UNSW Business School

School of Risk & Actuarial

ACTL2131
Probability and Mathematical Statistics

Course Outline
Semester 1, 2017

Part A: Course-Specific Information

Please consult Part B for key information on Business School policies (including those on plagiarism and special consideration), student responsibilities and student support services

Dear Students,

Welcome to ACTL2131 Probability and Mathematical Statistics. This course is one of eight courses covering the Core Technical subjects of the Institute of Actuaries offered in BActSt. Many of you will also be completing ACTL2111 Financial Mathematics for Actuaries. In the early weeks of the courses you will find that you will have to adjust to the study load in the courses and also take some time to note the links between these courses.

Probability is the branch of science concerned with the mathematical models and techniques for making quantitative inferences about uncertainty. Statistics deals with the collection and the analysis of data. Together, these two disciplines provide us with fundamental tools to analyse risk and manage the financial consequences of future uncertainties. This course provides you with a foundation in the probability models and statistical techniques required for analysing risks in modern financial markets. It provides a foundation for courses in your actuarial major in the final years of undergraduate study at UNSW. I hope you find the course challenging and interesting.

The course will be taught in a “flipped” way. The main rationale for the “flipped” structure is to bring the face-to-face time later in the learning process, when students are more comfortable with the materials, and more likely to interact and ask questions. The first conceptual encounter with the materials happens at home when students watch video lectures. They then move to a “lectorial”, whereby everyone is gathered in the lecture room. The word combines lectures—because they are run by the lecturer, and tutorial—because their goal is not to entirely “lecture” students, but also discuss a module at a higher conceptual level, and to cement students’ learning with other activities (such as guest lectures, discussions, advanced exercises). Finally, students move on to practicing their knowledge with tutorial exercises. At this stage, tutorial sessions provide some face-to-face on a weekly basis, to personalised help from the tutor. Weekly consultations with a lecturer and online tutor consultations are also available.

Please read it carefully and thoroughly, as it will be assumed that you are familiar with the contents.

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

Katja Ignatieva (LIC, course coordinator)

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PART A: COURSE-SPECIFIC INFORMATION

1 STAFF CONTACT DETAILS

Staff	E-mail	Lecture stream	Consultation	Telephone
Dr. Katja Ignatieva, course coordinator, lecturer in charge	k.ignatieva@unsw.edu.au	Stream A: Mon 09-11 BUS G26; Stream C: Mon 13-15 BUS G26	Mon 16-17, or after the lecture Business School, Room 651	9385 6810
Dr. Héloïse Labit Hardy	h.labithardy@unsw.edu.au	Stream B: Tue 09-11, BUS G21	Tue 16-17 CEPAR, Level 3, 223 ANZAC Pde, Room E313A	9385 7005
Dr. Han Li	han.li@unsw.edu.au	Stream D: Thu 09-11, BUS G26	Thu 11.15-12.15 CEPAR, Level 3, 223 ANZAC Pde, Room E20C	9385 5294
Dr. Jennifer Alonso Garcia	j.alonsogarcia@unsw.edu.au	Stream E: Tue 13-15 BUS G26	Tue 16-17 CEPAR, Level 3, 223 ANZAC Pde, Room E313A	9385 6672
Mr. Nikolay Gudkov	n.gudkov@unsw.edu.au	Stream F: Thu 14-16 BUS G26	Thu 17-18 School of Risk and Actuarial Studies, Level 6, East wing BS (outside the school)	0420780817

Katja is responsible for the administration and final assessment of the course, as well as the lectures for Stream A and C and related teaching and learning. Héloïse, Han, Jennifer and Nikolay are responsible the lecturer for Stream B, D, E and F, respectively, and related teaching and learning.

Tutors for ACTL 2131 are:

Staff	E-mail
Harry Liu	harry.liu.95@gmail.com
Hayden Lau	kawai.lau@unsw.edu.au
Yore Woo	yooree.woo@gmail.com
Mingda Xu	Mxu925@gmail.com

They are responsible for the tutorials and grading of mid-semester test and assignment assessment tasks.

Who should I contact?

1. Questions about the video lectures and lectorials: lecturer of your stream during the lectorials and consultation times;
2. Questions about tutorial problems: the tutors during the tutorials and consultation times (will be announced prior to mid-term and final exams);
3. Administrative enquiries about the course: Katja, during the consultation times or by e-mail;
4. Enquiries about coursework programs in Actuarial Studies: School office (rasadmin@unsw.edu.au);
5. Enrolment**:** Business School Student Centre: http://www.asb.unsw.edu.au/currentstudents/resources/businessstudentcentre/Pages/default.aspx

2 COURSE DETAILS

2.1 Teaching Times and Locations

This course consists of

- Self-study video recordings available on the course website;
- Lectorials: 2 contact hours with the lecturer assigned to your stream every week (week 1-7, 8-12)
- Weekly tutorials (weeks 2-13);
- 1 optional weekly contact hour with the lecturer assigned to your stream, Consultation.

Fore more details refer to course schedule in Section 7.

Lectorial times and locations are in the Table above (page 1)
Tutorials will take place every week, starting in week 2 and finishing in week 123.
Consultation times and locations are in the Table above (page 1)

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

Students should consult Moodle on a regular basis, since assignment questions and other course materials will be placed there. The web address is:
http://moodle.telt.unsw.edu.au/

Lectorials
Students must attend the lectorials for which they are enrolled.

Tutorials
Students must attend the tutorial for which they are enrolled. Attendance will be recorded and count towards meeting the requirements to pass the course. If you wish to change your tutorial then you must lodge an application to change your tutorial time with the Business School student service centre.

In tutorials, we will implement interactive learning where collaborative group work is highly encouraged. To get the most out of the tutorials, students should read lecture notes and textbooks and references and complete assigned homework problems in advance of the tutorial.

Consultations

Consultations are optional. If you choose to attend a consultation, please choose the one associated with your Lectorial stream.

Peer-Assisted-Support-Scheme (PASS):
In addition, ASOC has an actuarial PASS program which is available to enhance student learning in this course. It is highly recommended that you attend these sessions.

ASOC website: http://www.asoc.unsw.edu.au/
PASS peer support class times:
http://www.asoc.unsw.edu.au/index.php?option=com_content&view=article&id=48&Itemid=42
PASS material is available on https://sites.google.com/a/asoc.unsw.edu.au/unsw-asoc/downloads

2.2 Units of Credit

The course is worth 6 units of credit.

2.3 Summary of Course

This course covers probability and statistics topics relevant to actuarial studies. Topics covered include univariate and multivariate random variables, moments, moment generating functions, marginal and conditional distributions, sampling distributions, estimation methods, hypothesis tests, and linear regression. Examples relevant to actuarial studies, finance and insurance are used to illustrate the application of the topics covered.

2.4 Course Aims and Relationship to Other Courses

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

A. Demonstrate an understanding of probability theory;
B. Demonstrate an understanding of statistical theory;
C. Express your views on, and understanding of parameter estimation for parametric distributions;
D. Express your views on, and understanding of hypothesis testing;
E. Express your views on, and understanding of linear regression.

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. There is a document on Moodle with some assumed knowledge of mathematics and linear algebra. Consult the Course Coordinator if you do not have the required mathematical background.

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 is necessary knowledge for the more advanced coverage in ACTL3151 Life Contingencies and ACTL3162 General Insurance Techniques.

The course corresponds to the actuarial professional subject CT3 Probability and Mathematical 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).

2.5 Student Learning Outcomes

The aims of Section 2.3 (A to D) have been broken down into the following learning outcomes. At the end of the course students should be able to:

A1. Explain the concepts of probability.
A2. Explain the concepts of random variable, probability distribution, distribution function, expected value, variance and higher moments, and calculate expected values and probabilities associated with the distributions of random variables.
A3. Define a moment generating function, derive it in simple cases, and use it to evaluate moments
A4. Define basic discrete and continuous distributions, be able to apply them and simulate them in simple cases.
A5. Explain the concepts of independence, jointly distributed random variables and conditional distributions, and use generating functions to establish the distribution of linear combinations of independent random variables.
A6. Explain the concepts of conditional expectation and compound distribution, and apply them.
A7. State the central limit theorem, and apply it.
B1. Summarise the main features of a data set (exploratory data analysis).
B2. Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions.

C1. Describe the main methods of estimation and the main properties of estimators, and apply them.
C2. Construct confidence intervals for unknown parameters.
D1. Test hypothesis.
E1. Investigate linear relationships between variables using correlation analysis and regression analysis.

The following table shows how your Course Learning Outcomes relate to the overall Program Learning Goals and Outcomes, and indicates where these are assessed (they may also be developed in tutorials and other activities):

Program Learning Goals and Outcomes		**Course Learning Outcomes**	**Course Assessment Item**
This course helps you to achieve the following learning goals for all Business postgraduate coursework students:		*On successful completion of the course, you should be able to:*	*This learning outcome will be assessed in the following items:*
1	Knowledge	Become familiar with concepts of probability and statistical theory. Use probability knowledge and statistical skills to present data and relate to problems in actuarial studies.	• Exercise • Mid-semester exam • Assignment • Exam
2	Critical thinking and problem solving	Use the standard models of probability and statistics to interpret and analyse real problems in actuarial and risk modelling.	• Exercise • Mid-semester exam • Assignment • Exam
3a	Written communication	Construct written work that is logically and professionally presented.	• Assignment
3b	Oral communication	Communicate ideas in a succinct and clear manner.	• Active lectures participation
4	Teamwork	Work collaboratively to complete a task.	• Assignment • Active lectures participation
5a.	Ethical, social and environmental responsibility	Not specifically addressed in this course.	
5b.	Social and cultural awareness	Not specifically addressed in this course.	

For more information on the Undergraduate Program Learning Goals and Outcomes, see Part B of the course outline.

Business Undergraduate Program Learning Goals and Outcomes

1. Knowledge: **Our graduates will have in-depth disciplinary knowledge applicable in local and global contexts.**
You should be able to select and apply disciplinary knowledge to business situations in a local and global environment**.**

2. Critical thinking and problem solving: Our graduates will be critical thinkers and effective problem solvers.
You should be able to identify and research issues in business situations, analyse the issues, and propose appropriate and well-justified solutions.

3. Communication: Our graduates will be effective professional communicators.
You should be able to:

- **a.** Prepare written documents that are clear and concise, using appropriate style and presentation for the intended audience, purpose and context, and
- **b.** Prepare and deliver oral presentations that are clear, focused, well-structured, and delivered in a professional manner.

4. Teamwork: Our graduates will be effective team participants.
You should be able to participate collaboratively and responsibly in teams, and reflect on your own teamwork, and on the team's processes and ability to achieve outcomes.

5. Ethical, social and environmental responsibility: Our graduates will have a sound awareness of the ethical, social, cultural and environmental implications of business practice.
You should be able to:

a. Identify and assess ethical, environmental and/or sustainability considerations in business decision-making and practice, and
b. Identify social and cultural implications of business situations.

2.6 Learning Outcomes: coverage of Institute of Actuaries

This course corresponds largely with the actuarial professional subject CT3 Probability and Mathematical Statistics. The course's Learning Outcomes relate to the aims of this Institute of Actuaries course in the following way:

Course Learning Outcomes	Institute of Actuaries aims
A1	CT3: ii,
A2	CT3: iii
A3	CT3: iv
A4	CT3: v
A5	CT3: vi
A6	CT3: xiv
A7	CT3: vii
B1	CT3: i
B2	CT3: viii
B3	CT3: ix
B4	CT3: x
B5	CT3: xi

B6	CT3: xii
B7	CT3: xiii
C1	None
D1	None

3 LEARNING AND TEACHING ACTIVITIES

3.1 Approach to Learning and Teaching in the Course

The approach adopted in this course is one of assisted self-study. **The approach adopted in this course is called flipped classroom.** While reading this subsection, please refer to the schedule given in Section 7.

The main rationale for this new structure is to bring the face-to-face time later in the learning process, when students are more comfortable with the materials, and more likely to interact and ask questions. The first conceptual encounter with the materials happens at home when students watch the video lectures. They then move to a "lectorial", whereby everyone is gathered in the lecture room. The word combines *lectures*—because they are run by the lecturer, and with the whole group, and *tutorial*—because their goal is not to "lecture" students, but to discuss a module at a higher conceptual level, and to cement students' learning with other activities (such as guest lectures, discussions, advanced exercises). Finally, students move on to practicing their knowledge with tutorial exercises. At this stage, tutorial sessions provide some face-to-face on a weekly basis, to personalised help from the tutor.

Course materials are organised in 4 modules. Students are responsible to learn topics with the following materials:

- Prescribed textbooks (and recommended books for additional support)
- Video lectures available on the course website
- Tutorial exercises with solutions
- Past quizzes and exams for advanced exercises

Additionally, students who are not familiar with the software R should complete the module "R you ready?" (with videos, exercises and documents) which is available on the course website to all ACTL students.

The philosophy underpinning this course and its Teaching and Learning Strategies are based on "Guidelines on Learning that Inform Teaching at UNSW. These guidelines may be viewed at: www.guidelinesonlearning.unsw.edu.au. Specifically, 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 is very condensed and the subjects each week require that you know the material of past weeks. Therefore, falling behind will lead to less effective lectures and tutorials and is thus not recommended.

The course puts emphasis on statistics, i.e., parameter estimation, hypothesis testing and linear regression (week 5-12). In order to understand statistics one should have some knowledge about probability (week 1-4). The probability part of the course is taught in only four weeks, which means that the workload in those weeks might be larger than in the second part of the course. To ease the workload, you are expected to make exercises during the tutorials. The number of examples in the lecture notes has increased substantially. In the lecture you are required to make attempts to these examples, some of them are to do at home.

3.2 Learning Activities and Teaching Strategies

It is expected that the students will take a pro-active approach to learning. The course is organised in the following learning activities.

Self-study
During the time periods of self-study, students should cover the readings, video lectures and tutorials for the associated module. A required learning strategy for this course is to have read all prescribed readings, watched the associated video lectures and attempted the tutorial exercises before lectures.

Lectorials
The purpose of lectorials is to provide a logical structure for the topics that make up the course, to emphasize the important concepts and methods of each topic, and to provide relevant examples to which the concepts and methods are applied. Lectorials provide opportunities to ask questions about the associated modules.

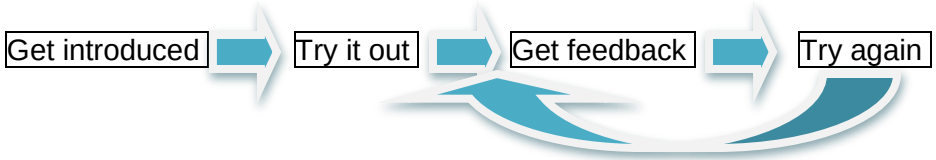
Tutorials
The more you read the more you know, **but the more you practice the more you learn and understand**. So the key to the understanding of this course is problem solving.

The purpose of tutorials is to enable you to raise questions about difficult topics or problems encountered in their studies. *Students must not expect another lecture, but must attempt the questions themselves in groups and the tutor will answer questions to the group, not to the whole class.*

A required learning strategy for the tutorials (on which provision of the course materials is based) is:

- Prior to make an attempt of the exercises, review your lecture notes and videos.
- Prior to the tutorial, make an attempt to the exercises you should make before the tutorial (see Section 7: Course Schedule).
- During the tutorial, make an attempt to the exercises you should make in the tutorial (see Section 7: Course Schedule).
- After the tutorial, make an attempt to the exercises you should after in the tutorial (see Section 7: Course Schedule).
- If you have questions about the tutorial exercises, ask them from your tutor. If you think you have a good understanding of the material, you should try and answer the questions of your peers. This will give you feedback on your ability to explain the material and hence how well you know the material.
- Check your answer using the tutorial solution.

The teaching strategy (including the feedback loop) in this course is:



The "Get introduced" (explanation of course concepts in the lecture) and "Try it out" (examples in the lecture) are part of the lecture. If you are not able to make satisfactory attempt to the examples in the lecture, this is feedback that you should revise the lecture material in depth after the lecture. The "Try again" (tutorial exercises) and "Get feedback" (answers from tutor/ tutorial solutions) are part of the tutorial.
The tutorial is designed to attempt the tutorial questions in groups (typically of 3-4 students). This collaborative working is advised since it allows learning from peers and allows the more advanced student with a possibility to test whether s/he knows the material in depth and is thereby able to explain it to peers. If the group is unable to solve a question, it can ask for help from the tutor. The tutor will not provide the answer, but would help you in the direction of the solution. This is because you should practice and learn by doing, rather than seeing the solution. At the end of the week the tutorial solutions will be posted on Moodle. It will only be posted at the end of the week to give you time to attempt the questions without a solution manual. The solution manual should not be part of attempting a question, but to verify whether your attempt was correct.

A required learning strategy for the tutorials (on which provision of the course materials is based) is:

- Prior to make an attempt of the exercises, review your lecture notes.
- Prior to the tutorial, make an attempt to the exercises you should make before the tutorial (see Section 7: Course Schedule).
- During the tutorial, make an attempt to the exercises you should make in the tutorial (see Section 7: Course Schedule).
- After the tutorial, make an attempt to the exercises you should after in the tutorial (see Section 7: Course Schedule).
- If you have questions about the tutorial exercises, ask them from your tutor. If you think you have a good understanding of the material, you should try and answer the questions of your peers. This will give you feedback on your ability to explain the material and hence how well you know the material.
- Check your answer using the tutorial solution.

3.3 Learning and Teaching Technologies

The course ACTL 2131 Probability and Mathematical Statistics is a condense course. To optimize the learning experience we will use several learning and teaching technologies.

Moodle
This course will use Moodle for communication with students.
Moodle will contain the course outline, lecture notes, homework and tutorial exercises, assessment information, and any notices relevant to this course. It is important that you visit the site regularly to see any notices posted there by the course coordinator. The site can be accessed at: http://moodle.telt.unsw.edu.au/

Video Lectures

You are expected to view the videos on Moodle before attending the lecture, see course schedule. The material covered in the videos will not be covered in the lectures, except when there are clarification questions from students. The lecture will provide tutorial style examples (i.e., using collaborative group work in lecture) of the material covered in the video lectures. Therefore, it is essential that you study this material before the lecture.

Turnitin
Turnitin will be used for handing in the assignment. More information will be given in the documentation for the assignment.
Some resources for help:
Turnitin tutorials:
http://www.turnitin.com/en_us/training/student-training Turnitin help centre:
http://www.turnitin.com/en_us/support/help-center/general-articles

4 ASSESSMENT

4.1 Formal Requirements

In order to pass these courses, you must:

1. achieve a composite mark of at least 50%; and
2. make a satisfactory attempt at all assessment tasks.

Students who have an overall performance at the Credit level (65% and above) are eligible for exemption of the Institute of Actuaries CT3 examination.

4.2 Assessment Details

Assessment of your performance in the course will be done through a number of tasks. These are listed in the table below.

Assessment Task	Weight	LO[1]	Length	Due Date
Mid-term	20%	Weeks 1-4: A1-A6, B1	1 hour	Friday, 7th April 17.00-19.00. Location: TBA
Individual Assignment	15%	A1-A7, B1, C1, D1	NA	Friday 26 May 11am sharp
Final examination	65%	All	2 hours	TBA

Mid-term
Technical skills are important in practice and this course provides foundation technical skills that will be useful throughout your working life.

[1] Course Learning Outcome that is assessed

In order to assess your understanding of the technical skills covered in the course there will be a 1-hour quiz during the session. The quiz will be closed book. Students will only be allowed to bring the textbook "Formulae and Tables for Actuarial Examinations" into the quiz, which should be **fully unannotated**!

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

The mid-term requires written responses, with students earning marks for correct mathematical working as well as part marks for incorrect responses with correct method and reasoning. They test not only your knowledge of the material, but also the depth of your understanding of it.

Individual Assignment

There will be one individual assignment for this course. The assignment is to be completed in R. The assignment offers students the opportunity to engage in independent research, engage in critical analysis, self-reflection and problem-solving, as well as to demonstrate their understanding of the concepts and perspectives that are central to actuarial studies. Students are reminded that the work they submit must be their own (see course outline part B). The material students submit for assessment must be their own. The assignment will be uploaded by the 21st April to Moodle.

Assignment Submission Procedure

Assignments must be submitted via the Turnitin submission box that is available on the course Moodle website. Turnitin reports on any similarities between their own cohort's assignments, and also with regard to other sources (such as the internet or all assignments submitted all around the world via Turnitin). More information is available at: http://elearning.unsw.edu.au/turnitin/content/TurnItInStudentSupport.cfm?ss=0
Please read this page, as we will assume that its content is familiar to you. You will be able to make multiple submissions. You need to check your document once it is submitted (check it on-screen). **We will not mark assignments that cannot be read on screen.**

Students are reminded of the risk that technical issues may delay or even prevent their submission (such as internet connection and/or computer breakdowns). Students should then consider either submitting their assignment from the university computer rooms or **allow enough time (at least 24 hours is recommended) between their submission and the due time**. The Turnitin module will not let you submit a late report. **No paper copy will be either accepted or graded.**

In case of a technical problem, the full document must be submitted to the course coordinator before the due time by e-mail, with explanations about why the student was not able to submit on time. In principle, this assignment will not be marked. It is only in exceptional circumstances where the assignment was submitted before the due time by e-mail that it may be marked—and this only if a valid reason is established.

Avoid a 0 for your assignment (in the mildest case) because of plagiarism

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

- The mathematical solutions you present are written up by you, without reference to any other student's work.
3. Students should make sure they understand what plagiarism is (see Section 5 and do the quiz) — cases of plagiarism have a *very high* probability of being discovered. For issues of collective work, having different persons marking the assignment does *not* decrease this probability.

Students should consult the Turnitin section of the website accessible to all ACTL students well in advance, as this gives a (non exhaustive) list of things that could go wrong and explains how the policies above are implemented.

Final Examination
The final examination will assess students' understanding of the concepts covered in the course and their ability to apply them to probability and statistics problems.

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. Students may bring their own calculators. All calculators must be either UNSW or Actuarial Studies approved.

4.3 Late Submission

The School of Risk and Actuarial Studies has a policy of grading late assignments with a zero mark. Punctual submission of work is required in order to satisfy the requirements of the course. The assignment may be marked at the discretion of the course co-ordinator if there is a valid reason for late submission and used in cases where your final overall results are marginal.

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.

5 COURSE RESOURCES

Textbooks
The prescribed textbooks for the course are:

1. [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:

2. [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].
4. [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:

5. [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.)
6. [H] Hossack, I., Pollard, J. & Zehnwirth, B. (1999), *Introductory Statistics with Applications in General Insurance*, Cambridge University Press, 2ed. (Want to see how statistics in 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 in the BCom the text "Formulae and Tables for Actuarial Examinations". This text must not be annotated. All students in the actuarial courses should purchase a copy of this text if they wish to use this in the final examinations for this course. The text is available from the UNSW bookstore, the UK Institute of Actuaries or from ActEd Australia. Visit the ActEd website at: http://www.acted.com.au

6 COURSE EVALUATION AND DEVELOPMENT

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

In the past years students have requested that more examples, which help to understand the lecture material, are discussed during the lectures. Further to that, the majority of students have indicated that they prefer to have the actual theory and theoretical concepts recorded in order to be able to review lecture material at any convenient time. Following this formal feedback in CATEI as well as informal discussions, a flipped classroom approach is adopted in this session (refer to Section 3 for more details).

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.

7 COURSE SCHEDULE

COURSE SCHEDULE

Week	Self-study	Lectorial	Tutorial
Week 1 27 February	Module 1	Module 1	
Week 2 6 March	Module 1	Module 1	Module 1
Week 3 13 March	Module 1	Module 1	Module 1
Week 4 20 March	Module 1-2	Module 1	Module 1
Week 5 27 March	Module 2	Module 2	Module 1
Week 6 03 April	Module 2	Module 2	Module 2
Mid-term examination: Friday 7 April 17:00 – 19:00			
Week 7 10 April *(Friday 14 April is Good Friday public holiday)*	Module 2-3	Module 3	Module 2
Mid-semester break: Friday 14 – Saturday 22 April inclusive			
Week 8 24 April *(Tuesday 25 April is Anzac Day public holiday)*	Module 3	Module 3	Module 3
	Guest lecture from the industry: 27 April, 6-7.30pm, Clancy Theatre. Speaker: TBC		
Week 9 1 May	Module 3-4	Module 3	Module 3
Week 10 8 May	Module 4	Module 4	Module 3
Week 11 15 May	Module 4	Module 4	Module 3
Week 12 22 May	Module 4	Module 4	Module 4
Week 13 29 May			Module 4

Modules	Topics	[W+]	[JR]	IAAust CT3	Week
Prliminaries	**Revision**				
	Probability space	2.1-2.10	1.1-1.3	ii.1-3	1
	Calculating with probablity		1.5-1.7	ii.1-7	1
	Counting		1.4	ii.3	1
1	**Probability Theory**				
1.1	**Mathematical methods**				
	Random variables	2.11, 3.1-3.2, 4.1-4.2, 4.11	2.1-2.2	iii.1-2	1
	Measures of location	3.3, 4.3	4.1	i.2, iii.3, vi.6	1
	Measure of dispersion	3.3, 4.3	4.2	i.3, iii.3, vi.6	1
	Moments (central/non-central)	3.9, 4.9	4.1-4.3	i.4, iii.3	1
	Generating functions	3.9, 3.10	4.5	iv.1-5, vi.7	1
1.2	**Univariate Ditributions**				
	Bernoulli Distribution	3.4	2.1.1	iii.1-4, iv.1-5, v.1, vi.6-7	2
	Binomial Distribution	3.4	2.1.2		2
	Geometric Distribution	3.5	2.1.3		2
	Negative Binomial Distribution	3.6	2.1.3		2
	Poisson Distribution	3.8	2.1.5		2
	Exponential Distribution	4.6	2.2.1		2
	Gamma Distribution	4.6	2.2.2		2
	Normal Distribution	4.5	2.2.3		2
	Uniform Distribution	4.4			2
	Beta Distribution	4.7	2.2.4		2
	Weibull Distribution				2
	Pareto Distribution				2

Modules	Topics	[W+]	[JR]	IAAust CT3	Week
1.3	**Joint and Multivariate Distributions**				
	Bivariate distribution functions	5.1-5.4	3.1-3.3	vi.1-3, vi.5	3
	Mean, variance, covariance & correlation	5.5-5.8	3.1-3.4	vi.4, vi.6	3
	Conditional Distributions	5.11	3.5	vi.1	3
	Bivariate Normal Distribution	5.1	3.3	vi.1-2	3
	Law of iterated expectation	5.11	4.4	xiv.1-2	3
	Conditional Variance Identity	5.11	4.4	xiv.1-2	3
	Multivarate distribution functions	5.9	3.1-3.3	vi.1-2	3
1.4	**Sampling and Summarizing Data**				
	Numerical methods	1.1-1.5	10.1-10.2	i.1	3
	Graphical methods	1.1-1.5	10.3-10.8	i.1	3
	Sampling with/without replacement	2.12, 7.1	7.1-7.2	i.2, viii.1-3	3
	Sample mean, variance, covariance	1.1-1.5	6.3	i.2, i.3, viii.3	3
	Properties of sample mean and sample variance	7.1-7.2	7.3	v.2, viii.5	4
	Order statistics	6.7	3.7		4
1.5	**Functions of Random Variables**				
	The CDF thecniques	6.1-6.3		v.4	4
	The Jacobian transformation technique	6.4, 6.6	3.6	v.4	4
	The MGF technique	6.5		v.4	4
	Convolution	5.1-5.4	3.6	vi.4	4
	Special sampling distributions	7.1-7.2	6.1-6.2	v.2, viii.5-7	4

			Properties of sample mean and sample variance	7.1-7.2	6.3,7.3	v.2, viii.5	4

Modules	Topics	[W+]	[JR]	IAAust CT3	Week
2	**Parameter Estimation**				
2.1	**Estimation techniques**				
	Introducition/Definitions	8.1-8.4	8.1-8.3	xi.3-5	5
	Method of Moments	9.6	8.4	xi.1	5
	Maxium Likelihood Estimation (MLE)	9.7, 9.8	8.5	xi.2	5
	Bayesian Estimation		8.6		5
2.2	**Limit theorems**				
	Chebyshev's inequality		4.2		5
	Convergence concepts	7.3	5.3	vii.1	5
	Law or Large Numbers	7.3-7.4	5.2	vii.2	5
	Central Limit Theorem	7.3-7.4	5.3	vii.2-3	5
2.3	**Evaluating Estimators**				
	UMVUE's	9.1-9.2	8.7	xi.3-5	6
	Cramer-Rao Low Bound	9.5	8.7	xi.3-5	6
	Consistent and sufficientstatistics	9.3-9.4	8.8	xi.3-5	6
	Confidence Intrevals	8.5-8.9	8.5.3	x.1-6	6
	Properties of MLEs	8.7-8.9	8.5.2	xi.6	6

Modules	Topics	[W+]	[JR]	IAAust CT3	Week
3	**Hypothesis Testing**				
3.1	**Statistical test procedure**				
	Selection of the null hypothesis, alternative hypothesis	10.1-10.2	9.1, 9.2.2	xi.1-3	7
	Regection region	10.3, 10.5	9.2.1		7
	Best critical region	10.3, 10.7	9.2.1		7
	Neuman Pearson Lemma	10.10	9.2		7
	Uniformly most powerful test	10.10	9.2.3		7
	Generalized Likelihood Ratio test	10.11	9.4		7
3.2	**Properties of the hypothesis testing**				
	Type I & II error	10.2, 10.4		xi.1-3	8
	Power of the test	10.10		xi.1-3	8
	p-value	10.6, 10.8, 10.9	9.2.1	xi.3	8
	k-sample test				8
	Jacque-Bera test				8
3.3	**Parametric tests**				
	Fisher's exact test	14.5	13.2	xi.4	9
	Contingency table	14.4-14.7	13.3-4		9
	Chi-2 goodness of fit test	14.1-14.3	13.3-4		9
	r-sample multinomial test	14.4-14.7			9
3.4	**Nonparametric tests**				
	One-sample sign test	15.1-15.3		xi.4	9

			Two-sample sign test	15.1-15.3	11.3.2	xi.4	9
3.5		**Goodness-of-fit test**					9
			Anderson-Darling &Kolmogorov-Smirnov test				9

Modules	Topics	[W+]	[JR]	IAAust CT3	Week
4	**Linear Regression**				
4.1	**Simple Linear Regression**				
	Correlation coefficient	11.8	14.2	xi.1-4	10
	Assumptions	11.1-11.2	14.1	xi.1-4	10
	Relationship between MLE and LSE	11.3-11.4	14.4	xi.5	10
	Partitioning the variability	13.1-13.2	14.4	xi.7, xi.9	10
4.2	**Testing in Simple Linear Regreesion**				
	Inference on Slope (t-test)	11.5, 11.9	14.4.5	xi.6	10
	Inference on intercept (t-test)	11.5, 11.9	14.4.5	xi.6	10
	Conference intervals	11.6, 11.9	14.4.2	xi.8	10
	Prediciton intervals	11.7, 11.9	14.4.2	xi.8	10
	Hypothesis test for population correlation	11.8, 11.9	14.4.3	xi.7	10
4.3	**Multiple Linear Regression**				
	Matrix notation	11.1	14.5	xi.9	11
	Assumptions	11.11	14.5	xi.9	11
	Statistical properties of LSEs	11.12		xi.9	11
	Inference on regression parameters	11.12		xi.6	11
	Inference on functions of regression parameters	11.13-11.15		xi.8	11
4.4	**Modelling with Linear Regression**				
	Confounding effects				
	Collinearity				12

			Heteroscedasticity					12
			Special explanatory	Explanatory variables:	Interaction of variables			12
			Special explanatory	Explanatory variables:	Categorical			12
			Model selection and validation					12