarism detection programme which is in regular use by the Schools. Many courses will also include online assessment which is accessed and submitted through VISION.

Other important information, such as the AMS Code of Practice, can be found in the MACS Organisation section of VISION.

Once you have registered and have your username and password, you can access VISION here: http://vision.hw.ac.uk/.
2.5.6 Computing Facilities

All AMS students are issued with accounts on the Univerisrty Desktop Service. For details of computer labs and availability see www.hw.ac.uk/schools/mathematical-computer-sciences/about/facilities.htm. Students are expected to use the computer facilities in an appropriate and considerate way. Abuse of the facilities is subject to various disciplinary measures, ranging from a ban on access to the facilities to, in extreme and flagrant cases, expulsion from the University. Examples of abuse include monopolising a terminal for non-academic related purposes, running excessively long or inappropriate print jobs, and displaying, circulating or printing offensive material on or from the Internet. Computer games and relay chat are specifically forbidden. Further information on policy regarding the abuse of computer facilities is available from Information Technology (IT) https://www.hw.ac.uk/documents/it-communications-facilities-acceptable-use.pdf.

2.5.7 Changes to Registration

Students should make any changes to course or degree registration through the relevant Director of Studies (see Section 2.1). Any changes must be made before the end of week 3 of semester, or a fee will be incurred. Forms can be obtained from the MACS Office (EM1.25) or http://www.macs.hw.ac.uk/macshome/forms.htm.

2.5.8 Staff-Student Committee

The Staff-Student Committee provides an additional channel of communication between staff and students within the AMS department. It consists of the School Officer, the Directors of Study, the President of the Students’ Actuarial Society and two student representatives from each of the four undergraduate years. Student representatives are elected annually.

The committee meets once or twice each semester. One of its major functions is to consider any concerns about current lecture courses, including teaching quality, and to take appropriate action for their resolution. Other matters of interest, such as the provision of computing facilities or the timing of lectures, may be discussed. Minutes of the meetings are available on VISION.

2.5.9 Course Evaluation

At the end of each course you take you will be asked to complete a course evaluation questionnaire, normally through VISION. Your views are important to us and the information gathered from these evaluations is analysed by the University and the resulting information is then fed into an annual review of the programme.
2.5.10 Feedback

Feedback is a two-way process. Feedback is provided to students in a variety of ways in order to help you to reflect on and to evaluate your progress and to assist you to take steps to improve before the next relevant assessment. For most courses, students can expect feedback on assessed coursework within three teaching weeks of the coursework due date. Feedback is sought from students via Student-Staff Liaison Committees and various surveys so that the School can continue to enhance the student learning experience. Your feedback is valued by the School, so please be sure to provide feedback whenever it is sought.

2.6 Personal Tutors

Each student studying an Undergraduate Programme will be assigned to a member of the academic staff (the personal tutor) who can be consulted on all aspects of the University.

You will normally retain the same personal tutor as long as you are registered on an AMS degree. The personal tutor is your main academic link with the University. Under certain circumstances, with the permission of the Head of AMS, it may be possible to change your personal tutor.

2.6.1 Regular Meetings

It is important that you see your personal tutor regularly. These meetings are particularly important for monitoring academic progress in the first and second years. All students must see their personal tutor at the start of Semester 1 and early in Semester 2. In addition, first and second year students must see their personal tutor in week 7 of Semester 1 and week 8 of Semester 2. Staff often arrange meetings via e-mail, or post notices on their office doors. It is your responsibility to find out what arrangements have been made. Remember to check your e-mail regularly.

2.6.2 Help and Advice

Every year a few students run into serious personal difficulties (e.g. family illness, accommodation, financial, etc.). As well as being generally supportive, your personal tutor can help in a number of practical ways. For example, if you are prevented from completing project work or sitting exams, your personal tutor can sometimes help with re-scheduling or making alternative arrangements for assessment. However, you must notify your personal tutor as soon as possible, or there is very little that can be done. This is particularly important if the difficulty affects your sitting Level 9 or 10 honours papers, as once taken there are no resits allowed for honours papers. Also, it is essential to submit a Mitigating Circumstances Form (see Section 2.7.2 Notification of Mitigating Circumstances).

With other problems, your personal tutor can put you in touch with the appropriate University support service (Chaplaincy, Medical Centre, Student Welfare Services or Student Union). Personal tutors are there to help; do not hesitate to contact yours if you need help.
2.6.3 Temporary Suspension of Studies

In certain situations it may be in your best interests to suspend your studies temporarily. It sometimes helps to take time out to deal with issues that are stopping you studying effectively – this might be a health or personal issue – and return to University at an agreed date. A Temporary Suspension of Studies (TSS) is when a student stops studying at the university for an extended period of time (usually no longer than one academic year), and then returns to resume their studies.

For further information see https://www.hw.ac.uk/students/studies/leaving/temporary-suspension-studies.htm.

If you are considering applying for a suspension of studies you should contact your personal tutor or director of studies to discuss this with them.

2.7 Attendance

2.7.1 Requirements

In order to achieve course and programme learning outcomes, students are expected to attend all scheduled course learning sessions (e.g. timetabled lectures, tutorials, lab sessions, etc).

Students who fail to satisfy course attendance requirements may, after due warning, be disallowed from presenting themselves for examination in the course (see https://www.hw.ac.uk/students/doc/compulsorywithdrawal.pdf).

2.7.2 Mitigating Circumstances

Should you have to miss a timetabled session due to ill health or other legitimate reasons, or there are any circumstances which could adversely affect your examination performance, it is very important that you notify your personal tutor as soon as possible.

You should also submit an application for consideration of Mitigating Circumstances (see https://www.hw.ac.uk/students/studies/examinations/mitigating-circumstances.htm), together with any supporting documents (e.g. medical certificates) to the MACS School Office (EM1.25).

The Examiners will always take such circumstances into account where appropriate, but the later the notification, the less scope there is to do so. In particular, notification should be as soon as possible after the mitigating circumstances have arisen, and certainly no later than the Examiners Meeting (usually at the end of the assessment period, or mid-August in the case of re-sits). Late notification will mean that either no account can be taken, or that formal procedures have to be invoked. In the latter case, final year students will not be permitted to graduate until these procedures have been completed. For further details, see the MACS Handbook and the University Regulations.
2.7.3 Examinations

It is the student’s responsibility to check all relevant examination timetables (including resits) on the Registry webpage www.hw.ac.uk/registry. Should you be required to resit any exams, you must be available to take them. Therefore do not book holidays or take on any other commitments during the resit diet. Note that students must take all examinations at the campus at which they are studying. Resits can only be taken at an overseas location in exceptional circumstances.

Any basic scientific calculator other than graphics calculators, programmable calculators, or those with text storage or retrievable facilities may be used in examinations. (Calculators are not provided.) Unless there are special circumstances, students are not allowed to use translation dictionaries in examinations.

Students are not allowed to have mobile phones or other communication devices on or about their persons during examinations. Phones may be left at the front of the examination room but they must be switched off.

Cheating in an exam or other assessed work is considered to be a very serious offence.

Students should be aware that reading exam papers or communicating with other candidates prior to the start of an exam, or taking unauthorised material into an exam (even if you don’t use it), is considered to be an attempt to cheat. Do not take any material into the exam hall with you – put it in your bag or in the bin.

If a student is found cheating in an exam the Student Discipline policy will apply – see https://www.hw.ac.uk/students/doc/discguidelines.pdf.

2.7.4 Coursework and continuous assessment

As well as end of semester examinations, most courses on the AMS degree programmes involve some element of coursework or continuous assessment such as midterm tests. Students will be informed by the course lecturer of the important dates for tests and project submission and must ensure that they attend / submit at these times. These dates are fixed and cannot be altered for individual students. If you are unexpectedly unable to attend or submit due to circumstances beyond your control you should contact the course lecturer and your personal tutor as soon as possible, as well as submit an application for consideration of Mitigating Circumstances to the School Office (see Section 2.7.2 for more detail).
2.8 PLAGIARISM, COLLUSION and CHEATING

Cheating in examinations and coursework, and plagiarism, that is, the presentation of another person’s ideas or work as one’s own, are very serious offences and are dealt with severely. They carry a range of penalties up to and including expulsion from the University. Students are responsible for familiarising themselves with the University policy on these matters.

The University website contains detailed explanation of what is meant by plagiarism with examples and consequences—see https://www.hw.ac.uk/students/studies/examinations/plagiarism.htm as well as Appendix B of this Guide, and Regulations 9 and 50 on the Registry’s website http://www1.hw.ac.uk/ordinances.

Your lecturer will always be very clear about the extent to which you can collaborate and share ideas with your classmates. It is never acceptable to share your electronic files with others.

2.9 Graduate Attributes

As a student of Heriot Watt you are part of a global community. You will meet new people, discover new interests, develop your life skills and enhance your employability and career prospects. The University will provide you with the opportunity to develop skills, qualities and academic abilities during your time as a student. These are know as the Four Heriot Watt Graduate Attributes: Specialist, Creative, Global and Professional,

These Graduate Attributes can help you shape your experiences while studying and to present your skills and qualities effectively to employers. For more information see https://www.hw.ac.uk/services/docs/gradattributes-visual.pdf.

2.10 Professional Development & Careers Advice

Professional development planning (PDP) is incorporated in all four years of the AMS degrees. This is a structured process designed to help students reflect upon their own learning, performance and achievements. One of its main purposes is to support students in the planning of their professional, education and career development, keeping the University’s Graduate Attributes in mind.

In addition to taking a PDP course in 1st year, students will periodically attend seminars on developing these skills, given by, for example, prospective employers. In later years there will be opportunities to develop presentation and group working skills. Students are encouraged to take every opportunity to help develop their own skills.

Career guidance is available through the University's Careers Advisory Service, which gives a number of presentations on topics related to careers. Students are encouraged to contact Alan Smith there for advice.
2.11 Exchange opportunities

There are two exchange agreements which give AMS students the opportunity to study abroad, at either the University of Melbourne (Australia) or the University of Waterloo (Canada). To be eligible, students will have to be consistently in the top 20% of the class. For further information, see the link in VISION, under the AMS Undergraduate Degree Programme section within the MACS Organisation section. Note that the Institute and Faculty of Actuaries accreditation policy does not apply to exchange programmes: exemptions will be determined on a subject-by-subject basis (see Section 4.1.2).

Students on the Actuarial Science degree also have the opportunity to transfer to the University’s Malaysian campus. Short term transfers are available, for one or two semesters in Years 2 or 3 (and then return to Edinburgh), or students can permanently transfer to Malaysia in any of Years 2, 3 or 4. Further information about Inter-Campus Transfers is available on the Go Global site: [https://www.hw.ac.uk/student-life/campus-life/go-global.htm](https://www.hw.ac.uk/student-life/campus-life/go-global.htm).

2.12 Diploma in Industrial Training / Industrial Placements

The Department encourages all students to undertake a year-long actuarial or financial services-based paid work placement during their studies. This can be done through the Diploma in Industrial Training (for eligible BSc (Hons) Actuarial Science students only) or by temporarily suspending your studies. More information about the Diploma in Industrial Training can be found on the School VISION website, within the AMS Undergraduate Degree Programmes section.

In all cases the student is responsible for securing a work placement. The University's Careers Advisory Service and the AMS Careers Advisor, Gavin Reid, can advise anyone interested on how to go about researching and applying for a placement. You are strongly advised to contact the Careers Advisory Service for help on writing CVs, online tests and assessment centres.

Second year Actuarial Science students are also encouraged to apply for the PwC Actuarial Flying Start programme, with successful candidates offered two six-month, paid, PwC work placements in London during their degree. Information about the applications process will be provided to students early in second year. Further details can be found on VISION, under the AMS Undergraduate Degree Programme section within the MACS Organisation section.
2.13 University Prizes and Bursaries

A number of prizes, for overall performance in each year, are available to AMS Students.

**Year 1**
University Prize
Standard Life Prize (may be shared)

**Year 2**
University Prize
Worshipful Company of Actuaries Prize (may be shared)

**Year 3**
University Prize
Scottish Widows Prize (may be shared)
Longevitas Prize for Survival Models

**Year 4**
Watt Club Medal for the Best Student
IMA Prize
Roger Gray Memorial Prize in Statistics

The Worshipful Company of Actuaries Charitable Trust offers a number of bursaries each year to final year honours students in Actuarial Science. Applicants are required to demonstrate need and reasonable progress on their degree, and should be seriously considering a career in the actuarial profession. Third year students who wish to apply should contact Gavin Reid at the beginning of second semester.
3 PROGRAMME STRUCTURES

The academic year is divided into two semesters. Each semester consists of 12 weeks teaching followed by an assessment period (2 weeks in Semester 1, and 4 weeks in Semester 2). Students must register for four courses each semester. These courses are listed in the relevant tables overleaf.

Each course has a five-character code; the first two characters indicate the department, the third is the level (0, 1 indicate Levels 10, 11 respectively). Usually, but not always, Level 7 courses are taken in the 1st year, Level 8 in the 2nd year and Level 9 and 10/11 courses in the 3rd and 4th years respectively.

A course is regarded as requiring 150 hours of student effort, and is worth 15 SCQF credits.

3.1 Assessment

Each course is awarded a grade in the range A-F: grade E is the minimum required for the award of credits, but at least a grade D is needed for progression to subsequent courses. Other grades are interpreted as follows:

- A - excellent, B - very good, C – good, F - inadequate. (See University Regulations for further details).

The minimum mark needed to gain a grade D is usually 40%. The correspondence between marks and other grades varies from course to course, but is approximately as follows: grade A, 70% or over; grade B, 60-69%; grade C, 50-59%; grade D, 40-49%.

3.2 Level 7 and 8 Courses

Course assessment is generally based on either coursework, an exam at the end of the semester, or a combination of both. Details for individual courses can be found in the relevant course description. If you do not obtain a grade D (or higher) in a Level 7 or 8 course at the first attempt, you are entitled to one further attempt.

3.3 Level 9, 10 and 11 Courses

Assessment of Level 9, 10 and 11 courses is generally as for Level 7 and 8. However, in some cases, the exam for a first semester course may take place at the end of the second semester. Also, note that some pairs of courses are synoptically linked; that is, both courses are assigned the same grade, based on the average mark for the individual courses. Details are in the relevant course description. All Level 9, 10 and 11 course marks count towards the final degree classification (see also Section 3.8.4 Final Degree Assessment).
3.4 Results and Progress Decisions

The University operates a Heriot-Watt Assessment and Progression System (HAPS) which specifies minimum progression requirements. Schools have the option to apply progression requirements above the minimum University requirement, which are approved by the Studies Committees. Students should refer to the programme specific information on progression requirements. This information is detailed below.

The Progression Board meets at the end of the academic year to decide which students will be allowed to proceed to the next year of their degree programme. The Director of Studies will write to inform you of the Board's decision, and whether you must resit any exams. The Registry also makes the results available online. To avoid any delay in receiving notification of your results, you should inform the School office of your summer address should it not be the same as your permanent home address.

3.5 First Year

3.5.1 First Year Courses

<table>
<thead>
<tr>
<th>1st Semester Courses</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F77SA Introduction to Statistical Science A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F17CA Calculus A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F17CC An introduction to university mathematics</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>C27OA Introductory Economics</td>
<td>FM</td>
<td>AS, SM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Semester Courses</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F77SB Introduction to Statistical Science B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F17CB Calculus B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F77PD Professional Development Planning</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>C37FF Finance &amp; Financial Reporting</td>
<td>FM</td>
<td>AS, SM</td>
</tr>
</tbody>
</table>

AS-Actuarial Science  FM-Financial Mathematics  SM- Statistical Modelling
3.5.2 Degree Requirements

**Actuarial Science**
Three mandatory and one optional course each semester. Any level 7 course may be chosen as an option, subject to timetable constraints and the approval of the Director of Studies.

Students should note that the options C37FF and C27OA can lead to exemptions from the CT2 and CT7 examinations of the Institute and Faculty of Actuaries (see Section 4 -Actuarial Exemptions).

**Financial Mathematics**
Eight mandatory courses.

**Statistical Modelling**
Three mandatory and one optional course each semester. Any level 7 course may be chosen as an option, subject to timetable constraints and the approval of the Director of Studies.

3.5.3 Proceeding to 2nd Year
If you obtain a grade D or better in all eight courses at the first attempt, you may proceed to the 2nd year of any AMS degree for which you have fulfilled the prerequisites. Otherwise, progress is determined by the progression board on a case-by-case basis, and you may be required to resit some exams in August.

If you do not obtain D's at this second attempt, you may be required to transfer to another degree programme for which you have enough credit points (e.g. Combined Studies, Mathematics), or withdraw from the University. You will be advised of your options.
3.6 Second Year

3.6.1 Second Year Courses

<table>
<thead>
<tr>
<th>1st Semester Courses</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F78PA Probability &amp; Statistics A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F78AA Actuarial &amp; Financial Mathematics A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F18CD Multivariable Calculus &amp; Real Analysis A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F18CF Linear Algebra</td>
<td>AS, FM, SM</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Semester Courses</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F78PB Probability &amp; Statistics B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F78AB Actuarial &amp; Financial Mathematics B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F18CE Multivariable Calculus &amp; Real Analysis B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F18NA Numerical Analysis A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>C37FF Finance &amp; Financial Reporting</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
</tbody>
</table>

AS-Actuarial Science  FM-Financial Mathematics  SM-Statistical Modelling

3.6.2 Degree Requirements

**Actuarial Science, Financial Mathematics and Statistical Modelling**
Seven mandatory courses, plus one optional course in Semester 2.

Direct entrant AS students should note that C37FF can lead to exemption from the CT2 examination of the Institute and Faculty of Actuaries (see Section 4 - Actuarial Exemptions).

Direct entrant FM students must take C37FF to fulfil degree requirements.

SM students may choose any Level 7 or 8 course as an option, subject to timetable constraints and the approval of the Director of Studies.
3.6.3 Proceeding to 3rd Year

Students who obtain a grade D or better in all eight courses and an average of at least 50% in F78AA/AB/PA/PB at the first attempt will be allowed to proceed to the 3rd year of any AMS degree for which they have fulfilled the prerequisites.

Students who obtain a grade D or better in all eight courses but an average of less than 50% in F78AA/AB/PA/PB will be required to transfer to the Ordinary degree (see Section 3.7.5 – Ordinary Degrees). Students on the Ordinary degree who obtain a grade D or better in all third year courses and have an average mark of at least 50% may be permitted to proceed to the 4th year of an AMS Honours degree.

Otherwise, progress is determined by the progression board on a case-by-case basis, and you may be required to resit some exams in August. If you do not obtains D’s at this second attempt, you may be required to transfer to another degree programme for which you have enough credit points (e.g. Combined Studies, Mathematics), or withdraw from the University. You will be advised of your options.

3.7 Third Year

3.7.1 Third Year Courses

<table>
<thead>
<tr>
<th>1st Semester Courses</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F79MA Statistical Models A</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F79SP Stochastic Processes</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F79PS Statistics for Social Science</td>
<td>SM</td>
<td></td>
</tr>
<tr>
<td>F70LA Life Insurance Mathematics A</td>
<td>AS</td>
<td></td>
</tr>
<tr>
<td>F79PA Portfolio Theory &amp; Asset Models</td>
<td>AS, FM</td>
<td>SM</td>
</tr>
<tr>
<td>C27OA Introductory Economics</td>
<td></td>
<td>FM</td>
</tr>
<tr>
<td>F19MV Vector Analysis</td>
<td></td>
<td>FM, SM</td>
</tr>
</tbody>
</table>
### 2nd Semester Courses

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Required</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>F79MB</td>
<td>Statistical Models B</td>
<td>AS, FM, SM</td>
<td></td>
</tr>
<tr>
<td>F79BI</td>
<td>Bayesian Inference &amp; Computational Methods</td>
<td>SM</td>
<td>FM</td>
</tr>
<tr>
<td>F79SU</td>
<td>Survival Models</td>
<td>AS, SM</td>
<td></td>
</tr>
<tr>
<td>F70LB</td>
<td>Life Insurance Mathematics B</td>
<td>AS</td>
<td></td>
</tr>
<tr>
<td>F79DF</td>
<td>Derivative Markets &amp; Discrete-time Finance</td>
<td>AS, FM</td>
<td>SM</td>
</tr>
<tr>
<td>F19MO</td>
<td>Ordinary Differential Equations</td>
<td>FM</td>
<td>SM</td>
</tr>
<tr>
<td>F19NB</td>
<td>Numerical Analysis B</td>
<td></td>
<td>FM</td>
</tr>
</tbody>
</table>

AS-Actuarial Science   FM-Financial Mathematics   SM-Statistical Modelling

### 3.7.2 Degree Requirements

**Actuarial Science**
Eight mandatory courses.

**Financial Mathematics**
Three mandatory and one optional course each semester. Direct entrant FM students must take C27OA to fulfil degree requirements.

**Statistical Modelling**
Three mandatory and one optional course each semester. SM students may choose any Level 7, 8 or 9 course as an option, subject to timetable constraints and the approval of the Director of Studies. However, note that only Level 9 and 10 courses count towards the final degree assessment (see Section 3.8.4 - Final Degree Assessment).

### 3.7.3 Synoptic Links (see Section 3.3)

The following pairs of courses are synoptically linked:

- F79MA and F79MB,
- F79SP and F79SU (not FM degree),
- F79PA and F79DF (not SM degree),
- F70LA and F70LB.
3.7.4 Proceeding to 4th Year

Students on an Honours degree who obtain a grade D or better in all eight courses, may be allowed to proceed to the 4th year.

If you obtain a grade D or better in at least six courses and have an average mark of at least 40%, you may be permitted, at the discretion of the examiners, to proceed to the 4th year of an AMS degree. In these cases you will be advised by the examiners of your options, and may be required to resit some papers in August, to satisfy the prerequisites for the 4th year courses.

However, note that otherwise, no resit is allowed for an Honours paper, and in all cases, it is the marks obtained at the first attempt that form part of the Final Degree Assessment (see Section 3.8.4). For further information, consult your personal tutor.

3.7.5 Ordinary Degrees

A candidate who obtains a grade D or better in at least four Level 9 courses and a total of at least 360 credits may be awarded the ordinary degree of B.Sc.

Students on the Ordinary degree who obtain a grade D or better in all eight Level 9 courses and have an average mark of at least 50% may be permitted to proceed to the 4th year of an AMS Honours degree.
3.8 Fourth Year

3.8.1 Fourth Year Courses

<table>
<thead>
<tr>
<th>1st Semester Courses</th>
<th>Req'd</th>
<th>Opt.</th>
<th>Elect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F70DA Statistics Dissertation A</td>
<td>SM</td>
<td></td>
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<tr>
<td>F79PS Statistics for Social Science</td>
<td>AS, FM</td>
<td></td>
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<tr>
<td>F70CF Continuous-time Finance</td>
<td>FM</td>
<td>AS, SM</td>
<td></td>
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<tr>
<td>F71RM Financial Risk Management</td>
<td>AS, FM, SM</td>
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<tr>
<td>F70PE Pensions</td>
<td>AS</td>
<td></td>
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<tr>
<td>F10MF Functional Analysis</td>
<td>AS</td>
<td></td>
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<tr>
<td>F10MM Optimisation</td>
<td>SM</td>
<td>AS, FM</td>
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</tr>
<tr>
<td>F10AM Mathematical Biology A</td>
<td>SM</td>
<td></td>
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<tr>
<td>F10NC Numerical Analysis C</td>
<td>FM, SM</td>
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<tr>
<td>C39SM International Bond and Currency Markets</td>
<td>FM</td>
<td>AS</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>2nd Semester Courses</th>
<th>Req'd</th>
<th>Opt.</th>
<th>Elect.</th>
</tr>
</thead>
<tbody>
<tr>
<td>F70DB Statistics Dissertation B</td>
<td>SM</td>
<td></td>
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</tr>
<tr>
<td>F70TS Time Series</td>
<td>SM</td>
<td>AS, FM</td>
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<tr>
<td>F79BI Bayesian Inference &amp; Computational Methods</td>
<td>AS, FM</td>
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<tr>
<td>F70DP Advanced Derivative Pricing</td>
<td>FM</td>
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<tr>
<td>F70RT Risk Theory</td>
<td>AS, FM, SM</td>
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<tr>
<td>F70LP Life Office Practice</td>
<td>AS</td>
<td></td>
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<tr>
<td>F71CM Credit Risk Modelling</td>
<td>FM</td>
<td></td>
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</tr>
<tr>
<td>F19MO Ordinary Differential Equations</td>
<td>AS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F10AN Mathematical Biology B</td>
<td>SM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F10ND Numerical Analysis D</td>
<td>FM, SM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C39TA Taxation (Tax Law)</td>
<td>AS</td>
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</tr>
</tbody>
</table>

AS-Actuarial Science        FM-Financial Mathematics        SM-Statistical Modelling

3.8.2 Degree Requirements

Actuarial Science
At least three optional courses plus at most one elective course each semester. Students must take both F70PE and F70LP, or neither.

Direct entrants to AS may take C27OA and/or C37FF to obtain exemption from the CT7 and/or CT2 examinations of the Institute and Faculty of Actuaries

Direct entrants to 3rd year AS may take F71AB to obtain exemption from the CT1 examination of the Institute and Faculty of Actuaries.
**Financial Mathematics**
One mandatory course and three optional courses each semester. At least four option courses must be at Level 10 or above.

**Statistical Modelling**
Two mandatory courses plus at least one optional course and at most one elective each semester.
Students transferring to the SM degree from one of the other AMS degrees must take F79PS and F79BI (if not already taken).

**3.8.3 Synoptic Links (see Section 3.3)**
The following pairs of courses are synoptically linked:
- F70DA and F70DB,
- F70PE and F70LP.

**3.8.4 Final Degree Assessment**
The Examiners take into account all course marks at Level 9 and above in deciding the class of Honours: the final mark is the average of those marks (note that Level 7 and 8 course marks are not included). In broad terms, an average mark of over 70% for first class honours, 60% - 70% for upper second class honours, 50% - 60% for lower second class honours, and 40% - 50% for third class honours, would be required, subject to the agreement of the Examiners.

Note that 480 credits are required for the award of an honours degree.

In borderline cases, a positive view may be taken of an improving performance from third to fourth year.
4 ACTUARIAL EXEMPTIONS

4.1 Introduction

The Actuarial Science degree has been accredited by the Institute and Faculty of Actuaries (IFoA), which means that students can obtain exemption from some of the subjects in the IFoA's examination system. There are two routes to gaining exemptions.

4.1.1 Accreditation

Students graduating with a good upper second class degree (normally an overall average of at least 65%) and who pass at grade D all subjects covered by third and fourth year courses will be eligible for exemption from all Core Technical Subjects covered in their degree from which they have obtained either a grade C (normally 50%), in the case of subjects covered by Level 7 and 8 courses, or a grade D (normally 40%), in the case of subjects covered by Level 9 and 10 courses.

4.1.2 Individual Exemptions

Students who do not attain the accreditation threshold as above will be considered for exemption from individual subjects as described below. The exemption standard for each subject will be reviewed each year by the profession's Independent Examiners and may vary from year to year.

Note that the accreditation policy does not cover exchange arrangements; in this case, all exemptions will be recommended on a subject-by-subject basis, taking into account performance at Heriot-Watt and the exchange university.

4.2 Core Technical Stage

Exemptions are based on performance in the relevant subjects as listed below.

Subject CT1 Financial Mathematics
Actuarial & Financial Mathematics F78AA & F78AB

Subject CT2 Finance & Financial Reporting
Finance & Financial Reporting C37FF.

Subject CT3 Probability & Mathematical Statistics
Probability & Statistics F78PA & F78PB.

Subject CT4 Models
Survival Models F79SP, Stochastic Processes F79SU.

Subject CT5 Contingencies
Life Insurance Mathematics F70LA & F70LB.

Subject CT6 Statistical Methods
Risk Theory F70RT, Time Series F70TS.

Subject CT7 Business Economics
Introductory Economics C27OA.
Subject CT8 Financial Economics
Portfolio Theory F79PA, Derivative Markets F79DF, Continuous-time Finance F70CF.

Subject CT9 Business Awareness:
The IFoA assesses this through a two-day residential course and does not grant exemption from this subject on the basis of university studies.

4.3 Later Stages of the Professional Syllabus

The later parts of the professional syllabus are divided into three stages: Core Applications, Specialist Technical, and Specialist Applications. In addition, the profession intends to develop a series of UK Practice Modules, which will not be required to qualify as a Fellow, but will be required in order to practise in the UK. Students on the MSc. in Actuarial Management can obtain exemptions from CA1, CA3 and three ST subjects. Otherwise, no exemptions are available, although some courses are relevant, as indicated in the brackets.

4.3.1 Core Applications Stage
Subject CA1 Actuarial Risk Management
Subject CA2 Model Documentation, Analysis and Reporting
Subject CA3 Communications

4.3.2 Specialist Technical Stage
Students choose two subjects. Note Subject ST3 no longer exists.
Subject ST1 Health and Care
Subject ST2 Life Insurance (F70LP)
Subject ST4 Pensions and Other Benefits (F70PE)
Subject ST5 Finance and Investment A
Subject ST6 Finance and Investment B (F70CF, F79DF)
Subject ST7 General Insurance: Reserving and Capital Modelling (F70RT)
Subject ST8 General Insurance: Pricing (F70RT)
Subject ST9 Enterprise Risk Management (F71RM)
4.3.3 Specialist Applications Stage
Students choose one subject.

**Subject SA1** Health and Care

**Subject SA2** Life Insurance (F70LP)

**Subject SA3** General Insurance

**Subject SA4** Pensions and Other Benefits (F70PE)

**Subject SA5** Finance

**Subject SA6** Investment

It is also possible to pass the Specialist Applications stage by writing a research dissertation (Subject SA0).

4.4 General Information
Some general points to note about the exemption system are:

4.4.1 The University cannot grant exemptions, the Independent Examiner appointed by the IFoA makes recommendations to the IFoA. Usually the recommendations are accepted.

4.4.2 Decisions regarding recommendations for exemptions are generally made on the basis of the student's performance at the first sitting of the relevant University exam. (Resits granted as a first attempt because of medical or other mitigating circumstances are usually counted as a first attempt for exemption purposes also.) The IFoA will only allow a student to resit a course for exemption purposes (in the absence of mitigating circumstances) if it is necessary to resit it for the purposes of progression or graduation, in which case the resit must be taken at the next reassessment opportunity, and the maximum mark that can be used for exemption purposes is the pass mark (40%). These resits are for subject-by-subject exemptions only, and will not alter your degree average, or your entitlement to exemptions from other courses under the accreditation agreement.

4.4.3 Decisions on a particular exemption are made at a meeting of staff and an independent examiner held at the end of the academic year in which the relevant information becomes available, following which students are informed of these decisions. However, the recommendations are not sent to the IFoA until the end of the academic year in which the student graduates. Graduating students will be issued with a letter confirming the recommendations, and advising on how to claim them upon joining the IFoA as a student member.
4.4.4. The IFoA will not grant any exemptions (or confirm that any will be granted) until a student has joined the profession, at which time you should complete an Exemptions Application Form, available from the IFoA. State clearly on the form that you are a graduate of the AMS Department at Heriot-Watt University; there will then be no need to supply details of syllabi or exam papers. Note there is a fee payable for each exemption granted.

4.4.5 There are frequent discussions between the AMS department and the IFoA about the rules and practices concerning exemptions. The above notes reflect the current position but it is possible that changes may occur without prior notice.

4.4.6 Any further questions can be addressed to Gavin Reid (G.G.Reid@hw.ac.uk).

4.5 Further Information

Further information about the IFoA’s Education strategy can be found on their website (www.actuaries.org.uk).
5 COURSE DESCRIPTIONS

The aims and summary of the courses are provided in this section.

Information about courses in the Mathematics Department and the School of Management & Languages can be found at the relevant websites:

http://www.ma.hw.ac.uk/maths/courseinfo/index.php

http://www2.hw.ac.uk/sml/undergraduate/

5.1 Level 7 Courses

F77SA INTRODUCTION TO STATISTICAL SCIENCE A

Lecturer: G. Streftaris

Aims: To provide an introduction to the statistical issues associated with the collection, description, and interpretation of data, and in addition, to introduce computer-based methods for graphically describing and summarising data.

Summary: The aim of statistical analysis is to provide insight by means of numbers. This process usually involves three stages:

1. collecting data,
2. describing and presenting data,
3. drawing conclusions from the data (inference).

In this course, we will (primarily) consider the statistical principles and techniques used in the first two stages in an analysis. There will be some discussion of inference at the end of the course.

Book:


Assessment: 2-hour final exam (70%), continuous assessment consisting of a class test (up to 20%) and a project (minimum 10%).
F77SB
INTRODUCTION TO
STATISTICAL SCIENCE B
Lecturer: R. Cruise

Aims: To develop simple probability models for data and understand important features of these models.

Summary: This course provides an introduction to the probability models for inference. The main topics covered are:

1. models for statistical inference: introduction to discrete probability models including sample spaces, probability functions, axioms of probability and consequences of the axioms;
2. conditional probability, Partition Theorem, Bayes' Theorem and independence;
3. special probability models for random experiments;
4. discrete random variables, expectation and variance.

Book: (useful, but not essential)

Assessment: 2-hour final exam (80%), two marked assignments (10% each).

F77PD
PROFESSIONAL DEVELOPMENT PLANNING
Lecturer: J. Phillips

Aims: To introduce students to the actuarial, statistical and financial mathematics professions and to improve their career planning. To help students build up a range of skills that will prepare them to cope well at the job interview stage and beyond.

Summary:
1. An analysis of the opportunities available to Actuarial Science, Financial Mathematics and Statistical Modelling graduates;
2. Case studies of career paths taken by graduates in these subject areas;
3. Professional Development Planning and the graduate selection process;
4. Using computer methods to solve problems of the type found in industry;
5. Taking part in games that simulate the business environment.

Assessment: Continuous assessment: group project analysing a particular company, presentation, written assignments and two computer projects.
AN INTRODUCTION TO UNIVERSITY MATHEMATICS

Lecturer: M. Lawson

Aims: To provide a bridge between school and university mathematics, with a particular emphasis on the central role of proofs in mathematics.

Summary: The conceptual aspects of mathematics – what is mathematics? What is an argument? Abstraction and Rules, Problem-solving and the need for checking covering:
1. Combinatorics
2. Complex numbers and polynomials
3. Matrices
4. Vectors

Assessment: 2-hour final exam (at least 70%), continuous assessment such as class tests or project work (up to 30%).

CALCULUS A

Lecturer: R. Szabo

Aims: A course on differential calculus with applications of differentiation and an introduction to integral calculus. It is designed for students who will specialize in mathematics, actuarial mathematics or statistics. The module builds on what the students learned at school but provides a greater depth of study and introduces new material and concepts.

Syllabus
- Functions
- Limits of functions.
- Introduction to Differentiation.
- Inverse Functions.
- Advanced Differentiation: Parametric differentiation, implicit differentiation.
- Derivatives of inverse functions, Inverse Trig functions. Hyperbolic functions and hyperbolic equations, Derivatives for hyperbolic functions and inverse hyperbolic functions.
- Introduction to Integration.
- Sequences and Series.

Contact Hours: 3 lectures and 1 tutorial per week.

Assessment: up to 30% by class tests or other continuous assessment at least 70% by end of semester 2-hour exam.
**Aims:** This course builds on the differential and integral calculus introduced in Calculus A, before moving on to introduce the basics of mathematical modelling techniques using first and second order ordinary differential equations. The course develops integration methods such as integration by parts and reduction formulae and describes some applications of integration. Solution methods for first and second order differential equations are introduced and used to investigate various physical problems.

**Syllabus:**
- Applications of differentiation
- Advanced Integration
- Differential Equations
- Modelling through first order equations
- Modelling through second order equations
- Recurrence relations

**Contact Hours:** 3 lectures and 1 tutorial per week.

**Assessment:** up to 20% by class tests or other continuous assessment. 80% by end of course 2-hour exam

**C27OA INTRODUCTORY ECONOMICS Lecturer: TBA**

**Aims:** To equip students with knowledge and understanding of the fundamental principles and concepts of microeconomics and macroeconomics. By the end of the course students should be able to apply their knowledge and understanding in the analysis of a range of economic problems. Students who perform well in this course may be recommended from exemption from subject CT7.

**Assessment:** Continuous assessment and a 2-hour exam.

**C37FF FINANCE AND FINANCIAL REPORTING Lecturer: TBA**

**Aims:** To provide a basic understanding of issues in corporate finance and cover the syllabus of subject CT2.

**Summary:**
1. Instruments used by companies to raise finance
2. Management of financial risk
3. Personal and corporate taxation
4. Interpretation of financial statements of companies and financial institutions

**Assessment:** Continuous assessment (30%) and a 2-hour exam (70%).
5.2 Level 8 Courses

F78PA PROBABILITY & STATISTICS A Lecturer: J. Hansen

**Summary:** The main topics covered in this course are:

1. Probability models: sample spaces, events, probability measures, axioms of probability and related results.
2. Random variables and their distributions.
3. Expectation, variance, and standard deviation of random variables.
4. Important random variables including Binomial, Geometric, Hypergeometric, Poisson, Uniform, Normal, Exponential, Gamma variables.
5. Conditional probability and independence including the chain rule, the partition rule and Bayes' Theorem.
6. Joint probability distributions, marginal and conditional distributions.
7. Independent random variables and sums of independent random variables, generating functions, the weak law of large numbers and the Central Limit Theorem.
8. Expectation of a function of random variables, covariance and correlation.

**Prerequisites:** F77SA and F77SB (or equivalent).

**Books:** Some helpful reference books include:

- R.P. Dobrow, Probability with Applications and R (Wiley, 2014);
- S. Ross, A First Course in Probability (details are already in the guide);
- T. Cacoullos, Exercises in Probability (Springer-Verlag,1989);
- Grimmett & Welsh, Probability: An Introduction (Clarendon Press, 1988);
- Verzani, Using R for Introductory Statistics (Chapman and Hall, 2005);

**Assessment:** 2-hour end-of-semester examination (85%), continuous assessment(15%).
F78PB PROBABILITY & STATISTICS B Lecturer: J. Phillips

**Aims:** To reinforce basic ideas related to the description and analysis of data, and provide the basis for the application of statistical modelling, estimation, hypothesis testing and regression.

**Summary:** This course follows on from Probability and Statistics A. It develops the basic ideas used in statistical analysis and inference, with an emphasis on how we learn from data using both graphical techniques and statistical methodology based on probability theory. Topics presented include: analysis of simple data; construction of statistical models; sampling distributions and properties of estimators; method of moments and introduction to maximum likelihood estimation; inference for data from one population; comparisons of data from two populations; confidence intervals with samples from one or two populations; hypothesis testing; issues related to association between two variables; linear regression; statistical computing.

**Prerequisites:** F77SA and F77SB (or equivalent).

**Books:**

**Assessment:** 2-hour end-of-semester examination (80%), continuous assessment (20%).

---

F78AA ACTUARIAL & FINANCIAL MATHEMATICS A Lecturer: C. Donnelly

**Aims:** The aim of this course, along with F78AB, is to give students a thorough understanding of basic actuarial techniques. Exemptions from Subject CT1 may be recommended for candidates who score sufficiently well in F78AA and F78AB.

**Summary:** In this course, you will learn how to deal with questions involving cashflows at discrete time points, and the accumulation and discounting of payments over discrete time intervals. Topics include:
1. interest rates and some actuarial notation,
2. loan schedules,
3. yields,
4. fixed interest securities,
5. discounted cash flows.

There are three lectures per week. Students attend weekly tutorials and three computer labs during the semester.

**Books:** Useful reference:
Alternative reference with additional exercises:

**Assessment:** 2-hour end-of-semester examination (80%), continuous assessment (10%), Excel-based assignment (10%).
F78AB ACTUARIAL & FINANCIAL MATHEMATICS B

Lecturer: TBA

Aims:
1. To introduce the continuous-time concept of cash flows and interest,
2. develop skills in applying continuous-time models to financial contracts and transactions,
3. model interest rates as random variables and apply those models,
4. introduce the principle of no-arbitrage and how to price financial contracts and construct the term-structure of interest rates assuming no-arbitrage,
5. value inflation-indexed cashflows.

Summary: This course builds on and extends the ideas contained in the related course F78AA. The concepts of a continuously-payable cashflow and the force of interest are considered. We incorporate inflationary increases into cashflows and value index-linked bonds. We see how interest-rate risk can be managed through the use of Redington's immunisation theory. As rates of return can be random, we see how to model them using random variables. Using the no-arbitrage principle, we price forward contracts. This leads on to a wider discussion of the term-structure of interest rates and the yield curve.

Books:

Assessment: 2-hour end-of-semester examination (85%) and continuous assessment (15%).

F18CF LINEAR ALGEBRA

Lecturer: C.Saemmann

Aims: This is a Level 8 course in Linear Algebra aimed at students specializing in Mathematics, Statistics, or Actuarial Mathematics. The course aims to provide sufficient knowledge of matrix theory and of the solution of systems of linear equations for use in later courses in mathematics and statistics; to give an understanding of the basic concepts of linear algebra; and to develop the ability to solve problems and prove theorems involving these concepts.

Summary:
Euclidean space: Vector spaces R2, R3 and Rn, Matrices, Basic matrix operations, Determinants.
Systems of linear equations: Gaussian elimination, Results on homogeneous and inhomogeneous systems, Matrix inversion.
Vector spaces: Definition and examples of vector spaces, Subspaces, Span, Linear independence, Bases and dimension.
Inner product spaces: Scalar or Inner products, Cauchy-Schwartz inequality, Orthogonality, Orthogonal projection, Orthonormal bases, Gram - Schmidt process, Vector products.
Linear transformations: Row and Column rank of a matrix, Applications to systems of equations, Range, Kernel, Rank and Nullity, Invertibility of linear transformations, Linear transformations and matrices.

Eigenvalues and eigenvectors: Calculation of Eigenvalues and Eigenvectors, Symmetric matrices, Diagonalisation of a matrix, Cayley Hamilton theorem, Iterates of matrices, applications to quadratic forms.

**Assessment:** 30% by class tests or other continuous assessment. 70% by end of course 2-hour exam.

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**MULTIVARIABLE CALCULUS & REAL ANALYSIS A**

**F18CD**

**Lecturer: A. Konechny**

**Aims:** The course aims to provide an introduction to the calculus for functions of several variables, which will provide sufficient expertise for use in various later courses. The students will also develop their general skills in differentiation, integration and algebraic manipulation.

**Summary:**
Applications of integration: Areas, volumes.
Integrals over infinite regions: The definition of the convergence of integrals of functions on unbounded intervals. Comparison tests and absolute convergence tests of integrals.
Sequences: Define a sequence of real numbers. Define bounded and convergent sequences, and the limit of a convergent sequence.

**Assessment:** Up to 30% by class tests or other continuous assessment. At least 70% by end of course 2-hour exam.
Aims:
The course aims to introduce students to the idea of rigorous mathematical arguments and, in particular, to discuss the rigorous foundations of calculus. An important feature of the course is the use of careful, rigorous proofs of the theorems used and one of the aims of the course is to improve student's ability to understand such arguments and to develop such proofs for themselves. A central concept in analysis is the idea of convergence, either of sequences, series or of functions, and this course aims to introduce this concept and provide the basic results which will be used in later courses. In addition, it will give methods of obtaining inequalities and approximations (with precise estimates of how good the approximations are), tests for convergence of series and power series and ways of identifying functions defined by power series and characterisations of functions (over bounded and unbounded intervals) for which the concept of area under the graph of a function makes sense.

Summary:
Sequences: Briefly recall the idea of a sequence of real numbers, and of bounded and convergent sequences.
Suprema and infima: Sup and inf of sets of real numbers. The completeness axiom for real numbers.
Monotone sequences: Monotone sequences and the monotone convergence theorem. Use of the monotone convergence theorem to prove convergence of sequences without knowing the limit.
Subsequences: Subsequences and the Bolzano-Weierstrass theorem.
First means value theorem: Statement and proof of the first mean value theorem, applications to inequalities.
nth mean value theorem: Statement and proof of the nth mean value theorem, applications to approximations.
Series and power series: Convergence of series, the comparison, ratio zero, absolute convergence and alternating series tests for series, radius of convergence of a power series properties of functions defined by power series, convergence of standard power series.
Riemann integration and convergence of integrals: Partitions, upper and lower sums, Riemann integrable functions.

Assessment: 15% by class tests or other continuous assessment. 85% by end of course 2-hour exam.
Aims:
When solving problems in science, engineering or economics, a real-life situation is first converted into a mathematical model. This is often called the formulation of the problem and it is given in terms of mathematical equations. Only a handful of model equations can be solved in a neat analytical form. Hence we need numerical analysis, comprising a set of techniques for finding approximate solutions of these equations. This course provides an introduction to very basic methods in numerical analysis both from a theoretical and a practical perspective. It also provides an introduction to programming the scientific computing package Matlab.

Syllabus:
- Solving general non-linear scalar equations
- Solving smooth non-linear scalar equations
- Analysis of orders of convergence for fixed point iteration
- Interpolation
- Numerical Integration
- Convergence of the numerical integration methods
- Numerical differentiation
- Computer arithmetics
- Basics of Matlab Programming
- Iteration techniques in Matlab
- Integration and differentiation in Matlab

3 lectures + 1 tutorial or lab session per week

Assessment: 30% by class tests or other continuous assessment
70% by end of module 2-hour exam
5.3 Level 9 Courses

F79MA STATISTICAL MODELS A Lecturer: G.J. Gibson / F. Daly

Aims: To describe and compare the main approaches to statistical inference, including classical and Bayesian, and to develop students' skills in practical, computer-based estimation and inference. This course also aims to develop students' independent research skills, and their report writing skills.

Summary: This course will consist of a mixture of lectures, tutorials, and project work. First and second year courses have discussed how to draw conclusions from data, and introduced some basic methods in an informal way. In this course we take a more fundamental approach to estimation and quantifying the accuracy of estimates.

In lectures we introduce the principles of classical and Bayesian inference discussing their different philosophical bases, and comparing the different solutions that each method gives to various problems of inference. The properties and fundamental importance of the likelihood are described, along with some important results on the sampling properties of estimators. The course will emphasise worked examples and there will be project work based on the computer implementation of the theory taught in lectures and tutorials. The statistical computer package R will be used for the project work.

Prerequisites: F78PA and F78PB (or equivalent).

Books:
- P.H. Garthwaite et al, Statistical Inference, 2nd ed. (Oxford Science Publ., 2002);
- G. Casella & R.L. Berger, Statistical Inference, 2nd ed. (Thomson Learning, 2002);

Assessment: 2-hour exam on the lecture material in December (60%) and two projects (20% each). This course is synoptically linked with F79MB.

F79MB STATISTICAL MODELS B Lecturer: D. Clancy

Aims: To develop students abilities in understanding and solving statistical problems, and to teach them how to choose appropriate techniques, analyse data and present results, especially in applications related to linear and generalised linear models.

Summary: The course will consist of a mixture of lectures and practical work. The first part of the course will focus on statistical modelling, including the selection of appropriate models, the analysis and interpretation of results, and diagnostics. Exploratory and graphical techniques will be considered, as well as more formal statistical procedures. Both parametric and nonparametric methods will be discussed, as will modern robust techniques. There will be considerable emphasis on examples, applications and case studies, especially for continuous response variables. Some theory of multiple linear regression in matrix notation will be presented. The course will go on to consider the theory and techniques for the analysis of categorical data,
including the use of generalised linear models (log-linear and logistic regression models). Practical applications will be emphasised throughout and computing facilities, especially R, will be used extensively.

**Prerequisites:** F78PA and F78PB (or equivalent).

**Books:** The following textbooks are recommended:
- A.J. Dobson, An Introduction to Generalized Linear Models, 2nd ed. (Chapman & Hall, 2002);
- J. Faraway, Linear models with R (Chapman & Hall, 2005);
- J. Faraway, Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models (Chapman & Hall/CRC, 2006);
- P.H. Garthwaite, I.T. Jolliffe & B. Jones, Statistical Inference, 2nd ed. (Prentice Hall, 2002);
- J. Verzani, Using R for Introductory Statistics (Chapman & Hall/CRC, 2005) (back-ground);

**Assessment:** Two practical assignments, to be handed in at specified times during the semester. This course is synoptically linked with F79MA.

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**F79PS STATISTICS FOR SOCIAL SCIENCE. Lecturer: J. Phillips**

**Aims:** To introduce students to the main classical statistical methods that are commonly applied in psychology and other social sciences and to give hands-on experience of using more advanced techniques for exploring multivariate data.

**Summary:** In social sciences, such as psychology, experiments and surveys typically yield large quantities of high-dimensional data (e.g. in the form of questionnaire responses) from which we wish to extract simpler underlying relationships, or evidence of differences in subgroups in a population. The course will give students a grounding in the most common classical statistical methods used in analysing psychological data, the correct interpretation of results, and the application of methods to real data sets using the computer package SPSS. Topics covered will include: confidence intervals, hypotheses testing, parametric and non-parametric statistical methods, analysis of variance (incorporating one-way designs, planned and unplanned comparisons, factorial designs and interactions), principal components analysis and the interpretation and use of factor analysis.

**Prerequisites:** F78PA and F78PB, or F78SC (or equivalent).

**Books:**
- Brace, Kemp & Snelgar, SPSS for Psychologists, 3rd ed. (Palgrave Macmillan, 2006);
- H. Coolican, Research Methods and Statistics in Psychology (Hodder & Stoughton, 1999);

**Assessment:** 2-hour exam in December (60%) and project work (40%).
**F79SP**  
**STOCHASTIC PROCESSES**  
**Lecturer: S. Foss**

**Aims:** To introduce fundamental stochastic processes which are useful in insurance, investment and stochastic modelling, and to develop techniques and methods for simulation and the analysis of the long term behaviour of these processes.

**Summary:** In this course, we develop methods for modelling systems or quantities which change randomly with time. Specifically, the evolution of a system is described by a collection \( \{X_t\} \) of random variables, where \( X_t \) denotes the state of the system at time \( t \).

Discrete-time processes studied include Markov chains. In particular, we consider branching processes, random walk processes, and more general countable state-space chains. Continuous-time processes studied include point processes, Poisson and compound Poisson processes; continuous time Markov processes; population, queueing and risk models.

**Prerequisites:** F78PA and F78PB (or equivalent).

**Books:** Useful reference books are

- P. Bremaud, An Introduction to Probabilistic Modeling, (Springer, 1997);
- Grimmett & Stirzaker, Probability and Random Processes, 3rd ed. (OUP, 2001);
- Grinstead & Snell, Introduction to Probability, (Amer. Math. Soc., 1997);

**Assessment:** 2-hour exam (80%) at the end of the 1st semester, project work (20%).

This course is synoptically linked to F79SU on all degrees except FM.

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**F79BI**  
**BAYESIAN INFERENCE & COMPUTATIONAL METHODS**  
**Lecturer: G.J. Gibson, G. Streftaris**

**Aims:** To provide students with a knowledge of modern Bayesian statistical inference, an understanding of the theory and application of stochastic simulation methods including MCMC, and experience of implementing the Bayesian approach in practical situations.

**Summary:** The course will review subjective and frequentist probability, the role of likelihood as a basis for inference, and give a comparative treatment of Bayesian and frequentist approaches. The key concepts in practical Bayesian statistics will be covered including: likelihood formulation; the incorporation of prior knowledge or ignorance in the prior; the interpretation of the posterior distribution as the totality of knowledge and its use in prediction. Methods for assessing the goodness-of-fit of models in the Bayesian context will be considered. A range of stochastic simulation methods for investigating posterior distributions will be considered. Methods will include rejection sampling, and Markov chain methods such as the Metropolis-Hastings algorithm and the Gibbs sampler. The use of stochastic methods for inference for
partially observed processes will be discussed and students will gain experience of implementing methods in computer laboratory sessions.

**Prerequisites:** F78PA and F78PB (or equivalent).

**Books:**
- (useful) P.H. Garthwaite et al, Statistical Inference, 2nd ed. (Oxford Sc. Publ., 2002);
- W.M Bolstad, Introduction to Bayesian Statistics (Wiley, 2004);

**Assessment:** 2-hour exam (60%) and two practical assignments (20% each).

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**PORTFOLIO THEORY & ASSET MODELS**  
Lecturer: S. Shneer, M Fahrenwaldt

**F79PA**

**Aims:** To introduce asset pricing and portfolio selection models. This course covers the first half of the material in Subject CT8 of the Institute and Faculty of Actuaries examinations. Summary: This course covers the following topics:
- Utility theory,
- Stochastic dominance
- Measures of investment risk,
- Mean-variance portfolio theory,
- Models of asset returns, and
- Efficient markets hypothesis.

Students are expected to understand the basic mathematical skills of decision theory and apply them to various stochastic problems.

**Prerequisites:** F78PA and F78AB (or equivalent).

**Books:**
- (Main reference) Joshi & Paterson, Introduction to Mathematical Portfolio Theory, 1st ed. (CUP);
- Brown, Elton, Goetzman & Gruber, Modern Portfolio Theory and Investment Analysis, 9th ed. (Wiley, older editions are adequate).

**Assessment:** 2-hour exam (80%) at the end of the 1st semester, a midterm test (10%) and two assignments (10%). This course is synoptically linked to F79DF on all degrees except SM.
Aims: This course introduces students to derivatives, their use in financial markets and how they are priced and hedged in discrete time. It introduces the relationship between financial markets and stochastic analysis.

Summary: The course introduces the idea of derivative securities and why they exist, explaining the role of forward and option contracts in risk management, and discusses various investment strategies involving derivatives. The concept of arbitrage-free pricing (cash-and-carry pricing) is explained and developed into the fundamental theorem of asset pricing in discrete time. Pricing on the binomial tree (the CRR model) is explained, for both European- and American-style derivatives, in the context of the fundamental theorem, and the relationship between the CRR model and the continuous-time Black-Scholes-Merton formula is discussed. The fundamental properties of option prices are given.

This course covers some of the material in Subject CT8 of the Institute and Faculty of Actuaries examinations.

Prerequisites: F78PA and F78AB (or equivalent).

Books: Recommended texts are:

- A. Chatterjea & R.A. Jarrow, An Introduction to Derivative Securities, Financial Markets and Risk Management (W.W. Norton, 2013);

Assessment: 2-hour end-of-semester exam (80%), continuous assessment (20%). This course is synoptically linked to F79PA on all degrees except SM.
Aims:
1. To understand the use of mathematical models of mortality, illness and other life-history events in the study of processes of actuarial interest.
2. To be able to estimate the parameters in these models, mainly by maximum likelihood.
3. To describe and apply methods of smoothing rates of mortality and other actuarial statistics based on observed data.

Summary:
1. Estimation procedures for lifetime distributions: Kaplan-Meier estimate of the survival function, the Nelson-Aalen estimate of the cumulative hazard function and estimation for the Cox model for proportional hazards.
2. Statistical models for transfers between multiple states (e.g., alive, ill, dead), relationships between probabilities of transfer and transition intensities, and estimation for the parameters in these models.
4. Computing facilities, especially R, will be used extensively and this work will be assessed by practical assignments.

Prerequisites: F78AB and F78PB (or equivalent).

Book:
I.D. Currie, Survival Models (Heriot-Watt University notes, supplied by the department).

Assessment: 2 hour exam (80%-90%), project work (10%-20%). The exact split between exam and project work will be announced at the start of the course. This course is synoptically linked to F79SP (except on the FM degree).
5.4 Level 10 and 11 Courses

F70TS TIME SERIES Lecturer: F. Daly

**Aims:** To introduce many of the fundamental concepts required for modelling and forecasting time series data.

**Summary:** A time series is a set of data consisting of observations made one after another in time. The analysis of time series data is an area of practical importance in finance, business, economics, industry, medicine, life and physical sciences and many other fields.

The course begins with real data, and some descriptive methods for identifying, and removing if appropriate, trend and seasonal effects. We consider moving averages and exponential smoothing, along with other approaches. This leads into the important concepts of stationarity and autocorrelation.

The main body of the course consists of modelling the stochastic mechanism which gives rise to an observed series, and then using model-based forecasting procedures to predict future values of the series.

The models we consider are autoregressive moving average (ARMA) processes, and autoregressive integrated moving average (ARIMA) processes. Various methods of parameter estimation are considered, including the method of moments, least-squares, conditional least-squares, and maximum likelihood. We then perform residual analysis, and consider over-fitting and the principle of parsimony. The course ends with consideration of various forecasting methods.

Although the approach is mainly orientated to utilising time-dependence, we also consider the frequency aspects of series and study the periodogram and the spectral density. We relate the two approaches.

**Prerequisites:** F78PA and F78PB (or equivalent).

**Books:** Useful references are

- C. Chatfield, The Analysis of Time Series (Chapman Hall);
- P. Diggle, Time Series (OUP);
- P. Cowpertwait and A. Metcalfe, Introductory Time Series with R (Springer).

**Assessment:** 2-hour exam (85%) and a project (15%).
**F70DA**  STATISTICS DISSERTATION A  Lecturer: D.Clancy
**F70DB**  STATISTICS DISSERTATION B  Lecturer: G.Streftaris

**Aims:** To carry out an extensive study of a problem in probability or statistics, testing skills learnt from previous courses, and to develop skills in project work, including literature search and the writing and presentation of reports.

**Summary:** Each student will do one project each semester. Students will be allocated to supervisors on registration in September; precise topics and work plans will be decided by supervisors in consultation with students.

**Prerequisites:** F79MA and F79MB.

**Assessment:** 1 dissertation per course. These courses are synoptically linked.

**F70LA**  LIFE INSURANCE MATHEMATICS A  Lecturer: P. Ridges

**Aims:** To extend the coverage of life assurance mathematics in F78AB to include some of the material for Subject CT5 of the Institute and Faculty of Actuaries examinations.

**Summary:** By combining the mathematics of finance and the mortality table, we can develop the functions necessary to value a wide range of benefits which may be payable on death or survival. Some of the functions will be clear extensions of those previously encountered, while others will be new. Such benefits are often provided by insurance policies. The course will study some of the essential calculations made by insurance companies in valuing their contracts and calculating premiums. You will learn how to deal with questions involving:
- selection and select life tables,
- actuarial functions using select life tables,
- with profits policies,
- net premiums and gross premiums,
- expenses and bonuses,
- net and gross premium policy values.

There will be three lectures, one tutorial per week. Also one computer lab (Microsoft Excel) in some weeks.

**Prerequisites:** F78AA and F78AB (or equivalent).

**Books:**

- Formulae and Tables for Actuarial Examinations – ESSENTIAL
- Dickson, Hardy & Waters, Actuarial Mathematics for Life Contingent Risks (CUP, 2009). An electronic version of this book is available in PDF format online. (F70LA covers material in the first seven chapters.)

**Assessment:** 2-hour exam (80%) at the end of the 1st semester and an Excel-based assignment (20%). This course is synoptically linked with F70LB.
F70LB  LIFE INSURANCE MATHEMATICS B  Lecturer: A.E. Sneddon

Aims: To extend the coverage of life assurance mathematics in F70LA to include further material for Subject CT5 of the Institute and Faculty of Actuaries examinations. Summary: In this course, you will learn how to deal with questions involving:

- Thiele's differential equation,
- Markov multiple-state models,
- risk reserves,
- insurances written on multiple lives,
- the features of disability and long-term care insurance contracts,
- heterogeneity and selection,
- single-figure indices,
- profit testing conventional and unit-linked insurance contracts.

There will be three lectures and one tutorial per week. Also one computer lab (Microsoft Excel) in some weeks.

Prerequisites & books: See F70LA.

Assessment: 2-hour exam (80%) at the end of the 2nd semester and an Excel-based assignment (20%). This course is synoptically linked with F70LA.

F70CF  CONTINUOUS-TIME FINANCE  Lecturer: T. Kleinow

Aims: This course develops the theory and practice of financial derivatives pricing in continuous time, following on from the course F79DF Derivatives Markets and Discrete-Time Finance.

Summary:

1. Theory of martingales in continuous time, Brownian motion, and its properties, stochastic integration, stochastic differential equations and Ito's formula, Girsanov's theorem and the Martingale Representation Theorem.
2. The Black-Scholes model, derivatives pricing using the martingale and PDE approaches, extensions to foreign currencies and dividend-paying stocks.
3. Portfolio risk management.
4. Interest rate models, and credit risk models.
5. Other models of security prices.

There will be weekly tutorial sessions, starting in the second week of term.

Prerequisites: F79SP and F79DF (or equivalent).

Books:

- M. Baxter & A. Rennie, Financial Calculus (CUP, 1996); R. Durrett, Stochastic Calculus (CRC Press);
- J. Hull, Options, Futures and Other Derivative Securities, 3rd/4th ed. (Prentice Hall, 1996);
- B. Oksendal, Stochastic Differential Equations (Springer, 1998); D. Williams, Probability with Martingales (CUP, 1997).

Assessment: 2-hour exam at the end of the 1st semester.
**Aims:** To introduce fundamental practical and technical issues in the actuarial management of UK occupational pension schemes.

**Summary:** The foundations of actuarial mathematics have been covered in 2nd and 3rd year courses. This course takes some of that work and places it in a practical context.

A pension scheme is an arrangement whereby an employer invests money for the benefit of its employees and their dependents after they retire or on death before retirement. Some obvious questions arising are:

- What level of benefit is reasonable?
- How should the cost of the benefits to the employer be spread out? How should the fund be invested?
- How can the actuary be certain that the scheme will not run out of money, even if the employer does?

The course will discuss benefit design - that is, exactly what benefits could be offered. We will discuss how the actuary can assess the cost of the benefits, including how she/he might choose the interest, inflation, salary and service table assumptions necessary. We will discuss investment principles and practice for pension schemes, and we will cover briefly the tax and legislation issues relevant to UK pension schemes.

While some of the work will be technical in nature, we will also consider some more general issues surrounding pension schemes, including monitoring pensions issues currently in the news. Students will be expected to read the financial press regularly and will be required to give a short presentation to the class on a particular current issue. Most technical actuarial work involves computers and this course will include regular computer laboratory sessions.

**Prerequisites:** F70LA and F70LB (or equivalent).

**Assessment:** This course and F70LP will be examined together in a 3-hour exam (80%) at the end of the 2nd semester. Both courses will have an assessed project (10% each).
F70LP    LIFE OFFICE PRACTICE    Lecturer: G. Reid

**Aims:** The aim of this course is to introduce students to the practical issues arising in life insurance and the management of a life insurance company.

**Summary:** The course covers modern life office practice, e.g. types of policy and the risks to which an office is exposed in writing them (conventional and unitised with-profits, non-profit, unit-linked), premiums, actuarial bases (for premiums, experience and valuation), bonus systems for distributing profits, solvency, nature and valuation of assets and liabilities, and asset shares. More advanced topics are also covered, including stochastic modelling, hedging/matching, reserving requirements, capital requirements, orphan assets, financial strength, and guarantees. The course will involve practical work, tutorial and project work. Most technical actuarial work involves computers and this course will include regular computer laboratory sessions.

**Prerequisites:** F70LA and F70LB (or equivalent).

**Assessment:** This course and F70PE will be examined together in a 3-hour exam (80%) at the end of the 2nd semester. Both courses will have an assessed project (10% each).

F70DP    ADVANCED DERIVATIVE PRICING    Lecturer: T.C. Johnson

**Aims:** The aim of this course is to introduce students to advanced and practical topics in derivative markets, which are essential preparation for a career in the financial industry. This course is available only to students on the BSc in Financial Mathematics.

**Summary:** The material develops ideas from F70CF and F79DF. The course begins with a review of some of the key concepts in stochastic calculus. It then moves on to applying these to the question of stochastic volatility, in pricing exotic options and in the interest rate markets. Numerical techniques for practical application of the theory are also covered. The course finishes with a discussion of structured products and synthetic securities and associated risk management issues.

**Prerequisites:** F79SP and F79DF (or equivalent).

**Books:**

- M. Joshi, The Concepts and Practice of Mathematical Finance (CUP, 2003); J.C. Hull, Options, Futures and Other Derivatives, 8th ed. (Prentice Hall, 2011);

**Assessment:** 2-hour exam (75%) and project work (25%).
Aims: To provide an introduction to the advanced statistical methods underpinning Financial Risk Management (FRM) and Enterprise Risk Management (ERM), and a thorough grounding in the wide range of risks facing a company. To develop key risk assessment skills.

Summary: This course will give students an introduction to the risk measurement and management process. We will see how financial institutions are faced with a bewildering array of risks of all types. Some of the course will focus on risks that are amenable to rigorous statistical analysis, and the process of selecting a good statistical model for forecasting the future. In isolation, students will already be familiar with the individual components of an analysis. The course pulls all of these together to look at the modelling process as a whole and as one part of the bigger risk management cycle. Essential elements of the learning and feedback process are the computer labs where we turn classroom theory into practice.

Prerequisites: F78PB and F79PA (or equivalent).

Books:


Assessment: 2-hour exam (80%) at the end of the 2nd semester, project work (20%).
F70RT  RISK THEORY  Lecturer: V. Shneer

Aims: To introduce and apply the statistical techniques used in the analysis of insurance processes, in particular for the assessment of premiums for short term insurance contracts, for reserving, and for assessing and managing solvency risk.

Summary: We look at some mathematical/statistical models and techniques which are useful in insurance, particularly short term insurance (for example motor, household, employers' liability).
We look at how to find the compound distribution of aggregate claims by combining the frequency of claims with the distribution of the amounts paid out on individual claims; we will consider how this might be used to set a premium, and how the insurers insure themselves through reinsurance.
We then study aspects of experience rating, which is a method of setting a premium for a policy which is affected by the claims history of that policy. We look at experience rating using Bayesian credibility theory, and in the context of No Claims Discount systems.
The final three topics covered are:
1. ruin theory (we consider a stochastic model for the reserves of a general insurer and examine the probability that the reserves fall below zero);
2. run-off triangles (we study methods used to determine appropriate reserves for general insurance);
3. simulation.

Prerequisites: F79MA (or equivalent).

Assessment: 2-hour exam at the end of the 2nd semester (85%), project work (15%).

F10MM  OPTIMISATION  Lecturer: D. Breit

Aims: To present different methods of solving optimisation problems in the areas of linear and nonlinear programming, and classical calculus of variations. In addition, there will be an introduction to numerical methods.

Summary: The syllabus is as follows:
1. Introduction: simplified examples of common real world situations leading to optimisation problems.
2. Linear programming (optimisation of linear functions subject to linear constraints): basic theory, simplex method, duality, practical techniques.
5. Variational problems: Euler-Lagrange equation, boundary conditions constraints.
Prerequisites: F18CD and F18CF.

Books: The course is based on the following book:

Assessment: 2-hour exam at the end of the 1st semester.

F71CM CREDIT RISK MODELLING Lecturer: M. Fahrenwaldt

Aims: To introduce students to quantitative models for measuring and managing credit risk; to provide students with an understanding of the credit risk methodology used in the financial industry and the regulatory framework in which the credit risk models operate.

Summary: Topics covered include:
1. Introduction to credit risk: credit-risky instruments, defaults, ratings.
2. Merton's model of the default of a firm.
3. Common industry models (KMV, CreditMetrics, CreditRisk+).
4. Modelling dependence between defaults with factor models.
5. Mixture models of default.
6. The Basel II regulatory capital formula.
7. Calculating the portfolio credit loss distribution.
8. Calibration and statistical inference for credit risk models.

Books:

Assessment: 2-hour exam
Actuarial Mathematics and Statistics: Code of Practice

What you can expect from AMS Staff

Teaching is one of the most important duties for AMS staff. Although academic staff have research and administrative duties which also need our attention, we aim to provide:

- Commitment to helping you learn
- Politeness and respect
- Availability for face-to-face meetings, either during scheduled office hours or at pre-arranged times
- Timely feedback and marks for coursework
- A prompt response from your mentor
- A timely reply to general email questions
- An opportunity to see your exam script to see where you went wrong, either at scheduled feedback sessions or by applying at the School Office to see your script. You can also make an appointment with the lecturer to get further advice on how to improve your work.

Sometimes staff members are away on University business and won’t be able to respond as quickly as normal. If this happens, they will tell you about it (e.g. on an "out-of-office" message) and will advise you who to contact instead.

*If you have a problem...*

For personal problems or any other problem that is interfering with your studying, please discuss it with your personal tutor. We are here to help. You can also discuss any personal problems with the staff in the Student Support Office.

For problems about a course, talk to the lecturer first. If that doesn't help, you can raise the matter with your Class Rep. or the Year Director of Studies.
What staff can expect from AMS students

Most importantly, we expect you to take charge of your own learning. This is your degree - to get the most of your time at the University you need to be independent and proactive. We understand that you may have other demands on your time, but as full-time students, your studies should come first. In addition, we expect:

- Commitment to your learning
- Politeness and respect, including switching off phones and other social media during classes.
- Attendance at classes. During the semester it is your responsibility to be available on campus to attend classes and in particular class tests.
- Preparation for classes as specified by your lecturers, such as studying lecture notes, working on tutorial questions and participating in online activities. For every hour of timetabled class, we expect you to spend 2-3 hours in private study.
- Persistance. Some topics and problems in mathematics are challenging and we expect you to make a sustained effort to master difficult topics. We are there to help you if you get stuck.
- Basic organisational skills, including coming to classes with pen and paper ready to take notes or with equipment for electronic note-taking, and using a calendar so that you don't forget deadlines and appointments.
- Attendance at any scheduled meeting with a staff member. If you can’t make a scheduled meeting with a staff member, please notify them in advance rather than just not turning up.
- Checking your email and logging into VISION at least every other day.
- A timely reply to email from staff.
- Willingness to learn from feedback on tutorial work, projects and exams, and an attempt to improve your work based on that feedback.
- Finally, we encourage you to keep yourself informed about new and interesting developments in your discipline (beyond what you learn in your courses). The department is full of experts in a wide range of areas who are happy to chat with you about topics of current interest. Seek them out!
STUDENT GUIDE TO PLAGIARISM ¹

Plagiarism is intellectual theft and is a major offence which the University takes seriously in all cases. Students must therefore avoid committing acts of plagiarism by following these guidelines and speaking to academic staff if they are uncertain about what plagiarism means. Those who are found to have plagiarised will be subject to the University’s disciplinary procedures, which may result in penalties ranging from the deduction of credits and modules already achieved by students to compulsory termination of studies. Students are advised to refer to Regulation 50 at http://www.hw.ac.uk/ordinances/regulations.pdf and to the Guidelines for Staff and Students on Discipline at http://www.hw.ac.uk/students/studies/examinations/plagiarism.htm for further details of how the University deals with all acts of plagiarism.

Introduction
1.1. This guide is intended to provide students at Heriot-Watt University with a clear definition of plagiarism and examples of how to avoid it.

1.2. The guide may also be of use to members of staff who seek to advise students on the various issues outlined below.

Definition
1.3. Plagiarism involves the act of taking the ideas, writings or inventions of another person and using these as if they were one’s own, whether intentionally or not. Plagiarism occurs where there is no acknowledgement that the writings or ideas belong to or have come from another source.

1.4. Most academic writing involves building on the work of others and this is acceptable as long as their contribution is identified and fully acknowledged. It is not wrong in itself to use the ideas, writings or inventions of others, provided that whoever does so is honest about acknowledging the source of that information. Many aspects of plagiarism can be simply avoided through proper referencing. However, plagiarism extends beyond minor errors in referencing the work of others and also includes the reproduction of an entire paper or passage of work or of the ideas and views contained in such pieces of work.

Good Practice
1.5. Academic work is almost always drawn from other published information supplemented by the writer’s own ideas, results or findings. Thus drawing from other work is entirely acceptable, but it is unacceptable not to acknowledge

¹ The author acknowledges the following sources of information used in preparing this guide to Plagiarism:

such work. Conventions or methods for making acknowledgements can vary slightly from subject to subject, and students should seek the advice of staff in their own School about ways of doing this. Generally, referencing systems fall into the Harvard (where the text citation is by author and date) and numeric (where the text citation is by using a number). Both systems refer readers to a list at the end of the piece of work where sufficient information is provided to enable the reader to locate the source for themselves.

1.6. When a student undertakes a piece of work that involves drawing on the writings or ideas of others, they must ensure that they acknowledge each contribution in the following manner:

- **Citations**: when a direct quotation, a figure, a general idea or other piece of information is taken from another source, the work and its source must be acknowledged and identified where it occurs in the text;

- **Quotations**: inverted commas must always be used to identify direct quotations, and the source of the quotation must be cited;

- **References**: the full details of all references and other sources must be listed in a section at the end of any piece of work, such as an essay, together with the full publication details. This is normally referred to as a “List of References” and it must include details of any and all sources of information that the student has referred to in producing their work. (This is slightly different to a Bibliography, which may also contain references and sources which, although not directly referred to in your work, you consulted in producing your work).

1.7. Students may wish to refer to the following examples which illustrate the basic principles of plagiarism and how students might avoid it in their work by using some very simple techniques:

1.7.1. **Example 1: A Clear Case of Plagiarism**

Examine the following example in which a student has simply inserted a passage of text *(in italics)* into their work directly from a book they have read:

> University and college managers should consider implementing strategic frameworks if they wish to embrace good management standards. *One of the key problems in setting a strategic framework for a college or university is that the individual institution has both positive and negative constraints placed upon its freedom of action.* Managers are employed to resolve these issues effectively.

This is an example of bad practice as the student makes no attempt to distinguish the passage they have inserted from their own work. Thus, this constitutes a clear case of plagiarism. Simply changing a few key words in such a passage of text (e.g. replace ‘problems’ with ‘difficulties’) does not make it the student’s work and it is still considered to be an act of plagiarism.
1.7.2. Common Mistakes

Students may also find the following examples of common plagiarism mistakes made by other students useful when reflecting on their own work:

- “I thought it would be okay as long as I included the source in my bibliography” [without indicating a quotation had been used in the text]
- “I made lots of notes for my essay and couldn’t remember where I found the information”
- “I thought it would be okay to use material that I had purchased online”
- “I thought it would be okay to copy the text if I changed some of the words into my own”
- “I thought that plagiarism only applied to essays, I didn’t know that it also applies to oral presentations/group projects etc”
- “I thought it would be okay just to use my tutor’s notes”
- “I didn’t think that you needed to reference material found on the web”
- “I left it too late and just didn’t have time to reference my sources”

None of the above are acceptable reasons for failing to acknowledge the use of others’ work and thereby constitute plagiarism.

1.8. What follows are examples of the measures that students should employ in order to correctly cite the words, thought or ideas of others that have influenced their work:

1.8.1. Example 2: Quoting the work of others

If a student wishes to cite a passage of text in order to support their own work, the correct way of doing so is to use quotation marks (e.g. “ ”) to show that the passage is someone else’s work, as follows:

“One of the key problems in setting a strategic framework for a college or university is that the individual institution has both positive and negative constraints placed upon its freedom of action”.

1.8.2. Example 3: Referencing the work of others

In addition to using quotation marks as above, students must also use a text citation. If the work being cited is a book, page numbers would also normally be required. Thus, using the Harvard system for a book:

“One of the key problems in setting a strategic framework for a college or university is that the individual institution has both positive and negative constraints placed upon its freedom of action” (Jones, 2001, p121).

The same reference could also be made to a book using the numeric system:

“One of the key problems in setting a strategic framework for a college or university is that the individual institution has both positive

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2 Extract from ‘Plagiarism at the University of Essex’ advice copyrighted and published by the Learning, Teaching and Quality Unit at the University of Essex (http://www.essex.ac.uk/plagiarism/reasons.html), reproduced with kind permission.
and negative constraints placed upon its freedom of action” (Ref. 1, p121).

More often, a piece of work will have multiple references and this serves to show an examiner that the student is drawing from a number of sources. For example, articles by Brown and by Smith may be cited as follows in the Harvard system

“It has been asserted that Higher Education in the United Kingdom continued to be poorly funded during the 1980’s [Brown, 1991], whereas more modern writers [Smith, 2002] argue that the HE sector actually received, in real terms, more funding during this period than the thirty year period immediately preceding it”.

or as follows using the numeric system:

“It has been asserted that Higher Education in the United Kingdom continued to be poorly funded during the 1980’s [Ref 1], whereas more modern writers [Ref 2] argue that the HE sector actually received, in real terms, more funding during this period than the thirty year period immediately preceding it”.

1.8.3. Example 4: Use of reference lists

Whichever system is used, a list must be included at the end, which allows the reader to locate the works cited for themselves. The Internet is also an increasingly popular source of information for students and details must again be provided. You should adhere to the following guidelines in all cases where you reference the work of others:

If the source is a book, the required information is as follows:
- Author’s name(s)
- Year of Publication
- Title of Book
- Place of Publication
- Publishers Name
- All Page Numbers cited
- Edition (if more than one, e.g. 3rd edition, 2001)

If the source is an article in a journal or periodical, the required information is as follows:
- Author’s name(s)
- Year of Publication
- Title of Journal
- Volume and part number
- Page numbers for the article

If the source is from the Internet, the required information is as follows:
- Author’s or Institution’s name ("Anon", if not known)
- Title of Document
- Date last accessed by student
- Full URL (e.g.http://www.lib.utk.edu/instruction/plagiarism/)
- Affiliation of author, if given (e.g. University of Tennessee)

The way in which the information is organised can vary, and there are some types of work (for example edited volumes and conference proceedings) where the required information is slightly different. Essentially, though, it is your responsibility to make it clear where you are citing references within your work.
and what the source is within your reference list. **Failure to do so is an act of plagiarism.**

1.9. Students are encouraged to use a style of acknowledgement that is appropriate to their own academic discipline and should seek advice from their mentor, course leader or other appropriate member of academic staff. There are also many reference sources available in the University Library which will provide useful guidance on referencing styles.

**Managing Plagiarism**

1.10. Students, supervisors and institutions have a joint role in ensuring that plagiarism is avoided in all areas of academic activity. Each role is outlined below as follows:

*How you can ensure that you avoid plagiarism in your work:*
- Take responsibility for applying the above principles of best practice and integrity within all of your work
- Be aware that your written work will be checked for plagiarism and that all incidents of plagiarism, if found, are likely to result in severe disciplinary action by the University. The standard penalty is to annul all assessments taken in the same diet of examinations (for details please refer to Regulation 50 at [http://www1.hw.ac.uk/ordinances/regulations.pdf](http://www1.hw.ac.uk/ordinances/regulations.pdf) and to the Guidelines for Staff and Students on Discipline at [http://www.hw.ac.uk/students/studies/record/discipline.htm](http://www.hw.ac.uk/students/studies/record/discipline.htm)).

*How your School will help you to avoid plagiarism:*
- Highlight written guidance on how you can avoid plagiarism and provide you with supplementary, verbal guidance wherever appropriate
- Regularly check student work to ensure that plagiarism has not taken place. This may involve both manual and electronic methods of checking. A number of plagiarism detection packages are in use at Heriot-Watt University, one example being the Joint Information Systems Committee (JISC) “TurnitIn” plagiarism detection software.
- Alert you to the procedures that will apply should you be found to have committed or be suspected of having committed an act of plagiarism and explain how further action will be taken in accordance with University policy and procedures.

*How the University will endeavour to reduce student plagiarism:*
- Provide clear written guidance on what constitutes plagiarism and how to avoid it directly to your School and to you
- Alert you and staff in your School to the penalties employed when dealing with plagiarism cases
- Take steps to ensure that a consistent approach is applied when dealing with cases of suspected plagiarism across the institution
- Take the issue of academic dishonesty very seriously and routinely investigate cases where students have plagiarised and apply appropriate penalties in all proven cases.