Students in this unit should read this unit guide carefully at the start of semester. It contains important information about the unit. If anything in it is unclear, please consult one of the teaching staff in the unit.

ABOUT THIS UNIT

Unit description:

This unit provides a rigorous mathematical development of compound interest theory, using calculus where appropriate, applying the theory to problems more complex than those encountered in ACST101 Techniques and Elements of Finance. Topics include the force of interest and its relationship to interest rates, inflation and capital gains tax, discrete and continuous term certain annuities, project appraisal, loans, bonds, yield curves, matching and immunisation, pricing by the ‘no arbitrage’ assumption and forward rate agreements. Students are assumed to be able to use the basic functionality of a spreadsheet package of their choice. The concepts developed in this unit are required in several subsequent units in the actuarial degree. Students gaining a grade of credit or higher in this unit are eligible for exemption from subject CT1 of the professional exams of The Institute of Actuaries of Australia.

Unit rationale:

Much of the work that actuaries do involves long term financial problems. For any problem spanning more than a few months, the effects of compound interest are significant. This unit is a detailed study of compound interest. As far as possible, the examples considered are real life problems, though in some cases we deliberately simplify scenarios so that we can concentrate on the interesting maths rather than getting distracted by fiddly details.

TEACHING STAFF

• Convenor and Lecturer: Jim Farmer

CONTACTING STAFF
You are encouraged to seek help at a time that is convenient to you by using this unit’s iLearn web site, described later in this document.

- Questions about the unit material should be placed in the appropriate Forum in the unit’s web site. (In the Blackboard software used in previous years these were called Discussion Forums.)
- Administrative questions which have not already been answered in this document or the Student Guide should be sent to the unit’s Teaching Assistant using a Dialog in the unit’s web site. (Dialogs are the equivalent of Blackboard’s Mail tool.)

### CLASSES

- There are 4 hours of face-to-face teaching per week consisting of 3 hours of lectures and 1 hour of tutorial.
- Class times can be found at: http://www.timetables.mq.edu.au/
- In this unit, there are no tutorials in Week 1.
- Since all ACST202 tutorials are scheduled at the same time, we take the opportunity to stream the classes based on past performance. Ignore the tute location you selected in eStudent. Check the unit’s web site around Monday of Week 2 to find the location of your tutorial.

### REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

Lecture notes, tutorial exercises and readings are available on the unit’s web site.

The following is a list of all textbooks we are aware of that cover material from this unit, with their Macquarie University call numbers where appropriate.

Course notes for the UK Institute courses may be purchased from ActEd. (http://www.acted.com.au)

**TECHNOLOGY USED AND REQUIRED**

- You will require a calculator. For the test and the final exam, you may only use non-programmable calculators which are not able to store text.
- You may find it useful to be able to construct spreadsheets to verify your solutions to tutorial exercises. We do not prescribe any particular brand of spreadsheet.

**UNIT WEB PAGE**

- Course material is available on iLearn.
- The Blackboard Learning Management System used in previous years has been replaced by Moodle. iLearn is the university’s chosen name for a suite of software packages including Moodle, eStudent, Turnitin and other components. In this unit, only the Moodle component is being used.
- You can login at https://ilearn.mq.edu.au/

**LEARNING OUTCOMES**

The learning outcomes of this unit are that students should be able to demonstrate a deep understanding of:

1. Compound interest theory in both discrete and continuous time
2. The use of annuities
3. The mathematics of loans
4. The mathematics involved in analysing investment projects
5. Valuation of fixed interest securities, including the use of yield curves & use of the “no arbitrage” pricing method
6. Immunisation theory in the context of variations in interest rates.

**GRADUATE CAPABILITIES**

In addition to the discipline-based learning objectives, all academic programs at Macquarie seek to develop the capabilities the University’s graduates will need to develop to address the challenges, and to be effective, engaged participants in their world.

This unit contributes to this by developing the following graduate capabilities:

1. **Discipline Specific Knowledge and Skills**
   (a) Have an appreciation of the time value of money.
   (b) Be an expert in compound interest theory, in both discrete and continuous scenarios.
2. **Critical, Analytical and Integrative Thinking**
3. **Problem Solving Capability**
4. **Effective Communication**
LEARNING AND TEACHING ACTIVITIES

This unit is taught via lectures and tutorials. However, a significant amount of the lecture time will be spent on attempting problems. The emphasis is on learning by doing.

Students are expected to make a serious attempt at all tutorial problems prior to the relevant tutorial.

A detailed list of topics is provided at the end of this document.

RESEARCH AND PRACTICE

This unit uses research from external sources. While the mathematical techniques used in this unit are often quite complex, most were discovered over a century ago. Hence you can find the research we are using in the textbooks cited above, rather than needing to source recent research papers.

RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES

<table>
<thead>
<tr>
<th></th>
<th>Assessment Task 1</th>
<th>Assessment Task 2</th>
<th>Assessment Task 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title/Name</td>
<td>4 online quizzes on Topics 1 to 4</td>
<td>Test</td>
<td>Final Exam</td>
</tr>
<tr>
<td>Description</td>
<td>Early diagnostic tasks</td>
<td>Test held during class time</td>
<td>More detail below</td>
</tr>
<tr>
<td>Due date</td>
<td>Available from start of classes</td>
<td>Wednesday 21 March lecture</td>
<td>Held during final exam period</td>
</tr>
<tr>
<td>% Weighting</td>
<td>20%</td>
<td>10%</td>
<td>70%</td>
</tr>
<tr>
<td>Grading method</td>
<td>For the purpose of the satisfactory coursework requirement for special consideration requests, a raw mark of 65% is required for a pass.</td>
<td>To earn a particular grade you must meet the requirements of the definition of that grade.</td>
<td></td>
</tr>
<tr>
<td>Submission</td>
<td>Online</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Feedback (type, method, date)</td>
<td>Assessment Task 1</td>
<td>Assessment Task 2</td>
<td>Assessment Task 3</td>
</tr>
<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Immediate online feedback</td>
<td></td>
<td>Tasks will be returned at class as soon as possible. Uncollected items will be left at BESS. Test solutions, with comments on any common errors will be made available on the unit’s web site.</td>
<td></td>
</tr>
<tr>
<td>Estimated student workload (hours)</td>
<td>2</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Learning outcomes assessed</td>
<td>1 &amp; 2</td>
<td>1</td>
<td>All</td>
</tr>
<tr>
<td>Graduate capabilities assessed</td>
<td>1</td>
<td>1</td>
<td>All</td>
</tr>
</tbody>
</table>

For task 1 no extensions will be granted. If a student lodges a valid special consideration request in respect to a quiz, the weighting of the other quizzes will be increased appropriately to adjust for the missing quiz.

- Examinations

A final examination is included as an assessment task for this unit to provide assurance that:
  i) the product belongs to the student and
  ii) the student has attained the knowledge and skills tested in the exam.

A 3 hour final examination for this unit will be held during the University Examination period.

The University Examination period in First Half Year 2012 is from Tuesday 12 June to Friday 29 June.

You are expected to present yourself for examination at the time and place designated in the University Examination Timetable. The timetable will be available in Draft form approximately eight weeks before the commencement of
the examinations and in Final form approximately four weeks before the
commencement of the examinations.
http://exams.mq.edu.au/

The only exception to not sitting an examination at the designated time is because
of documented illness or unavoidable disruption. In these circumstances you may
wish to consider applying for Special Consideration. The University’s policy on
special consideration process is available at
http://www.mq.edu.au/policy/docs/special_consideration/policy.html

If a Supplementary Examination is granted as a result of the Special
Consideration process the examination will be scheduled after the conclusion of
the official examination period.

The Macquarie university examination policy details the principles and conduct of
examinations at the University. The policy is available at:
http://www.mq.edu.au/policy/docs/examination/policy.htm

**ACADEMIC HONESTY**

The nature of scholarly endeavour, dependent as it is on the work of others, binds all
members of the University community to abide by the principles of academic honesty.
Its fundamental principle is that all staff and students act with integrity in the creation,
development, application and use of ideas and information. This means that:

- all academic work claimed as original is the work of the author making the
  claim
- all academic collaborations are acknowledged
- academic work is not falsified in any way
- when the ideas of others are used, these ideas are acknowledged
  appropriately.

Further information on the academic honesty can be found in the Macquarie
University Academic Honesty Policy at
http://www.mq.edu.au/policy/docs/academic_honesty/policy.html

**GRADES**

Macquarie University uses the following grades in coursework units of study:

HD - High Distinction
D - Distinction
CR - Credit
P - Pass
F - Fail

Grade descriptors and other information concerning grading are contained in the
Macquarie University Grading Policy which is available at:
GRADING APPEALS AND FINAL EXAMINATION SCRIPT VIEWING

If, at the conclusion of the unit, you have performed below expectations, and are considering lodging an appeal of grade and/or viewing your final exam script please refer to the following website which provides information about these processes and the cut off dates in the first instance. Please read the instructions provided concerning what constitutes a valid grounds for appeal before appealing your grade.

http://www.businessandeconomics.mq.edu.au/new_and_current_students/undergraduate_current_students/how_do_i/grade_appeals

SPECIAL CONSIDERATION

The University is committed to equity and fairness in all aspects of its learning and teaching. In stating this commitment, the University recognises that there may be circumstances where a student is prevented by unavoidable disruption from performing in accordance with their ability. A special consideration policy exists to support students who experience serious and unavoidable disruption such that they do not reach their usual demonstrated performance level. The policy is available at: http://www.mq.edu.au/policy/docs/special_consideration/policy.html

STUDENT SUPPORT SERVICES

Macquarie University provides a range of Academic Support Services. Details of these and other services for students can be accessed at http://www.student.mq.edu.au.

IT CONDITIONS OF USE

Access to all student computing facilities within the Faculty of Business and Economics is restricted to authorised coursework for approved units. Student ID cards must be displayed in the locations provided at all times.

Students are expected to act responsibly when using University IT facilities. The following regulations apply to the use of computing facilities and online services:

- Accessing inappropriate web sites or downloading inappropriate material is not permitted. Material that is not related to coursework for approved units is deemed inappropriate.
- Downloading copyright material without permission from the copyright owner is illegal, and strictly prohibited. Students detected undertaking such activities will face disciplinary action, which may result in criminal proceedings.

Non-compliance with these conditions may result in disciplinary action without further notice.
Students must use their Macquarie University email addresses to communicate with staff as it is University policy that the University issued email account is used for official University communication.
### Detailed Schedule & List of Topics

<table>
<thead>
<tr>
<th>Week</th>
<th>Week Begins</th>
<th>Topics Covered in Lectures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27 Feb</td>
<td>1. Interest Rates – Discrete time scenarios</td>
</tr>
<tr>
<td>2</td>
<td>5 March</td>
<td>2. Inflation and Capital Gains Tax&lt;br&gt;3. Forces of Interest – Continuous time scenarios</td>
</tr>
<tr>
<td>3</td>
<td>12 March</td>
<td>4. Level Annuities</td>
</tr>
<tr>
<td>4</td>
<td>19 March</td>
<td>5. Varying Annuities&lt;br&gt;Wednesday: Test on Topics 1 to 3.</td>
</tr>
<tr>
<td>5</td>
<td>26 March</td>
<td>6. Loans</td>
</tr>
<tr>
<td>6</td>
<td>2 April</td>
<td>7. Project Appraisal</td>
</tr>
<tr>
<td>7</td>
<td>23 April</td>
<td>8. Measuring Investment Performance&lt;br&gt;Public holiday deletes Wednesday lecture and tute</td>
</tr>
<tr>
<td>8</td>
<td>30 April</td>
<td>9. Bonds</td>
</tr>
<tr>
<td>9</td>
<td>7 May</td>
<td>10. Yield Curves</td>
</tr>
<tr>
<td>10</td>
<td>14 May</td>
<td>11. Forward Contracts</td>
</tr>
<tr>
<td>11</td>
<td>21 May</td>
<td>12. Bond Statistics</td>
</tr>
<tr>
<td>12</td>
<td>28 May</td>
<td>13. Immunisation</td>
</tr>
<tr>
<td>13</td>
<td>4 June</td>
<td></td>
</tr>
</tbody>
</table>

There are no tutorials in Week 1. Tutorials will usually lag lectures by one week. For example, the week 2 tutorial is on the material from the week 1 lecture. Topics 7 and 8 are both short, and the spare lecture time will be spent on the Topic 7 tutorial exercises, the public holiday having deleted the normal tutorial slot.

**Detailed list of topics**

1. Compound interest; effective and nominal interest and discount rates; accumulating and discounting at constant and at discretely changing interest rates; simple interest and simple discount; valuation of single payment securities.

2. Inflation; real interest rates; CPI; capital gains tax based on real and nominal gains.

3. The force of interest; accumulating and discounting at continuously changing interest rates; valuing continuous cash flows; continuously removed interest.

4. Level annuities; \( a_{\ddot{n}}, a_{\ddot{n}}^p, \ddot{a}_n, s_{\ddot{n}}, s_{\ddot{n}}^p, \ddot{s}_n, \ddot{s}_n^p; a_{\ddot{n}}^{(p)}, a_{\ddot{n}}^{(p)}(p), s_{\ddot{n}}^{(p)}, \ddot{s}_n^{(p)}; \) limit properties linking discrete annuities to continuous annuities; perpetuities; deferred annuities; dealing with changing interest rates; use of \( \frac{i^{(p)}}{d^{(p)}}, \frac{i}{d^{(p)}} \) and \( \ddot{\delta} \) factors to adjust timing of cash flows.

5. Arithmetically varying annuities; \((Ia)_{\ddot{n}}, (I\ddot{a})_{\ddot{n}}, (I\dddot{a})_{\ddot{n}}, (I\dddot{s})_{\ddot{n}}, (I\ddot{s})_{\ddot{n}}, (I\ddot{\ddot{s}})_{\ddot{n}}, (I\dddot{\dddot{s}})_{\ddot{n}}; \) Geometrically varying annuities.
6. Loans; Interest only loans; Reducible Rate loans; Loan repayment schedules; Finding instalments and loan outstanding; dealing with changes in interest rates by adjusting repayments or by adjusting the term of the loan; the legislation banning flat rate loans.

7. Project Appraisal; IRR; NPV; discounted payback period; problems involving different interest rates on loans and deposits; deficiencies of IRR for project assessment.

8. Money weighted rates of return and time weighted rates of return; calculation from accounts and from unit-pricing system data; linked rates of return.

9. Bonds: Face value; coupon rate; maturing at a premium or discount; valuing with and without allowance for tax given a yield to maturity; calculating yield to maturity given price; indexed (capital) bonds; purchasing cum and ex interest.

10. Yield Curves; spot rates and forward rates; calculations using the no-arbitrage assumption; valuation of bonds using spot rates; spot rate yield curve; par bond yield curve.

11. Forward contracts; derivation of formula for the forward price & the value of an existing contract under the no-arbitrage assumption; allowance for fixed dollar income on the security prior to delivery date; assumptions and limitations of the no-arbitrage model.

12. Bond statistics; Theoretical definitions and practical approximations for calculating: discounted mean term, duration, volatility, modified duration, convexity, M^2 or spread.

13. Absolute immunisation and Redington immunisation; derivation of formula and worked examples with fixed and certain liabilities and government bonds.