MACQUARIE UNIVERSITY

FACULTY OF BUSINESS AND ECONOMICS

ACST202
Mathematics of Finance

Semester 1, 2010

Department of Actuarial Studies

Year/Semester: Semester 1, 2010
Unit convenor: Jim Farmer
Prerequisites: ACST101(Cr) and MATH133(P) and a GPA of at least 2.50.

Students in this unit should read this unit outline 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

Credit Points: 3

Unit Description:

The unit develops the techniques required to deal with compound interest problems which are more complex than those discussed in ACST101. Topics include the force of interest and its relationship with the annual rate of compound interest; loans repayable by instalments of principal and interest; the effect of income and capital gains tax; the use of discounted cash flow techniques in product appraisal; simple stochastic interest rate models; unit-pricing systems; yield curves, matching and immunisation; forward rate agreements; pricing using the no-arbitrage assumption. It is assumed 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 study of compound interest, with a few very brief diversions into alternative systems of 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 slowed down by fiddly details.

Lectures are shared with the postgraduate unit ACST851.

TEACHING STAFF

The unit convenor and lecturer, Jim Farmer, can be contacted via the unit's web site. However:
- 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.

Tutors cannot be contacted other than during tutorials.

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.

- Broverman, Samuel. "Mathematics of Investment & Credit" 3rd Edition. Mad River Books. (http://www.actexmadriver.com) HG4515.3.B76/2004. (2nd edition: HG4515.3.B76/1996.)
- Daniel, James W and Vaaler, Leslie J F. "Mathematical Interest Theory". Pearson Prentice Hall. 2007. HB539.D33/2007.
- Donald D.W.A. "Compound Interest and Annuities Certain" 1970. Heinemann HG8790.D65/1970. Out of print. (While this book is dated 1970, the section explaining how to use hand-cranked calculating machines suggests this edition wasn't significantly updated from the earlier 1953 edition. Given the existence of cheap electronic calculators, many of the techniques described in this book are now irrelevant.)
- Kellison, Stephen G. "The Theory of Interest" Irwin, HB539.K28/1991
- Knox, Zima and Brown. "Mathematics of Finance" 2nd Edition. McGraw Hill. HF5691.K56/1999 (This book does not cover any significant amount of ACST200 material, but is useful for revising ACST101 material.)
- McCutcheon, J.J. and Scott W.F. "An Introduction to the Mathematics of Finance" Heinemann. 1986. HF5691.M27. (Available for purchase via http://wam.actuaries.org.uk.)
- Sherris, Michael. "Money and Capital Markets" 2nd Edition. HG4515.S54
- Course notes for the UK courses may be purchased from ActEd. (http://www.acted.com.au)

UNIT WEB PAGE

The unit web site can be accessed via the logon facility at http://learn.mq.edu.au

LEARNING OBJECTIVES AND OUTCOMES

By the end of the unit you should be able to demonstrate competence in the range of techniques described in the unit notes and lectures. Ideally you will be able to demonstrate an understanding of the techniques rather than simply demonstrating the ability to rote learn formulae without understanding. You should also be able to demonstrate ethical behaviour by complying with examination rules and by not cheating on assessment tasks.

This unit aims to help develop the following graduate capabilities:

- Discipline Specific Knowledge and Skills
- Critical, Analytical and Integrative Thinking
- Problem Solving and Research Capability
- 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.

Week	Week Begins	Topics Covered
1	22 Feb	1. Interest Rates – Discrete Scenarios 2. Inflation and Capital Gains Tax – Reading topic
2	1 March	3. Forces of Interest – Continuous Scenarios
3	8 March	4. Level Annuities
4	15 March	5. Varying Annuities Thursday: Test on Topics 1 to 3.
5	22 March	6. Loans
6	29 March	7. Project Appraisal – Reading Topic Friday public holiday
		2-week study break
7	19 April	8. Yields on funds Thursday: Test on Topics 4 and 5.
8	26 April	9. Bonds Monday public holiday
9	3 May	10. Yield Curves
10	10 May	11. Forward Contracts
11	17 May	12. Bond Statistics
12	24 May	13. Immunisation
13	31 May	

Detailed list of topics

Compound interest; effective and nominal interest and discount rates; force of interest; accumulating and discounting at discretely changing and continuously changing interest rates; discrete and continuous cash flows; continuously removed interest.

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

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

Varying annuities; $(Ia)_{\overline{n}|}, (I\ddot{a})_{\overline{n}|}, (I\overline{a})_{\overline{n}|}, (\overline{I}\,\overline{a})_{\overline{n}|}, (Is)_{\overline{n}|}, (I\ddot{s})_{\overline{n}|}, (I\,\overline{s})_{\overline{n}|}, (\overline{I}\,\overline{s})_{\overline{n}|}$; Geometrically varying annuities.

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.

Bonds: Face value, coupon rate, valuing with and without allowance for tax; indexed (capital) bonds; purchasing cum and ex interest; legislation banning flat rate loans.

Yields on Funds; money weighted rates of return and time weighted rates of return; calculation from accounts and from unit-pricing system data; Hardy's formula; linked rates of return.

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

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;

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.

Bond statistics; discounted mean term; duration; volatility; modified duration and formulae linking them. Convexity. Theoretical definitions and practical approximations.

Immunisation: 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

The assessment tasks are designed to test your understanding of the unit material. However, an overriding constraint is that the range of assessment tasks ensures that the unit attains its accreditation status with the Institute of Actuaries of Australia.

Test 1	15%
Test 2	15%
Examination	70%

There are also Blackboard Quizzes covering some of the early topics. These can provide you with early feedback. They do not count for assessment and hence are a no-risk diagnostic tool.

In respect of the class test and exam, except where explicitly stated otherwise, we are not just assessing the correctness of your final answer. You will also be judged on your ability to provide a coherent solution and to provide clear verbal explanations.

Class tests will be returned at a convenient class after the marking has been completed. If you miss the relevant class, you can collect your test from E4B 106 - Business and Economics Student Services (BESS).

The final exam is of three hours length and is held during the University Examination period.

The University Examination period in First Half Year 2010 is from 7 June 2010 to 25 June 2010.

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. The timetable will be available at:
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. Information about unavoidable disruption and the special consideration process is available at
http://www.reg.mq.edu.au/Forms/APSCon.pdf

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.

You are advised that it is Macquarie University policy not to set early examinations for individuals or groups of students. All students are expected to ensure that they are available until the end of the teaching semester, that is, the final day of the official examination period.

PLAGIARISM

The University defines plagiarism in its rules: "Plagiarism involves using the work of another person and presenting it as one's own." Plagiarism is a serious breach of the University's rules and carries significant penalties. You must read the University's practices and procedures on plagiarism. These can be found in the *Handbook of Undergraduate Studies* or on the web at: http://www.student.mq.edu.au/plagiarism/

The policies and procedures explain what plagiarism is, how to avoid it, the procedures that will be taken in cases of suspected plagiarism, and the penalties if you are found guilty. Penalties may include a deduction of marks, failure in the unit, and/or referral to the University Discipline Committee.

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.