

THE UNIVERSITY OF
NEW SOUTH WALES



Australian School of Business
School of Actuarial Studies

ACTL5102
FINANCIAL MATHEMATICS

COURSE OUTLINE
SEMESTER 1, 2009

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Sydney 2052 Australia

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Dear Students

Welcome to ACTL5102 Financial Mathematics (for Actuaries). This course is one of eight courses covering the Core Technical subjects of the Institute of Actuaries offered in the Master of Actuarial Studies. Many of you will also be completing some of the courses ACTL5101 Probability and Statistics for Actuaries, ACTL5104 Actuarial Statistics and ACTL5105 Life Insurance and Superannuation Models in this session. In the early weeks of the courses you will find that you will have to adjust to the study load in the courses and also take some time to note the links between these courses.

Financial mathematics is a fundamental tool used by actuaries and actuarial graduates in the financial services industry. In the early days of the actuarial profession it was necessary to develop the mathematics of financial transactions, of annuities and of loans as well as models for mortality in life insurance products. This course will provide you with a foundation in the financial mathematics required for modern financial markets and provide a foundation for other actuarial courses in the Master of Actuarial Studies. We hope you find the course challenging and interesting.

This course outline has details of the course requirements, course aims and learning outcomes, content, teaching methods, assessment tasks, texts and readings, and expectations. Please read it carefully and thoroughly, as it will be assumed that you are familiar with the contents.

If you have any questions about the course at any time then please contact me.

I look forward to guiding your learning through the duration of the course.

Dr Benjamin Avanzi

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1. STAFF CONTACT DETAILS

The Course Coordinator and Lecturer in Charge is Dr Benjamin Avanzi:

Staff	E-mail	Room	Telephone
Dr Benjamin Avanzi	b.avanzi@unsw.edu.au	Quad 2071	9385 9844

He is responsible for course administration, final assessment of the course and responsible for the lectures and related teaching and learning. His consultation times are on Thursdays, 5pm to 7pm until 21 May 2009, then only by e-mail.

Dr Benjamin Avanzi will teach from week 1 to 10 and Dr Bernard Wong will teach weeks 11 and 12:

Staff	E-mail	Room	Telephone
Dr Benjamin Avanzi	b.avanzi@unsw.edu.au	Quad 2071	9385 9844
Dr Bernard Wong	bernard.wong@unsw.edu.au	Quad 2076	9385 2827

Dr Avanzi's consultation times are given above. Dr Wong's consultation times will be on Thursdays 28 May 2009 and 4 June 2009, from 5pm to 6pm. Exam preparation consultation times will be advised through the course website.

Who should I contact?

- Questions about the lectures or homework questions: the relevant teaching staff (during their consultation times or by e-mail);
- Administrative enquiries about the course: Dr Benjamin Avanzi, during his consultation times or by e-mail;
- Enquiries about undergraduate coursework programs in Actuarial Studies: the Undergraduate Programs Coordinator (Dr Sachi Purcal, s.purcal@unsw.edu.au) or the administrative officer (Ms Bindya Subba, b.subba@unsw.edu.au);
- Enrolment: School of Actuarial Studies Reception (Room 2058) or the Administrative Officer (Ms Bindya Subba, b.subba@unsw.edu.au).

2. COURSE DETAILS

2.1 Teaching Times and Locations

Lectures

This Course consists of a 3 hour lecture.

The lecture is held on **Wednesdays from 6pm to 9pm in ASB 119.**

Timetables and locations are correct at time of printing. A full timetable of lectures and topics is provided later in this Course study guide. Any alterations to the lecture times or locations will be advised in lectures and via the Course WebCT Vista site.

Students should consult the WebCT Vista site on a regular basis, since assignment questions and other course materials will be placed there. The web address is: <http://vista.elearning.unsw.edu.au>.

2.2 Units of Credit

6

For professional recognition a separate postgraduate course equivalent to ACTL5102 is offered to students enrolled in the Bachelor of Commerce and majoring in Actuarial Studies. Students enrolled in ACTL2001 **must only attend** the undergraduate lectures. Students attending the postgraduate course ACTL5102 must be enrolled in the Master of Actuarial Studies. Faculty and School policy does not allow undergraduate attendance at postgraduate lectures or postgraduate attendance at undergraduate lectures.

2.3 Summary of Course

This course develops the financial mathematics required for the analysis of financial and insurance transactions. Topics covered include: mathematics of compound interest; valuation of cash flows of simple insurance contracts; analysis and valuation of annuities, bonds, loans and other securities; yield curves and immunisation; introduction to stochastic interest rate models and actuarial applications.

2.4 Course Aims and Relationship to Other Courses

At the end of the course students should be able to:

- A. Explain how to evaluate, and assign a single value to, a series of contingent cash flows under different assumption on the time value of money (interest);
- B. Understand and assess the principles underlying the evaluation of the main securities that are available in the financial markets;
- C. Demonstrate their ability to apply the technical skills related to the course in a professional context.

This course is coverage of financial mathematics at an introductory level with a strong foundation in mathematics. The assumed knowledge of the course is a good understanding of mathematics as covered in a full year undergraduate program in Calculus and Linear Algebra. The main mathematical topics are covered in a series of lectures by Randell Heyman on a CD available from the Actuarial Studies School office. Students should review these lectures at the very latest by the end of Week 1 of teaching. Consult the Course Coordinator if you do not have the required mathematical background.

ACTL5102 Financial Mathematics for Actuaries develops the basic concepts of financial mathematics. Parts of the course will apply some of the concepts covered in

ACTL5101 Probability and Statistics for Actuaries. More advanced models are covered in ACTL5103 Stochastic Models for Actuarial Applications and ACTL5105 Life Insurance and Superannuation Models. The course is necessary knowledge for the more advanced coverage in ACTL5109 Financial Economics for Insurance and Superannuation and an introduction to the more extensive coverage in ACTL5105 Life Insurance and Superannuation Models.

Students should have a solid background in mathematics and are assumed to be able to use a computer to analyse financial problems. You should be able to use a word processing package (such as WORD), a spreadsheet (such as EXCEL) and computational software (such as R, MATLAB, or MAPLE). Students should use whatever computer programs they are most familiar with in doing assignments and other assigned tasks.

2.5 Student Learning Outcomes

The aims of Section 2.4 (A to C) have been unpacked in the following learning outcomes. At the end of the course students should be able to:

- A1. Understand the concept of time value of money;
- A2. Explain and compare different assumptions about interest: simple vs compound interest, discount interest, nominal vs effective interest rates, rate vs force of interest, real vs money interest rates, the term structure of interest, as well as simple stochastic interest models;
- A3. Understand the relation between a present value, a set of cash flows and interest, be able to determine one in function of the others in a variety of situations, as well as understand the interest rate risk (duration, immunisation);
- A4. Explain how to modify a simple valuation problem by taking into account tax and transaction costs;
- A5. Assess financial calculations for reasonableness and criticise their assumptions;
- B1. Describe, compare and value the following securities: bonds, shares, loans, forwards and futures contracts, options, annuities and life insurance contracts;
- B2. Describe the basic market conventions in the securities and money markets for the instruments introduced during the course;
- B3. Develop formulae for the expected value and variance of the present values of simple insurance and annuity contracts, assuming constant deterministic interest;
- C1. Integrate financial valuation concepts and their application to practical situations such as in investment project appraisals or in financial markets;
- C2. Explain difficult concepts in simple terms and in an effective way, both in oral and written forms;
- C3. Use relevant software to perform the calculations.

These Learning Outcomes relate to the ASB Graduate Attributes in the following way:

Course Learning Outcomes	ASB Graduate Attributes
All	1. Critical thinking and problem solving
C2, C3	2. Communication
None	3. Teamwork and leadership

None	4. Social, ethical and global perspectives
A5, C1	5. In-depth engagement with relevant disciplinary knowledge
C1, C2, C3 (All)	6. Professional skills

The course covers the syllabus of the Institute of Actuaries CT1 Financial Mathematics examination. The course's Learning Outcomes relate to the aims of Institute of Actuaries aims in the following way:

Course Learning Outcomes	Institute of Actuaries aims
A1	CT1: 2
A2	CT1: 3, 4, 13, 14
A3	None
A4	CT1: 1, 5, 6, 7, 8, 11
A5	CT1: 11
B1	(CT2: v.3)
B2	CT1: 10, 12
B3	(CT5: introduction)
C1	(CT2: x.1)
C2	None
C3	None

3. LEARNING AND TEACHING ACTIVITIES

3.1 Approach to Learning and Teaching in the Course

Lectures will review the main topics and provide coverage of the course concepts. They are an opportunity for students to develop an understanding of the main topics covered in the course and the level of knowledge expected. They provide a guide to the course of study during the session and the material students need to read and review. Students should read the prescribed readings prior to the lecture.

Homework problems presentations and in-class discussion are for students to ask questions on aspects of the course that need further clarification, to develop presentation skills, and to interact with other students in the course. Students need to attempt the homework problems prior to the lectures and identify problems that require closer review. Students are strongly encouraged to work in team as it is an opportunity to learn from other students and to develop team skills.

3.2 Learning Activities and Teaching Strategies

It is expected the students will take a pro-active approach to learning. The course is organised in the learning activities given in the following table. The Course Aims and ASB Graduate Attributes they should develop are also indicated.

Activity	A	B	C	1	2	3	4	5	6
Required readings	X	X		X					X
Lectures and in-class activities	X	X	X	X		X	X		X
In-class homework problems discussion	X	X		X		X			X
Homework problems presentations	X	X	X	X	X	X			X
Optional readings	X	X		X				X	X
Optional exercises	X	X		X				X	X

The aims A and B are developed during all activities. The aim C is strongly related with the ASB Graduate Attributes 2, 5 and 6 and emphasis on this aim will be put during the associated activities. By nature, the actuarial program develops problem-solving and professional skills (ASB Graduate Attributes 1 and 6), and all activities contribute to that development. Thus, special care is taken when designing in-class activities, homework problems and optional readings in order to also develop the ASB Graduate Attributes 2 to 5.

Students are expected to perform these activities in the following time frame (for the outcomes of week k):

Week $k-1$	Week k	Week $k+1$
- Required readings - Try to solve homework questions (if possible, in team) and prepare questions	- Attend lecture - Attend in-class homework problems discussion and review solutions - Review lecture notes and video, and seek help if needed	- Review relevant past final exams questions - Optional readings - Optional exercises

Thus, you should, in a given week, work on these three different stages for their corresponding three different course weeks. This proposed learning strategy should in itself develop the 6th ASB Graduate Attribute. We would like to stress that a deeper grasp of materials is expected from students at the final exam level than at the homework problem level (or quizzes level); the first point in the Week $k+1$ column is thus essential and should not be postponed until the end of the course.

Detailed information about these activities for each week are available on the course website (see also the summary table at the end of this document). From time to time, the University will send important announcements to your university e-mail address without providing you with a paper copy. You will be deemed to have received any

information posted on the website or received by e-mail. It is also your responsibility to keep the University informed of all changes to your contact details.

It is expected that you will spend at least ten hours per week studying this course. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a cause of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

4. ASSESSMENT

4.1 Formal Requirements

In order to pass the course students must complete and submit all components of assessment at or before the due times. Late assessment submissions will not be marked. It is important that students be punctual and reliable when submitting assessment. This is an important workplace requirement and students need to ensure they meet deadlines.

Your regular and punctual attendance at lectures and seminars is expected in this course. University regulations indicate that if students attend less than eighty per cent of scheduled classes they may be refused final assessment.

4.2 Assessment Details

Assessment of your performance in the course will be done through a number of tasks, whose list you will find in the following table with relevant details.

Assessment Task	Weight	LO¹	ASB GA²	Length	Due Date
Homework problem presentation	5%	A5, C2	1, 2, 3, 6	N/a	N/a
Quiz 1	7.5%	Weeks 1-4: A1, A2, A3, B1	1, 2, 5, 6	50 mins	1 April 2009, 6.05pm- 6.55pm
Major Assignment	10%	C	1, 2, 4, 5, 6	N/a	1 May 2009, 9.55am sharp
Quiz 2	7.5%	Weeks 5-8: A2, A3, A4, B1, B2	1, 2, 5, 6	50 mins	6 May 2009, 6.05pm- 6.55pm
Final examination	70%	A and B	1, 2, 5, 6	3 hours	TBA

In order to pass the course students must perform satisfactorily in all course assessment components. Students who have an overall performance at the Credit level (65% and above) are eligible for exemption of the Institute of Actuaries CT1 examination. It is a requirement towards this eligibility that the final examination weighting is at least 70%.

¹ Course Learning Outcome that is assessed

² ASB Graduate Attribute that is assessed

Homework problem Presentation

Communication skills are amongst the most important graduate attributes that employers of commerce and actuarial graduates require. Students need to be able to explain complex financial concepts and problems in simple terms and to be able to explain why their answer is reasonable. Homework problems presentations provide an opportunity for you to develop these skills.

During the session, students will be allocated a week for a problem presentation commencing Week 2. Each problem presentation consists of an oral presentation and discussion of a problem presentation exercise set for that week. Written answers to the problem presentation exercises presented must be handed in at the end of the lecture.

Failure to appear on time for an oral presentation, or to submit a written answer, will result in a zero mark and unsatisfactory performance for the purposes of passing the course unless a satisfactory reason is provided in writing to the Course Coordinator.

An overall mark, ranging from 1 to 5, will be assigned based on the following assessment criteria:

- Organisation: the student made the question clear, defined adequately the terms and concepts that are needed, outlined clearly the solution, and provided sufficient information and details.
- Audience participation: the student encouraged questions from the audience, handed them adeptly, and kept control of the discussion.
- Delivery: the student appeared confident and enthusiastic, spoke clearly and audibly, addressed and kept eye contact with all parts of the audience, and ran the presentation at the right pace and within the time limit.
- Visual aids: the visual aids that the student prepared were well prepared, appropriate, and visible to the entire audience.
- Written report: the student submitted a well organised, neat and flawless report.

Feedback on the students' performance will be given by the lecturer through an assessment sheet addressing each of these criteria at the lecture of the following week. Students are encouraged to seek further feedback if they wish to. Students should keep these assessment criteria in mind while they prepare their presentation and report.

In Class Quizzes

There will be two in-class written answer quizzes in weeks 4 and 8 each of 50 minutes duration. **The quizzes will take place on Wednesdays, from 6.05pm to 6.55pm.** Venue will be advertised later. The in class quizzes will be closed book. Students will only be allowed to bring the text "Formulae and Tables for Actuarial Examinations" into the in class exams.

Normal examination rules apply to the conduct of class quizzes. Calculators will be allowed in the class quizzes and the final examination but a clear indication of all of the steps involved in your calculations must be shown. The University will not supply calculators to students for use in examinations where the provision of calculators has not been requested by the course examiner. It is the student's responsibility to be familiar with the rules governing the conduct of examinations.

The class quizzes require written responses, with students earning marks for correct mathematical working as well as part marks for incorrect responses with correct method and reasoning. They test not only their knowledge of the material, but also the depth of their understanding of it. They assist in the development of ASB Graduate Attributes 1, 5 and 6.

Major Assignment

The practical application of the course concepts based on actual financial market problems is an important graduate attribute that employers require and this course aims to provide at least some introductory exposure to this. Writing skills for technical material are also important.

There will be one major Assignment for this course involving the practical application of course concepts to a financial market problem. This will provide students with an opportunity to also develop writing skills.

The assignment offers students the opportunity to engage in independent research, engage in critical analysis, self-reflection and problem solving, as well as to demonstrate their understanding of the concepts and perspectives that are central to actuarial studies. A solid attempt at the assignment will contribute towards developing ASB Graduate Attributes 1, 2, 4, 5 and 6.

Full information about the major assignment is given in Section 11.

Final Examination

The final examination will assess students understanding of the concepts covered in the course and their ability to apply them to financial market problems. A deeper grasp of materials is expected from students at the final exam level than at the homework problem level (or quizzes level). Preparation for the final exam contributes to developing ASB Graduate Attributes 1, 2, 5 and 6.

The final examination will be a three-hour written paper. The final examination will be closed book. Students will only be allowed to bring the text "Formulae and Tables for Actuarial Examinations" into the exam. This must not be annotated.

5. ACADEMIC HONESTY AND PLAGIARISM

The University regards plagiarism as a form of academic misconduct, and has very strict rules regarding plagiarism. For UNSW policies, penalties and information to help you avoid plagiarism see: <http://www.lc.unsw.edu.au/plagiarism/index.html> as well as the guidelines in the online ELISE tutorial for all new UNSW students: <http://info.library.unsw.edu.au/skills/tutorials/InfoSkills/index.html>.

To see if you understand plagiarism, do this short quiz:

<http://www.lc.unsw.edu.au/plagiarism/plagquiz.html>

For information on how to acknowledge your sources and reference correctly, see:

<http://www.lc.unsw.edu.au/onlib/ref.html>

For the ASB Harvard Referencing Guide, see:

http://www.docs.fce.unsw.edu.au/fce/EDU/harvard_ref_guide.pdf

School of Actuarial Studies Policy on Plagiarism

The School of Actuarial Studies views any form of plagiarism as unacceptable. The School follows University Procedures in the event of any student plagiarism. In cases of plagiarism for in session assessment the minimum penalty all students involved can expect is to receive a mark of zero for the particular assessment item. The Head of School will be informed, and the School will also keep a record of student Plagiarism cases. Students should familiarise themselves with the University Policy and Procedures and ensure they have consulted The Learning Centre web site so that they are aware of and understand the concepts and practices of academic honesty and plagiarism.

6. COURSE RESOURCES

Textbooks

The required textbooks for the course are:

- Broverman, S.A. (2008), Mathematics of Investment and Credit, 4th Edition, ACTEX Publications. [A solutions manual is available for purchase.]
- Sherris, M. (1996), Money and Capital Markets, Pricing, Yields and Analysis, 2nd Edition, Allen & Unwin.

Additional (optional) readings are:

- The Actuarial Education Company, Course CT1 Study Guide. [A subset of the course, which has the advantage of showing exactly what the Institute of Actuaries expects from students at CT1 exam, should you need to take the exam later]
- Daniel, J. W. and Vaaler, L. J. F. (2007), Mathematical Interest Theory, Pearson, Prentice Hall. [A book similar to Broverman's, useful as a second reference if a second, different explanation is necessary. It also has the advantage of discussing the use of modern calculators and explaining how to use them]
- Boyle, P.P., Cox, S.H., Dufresne, D., Gerber, H.U., Mueller, H.H., Pedersen, H.W., Pliska, S.R., Sherris, M., Shiu, E.S., Tan, K.S. (2001) Financial Economics: With Applications to Investments, Insurance and Pensions, Harry H. Panjer Ed., The Actuarial Foundation, Schaumburg, Illinois. [An advanced textbook, too advanced for the level of the course. However, chapter 3, a required reading, is available for download from the library in the MyCourse page of the course. Useful as an optional reading for the learning outcomes B1 and B2 (see website)]

- Gerber, H.U. (1997), Life Insurance Mathematics, Springer-Verlag, 3rd Edition. [The absolute classic in Life Insurance Mathematics. Useful as an extremely concise optional reading for the learning outcomes A1, A2, A3, B1 and B3. It was a required textbook for ACTL3002 in 2008; a new edition is not likely to appear in a near future]
- Bowers, N.L. Gerber, H.U., Hickman, J.C., Jones, D.A. and Nesbitt, C.J. (1997), Actuarial Mathematics, Society of Actuaries, 2nd Edition [Another classic useful as a reference for the learning outcomes A3 and B3. It was a required textbook for ACTL3002 in 2008; a new edition is not likely to appear in a near future]

All these books are available from the library, some of them with copies in the reserve. Should the quantity available be insufficient, please inform the course coordinator, who will forward this information for the library.

Formulae & Tables

Students will only be allowed to bring into the examinations for the Actuarial courses in the BCom the text "Formulae and Tables for Actuarial Examinations". This text must not be annotated. All students in the actuarial courses should purchase a copy of this text if they wish to use this in the final examinations for this course. The text is available from the UK Institute of Actuaries or from ActEd Australia. Visit the ActEd website at <http://www.acted.com.au>.

Course WebCT Vista

This course will use WebCT Vista for communication with students. The link therein to 'The Admin Corner' (abbreviated as TAC) will prove invaluable.

The WebCT Vista site for this course will contain the course outline, lecture notes, homework exercises, assessment information, and any notices relevant to this course. It is important that you visit the site regularly to see any notices posted there by the course coordinator. The site can be accessed from the WebCT Vista log-in page at: <http://vista.elearning.unsw.edu.au/>.

7. COURSE EVALUATION AND DEVELOPMENT

Each course in actuarial studies at UNSW is reviewed each session by the course coordinator using student evaluative feedback from UNSW's Course and Teaching Evaluation and Improvement (CATEI) Process. Student feedback is taken seriously, and continual improvements are made to the course based on such feedback. Significant changes to the course are communicated to students taking the course. Your input into improving future offerings of the course is highly valued.

Based on comments of previous years' students, we will record all lectures using Camtesia, and we have rebalanced topics between the lectures.

In terms of course development, we aligned more clearly the course activities and assessment tasks to its (newly defined) aims and learning outcomes. Also, a new website with a lot of information has been developed, which has been organised in function of its activities and assessment items. The major assignment will be submitted using Turnitin for the first time in the School of Actuarial Studies, and it will be graded on screen for the first time (to our knowledge) in the Australian School of Business.

8. STUDENT RESPONSIBILITIES AND CONDUCT

Students are expected to be familiar with and adhere to university policies in relation to class attendance and general conduct and behaviour, including maintaining a safe, respectful environment; and to understand their obligations in relation to workload, assessment and keeping informed.

Information and policies on these topics can be found in the 'A-Z Student Guide': <https://my.unsw.edu.au/student/atoz/ABC.html>. See, especially, information on 'Attendance and Absence', 'Academic Misconduct', 'Assessment Information', 'Examinations', 'Special Consideration', 'Student Responsibilities', 'Workload' and policies such as 'Occupational Health and Safety'.

8.1 Special Consideration and Supplementary Examinations

UNSW policy and process for Special Consideration applies (see <https://my.unsw.edu.au/student/atoz/SpecialConsideration.html>). Specifically:

- Applications for special consideration (including supplementary examinations) must go through UNSW Central administration (within 3 working days of the assessment to which it refers) – applications will not be accepted by teaching staff;
- Applying for special consideration does not automatically mean that you will be granted additional assessment or that you will be awarded an amended result;
- If you are making an application for special consideration (through UNSW Central Administration) please notify your Course Coordinator or Lecturer in Charge;
- Please note: a register of applications for Special Consideration is maintained. History of previous applications for Special Consideration is taken into account when considering each case.

Students who believe that their performance in this course, either during session or in an examination, has been adversely affected by sickness, misadventure or other circumstances beyond their control may apply for special consideration for affected assessments. See the University web site for more details:

<http://www.student.unsw.edu.au/atoz/atoz-Special.shtml>

Students may be required to sit for an oral or written supplementary examination. Any supplementary examination date will be advised to students after the final examination. In general, a supplementary examination will only be offered to a student who has been prevented from taking the Final Examination who has been placed at a serious disadvantage during the examination, and whose circumstances have improved considerably in the period since the relevant examination was held. Failure to attend a supplementary examination, if you have been granted one, will result in forfeiture of any additional assessment granted to you. Satisfactory performance in any course assessment is required in order to be granted a supplementary examination.

STUDENTS SHOULD NOTE THAT SPECIAL CONSIDERATION WILL NOT BE GRANTED UNLESS PERFORMANCE AND ATTENDANCE AT LECTURES IS SATISFACTORY. THIS WILL USUALLY MEAN THAT YOU WILL HAVE TO PASS ALL ASSESMENT TASKS IN ORDER FOR ANY SPECIAL CONSIDERATION TO BE GIVEN.

ASB Policy and Process for Special Consideration and Supplementary Exams

In the ASB, requests for special consideration are determined by a Faculty wide panel which will advise the Lecturer in Charge of appropriate action.

If the Faculty panel (see above) grants a special consideration request, this may entitle the student to sit a supplementary examination. In such cases the following procedures will apply:

Supplementary exams will be scheduled centrally and will be held approximately two weeks after the formal examination period. Actual date will be advised by mid-semester.

Where a student is granted a supplementary examination as a result of a request for special consideration, the student's original exam (if completed) will not be marked and only the mark achieved in the supplementary examination will count towards the final grade.

Further information concerning supplementary examinations is available on the 'Policies and Guidelines for Current Students' page of the ASB website:
<http://www.business.unsw.edu.au/currentstudents>.

Consideration for Missed Assessments (other than final examination)

If you miss a test or are unable to submit your assignment by the due time & date, and you have a valid reason, you need to inform the Actuarial Studies office as soon as possible. You must provide written documentation requesting consideration to the Actuarial Studies office, in the form of a letter explaining your reasons with evidence attached, i.e. medical certificate, police report etc. You should note the course details, your student ID and contact details in your letter as well. As per University rules these considerations must be submitted within 3 working days of the assessment date. If no request is received or it is received after 3 working days you will be awarded a zero mark for that assessment.

Review of Results of Assessments (other than final examination)

As per University rules, if you wish a piece of course assessment to be re-checked, for addition error or incorrect marking, you need to contact the Actuarial Studies office within 15 working days of the assessment being available for collection. You will need to bring in the assessment and provide a note as to the error or reason for review to the Actuarial Studies office. The assessment will be passed onto the relevant academic for review. Students will be able to collect back the assessment from the Actuarial Studies office.

8.2 General Conduct and Behaviour

You are expected to conduct yourself with consideration and respect for the needs of your fellow students and teaching staff. Conduct that unduly disrupts or interferes with a class, such as ringing or talking on mobile phones, is not acceptable and students may be asked to leave the class. More information on student conduct is available at:
www.my.unsw.edu.au

8.3 Occupational Health and Safety

UNSW Policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others. For more information, see
<https://my.unsw.edu.au/student/atoz/OccupationalHealth.html>.

9. ADDITIONAL STUDENT RESOURCES AND SUPPORT

The University and the ASB provide a wide range of support services for students, including:

- **ASB Education Development Unit (EDU)** (www.business.unsw.edu.au/edu)
Academic writing, study skills and maths support specifically for ASB students. Services include workshops, online and printed resources, and individual consultations. EDU Office: Room GO7, Ground Floor, ASB Building (opposite Student Centre); Ph: 9385 5584; Email: edu@unsw.edu.au
- **UNSW Learning Centre** (www.lc.unsw.edu.au)
Academic skills support services, including workshops and resources, for all UNSW students. See website for details.
- **Library training and search support services:** <http://info.library.unsw.edu.au>
- **UNSW IT Service Desk:** Technical support for problems logging in to websites, downloading documents etc. Library, Level 2; Ph: 9385 1333. Website: www.its.unsw.edu.au/support/support_home.html
- **UNSW Counselling Service** (<http://www.counselling.unsw.edu.au>)
Free, confidential service for problems of a personal or academic nature; and workshops on study issues such as 'Coping With Stress' and 'Procrastination'. Office: Level 2, Quadrangle East Wing; Ph: 9385 5418
- **Student Equity & Disabilities Unit** (<http://www.studentequity.unsw.edu.au>)
Advice regarding equity and diversity issues, and support for students who have a disability or disadvantage that interferes with their learning. Office: Ground Floor, John Goodsell Building; Ph: 9385 4734

10. COURSE SCHEDULE

Week/date	LO	Topics	Broverman	Sherris
1 11/03/09	A1	Introduction	1.1-1.3	p. 1-10, 27-30
	A3	Time value of money		
	A2	Cash Flow models		
	A3	Compound vs simple interest		
		Equation of value		
2 18/03/09	A2	Nominal vs effective rate of interest and discount	1.4-1.7	p. 30-32
	A2	Rate vs force of interest		
	A2	Real vs money interest rates		
3 25/03/09	B1	Description of annuities certain	2.1-2.2.2	p. 32-34
	A3,B1	Valuation of annuities certain in discrete time		
4 01/04/09	A3,B1	Valuation of annuities certain in continuous time	2.2.3, 2.3	p. 55-58
	A3,B1	Valuation of annuities certain with non-constant payments		
01/04/09, 6.05pm-6.55pm: Quiz 1 (venue TBA)				
5 08/04/2009	A3	Loans and repayment schedules	3.1-3.3	
	A4	Allowing for costs and taxation		p. 22-26
	C3	Spreadsheet modelling		
15/04/09	<i>University break (Easter)</i>			
6 22/04/09	B1	Description and valuation of fixed rate securities	3.4.1, 4, 8.4	p. 11-14, 32-43
	A4	Allowing for costs and taxation		p. 58-73
	A2	Yield rates and reinvestment rates	2.4.1, 2.2.5	p. 45-55
	C1,C3	Project Evaluation and Project Appraisal Techniques		
7 29/04/09	A3	The term structure of interest	6	
	A3	Spot vs forward rates of interest		p.95-103
	B1, B2	Description and valuation of forward and futures contracts: the non-arbitrage pricing rule	9.1, 9.4	p. 103-126, 129-131
	B1, C1	Hedging		
01/05/09, 9.55am: Assignment due (via turnitin on the course website)				
8 06/05/09	A3	Interest rate risk: duration, convexity and immunisation	7	5, p. 126-129
06/05/09, 6.05pm-6.55pm: Quiz 2 (venue TBA)				
9 13/05/09	B1, B2	Description and valuation of swaps		7
	A3	Present value of contingent cash flows		
	B1, B2	Description and valuation of options	9.2-9.3	8
10 20/05/09	B3	The future lifetime of a life aged x		
	B3	Life Insurance		
	B3	Elementary Life Annuities		
11 and 12 27/05/09	A2	Stochastic return models		9
03/06/09	A2, A3	Annuity accumulations with stochastic interest		

This timetable may be altered. Students will be advised of any changes in lectures and via the course web site. Detailed information about other learning activities (such as optional reading) and their suggested timing is available on the website.

11. MAJOR ASSIGNMENT

11.1 Learning outcomes

The assignment aims particularly at developing the course learning outcomes associated to the aim C, as well as the ASB Graduate Attributes 1, 2, 4, 5, and 6. It is based on the application of the technical concepts introduced within the aims A and B, at the level covered up to week 6.

While using concepts covered during the weeks 1 to 6 under the course aims A and B, the first part of the assignment aims at developing the learning outcomes related to aim C. Thus, half of the marks will be assigned to the technical accuracy of the report, and the other half to the learning outcomes C1 to C3.

The second part of focuses particularly on the ASB Graduate Attributes 1, 2, 4 and 5, but is also related to the course learning outcomes A5 and C1.

11.2 Assignment, part 1 – Actuarial report

Assignment background

Ms Sharon Smith has inherited \$1.7 million from a cousin in Perth. Given the current financial distress and the good opportunities on the Sydney real estate market, she wants to invest that money in real estate with the help of 30 years mortgages. She is 30 years old and this would be a good way to save money for her retirement.

She is currently renting her home, but she likes it a lot and has asked the owner how much she could buy it for. The owner agrees to sell it at a price of \$700,000 (stamp duty included). She reckons that she could buy her home, as well as 1 or 2 investment properties. She looked around and found two such properties that interest her:

1. A small block of two 2 bedroom apartments and two 1 bedroom apartments in Maroubra. The price is \$1.5 million, and she expects its value to grow at an average 2% per year over the next 30 years.
2. A nice 3 bedroom luxury townhouse in Coogee at a price of \$1 million. This property's value is expected to grow at an average annual 4% over the next 30 years.

She is a philosopher and has a good feeling about financial matters, although no quantitative skills. She could go directly to a bank to ask for offers for a mortgage, but she does not know what properties she should buy (she definitely wants to buy the block, but wonders if purchasing the townhouse is a good idea) and how much to borrow for each of these. A bank she contacted suggested that she should invest the same percentage in all three properties. She has a feeling that these should not be chosen randomly, but has no idea of how to determine what she should do. She has contacted you, and asked you to send her your recommendations in a concise, easily understandable report.

Additional information and assumptions

Costs and revenue of investments:

The value of Ms Smith's home is expected to grow at an average 1% per year over the next 30 years. The net rental return of all the properties (after water and council's taxes, as well as provision of a sinking fund for renovations) is expected, for a given year, to be of 0.1% per week of the value of the property at the beginning of the year, 51 weeks per year (one week is omitted because of possible vacancy between tenants). Ms Smith will sell all the properties she purchased at the end of the

mortgage. It is assumed that all the rents are paid as a lump sum at the beginning of the year. The properties are bought at the beginning of the first year and sold at the end of the 30th year.

Mortgage contracts conditions

It not possible to borrow less than 20% or more than 80% of the value of a given property. The current mortgage variable rate (assumed to stay constant over the next 30 years) is 5.91%. However, the bank offers a permanent discount (over the 30 years) of 0.5% if the initial amount that Ms Smith borrows is more than \$150,000, 0.6% if it is more than \$250,000 or 0.7% if it is more than \$700,000. These figures are all calculated separately for each mortgage. Initial and periodical costs are omitted. It is assumed that the mortgage is repaid by annual payments paid at the beginning of each year.

Tax

Thanks to her new financial condition, Ms Smith would like to stop working and focus entirely on her philosophical works. Thus, her only income will come from the investment of the \$1.7 million she has just inherited.

It is assumed that she will be taxed on her income at the current 2008-2009 rates for residents³. The capital gain she will earn on her home is tax exempt. However, capital gains on her investment properties are taxed as income⁴. The Medicare levy is omitted. On the other hand, interest paid on the investment mortgage is tax deductible, which is not the case for interest paid on her personal home loan.

Others

If the value of the property Ms Smith purchases as a home is less than \$750,000, she is eligible for a first home buyer grant of \$14,000 (only once), received at the moment of purchase. At the beginning of the first year, Ms Smith is supposed to have only the amount of her inheritance on her bank account, which bears no interest.

Please make any other assumption explicit.

Your report

In your report, please address the following points in the same order.

First, assume that Ms Smith is going to buy her home and only the first property (block). She funds 60% of her home value and uses the rest of her inheritance on her investment property's mortgage.

1. Calculate the annual repayments due on both her home loan and the mortgage on the investment property.
2. Present a table for her home loan with the outstanding balance (just before payment of the annuity), the amount of the annuity, its reimbursement component, and its interest component.
3. Create and present a table with all the cash flows incurred by this initial solution (including tax and purchase/sale of the properties).
4. Calculate the IRR on Ms Smith's net cash flows. In this particular situation, is it a good indicator? Why?

³ See, for instance, <http://www.ato.gov.au/individuals/content.asp?doc=/content/12333.htm>

⁴ Note: the calculations to determine the capital gains are in reality much more complicated (see, for instance, <http://www.ato.gov.au/individuals/pathway.asp?pc=001/002/026&cy=1>). You are not asked here to make realistic calculations on the capital gains, but merely to take the difference between proceeds and purchase price as taxable income for the investment properties.

5. Determine what is the optimal percentage of Ms Smith's home value that she should initially invest, if she wants to maximize the IRR of her net cash flows. Is there a rationale behind this?
[Hint: it is recommended to use a spreadsheet or another software that will calculate all the cash flows and the IRR in function of the percentage invested in Ms Smith's home.]
6. Present and comment on a table with all cash flows according to the solution found in 5 (if it is different from the initial solution).

Assume now that Ms Smith buys her home without a home loan (she invests \$700,000 and does not borrow anything to buy it).

7. Determine what is the optimal percentage of Ms Smith's second investment property's value that she should initially invest, if she wants to maximize the IRR of her net cash flows. Is there a rationale behind this?
[Hint: it is recommended to modify your spreadsheet by fixing the amount invested in Ms Smith's home at 100% and make the new variable the percentage of the second investment property's value that is invested.]
8. Present and comment on a table with all cash flows according to the solution found in 7.
9. Calculate the NPV of all net cash flows for both the solution proposed by the bank and your solution in 8. For this, choose an appropriate interest rate.
[Comment: this is, by the way, the value of your services for Ms Smith...]

You have answered Ms Smith's questions. However, as a consultant, you also need to use your brain and try to find an even better solution, and also provide additional information if relevant. For the following, assume that Ms Smith initially invests 100% of her home's value, 20% of her first investment property's value, and 70% of her second investment property's value.

10. Create and comment on a table with both the (accrued) value of Ms Smith real estate assets, the outstanding balance of her mortgage contracts, the balance of her bank account, and her resulting net wealth for the next 30 years. Use the figures as per immediately after the payment of the mortgage annuities.
11. What is the maximum amount (indexed by 2% every year, rounded to the appropriate next \$100) that Ms Smith can take out of her bank account at the beginning of each year, if she does not want it to be negative at any time?
12. Capital gains on Ms Smith's home are tax exempted. You wonder if her buying and living in the second investment property instead (the luxury townhouse) would not improve the IRR of her investments. Find the answer to that question and explain what it means.
[Hint: go through the whole procedure again, but do not replicate all outputs and discussions! Show only relevant results and tables (if any).]
13. Optional section: you will be granted up to 5 bonus marks if you add another relevant and interesting point to your report. However, if your addition is irrelevant and inappropriate, up to 5 marks of malus can be *removed* from your final result. You need to use your judgement before deciding if you want to add something.

11.3 Assignment, part 2 - Essay

Download and read the paper "The Financial Modelers' Manifesto" by Emanuel Derman and Paul Wilmott (2009) for SSRN at the following location:

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1324878

Write a short essay reflecting on how a financial modeller should behave with respect to the use of his knowledge and with respect to how he communicates his work to less (technically) knowledgeable persons. Reflect also on the consequences this behaviour may have. In addition, explain how this influences the way an actuary should approach his learning throughout his studies.

Your essay has to be written on no more than 2 pages **double spaced**, in Times 12. All four page margins, on both pages, must be at least 2 cm.

11.4 Additional instructions and directions

Your report (Part 1) is a report to Ms Smith, not to the lecturer. You should create it as if you were a consultant who sent a report to a client: Ms Smith. It has to be neat, clear, concise, respectful, and serious. Ms Smith should be able to read and understand it without calling you to ask questions (both of you have other tasks to attend to). Finish your report by discussing the validity of your work and its assumptions.

In an appendix (to the attention of the person grading the report, not Ms Smith) give all the details about your calculations made in Part 1 (for instance, Excel worksheets).

Your essay must be written in your own words. Show that you spent time thinking about the manifesto. Although your ideas have to be communicated in an effective way, this is what we really expect from you, rather than writing beautiful, but empty English sentences.

Your assignment (the report, the appendix, and the essay – in that order) must be uploaded as a **unique pdf document** and all parts must be in **portrait format**. As long as the due date is still future, you can resubmit your work; the previous version of your assignment will be replaced by the new version.

Although part 1 assesses your *professional* writing skills, part 2 assesses your *academic* writing skills. To seek help about writing skills, please contact the ASB Education Development Unit (EDU), whose address you will find in Section 9 above.

Students are reminded that the work they submit must be their own (see section 5 above). While we have no problem with students working together on the assignment problems, the material students submit for assessment must be their own. This means that:

- The mathematical solutions you present are written up by you, without reference to any other student's work.
- Any spreadsheet solutions you present are from your own spreadsheets, which you yourself developed, without any reference to any other student's work.

The students are advised that their assignment will be submitted via Turnitin, which reports on any similarities between their own cohort's assignments, and also with regard to other sources (such as the internet or all assignments submitted all around the world via Turnitin). More information is available at:

<http://elearning.unsw.edu.au/turnitin/content/TurnItInStudentSupport.cfm?ss=0>

Please read this page, as we will assume that its content is familiar to you. You will be able to make multiple submissions, but won't have access to the originality reports.

11.5 Assignment submission procedure

Assignments must be submitted via the Turnitin submission box that is available on the course WebCT Vista website.

Please note that it is School policy that late assignments, even by one minute, will not be marked. Assignments MUST be submitted prior to the due time and date. The School of Actuarial Studies has a policy of grading late assignments with a zero mark. Punctual submission of work is required in order to satisfy the requirements of the course. The assignment may be marked at the discretion of the course co-ordinator if there is a valid reason for late submission and used in cases where your final overall results are marginal.

Students are reminded of the risk that technical issues may delay or even prevent their submission (such as internet connection and/or computer breakdowns). Students should then consider either submitting their assignment from the university computer rooms or allow enough time buffer between their submission and the due time. The Turnitin module will not let you submit a late report. **No paper copy will be either accepted or graded.**

11.6 Assessment criteria

Part	Aims	ASB GA	Criteria	Marks
1	A, B	1, 6	Technical accuracy (Details will be given after having graded the assignments)	40
	C	2, 6	The report is addressed to Ms Smith and is neat, clear, concise, respectful, and serious	10
			The student has demonstrated his/her ability to integrate his/her technical skills to a practical situation	10
			The student was able to explain difficult concepts in simple terms and in an effective way	10
			The student has demonstrated his/her ability to use a software program to perform the calculations, in a way that was appropriate to his/her task	10
2	A5, C1	1, 2, 4, 5	The student has been able to summarise in his/her own words the social, ethical and global implications of a financial modeller's work.	10
			The student has been able to demonstrate that he/she spent time thinking about the impact of the manifesto on the way one should approach his/her future professional duties as a financial modeller.	5
			The student has been able to demonstrate that he/she spent time thinking about the impact of the manifesto on the way he/she will approach the rest of his/her studies.	5