UNSW Course Outline

ACTL5103 Stochastic Modelling for Actuaries - 2024

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General Course Information

Course Code : ACTL5103
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 : Postgraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This course introduces the stochastic models used by actuaries to model both liabilities and assets and illustrates their applications in actuarial work. Topics covered include main features of a Markov chain and applications to experience rating; Markov process models and

applications to insurance, survival, sickness and marriage models; methods for simulation of a stochastic process; estimation of Markov chains. Students will be expected to implement models using the R software in a numerical computer package.

Course Aims

A. An understanding of Markov Chains and capability to implement for a frequency-based experience rating No Claim Discount (NCD) scheme using data

B. An understanding of Markov processes that can be used for insurance, survival, sickness, financial modelling, credit and operational risk management

C. Develop an understanding of the main concepts of Monte Carlo simulation of a stochastic process and a capability to carry out simple simulation procedures

D. Develop an understanding of the basic concepts underlying the analysis of time series model and a capability to apply basic concepts to data

E. Express his/her views on, and understanding of, an aspect of stochastic modelling

Relationship to Other Courses

The primary aim of this course is to provide students with an understanding of the mathematical concepts and techniques that actuaries use to model stochastic processes of both assets and liabilities.

This course introduces the stochastic models used by actuaries to model both liabilities and assets and illustrates their applications in actuarial work. The material is mathematically rigorous with a strong foundation in mathematics. The required knowledge for the course is a good understanding of probability and statistics as covered in ACTL5101 Probability and Mathematical Statistics. You should also be proficient with calculus and linear algebra. Consult the Course Coordinator if you do not have the required mathematical background.

The course will have applications in other courses in the actuarial major. More advanced models are covered in ACTL5104 Survival Analysis and Prediction of Life and Health Related Risks and ACTL5106 Insurance Risk Models. The course is necessary knowledge for the more advanced coverage in ACTL5104 Survival Analysis and Prediction of Life and Health Related Risks, ACTL5105 Life Insurance and Superannuation, ACTL5106 Insurance Risk Models, and ACTL5109 Financial Economics for Insurance and Superannuation. Advanced data analytics methods

relevant to actuarial work are covered in ACTL5110 Statistical Machine Learning for Risk and Actuarial Applications. Furthermore, the time series is covered in ACTL5301 Quantitative Risk Management Techniques.

Course Learning Outcomes

Course Learning Outcomes	Program learning outcomes
CLO1 : Describe and explain concepts and principles of actuarial modelling.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO2 : Describe and explain the main terminology of stochastic processes, including their classification into different types.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO3 : Define the key features and properties of a Markov Chain	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO4 : Implement Markov Chains for a frequency-based experience rating No Claim Discount (NCD) scheme using data.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO5 : Define the main features of a Markov Process and use simple Markov Processes to analyse insurance, survival, sickness and marriage models.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO6 : Identify and apply Markov processes that can be used for insurance, survival, sickness and financial modelling.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO7 : Identify and apply the main concepts of “Monte Carlo” simulation of a stochastic process and carry out simple simulation procedures.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO8 : Explain the concepts of ‘Monte Carlo’ simulation of a stochastic process using a series of pseudo-random numbers and apply simulation to simple actuarial problems.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO9 : Estimate transition probability and matrix of discrete-time and continuous-time Markov chains.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO10 : Express his/her views on, and understanding of, an aspect of statistic models.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO11 : Develop communication skills for the presentation of complex statistical models in written report form.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO12 : Construct written work which is logically and professionally presented.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication

Course Learning Outcomes	Assessment Item
CLO1 : Describe and explain concepts and principles of actuarial modelling.	• Formative assessment • Final Examination
CLO2 : Describe and explain the main terminology of stochastic processes, including their classification into different types.	• Formative assessment • Final Examination
CLO3 : Define the key features and properties of a Markov Chain	• Formative assessment • Final Examination
CLO4 : Implement Markov Chains for a frequency-based experience rating No Claim Discount (NCD) scheme using data.	• Formative assessment • Final Examination
CLO5 : Define the main features of a Markov Process and use simple Markov Processes to analyse insurance, survival, sickness and marriage models.	• Formative assessment • Final Examination
CLO6 : Identify and apply Markov processes that can be used for insurance, survival, sickness and financial modelling.	• Final Examination
CLO7 : Identify and apply the main concepts of “Monte Carlo” simulation of a stochastic process and carry out simple simulation procedures.	• Final Examination
CLO8 : Explain the concepts of ‘Monte Carlo’ simulation of a stochastic process using a series of pseudo-random numbers and apply simulation to simple actuarial problems.	• Major Assignment • Final Examination
CLO9 : Estimate transition probability and matrix of discrete-time and continuous-time Markov chains.	• Final Examination
CLO10 : Express his/her views on, and understanding of, an aspect of statistic models.	• Final Examination
CLO11 : Develop communication skills for the presentation of complex statistical models in written report form.	• Major Assignment • Final Examination
CLO12 : Construct written work which is logically and professionally presented.	• Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | EdStem

Learning and Teaching in this course

The course website is available on Moodle: https://moodle.telt.unsw.edu.au/login/index.php or via my.unsw.edu.au.

All course contents will be available from the Moodle course website. (It is essential that you visit the site regularly to see any notices posted there by the course coordinator, as it will be assumed that they are known to you within a reasonable time.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Formative assessment Assessment Format: Individual	10%	Start Date: Mondays in Weeks 3, 5, 7 and 9 Due Date: Week 3: 10 June - 16 June, Week 5: 24 June - 30 June, Week 7: 08 July - 14 July, Week 9: 22 July - 28 July
Major Assignment Assessment Format: Individual	30%	Start Date: 24/06/2024 09:00 AM Due Date: 19/07/2024 04:00 PM
Final Examination Assessment Format: Individual	60%	Start Date: Not Applicable Due Date: Not Applicable

Assessment Details

Formative assessment

Assessment Overview

These are aimed at encouraging students to keep up with the course materials.

Course Learning Outcomes

- CLO1 : Describe and explain concepts and principles of actuarial modelling.
- CLO2 : Describe and explain the main terminology of stochastic processes, including their classification into different types.
- CLO3 : Define the key features and properties of a Markov Chain
- CLO4 : Implement Markov Chains for a frequency-based experience rating No Claim Discount (NCD) scheme using data.
- CLO5 : Define the main features of a Markov Process and use simple Markov Processes to analyse insurance, survival, sickness and marriage models.

Detailed Assessment Description

There are four formative assessments. These comprise online quizzes and online discussion questions. Students are required to complete these via Storywall. These will assess students' understanding of the concepts covered in the course and their ability to apply them to stochastic actuarial modelling problems. Students will be given 5 days to complete it at home (or any place with an internet connection) and submit it online. Full credit will be given to students who have made a reasonable attempt. More details will be available on the course Moodle page.

Assessment Length

5 days each

Submission notes

Submission via Storywall

Assignment submission Turnitin type

This is not a Turnitin assignment

Major Assignment

Assessment Overview

A group assignment task involving application of course concepts.

Course Learning Outcomes

- CLO8 : Explain the concepts of 'Monte Carlo' simulation of a stochastic process using a series of pseudo-random numbers and apply simulation to simple actuarial problems.
- CLO11 : Develop communication skills for the presentation of complex statistical models in written report form.

Detailed Assessment Description

The practical application of the course concepts based on real life actuarial 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 (individual) Assignment for this course involving the practical application and interpretation of course concepts. It is based on the application of the technical concepts introduced within the learning outcomes 1-7. The assignment offers students the opportunity to 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. The assignment specifically assesses the program goals "Knowledge", "Problem solving and critical thinking", as well as "Communication". Full information about the major assignment will be released early in the session.

Assessment Length

26 days

Assignment submission Turnitin type

This assignment is submitted through Turnitin and students do not see Turnitin similarity reports.

Final Examination

Assessment Overview

The examination will aim to assess the achievement of the learning course outcomes.

Course Learning Outcomes

- CLO1 : Describe and explain concepts and principles of actuarial modelling.
- CLO2 : Describe and explain the main terminology of stochastic processes, including their classification into different types.
- CLO3 : Define the key features and properties of a Markov Chain
- CLO4 : Implement Markov Chains for a frequency-based experience rating No Claim Discount (NCD) scheme using data.
- CLO5 : Define the main features of a Markov Process and use simple Markov Processes to analyse insurance, survival, sickness and marriage models.
- CLO6 : Identify and apply Markov processes that can be used for insurance, survival, sickness and financial modelling.
- CLO7 : Identify and apply the main concepts of “Monte Carlo” simulation of a stochastic process and carry out simple simulation procedures.
- CLO8 : Explain the concepts of ‘Monte Carlo’ simulation of a stochastic process using a series of pseudo-random numbers and apply simulation to simple actuarial problems.
- CLO9 : Estimate transition probability and matrix of discrete-time and continuous-time Markov chains.
- CLO10 : Express his/her views on, and understanding of, an aspect of statistic models.
- CLO11 : Develop communication skills for the presentation of complex statistical models in written report form.
- CLO12 : Construct written work which is logically and professionally presented.

Detailed Assessment Description

The final examination will assess students understanding of the concepts covered in the course and readings and their ability to apply them to practical problems. A deeper grasp of materials is expected from students at the final exam level than at the tutorial level.

The final examination will be a two-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.

Assessment Length

2 hours

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Grading Basis

Standard

Requirements to pass course

In order to pass the course students must obtain an overall composite mark of 50 at least. 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 tutorials is expected in this course.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Module 0: Stochastic processes Module 1: Discrete-time Markov Chains
Week 2 : 3 June - 9 June	Lecture	Module 1: Discrete-time Markov Chains Module 2: Introduction to Simulation
Week 3 : 10 June - 16 June	Lecture	Module 2: Introduction to Simulation Module 3: Exponential Distribution and the Poisson Process Formative assessment
Week 4 : 17 June - 23 June	Lecture	Module 3: Exponential Distribution and the Poisson Process
Week 5 : 24 June - 30 June	Lecture	Module 4: Continuous-time Markov Chains Formative assessment Assignment released
Week 6 : 1 July - 7 July	Lecture	No classes in flexibility week
Week 7 : 8 July - 14 July	Lecture	Module 4: Continuous-time Markov Chains Formative assessment
Week 8 : 15 July - 21 July	Lecture	Module 4: Continuous-time Markov Chains Assignment Due
Week 9 : 22 July - 28 July	Lecture	Module 5: Estimating Markov Chain transition probabilities and matrices Formative assessment
Week 10 : 29 July - 4 August	Lecture	Module 5: Estimating Markov Chain transition probabilities and matrices Plus Final exam instructions

Attendance Requirements

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

General Schedule Information

The timetable may be altered. Students will be advised of any changes in lectures and via the course web site.

Course Resources

Prescribed Resources

- Sheldon M. Ross, Introduction to Probability Models, 12th edition, Academic Press 2014
- Formulae and Tables for Actuarial Examinations of the Faculty of Actuaries and the Institute of Actuaries

Recommended Resources

- Sheldon M. Ross, Stochastic Processes, 2nd edition, John Wiley, 1996

Course Evaluation and Development

Each year feedback is sought from students and other stakeholders about the courses offered in the School and continual improvements are made based on this feedback. UNSW's myExperience survey is one of the ways in which student evaluative feedback is gathered. In this course, we will seek your feedback through end of semester myExperience responses.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Lecturer	Yang Shen		Room 641, Level 6, East Wing, UNSW Business School Building	9385 3566		No	Yes

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 Plagarism

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.