



UNSW Course Outline

ACTL2111 Financial Mathematics for Actuaries - 2024

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General Course Information

Course Code : ACTL2111

Year : 2024

Term : Term 2

Teaching Period : T2

Is a multi-term course? : No

Faculty : UNSW Business School

Academic Unit : School of Risk and Actuarial Studies

Delivery Mode : In Person

Delivery Format : Standard

Delivery Location : Kensington

Campus : Sydney

Study Level : Undergraduate

Units of Credit : 6

Useful Links

[Handbook Class Timetable](#)

Course Details & Outcomes

Course Description

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.

Relationship to Other Courses

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

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

This course covers financial mathematics at an introductory level. 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.

ACTL2111 Financial Mathematics for Actuaries builds on the basic concepts of financial mathematics. Parts of the course will apply some of the concepts covered in ACTL2131 Probability and Mathematical Statistics. More advanced models are covered in ACTL2102 Foundations of Actuarial Models. The course is necessary knowledge for the more advanced coverage in ACTL3182 Asset-Liability and Derivative Models and is an introduction to the more extensive coverage in ACTL3151 Actuarial Mathematics for Insurance and Superannuation.

Furthermore, students should be able to use a word processing package (such as WORD) and Excel spreadsheet. Knowledge of computational software (such as R, MATLAB, or MAPLE) is also recommended although not necessary.

Course Learning Outcomes

Course Learning Outcomes	Program learning outcomes
CLO1 : Understand the concept of time value of money	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO2 : Explain and compare different types of 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	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO3 : Understand the relation between a present value, a set of cash flows and interest, as well as understand the interest rate risk (duration, immunisation) confidently the calculations and concepts learnt and applied in practical situations	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO4 : Explain how to modify a simple valuation problem by taking into account tax and transaction costs	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO5 : Assess financial calculations for reasonableness and criticise their assumptions	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO6 : Describe, compare and value the following securities: bonds, shares, loans, forwards and futures contracts, options, annuities and life insurance contracts	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO7 : Describe the basic market conventions in the securities and money markets for the instruments introduced during the course	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO8 : Develop formulae for the expected value and variance of the present values of simple insurance and annuity contracts, assuming constant deterministic interest	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO9 : Integrate financial valuation concepts to practical situations such as in investment project appraisals or in financial markets	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication
CLO10 : Explain difficult concepts in simple terms and in an effective way, both in oral and written forms.	<ul style="list-style-type: none"> PLO1 : Business Knowledge PLO2 : Problem Solving PLO3 : Business Communication

Course Learning Outcomes	Assessment Item
CLO1 : Understand the concept of time value of money	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO2 : Explain and compare different types of 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	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO3 : Understand the relation between a present value, a set of cash flows and interest, as well as understand the interest rate risk (duration, immunisation) confidently the calculations and concepts learnt and applied in practical situations	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO4 : Explain how to modify a simple valuation problem by taking into account tax and transaction costs	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO5 : Assess financial calculations for reasonableness and criticise their assumptions	<ul style="list-style-type: none"> • Final Examination
CLO6 : Describe, compare and value the following securities: bonds, shares, loans, forwards and futures contracts, options, annuities and life insurance contracts	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO7 : Describe the basic market conventions in the securities and money markets for the instruments introduced during the course	<ul style="list-style-type: none"> • Final Examination
CLO8 : Develop formulae for the expected value and variance of the present values of simple insurance and annuity contracts, assuming constant deterministic interest	<ul style="list-style-type: none"> • Quiz • Final Examination
CLO9 : Integrate financial valuation concepts to practical situations such as in investment project appraisals or in financial markets	<ul style="list-style-type: none"> • Assignment • Quiz • Final Examination
CLO10 : Explain difficult concepts in simple terms and in an effective way, both in oral and written forms.	<ul style="list-style-type: none"> • Assignment • Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360 | Zoom | EdStem

Learning and Teaching in this course

The approach adopted in this course is one of assisted self-study. While reading this subsection, please refer to the detailed course schedule.

Course materials are broadly organised in 7 categories. They consist of:

- Overview videos/ videos on common mistakes for each module

- Lecture recordings (available after each in-person lecture)
- Fully annotated lecture slides (available after each in-person lecture)
- Prescribed/reference books
- Exercises with solutions
- Selected past quizzes and exams for advanced exercises
- Downloadable "R tutorials" (platform for students to use R to solve problems)

Lectures and the annotated slides are expected to be the most important for your learning, as these contain not only the fundamental concepts/theory, derivation of important results and some numerical examples but also intuition and big picture, while the exercises let you practice solving the related problems. During the weekly lecture, the LIC will go through the lecture slides in detail and provide further explanations and annotations, and students will also have the opportunity to ask questions on aspects of the course that need further clarification.

In each week, students are recommended to read the relevant sections of the prescribed books, watch a short overview video called "pre-module video" (if a new module is to begin), attend the lecture in person, attend the lab tutorials (weeks 1-5 and 7-8), and attempt the tutorial exercises prior to attending the tutorials. If a module ends in the week, students should watch the corresponding videos explaining some common mistakes/misconceptions (called "post-module videos"). The LIC also has weekly consultation hour (online) to answer students' questions.

In the tutorials, students have the chance to interact with the tutor and other students in the course. Students need to attempt the tutorial exercises prior to the tutorial classes and identify problems that require closer review during tutorials. They are an opportunity to learn from other students and to develop team skills by working on problems with other students.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Program learning outcomes
Quiz Assessment Format: Individual	15%		<ul style="list-style-type: none"> • PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
Assignment Assessment Format: Individual	25%		<ul style="list-style-type: none"> • PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
Final Examination Assessment Format: Individual	60%		<ul style="list-style-type: none"> • PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication

Assessment Details

Quiz

Assessment Overview

There will be two online quizzes (7.5% each). Each quiz will take about one hour to complete, and

students will be given a 3-day window to work on the quiz. Full credit will be awarded based on a genuine attempt.

Assesses: PLO1, PLO2, PLO3

Course Learning Outcomes

- CLO1 : Understand the concept of time value of money
- CLO2 : Explain and compare different types of 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
- CLO3 : Understand the relation between a present value, a set of cash flows and interest, as well as understand the interest rate risk (duration, immunisation) confidently the calculations and concepts learnt and applied in practical situations
- CLO4 : Explain how to modify a simple valuation problem by taking into account tax and transaction costs
- CLO6 : Describe, compare and value the following securities: bonds, shares, loans, forwards and futures contracts, options, annuities and life insurance contracts
- CLO8 : Develop formulae for the expected value and variance of the present values of simple insurance and annuity contracts, assuming constant deterministic interest
- CLO9 : Integrate financial valuation concepts to practical situations such as in investment project appraisals or in financial markets

Detailed Assessment Description

The quiz will take place online on Moodle and can be taken at home or any place with an internet connection.

Assignment

Assessment Overview

This is an Excel-based assignment for students to apply the theory learnt from lectures together with the Excel skills learnt from the lab sessions. Students will be given at least 2 weeks to complete the assignment.

Assesses: PLO1, PLO2, PLO3

Course Learning Outcomes

- CLO9 : Integrate financial valuation concepts to practical situations such as in investment project appraisals or in financial markets
- CLO10 : Explain difficult concepts in simple terms and in an effective way, both in oral and written forms.

Detailed Assessment Description

The practical application of the course concepts based on actual financial 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.

The assignment will assess application of Excel concepts to solving real life financial mathematics problems. This will provide students with an opportunity to develop communication and computational skills. It offers students the opportunity to engage in independent research, engage in critical analysis, and problem solving, as well as to demonstrate their understanding of the concepts and perspectives that are central to actuarial studies. The assignment will be made available at least two weeks before the due date, and students need to complete the assignment by submitting a single Excel document.

Final Examination

Assessment Overview

This is a 2-hour closed book exam that will be invigilated and scheduled during the university exam period.

Assesses: PLO1, PLO2, PLO3

Course Learning Outcomes

- CLO1 : Understand the concept of time value of money
- CLO2 : Explain and compare different types of 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
- CLO3 : Understand the relation between a present value, a set of cash flows and interest, as well as understand the interest rate risk (duration, immunisation) confidently the calculations and concepts learnt and applied in practical situations
- CLO4 : Explain how to modify a simple valuation problem by taking into account tax and transaction costs
- CLO5 : Assess financial calculations for reasonableness and criticise their assumptions
- CLO6 : Describe, compare and value the following securities: bonds, shares, loans, forwards and futures contracts, options, annuities and life insurance contracts
- CLO7 : Describe the basic market conventions in the securities and money markets for the instruments introduced during the course
- CLO8 : Develop formulae for the expected value and variance of the present values of simple insurance and annuity contracts, assuming constant deterministic interest
- CLO9 : Integrate financial valuation concepts to practical situations such as in investment project appraisals or in financial markets
- CLO10 : Explain difficult concepts in simple terms and in an effective way, both in oral and

written forms.

Detailed Assessment Description

The final exam 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.

The final exam will take place on campus and will last for 2 hours on a date scheduled by the university. The final exam will be a closed book invigilated exam, and students will only be allowed to use the text "Formulae and Tables for Actuarial Examinations" into the exam. This must not be annotated.

General Assessment Information

Grading Basis

Standard

Requirements to pass course

A student is required to achieve 50% to pass the course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Module 1 (Time Value of Money and Valuation of Cash Flows)
Week 2 : 3 June - 9 June	Lecture	Module 1 (Time Value of Money and Valuation of Cash Flows)
Week 3 : 10 June - 16 June	Lecture	Module 1 (Time Value of Money and Valuation of Cash Flows)
Week 4 : 17 June - 23 June	Lecture	Module 1 (Time Value of Money and Valuation of Cash Flows) Module 2 (Modelling Loans and Repayments)
Week 5 : 24 June - 30 June	Lecture	Module 2 (Modelling Loans and Repayments)
	Assessment	Online quiz 1
Week 7 : 8 July - 14 July	Lecture	Module 2 (Modelling Loans and Repayments) Module 3 (Interest Rate Risk)
Week 8 : 15 July - 21 July	Lecture	Module 3 (Interest Rate Risk) Module 4 (Derivatives)
	Assessment	Assignment due (tentative)
Week 9 : 22 July - 28 July	Lecture	Module 4 (Derivatives)
Week 10 : 29 July - 4 August	Lecture	Module 4 (Derivatives) Module 5 (Stochastic Returns)

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Prescribed Resources

Textbooks

The required textbooks for the course are:

- Broverman, S.A. (2015/2017), Mathematics of Investment and Credit, 6th/7th Edition, ACTEX Publications. [A solutions manual is available for purchase. The 5th Edition is still largely similar to the 6th and 7th Editions, so it is possible to learn with the 5th Edition as well. However, the 4th, 3rd and 2nd Editions are not recommended.]
- Sherris, M. (1996), Money and Capital Markets, Pricing, Yields and Analysis, 2nd Edition, Allen & Unwin.

Additional (optional) readings are:

- Daniel, J. W. and Vaaler, L. J. F. (2007), Mathematical Interest Theory, Pearson, Prentice Hall. [A book similar to Brovermans, 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, perhaps a bit too advanced for the level of the course.]
- 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. 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 reference; 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.

Formulae & Tables

For closed book exams, students will only be allowed to bring into the examinations for the Actuarial courses in the Bachelor of Actuarial programme 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 UNSW Bookshop or the UK Institute of Actuaries.

Course website

The course Moodle website is available from the [UNSW TELT platform](#).

To access the Moodle online support site for students, follow the links from that website to UNSW Moodle Support/Support for Students. Additional technical support can be obtained from itservicecentre@unsw.edu.au (02 9385 1333).

All course contents will be available from the course website. It is essential that you visit the site regularly (at least once in two days) to see any announcements posted there by the course coordinator, as it will be assumed that they are known to you within a reasonable time.

Course Evaluation and Development

Feedback is regularly sought from students and continual improvements are made based on this feedback. At the end of this course, you will be asked to complete the myExperience survey, which provides a key source of student evaluative feedback. Your input into this quality enhancement process is extremely valuable in assisting us to meet the needs of our students and provide an effective and enriching learning experience. The results of all surveys are carefully considered and do lead to action towards enhancing educational quality.

Each course in actuarial studies at UNSW is reviewed each session by the course co-ordinator using student evaluative feedback from myExperience. 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.

Some of the additional developments have been effected in recent years include:

- Replacement of an invigilated mid-term exam by two formative online quizzes;
- Corrections of typos in the exercises and improvement of the solutions;
- Enhancement of Excel lab materials;
- Removal of the module on life contingencies;
- Preparation of online videos to give student an overview (pre-module) on each module and some explanations on common mistakes/misconception (post-module);
- Development of "R tutorials" for students to learn to use R to solve practical problems related to the course.
- Reduction of assessment weight on the final exam.

We repeat that we take students' feedback extremely seriously and we count on your cooperation when seeking feedback that will help us identify the strengths and weaknesses of the course contents and learning and teaching strategies. We guarantee that the process is

entirely anonymous and that your feedback will not have any impact on your final results.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Kyu Park					No	Yes
Tutor	Sam Luo					No	No

Other Useful Information

Academic Information

COURSE POLICIES AND SUPPORT

The Business School expects that you are familiar with the contents of this course outline and the UNSW and Business School learning expectations, rules, policies and support services as listed below:

- Program Learning Outcomes
- Academic Integrity and Plagiarism
- Student Responsibilities and Conduct
- Special Consideration
- Protocol for Viewing Final Exam Scripts
- Student Learning Support Services

Further information is provided on the [key policies and support page](#).

Students may not circulate or post online any course materials such as handouts, exams, syllabi or similar resources from their courses without the written permission of their instructor.

STUDENT LEARNING OUTCOMES

The Course Learning Outcomes (CLOs) – under the Outcomes tab – are what you should be able to demonstrate by the end of this course, if you participate fully in learning activities and successfully complete the assessment items.

CLOs also contribute to your achievement of the Program Learning Outcomes (PLOs), which are developed across the duration of a program. PLOs are, in turn, directly linked to [UNSW graduate capabilities](#). More information on Coursework PLOs is available on the [key policies and](#)

support page. For PG Research PLOs, including MPDBS, please refer to the [UNSW HDR Learning Outcomes](#).

Academic Honesty and Plagiarism

As a student at UNSW you are expected to display [academic integrity](#) in your work and interactions. Where a student breaches the [UNSW Student Code](#) with respect to academic integrity, the University may take disciplinary action under the Student Misconduct Procedure. To assure academic integrity, you may be required to demonstrate reasoning, research and the process of constructing work submitted for assessment.

To assist you in understanding what academic integrity means, and how to ensure that you do comply with the UNSW Student Code, it is strongly recommended that you complete the [Working with Academic Integrity](#) module before submitting your first assessment task. It is a free, online self-paced Moodle module that should take about one hour to complete.

Submission of Assessment Tasks

SPECIAL CONSIDERATION

You can apply for special consideration when illness or other circumstances beyond your control interfere with your performance in a specific assessment task or tasks, including online exams. Students studying remotely who have exams scheduled between 10pm and 7am local time, are also able to apply for special consideration to sit a supplementary exam at a time outside of these hours.

Special consideration is primarily intended to provide you with an extra opportunity to demonstrate the level of performance of which you are capable. To apply, and for further information, see Special Consideration on the UNSW [Current Students](#) page.

Special consideration applications will be assessed centrally by the Case Review Team, who will update the online application with the outcome and add any relevant comments. The change to the status of the application immediately sends an email to the student and to the assessor with the outcome of the application.

Please note the following:

1. Applications can only be made through Online Services in myUNSW (see the UNSW [Current](#)

[Students](#) page). Applications will not be accepted by teaching staff. The lecturer-in-charge/course coordinator will be automatically notified when your application is processed.

2. Applying for special consideration does not automatically mean that you will be granted a supplementary exam or other concession.
3. If you experience illness or misadventure in the lead up to an exam or assessment, you must submit an application for special consideration, either prior to the examination taking place, or prior to the assessment submission deadline, except where illness or misadventure prevent you from doing so.
4. If your circumstances stop you from applying before your exam or assessment due date, you must apply within 3 working days of the assessment or the period covered by your supporting documentation.
5. Under the UNSW Fit To Sit/Submit rule, if you sit the exam/submit an assignment, you are declaring yourself well enough to do so and are cannot subsequently apply for special consideration.
6. If you become unwell on the day of – or during – an exam, you must stop working on your exam, advise your course coordinator or tutor and provide a medical certificate dated within 24 hours of the exam, with your special consideration application. For online exams, you must contact your course coordinator or tutor immediately via email, Moodle or chat and advise them you are unwell and submit screenshots of your conversation along with your medical certificate and application.
7. Special consideration requests do not allow the awarding of additional marks to students.

Further information on Business School policy and procedure can be found under “Special Consideration” on the [key policies and support](#) page.

LATE SUBMISSION PENALTIES

For assessments other than examinations, late submission will incur a penalty of 5% per day or part thereof (including weekends) from the due date and time. An assessment will not be accepted after 5 days (120 hours) of the original deadline unless special consideration has been approved. An assignment is considered late if the requested format, such as hard copy or electronic copy, has not been submitted on time or where the ‘wrong’ assignment has been submitted.

For assessments which account for 10% or less of the overall course grade, and where answers are immediately discussed or debriefed, the LIC may stipulate a different penalty. Details of such late penalties will be available on the course Moodle page.

FEEDBACK ON YOUR ASSESSMENT TASK PERFORMANCE

Feedback on student performance from formative and summative assessment tasks will be

provided to students in a timely manner. Assessment tasks completed within the teaching period of a course, other than a final assessment, will be assessed and students provided with feedback, with or without a provisional result, within 10 working days of submission, under normal circumstances. Feedback on continuous assessment tasks (e.g. laboratory and studio-based, workplace-based, weekly quizzes) will be provided prior to the midpoint of the course.

Faculty-specific Information

PROTOCOL FOR VIEWING FINAL EXAM SCRIPTS

UNSW students have the right to view their final exam scripts, subject to a small number of very specific exemptions. The UNSW Business School has set a [protocol](#) under which students may view their final exam script. Individual schools within the Faculty may also set up additional local processes for viewing final exam scripts, so it is important that you check with your School.

If you are completing courses from the following schools, please note the additional school-specific information:

- Students in the **School of Accounting, Auditing & Taxation** who wish to view their final examination script should also refer to [this page](#).
- Students in the **School of Banking & Finance** should also refer to [this page](#).
- Students in the **School of Information Systems & Technology Management** should also refer to [this page](#).

COURSE EVALUATION AND DEVELOPMENT

Feedback is regularly sought from students and continual improvements are made based on this feedback. At the end of this course, you will be asked to complete the [myExperience survey](#), which provides a key source of student evaluative feedback. Your input into this quality enhancement process is extremely valuable in assisting us to meet the needs of our students and provide an effective and enriching learning experience. The results of all surveys are carefully considered and do lead to action towards enhancing educational quality.

QUALITY ASSURANCE

The Business School is actively monitoring student learning and quality of the student experience in all its programs. A random selection of completed assessment tasks may be used for quality assurance, such as to determine the extent to which program learning goals are being achieved. The information is required for accreditation purposes, and aggregated findings will be

used to inform changes aimed at improving the quality of Business School programs. All material used for such processes will be treated as confidential.

TEACHING TIMES AND LOCATIONS

Please note that teaching times and locations are subject to change. Students are strongly advised to refer to the [Class Timetable website](#) for the most up-to-date teaching times and locations.