



UNSW

UNSW Course Outline

ACTL2131 Probability and Mathematical Statistics - 2024

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General Course Information

Course Code : ACTL2131

Year : 2024

Term : Term 1

Teaching Period : T1

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 covers probability and statistics topics relevant to actuarial studies. Topics covered include univariate/multivariate random variables, moments, probability generating functions, moment generating functions, marginal and conditional distributions, sampling distributions,

estimation methods, hypothesis tests, regression, analysis of variance. Examples relevant to actuarial studies, finance and insurance are used to illustrate the application of the topics covered.

Course Aims

This course is to provide students with an understanding of statistics and statistical techniques used in solving actuarial problems

Relationship to Other Courses

This course covers probability and statistics at an introductory yet mathematically rigorous 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 of university calculus and linear algebra.

ACTL2131 Probability and Mathematical Statistics will have applications in other courses in the actuarial major. More advanced models are covered in ACTL2102 Foundations of Actuarial Models. The course contains necessary knowledge for the more advanced coverage in ACTL3151 Life Contingencies and ACTL3162 General Insurance Techniques.

The course corresponds to part of the actuarial professional subject CS1 Actuarial Statistics. Students achieving Credit or higher grades will be recommended for exemption from the professional examination. Exemptions from professional actuarial examinations require above average performance in the equivalent University course.

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) and a spreadsheet (such as EXCEL) as well as the statistical software R.

Course Learning Outcomes

Course Learning Outcomes	Program learning outcomes
CLO1 : Become familiar with concepts of probability and statistical theory	<ul style="list-style-type: none">• PLO1 : Business Knowledge• PLO2 : Problem Solving
CLO2 : Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies	<ul style="list-style-type: none">• PLO1 : Business Knowledge• PLO3 : Business Communication• PLO5 : Responsible Business Practice• PLO7 : Leadership Development
CLO3 : Use the standard models of probability and statistics to interpret and analyse real problems in actuarial and risk modelling	<ul style="list-style-type: none">• PLO1 : Business Knowledge• PLO3 : Business Communication• PLO7 : Leadership Development
CLO4 : Construct written work that is logically and professionally presented	<ul style="list-style-type: none">• PLO1 : Business Knowledge• PLO3 : Business Communication• PLO7 : Leadership Development
CLO5 : Communicate ideas in a succinct and clear manner	<ul style="list-style-type: none">• PLO3 : Business Communication• PLO7 : Leadership Development
CLO6 : Work collaboratively to complete a task	<ul style="list-style-type: none">• PLO3 : Business Communication• PLO4 : Teamwork

Course Learning Outcomes	Assessment Item
CLO1 : Become familiar with concepts of probability and statistical theory	<ul style="list-style-type: none">• Final Examination• Assignment• Quiz
CLO2 : Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies	<ul style="list-style-type: none">• Final Examination• Assignment• Quiz
CLO3 : Use the standard models of probability and statistics to interpret and analyse real problems in actuarial and risk modelling	<ul style="list-style-type: none">• Final Examination• Assignment• Quiz
CLO4 : Construct written work that is logically and professionally presented	<ul style="list-style-type: none">• Assignment
CLO5 : Communicate ideas in a succinct and clear manner	<ul style="list-style-type: none">• Assignment
CLO6 : Work collaboratively to complete a task	<ul style="list-style-type: none">• Assignment

Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360

Learning and Teaching in this course

The course is delivered in-person, with lectures crafted to enhance students' comprehension of

the material. Additionally, tutorials provide an opportunity for students to apply and practice their acquired knowledge. Both lectures and tutorials are conducted in a face-to-face setting.

Course materials are organised in 2 modules (Module 1: Probability; Module 2: Statistics). Students are responsible for learning topics with the following materials:

- Lecture slides
- Tutorial questions
- Past exams
- Prescribed textbooks

The lectures, tutorials and assessment have been designed to appropriately challenge students and support the achievement of the desired learning outcomes. A climate of inquiry and dialogue is encouraged between students and teachers and among students (in and out of class). The lecturers and tutors aim to provide meaningful and timely feedback to students to improve learning outcome. This is not a course where you can become proficient just by observing.

You will need to get involved in class - evaluating information, asking and answering questions. You also must learn to organize your independent study and practice enough problems to gain a thorough understanding of concepts and how to apply them.

This course material each week requires that you know the material of previous weeks. Therefore, falling behind will lead to less effective lectures and tutorials and is thus not recommended.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Examination Assessment Format: Individual	60%	
Assignment Assessment Format: Individual	20%	
Quiz Assessment Format: Individual	15%	
Participation Mark Assessment Format: Individual	5%	

Assessment Details

Final Examination

Assessment Overview

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

Course Learning Outcomes

- CLO1 : Become familiar with concepts of probability and statistical theory
- CLO2 : Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies
- CLO3 : Use the standard models of probability and statistics to interpret and analyse real problems in actuarial and risk modelling

Assignment

Assessment Overview

The assignment component is split into two parts: a theoretical assignment in week 5, mirroring the format of the final exam to account for 10%, and a practical assignment using R programming to be completed during weeks 9-10, also worth 10%.

Course Learning Outcomes

- CLO1 : Become familiar with concepts of probability and statistical theory
- CLO2 : Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies
- CLO3 : Use the standard models of probability and statistics to interpret and analyse real problems in actuarial and risk modelling
- CLO4 : Construct written work that is logically and professionally presented
- CLO5 : Communicate ideas in a succinct and clear manner
- CLO6 : Work collaboratively to complete a task

Quiz

Assessment Overview

Short formative assessments occurring on a fortnightly basis to keep students engaged and provide ongoing feedback on their learning progress.

Course Learning Outcomes

- CLO1 : Become familiar with concepts of probability and statistical theory
- CLO2 : Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies
- CLO3 : Use the standard models of probability and statistics to interpret and analyse real

problems in actuarial and risk modelling

Participation Mark

Assessment Overview

To encourage active engagement in the course, a participation mark rewards regular contribution and interaction within the tutorial.

PLO2: Problem solving

PLO3: Business communication

General Assessment Information

All details and schedule of assessments will be provided on the course Moodle site.

Grading Basis

Standard

Requirements to pass course

Achieve a composite mark of 50 out of 100.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 12 February - 18 February	Lecture	1.1 Introduction to probability Sample space, probability measure Conditional probability and independence Random variables and distributions Measures of location Measure of dispersion Moments (central/non-central) Generating functions
Week 2 : 19 February - 25 February	Lecture	1.2 Univariate Distributions Bernoulli Distribution Binomial Distribution Geometric Distribution Negative Binomial Distribution Poisson Distribution Exponential Distribution Gamma Distribution
Week 3 : 26 February - 3 March	Lecture	1.2 Univariate Distributions Normal Distribution Log-Normal Distribution Uniform Distribution Beta Distribution 1.3 Joint and Multivariate Distributions Bivariate distribution functions Mean, variance, covariance & correlation
Week 4 : 4 March - 10 March	Lecture	1.3 Joint and Multivariate Distributions Conditional Distributions Bivariate Normal Distribution Multivariate distribution functions 1.4 Functions of Random Variables The CDF techniques The Jacobian transformation technique The MGF technique Order statistics, min, max Convolution
Week 5 : 11 March - 17 March	Lecture	1.4 Functions of Random Variables Special sampling distributions (Student-t, F, Chi2 distributions) 1.5 Sequences and Convergence of Random Variables Chebyshev's inequality Convergence concepts Law of Large Numbers Central Limit Theorem Applications of convergence to distributional approximations
Week 6 : 18 March - 24 March	Lecture	Flexibility week
Week 7 : 25 March - 31 March	Lecture	2.1 Data Exploration: Visualisation and Descriptive Statistics Numerical methods Graphical methods Properties of sample mean and sample variance 2.2 Point and interval estimation techniques Introduction/Definitions Method of Moments Maximum Likelihood Estimation (MLE)
Week 8 : 1 April - 7 April	Lecture	2.2 Point and interval estimation techniques Confidence Intervals 2.3 Evaluating point estimators UMVUE Cramer-Rao Low Bound Consistency Properties of MLEs
Week 9 : 8 April - 14 April	Lecture	2.4 Hypothesis testing Introduction to hypothesis testing Rejection region Type I & II error Power of the test p-value Relation between confidence intervals and hypothesis tests 2.5 Parametric and nonparametric hypothesis tests Two-sample test of means Two-sample test of variances Wald test

Week 10 : 15 April - 21 April	Lecture	2.5 Parametric and nonparametric hypothesis tests Generalized Likelihood Ratio test Contingency table and Chi-2 tests
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Attendance Requirements

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

General Schedule Information

The provided schedule is an estimate. Completion times for specific topics may vary, as we may progress through some topics more quickly or slowly than anticipated.

Tutorials will be structured around the content discussed in that week's lecture.

Complete information and the schedule for assessments will be made available on the Moodle website.

Course Resources

Prescribed Resources

Textbooks

The prescribed textbooks for the course are:

- [FT] The Faculty of Actuaries and The Institute of Actuaries (2002), Formulae and tables for examinations of the Faculty of Actuaries and The Institute of Actuaries. (The formulae book you can use, if unannotated, in quizzes and exams for actuarial courses.)

Suggested textbooks for the course are:

- [W+] Wackerly, D.D., Mendenhall, W. & Schaeffer, R.L (2008), Mathematical Statistics with Applications, Duxbury, 7th ed. Well respected introductory textbook. Not as difficult as [JR].
- [JR] Rice, J.A. (2007), Mathematical Statistics and Data Analysis, Duxbury Press, 3ed. Well regarded and comprehensive textbook. More technical than [W+].

You are advised to have one (or both) of these textbooks in this course. Depending on your mathematical background you should choose either [W+] or [JR].

Optional readings are:

- [CT] The Actuarial Education Company (2010), CT3 Combined Materials Pack, ActEd. (This is the Institute of Actuaries study material for the CT3 exam. Only the syllabus can be downloaded for free.)
- [H] Hossack, I., Pollard, J. & Zehnwirth, B. (1999), Introductory Statistics with Applications in

General Insurance, Cambridge University Press, 2ed. (Want to see how statistics is used in the most statistical actuarial practice area, general insurance? Here's your starting place.)

Formulae & Tables

Students will only be allowed to bring into the examinations for the Actuarial courses 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 bookstore, the UK Institute of Actuaries or from ActEd Australia.

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.

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Katja Ignatieva		Business School		provided on Moodle	No	Yes
	Robert Annabel		Business School		provided on Moodle	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.