UNSW Course Outline

ACTL5106 Insurance Risk Models - 2024

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General Course Information

Course Code : ACTL5106
Year : 2024
Term : Term 3
Teaching Period : T3
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 focuses on the principles and mathematical models that describe the random quantities and processes in general insurance practice. It invovles constructing mathematical models and utilising historical data to predict futgure insurance costs and risks. Key areas of

study include data analysis, loss models, reinsurance treaties, premium calculation, claims reserving, ruin theory, Bayesian inference, and credibility theory.

Course Aims

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

A. Model the excess of aggregate premiums over aggregate losses at any point in the future and describe how the model can be used;

B. Fit a distribution to data;

C. Incorporate past experience (of a contract or insured) into pricing and reserving;

D. Give an overview of basic decision and game theory

Relationship to Other Courses

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

- Model the excess of aggregate premiums over aggregate losses at any point in the future and describe how the model can be used;
- Fit a distribution to data;
- Incorporate past experience (of a contract or insured) into pricing and reserving.

This course covers the mathematical foundations of non-life insurance risk modelling. The assumed knowledge for this course is a solid foundation in ACTL5101, ACTL5102 and ACTL5103. Depending on their educational background, some students may be allowed to enroll in this course without having completed these courses. We advise you to consult the lecturer if you do not have the required background.

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.

Course Learning Outcomes

Course Learning Outcomes	Program learning outcomes
CLO1 : Calculate or approximate the distribution of sum losses for both fixed and random quantities.	• PLO1 : Business Knowledge • PLO2 : Problem Solving
CLO2 : Determine the value of reinsurance contracts using actuarial calculations.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO3 : Describe the classical risk model that contrasts aggregate premiums with aggregate losses.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO4 : Determine the likelihood of future losses exceeding premiums in simple scenarios.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO5 : Analyze data to compute key statistics and identify suitable distributions for modeling.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO6 : Estimate distribution parameters using data, whether complete, censored, or truncated.	• PLO1 : Business Knowledge • PLO2 : Problem Solving
CLO7 : Critique and evaluate the fit of statistical models through a variety of metrics.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
CLO8 : Implement Generalized Linear Models (GLM) in straightforward situations.	• PLO1 : Business Knowledge • PLO2 : Problem Solving
CLO9 : Compute Bayesian premiums for losses based on historical data using model-based approaches.	• PLO1 : Business Knowledge • PLO2 : Problem Solving
CLO10 : Forecast the expected present value of liabilities from already incurred claims.	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication • PLO5 : Responsible Business Practice

Course Learning Outcomes	Assessment Item
CLO1 : Calculate or approximate the distribution of sum losses for both fixed and random quantities.	• Final Examination • Assignment • Formative Assessment
CLO2 : Determine the value of reinsurance contracts using actuarial calculations.	• Final Examination • Assignment • Formative Assessment
CLO3 : Describe the classical risk model that contrasts aggregate premiums with aggregate losses.	• Final Examination • Assignment • Formative Assessment
CLO4 : Determine the likelihood of future losses exceeding premiums in simple scenarios.	• Final Examination • Assignment • Formative Assessment
CLO5 : Analyze data to compute key statistics and identify suitable distributions for modeling.	• Final Examination • Assignment • Formative Assessment
CLO6 : Estimate distribution parameters using data, whether complete, censored, or truncated.	• Final Examination • Assignment • Formative Assessment
CLO7 : Critique and evaluate the fit of statistical models through a variety of metrics.	• Final Examination • Assignment • Formative Assessment
CLO8 : Implement Generalized Linear Models (GLM) in straightforward situations.	• Final Examination
CLO9 : Compute Bayesian premiums for losses based on historical data using model-based approaches.	• Final Examination
CLO10 : Forecast the expected present value of liabilities from already incurred claims.	• Final Examination

Learning and Teaching Technologies

Moodle - Learning Management System | EdStem | Echo 360

Learning and Teaching in this course

Students are expected to come to the onsite lecture. During the lecture, the main topics are taught and learned how to apply the theories and techniques with examples. They are an opportunity for students to develop an understanding of the main topics covered in the course and the level of knowledge expected.

Although lectures are supposed to be automatically recorded by the system and made available on Moodle, the lecture recordings are never meant to be a replacement of in-person lectures. There are occasionally technical issues of the recording system regarding the availability and the

quality of the recordings, and in such cases, it is not the LIC's responsibility to redeliver the lecture or supply a replacement recording.

Tutorials and in-class activities are for students to ask questions on aspects of the course that need further clarification, and to interact with other students in the course. Students need to attempt the tutorial exercises alone first and identify problems that require closer review. Students are strongly encouraged to work in teams as it is an opportunity to learn from other students and to potentially develop team skills.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates	Program learning outcomes
Final Examination Assessment Format: Individual	60%		• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
Assignment Assessment Format: Individual Short Extension: Yes (3 days)	25%	Start Date: TBC Due Date: Week 7	• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication
Formative Assessment Assessment Format: Individual Short Extension: Yes (1 day)	15%		• PLO1 : Business Knowledge • PLO2 : Problem Solving • PLO3 : Business Communication

Assessment Details
Final Examination

Assessment Overview

To assess students understanding of the concepts and ability to apply them to various problems in general insurance and valuation in line with the professional syllabus.

Course Learning Outcomes

- CLO1 : Calculate or approximate the distribution of sum losses for both fixed and random quantities.
- CLO2 : Determine the value of reinsurance contracts using actuarial calculations.
- CLO3 : Describe the classical risk model that contrasts aggregate premiums with aggregate losses.
- CLO4 : Determine the likelihood of future losses exceeding premiums in simple scenarios.
- CLO5 : Analyze data to compute key statistics and identify suitable distributions for modeling.
- CLO6 : Estimate distribution parameters using data, whether complete, censored, or

truncated.
- CLO7 : Critique and evaluate the fit of statistical models through a variety of metrics.
- CLO8 : Implement Generalized Linear Models (GLM) in straightforward situations.
- CLO9 : Compute Bayesian premiums for losses based on historical data using model-based approaches.
- CLO10 : Forecast the expected present value of liabilities from already incurred claims.

<u>Detailed Assessment Description</u>

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 exam will be an invigilated closed book exam held on UNSW's Kensington campus on a date scheduled by the university. It is a mandatory requirement that you attend the exam on campus. All calculators must be UNSW approved. The University will not supply calculators to students for use in examinations. It is the student's responsibility to be familiar with the rules governing the conduct of examinations. Further instructions on how to prepare for the exam will be provided to you during the term.

<u>Assignment submission Turnitin type</u>

This is not a Turnitin assignment

<u>Generative AI Permission Level</u>

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see here.

Assignment

<u>Assessment Overview</u>

To assess students ability to apply technical concepts to solve problems based on critical analysis of data and demonstrate business communication.

<u>Course Learning Outcomes</u>

- CLO1 : Calculate or approximate the distribution of sum losses for both fixed and random quantities.
- CLO2 : Determine the value of reinsurance contracts using actuarial calculations.
- CLO3 : Describe the classical risk model that contrasts aggregate premiums with aggregate losses.

- CLO4 : Determine the likelihood of future losses exceeding premiums in simple scenarios.
- CLO5 : Analyze data to compute key statistics and identify suitable distributions for modeling.
- CLO6 : Estimate distribution parameters using data, whether complete, censored, or truncated.
- CLO7 : Critique and evaluate the fit of statistical models through a variety of metrics.

<u>Detailed Assessment Description</u>

There will be one major (individual) assignment for this course involving the application and interpretation of course concepts. It is based on the application of technical concepts. 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. Tentatively, the assignment will be due in Week 7 (TBC), and full information about the assignment will be released at least 3 weeks prior to the due date.

<u>Assignment submission Turnitin type</u>

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

<u>Generative AI Permission Level</u>

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.

If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see here.

When developing R code for your assignment, you are permitted to use Generative AI tools. Ensure that any assistance received from these tools is fully acknowledged with proper referencing.

Formative Assessment

Assessment Overview

Comprise online quizzes and online discussion questions to assess students understanding of the basic concepts covered in the course and their ability to apply them to general insurance problems.

Course Learning Outcomes

- CLO1 : Calculate or approximate the distribution of sum losses for both fixed and random quantities.
- CLO2 : Determine the value of reinsurance contracts using actuarial calculations.
- CLO3 : Describe the classical risk model that contrasts aggregate premiums with aggregate losses.
- CLO4 : Determine the likelihood of future losses exceeding premiums in simple scenarios.
- CLO5 : Analyze data to compute key statistics and identify suitable distributions for modeling.
- CLO6 : Estimate distribution parameters using data, whether complete, censored, or truncated.
- CLO7 : Critique and evaluate the fit of statistical models through a variety of metrics.

Detailed Assessment Description

There are 3 online quizzes and 2 discussion questions (Due in Weeks 2,3,4,8,9, TBC), and students are required to complete them via Moodle. Quizzes will assess students' understanding of the concepts covered in the course. The length of each quiz will be approximately 20 minutes (which consists e.g. MCQ, short/numeric answers, and long answers). Students will be given 3 days to complete each quiz at home (or any place with an internet connection) and submit it online. Full credit (3% per quiz) will be given to students who have made a reasonable attempt. Feedback will be provided. For each discussion question, each student needs to (i) create a post in the forum (in response to a topic/question posted by the teaching staff); and (ii) respond to or comment on one another student's post in the forum. Full credit (3% per discussion question) will be given to students who have done these two tasks. Detailed instructions will be provided in Moodle.

Assignment submission Turnitin type

This is not a Turnitin assignment

Generative AI Permission Level

Simple Editing Assistance

In completing this assessment, you are permitted to use standard editing and referencing functions in the software you use to complete your assessment. These functions are described

below. You must not use any functions that generate or paraphrase passages of text or other media, whether based on your own work or not.

If your Convenor has concerns that your submission contains passages of AI-generated text or media, you may be asked to account for your work. If you are unable to satisfactorily demonstrate your understanding of your submission you may be referred to UNSW Conduct & Integrity Office for investigation for academic misconduct and possible penalties.

For more information on Generative AI and permitted use please see here.

General Assessment Information

As a student at UNSW you are expected to display academic integrity in your work and interactions. Where a student breaches the UNSW Code of Conduct with respect to academic integrity, the University may take disciplinary action. 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 Code of Conduct, 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.

Grading Basis

Standard

Requirements to pass course

In order to pass this course students must:

- Achieve a composite mark of at least 50 out of 100
- Engage actively in course learning activities and attempt all assessment requirements
- Meet any additional requirements specified in the assessment details
- Meet the specified attendance requirements of the course

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Module 0: Introduction Module 1: Fitting Loss Models Module 2: Individual Claim Size Modeling
Week 2 : 16 September - 22 September	Lecture	Module 2: Individual Claim Size Modeling Module 3: Collective Risk Modelling
Week 3 : 23 September - 29 September	Lecture	Module 3: Collective Risk Modelling Module 4: Approximations for Compound Distributions
Week 4 : 30 September - 6 October	Lecture	Module 5: Liability Valuations- Ruin Theory
Week 5 : 7 October - 13 October	Lecture	Module 5: Liability Valuations- Ruin Theory Module 6: Liability Valuations- Claims Reserving
Week 6 : 14 October - 20 October	Homework	Flexibility Week - No Classes
Week 7 : 21 October - 27 October	Lecture	Module 6: Liability Valuations- Claims Reserving
Week 8 : 28 October - 3 November	Lecture	Guest lecture, application Module 7: Bayesian Models and Credibility Theory
Week 9 : 4 November - 10 November	Lecture	Module 7: Bayesian Models and Credibility Theory
Week 10 : 11 November - 17 November	Lecture	Module 7: Bayesian Models and Credibility Theory Review

Attendance Requirements

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

Course Resources

Prescribed Resources

Course references

Note that most references are freely downloadable and/or available from the library.

The main reference book for the course is:

- [MW] Wüthrich, Mario (2014), Non-Life Insurance: Mathematics and Statistics. This book is can be downloaded for FREE from SSRN.
- Prof. Wüthrich is a professor at ETHZ and makes his book freely available worldwide. He updates his book regularly, so I recommend you check regularly for newer versions, and if you print, that you do so chapter per chapter at the last moment.

Suggested readings/references are:

- Bühlmann, H. and Gisler, A. (2005), A Course in Credibility Theory and its Applications, Springer [Chapter 1 corresponds to our Module 6. Link.]
- Bowers, N.L. Gerber, H.U., Hickman, J.C., Jones, D.A. and Nesbitt, C.J. (1997), Actuarial Mathematics, Society of Actuaries, 2nd Edition [A great classic for Modules 1-5. Most

students having completed the life insurance course should already have a copy.]
- Dickson, D.C.M (1995), A review of Panjer's recursion formula and its applications, British Actuarial Journal 1:1, pp. 107-124 [This corresponds to our Module 4. Link.]
- Klugman, S. and Rioux, J. (2006), Toward a Unified Approach to Fitting Loss Models, North American Actuarial Journal 10:1, pp. 63-83 [This corresponds to our Module 3. Link.]
- Klugman, S.A., Panjer, H.H. and Willmot, G.E. (2019), Loss Models: From Data to Decisions, John Wiley & Sons, 5th Edition. [Chapters 16, 17 and 18 correspond to our Module 6.]

Most references are available from the library.

Course website

The course website is available on Moodle or via my.unsw.edu.au.

The course contents will be available from the 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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Jae Kyung Woo					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 [Policies and Guidelines](#) 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 [Policies and Guidelines](#) page. For PG Research PLOs, including MPDBS, please refer to [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 Code of Conduct](#) with respect to academic integrity, the University may take disciplinary action. 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 Code of Conduct, 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

SHORT EXTENSIONS

Short Extension is a new process that allows you to apply for an extended deadline on your assessment without the need to provide supporting documentation, offering immediate approval during brief, life-disrupting events. Requests are automatically approved once submitted.

Short extensions are ONLY available for some assessments. Check your course outline or

Moodle to see if this is offered for your assessments. Where a short extension exists, all students enrolled in that course in that term are eligible to apply. Further details are available the UNSW Current Students page.

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. Special consideration is primarily intended to provide you with an extra opportunity to demonstrate the level of performance of which you are capable.

Applications can only be made online and will NOT be accepted by teaching staff. 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. The majority of applications will be processed within 3-5 working days.

For further information, and to apply, see Special Consideration on the UNSW Current Students page.

LATE SUBMISSION PENALTIES

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. In the case of an approved Equitable Learning Plan (ELP) provision, special consideration or short extension, the late penalty applies from the date of approved time extension. After five days from the extended deadline, the assessment cannot be submited.

An assessment is considered late if the requested format, such as hard copy or electronic copy, has not been submitted on time or where the 'wrong' assessment 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.