About This Unit

Unit Description:
Topics include types of interest rate; amortising loans; effect of income and capital gains taxes; discounted cash flow techniques; annuities; measuring investment performance; bond pricing; yield curves; matching and immunisation; forward rate agreements; pricing using the “no arbitrage” assumption. It is assumed that students are able to use spreadsheets.

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

Use the unit’s web site.
• Questions about the unit material should be placed in the Discussion Area.
• Administrative questions which have not already been answered in this document or the Student Guide should be sent to the “Administration Inquiries” account using the mail tool in the unit’s web site.
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/

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.


TECHNOLOGY USED AND REQUIRED

- You will require a calculator. Calculators which can store text may not be used in the tests or exam.
- You may find it useful to be able to construct spreadsheets to verify your solutions to tutorial exercises. The assignment will also require construction of simple spreadsheets. We do not prescribe any particular brand of spreadsheet.

UNIT WEB PAGE

- Course material is available on the learning management system (BlackBoard)
- You can login at http://learn.mq.edu.au
LEARNING OUTCOMES

The learning outcomes of this unit are:

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.
6. The “no arbitrage” pricing method
7. 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 and Research Capability
4 Effective Communication

TEACHING AND LEARNING STRATEGY

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.

All classes are held on Friday morning

<table>
<thead>
<tr>
<th>Week</th>
<th>Class Date</th>
<th>Topics Covered</th>
</tr>
</thead>
</table>
| 1    | 5 Aug      | 1. Interest Rates – Discrete time scenarios  
          2. Inflation and Capital Gains Tax |
| 2    | 12 Aug     | 3. Forces of Interest – Continuous time scenarios |
| 3    | 19 Aug     | 4. Level Annuities |
| 4    | 26 Aug     | 5. Varying Annuities |
| 5    | 2 Sep      | 6. Loans |
| 6    | 9 Sep      | 7. Project Appraisal |
| 7    | 16 Sep     | 8. Measuring Investment Performance |
2-week study break

<table>
<thead>
<tr>
<th>8</th>
<th>7 Oct</th>
<th>9. Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>14 Oct</td>
<td>10. Yield Curves</td>
</tr>
<tr>
<td>10</td>
<td>21 Oct</td>
<td>11. Forward Contracts</td>
</tr>
<tr>
<td>11</td>
<td>28 Oct</td>
<td>12. Bond Statistics</td>
</tr>
<tr>
<td>12</td>
<td>4 Nov</td>
<td>13. Immunisation</td>
</tr>
<tr>
<td>13</td>
<td>11 Nov</td>
<td></td>
</tr>
</tbody>
</table>

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

5. Arithmetically 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; 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, M² or spread.

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

**RELATIONSHIP BETWEEN ASSESSMENT AND LEARNING OUTCOMES**

<table>
<thead>
<tr>
<th>Assessment Task 1</th>
<th>Assessment Task 2</th>
<th>Assessment Task 3</th>
<th>Assessment Task 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title/Name</td>
<td>Online quizzes</td>
<td>Test</td>
<td>Assignment</td>
</tr>
<tr>
<td>Description</td>
<td>Early diagnostic tasks</td>
<td>Tests held during class time</td>
<td>Spreadsheet assignment</td>
</tr>
<tr>
<td>Due date</td>
<td>Available from start of classes</td>
<td>See timetable above</td>
<td>Friday 28 October, 12 noon.</td>
</tr>
<tr>
<td>% Weighting</td>
<td>0</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Grading method</td>
<td>Not applicable</td>
<td>To earn a particular grade you must meet the requirements of the definition of that grade.</td>
<td>To lecturer during class or to E4A 616 at other times.</td>
</tr>
<tr>
<td>Submission method</td>
<td>Online</td>
<td>Not applicable</td>
<td>To lecturer during class or to E4A 616 at other times.</td>
</tr>
<tr>
<td>Feedback (type, method, date)</td>
<td>Immediate online feedback</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>Not applicable</td>
</tr>
<tr>
<td>Estimated student workload (hours)</td>
<td>6</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Learning outcomes assessed</td>
<td>1-4</td>
<td>1</td>
<td>1,3</td>
</tr>
<tr>
<td>Graduate capabilities assessed</td>
<td>1</td>
<td>1</td>
<td>All</td>
</tr>
</tbody>
</table>
With respect to the assignment, no late submissions will be accepted.

- 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 2nd Half Year 2011 is from 14 November to 2 December.

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://www.timetables.mq.edu.au/exam

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
This policy also applies to the class test.

**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: http://www.mq.edu.au/policy/docs/grading/policy.html

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/procedure.html

STUDENT SUPPORT SERVICES

Macquarie University provides a range of Academic Student Support Services. Details of these services can be accessed at http://www.student.mq.edu.au.
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 utilising 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 unit 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.