ACTL5106
Insurance Risk Models

Course Outline
Semester 2, 2015

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.
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PART A: COURSE-SPECIFIC INFORMATION

1 STAFF CONTACT DETAILS
The Course Coordinator and Lecturer in Charge is Dr Benjamin Avanzi:

<table>
<thead>
<tr>
<th>Staff</th>
<th>E-mail</th>
<th>Room</th>
<th>Telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/Prof Benjamin Avanzi</td>
<td><a href="mailto:b.avanzi@unsw.edu.au">b.avanzi@unsw.edu.au</a></td>
<td>UNSW Business School 640</td>
<td>9385 0798</td>
</tr>
</tbody>
</table>

He is responsible for course administration, final assessment of the course and responsible for the lectures and related teaching and learning. His consultation times are on Wednesdays, 11am-12pm, from 29 July to 28 October 2015 (including 30 September 2015). Exam preparation consultation times will be announced later on the course website.

There won’t be tutorials in this course, but tutors will be available for consultation:

<table>
<thead>
<tr>
<th>Staff</th>
<th>E-mail</th>
<th>Consultation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vincent Tu</td>
<td><a href="mailto:v.tu@unsw.edu.au">v.tu@unsw.edu.au</a></td>
<td>***</td>
</tr>
<tr>
<td>Xinda Yang</td>
<td><a href="mailto:xinda.yang@unsw.edu.au">xinda.yang@unsw.edu.au</a></td>
<td>***</td>
</tr>
</tbody>
</table>

*** Tutors will hold consultation once the week before any in-session assessment. The consultation times will be advertised on the course website.

2 COURSE DETAILS

2.1 Teaching Times and Locations
This Course consists of weekly 3 hour lectures (weeks 1 to 12) – see below.

Lectures
Lectures will be held on Mondays from 6pm to 9pm in ASBus 105, from week 1 to week 12 (with the exclusion of week 9 which is a public holiday). Timetables and locations are correct at time of editing. A full timetable of lectures and topics is provided later in this Course outline. Any alterations to the lecture times or locations will be advised in lectures and via the Course website.

2.2 Units of Credit
The course is worth 6 units of credit.

2.3 Summary of Course
This course covers the actuarial mathematics, statistics and models used in non-life insurance actuarial practice. Topics covered include: basic concepts of decision theory and Bayesian statistics; loss distributions and reinsurance, risk models including compound Poisson; estimation of aggregate claims distribution; probability of ruin; premium rating and credibility; experience rating systems; claims reserving for loss run-off data and generalised linear models. Students will apply these techniques with respect to principles of effective general insurance management. This course will cover the requirements for the Actuaries Institute CT6 course and students gaining at least a credit assessment will be recommended for exemption from the CT6 course.
2.4 Course Aims and Relationship to Other Courses

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.

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 enrol 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. The main mathematical topics are covered in a series of lectures by Randell Heyman that are available on the ACTL students common website (section “Back to Basics: Basic Mathematical Tools for Actuarial Students”). Students should review these lectures as well as Chapter 1.2 of the main textbook of the course at the very latest by the end of the first week.

2.5 Student Learning Outcomes

The aims of Section 2.4 (A to D) have been broken down into the following learning outcomes. At the end of the course students should be able to:

A1. Calculate or approximate the distribution of the sum of losses, when their number is either deterministic or random;
A2. Calculate the value of a reinsurance contract;
A3. Describe the classical model of risk theory for the excess of aggregate premiums over aggregate losses;
A4. Determine, for simple cases, the probability that aggregate losses will exceed aggregate premiums at any point in the future;
B1. Calculate descriptive statistics and identify candidate distributions for fitting a model to data;
B2. Estimate parameters of a given distribution using complete or censored/truncated data;
B3. Evaluate the goodness of fit of a model via a range of metrics;
B4. Understand Generalised Linear Models (GLM) and apply them in simple situations;
B5. Understand how to model dependence between random variables using copulas;
C1. Determine the pure Bayesian premium of a loss, given its experience, using parametric or non-parametric models;
C2. Determine the expected present value of future liabilities arising from claims already incurred;
D1. Discuss and apply elements of both decision and game theory

The Course Learning Outcomes are what you should be able to DO by the end of this course if you participate fully in learning activities and successfully complete the assessment items.
This course corresponds largely with the actuarial professional subject CT6 Statistical Methods. ACTL5103 covers several topics from this subject as well (CT6 aims iii.1, vi, ix and x). The course’s Learning Outcomes relate to the aims of Institute of Actuaries aims in the following way:

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>Institute of Actuaries aims</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>CT6: ii, iii</td>
</tr>
<tr>
<td>A2</td>
<td>CT6: ii, iii</td>
</tr>
<tr>
<td>A3</td>
<td>CT6: iv</td>
</tr>
<tr>
<td>A4</td>
<td>CT6: iv</td>
</tr>
<tr>
<td>B1</td>
<td>CT6: ii</td>
</tr>
<tr>
<td>B2</td>
<td>CT6: ii</td>
</tr>
<tr>
<td>B3</td>
<td>CT6: ii</td>
</tr>
<tr>
<td>B4</td>
<td>CT6: vii</td>
</tr>
<tr>
<td>B5</td>
<td>none</td>
</tr>
<tr>
<td>C1</td>
<td>CT6: v</td>
</tr>
<tr>
<td>C2</td>
<td>CT6: vi</td>
</tr>
<tr>
<td>D1</td>
<td>CT6: i</td>
</tr>
</tbody>
</table>

The Learning Outcomes in this course also help you to achieve some of the overall Program Learning Goals and Outcomes for all postgraduate students in the Business School. Program Learning Goals are what we want you to BE or HAVE by the time you successfully complete your degree (e.g. ‘be an effective team player’). You demonstrate this by achieving specific Program Learning Outcomes - what you are able to DO by the end of your degree (e.g. ‘participate collaboratively and responsibly in teams’).

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

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**Business Postgraduate Coursework Program Learning Goals and Outcomes**

1. **Knowledge:** Our graduates will have current disciplinary or interdisciplinary knowledge applicable in local and global contexts.
   You should be able to identify and apply current knowledge of disciplinary or interdisciplinary theory and professional practice to business in local and global environments.

2. **Critical thinking and problem solving:** Our graduates will have critical thinking and problem solving skills applicable to business and management practice or issues.
   You should be able to identify, research and analyse complex issues and problems in business and/or management, and propose appropriate and well-justified solutions.
3. Communication: Our graduates will be effective communicators in professional contexts. You should be able to:
   a. Produce written documents that communicate complex disciplinary ideas and information effectively for the intended audience and purpose, and
   b. Produce oral presentations that communicate complex disciplinary ideas and information effectively for the intended audience and purpose.

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 ethical, social, cultural and environmental implications of business issues and practice. You should be able to:
   a. Identify and assess ethical, environmental and/or sustainability considerations in business decision-making and practice, and
   b. Consider social and cultural implications of business and/or management practice.

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):

<table>
<thead>
<tr>
<th>Program Learning Goals and Outcomes</th>
<th>Course Learning Outcomes</th>
<th>Course Assessment Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course helps you to achieve the following learning goals for all Business postgraduate students:</td>
<td>On successful completion of the course, you should be able to:</td>
<td>This learning outcome will be assessed in the following items:</td>
</tr>
</tbody>
</table>
| 1 Knowledge | All | • Assignment  
• Mid-term Exam  
• Final Exam |
| 2 Critical thinking and problem solving | All | • Assignment  
• Mid-term Exam  
• Final Exam |
| 3a Written communication | All | • Assignment  
• Mid-term Exam  
• Final Exam |
| 3b Oral communication | Not specifically addressed in this course | |
| 4 Teamwork | Not specifically addressed in this course | |
| 5a. Ethical, social and environmental responsibility | Not specifically addressed in this course | |
| 5b. Social and cultural awareness | Not specifically addressed in this course | |
3 LEARNING AND TEACHING ACTIVITIES

3.1 Approach to Learning and Teaching in the Course
Lectures will review the main topics and provide coverage of the course concepts. They are an opportunity for students to develop an understanding of the main topics covered in the course and the level of knowledge expected. They provide a guide to the course of study during the session and the material students need to read and review. Students should read the prescribed readings prior to the lecture.

3.2 Learning Activities and Teaching Strategies
It is expected the students will take a pro-active approach to learning. The course is organised into learning activities given in the following table. The Course Aims and Program Learning Goals they should develop are also indicated.

<table>
<thead>
<tr>
<th>Activity</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required readings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lectures and in-class activities</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-class discussion of homework problems</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional readings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional exercises</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The aims A to D are developed during all activities. By nature, the actuarial program develops problem-solving and professional skills (Program Goals 1 and 2), and all activities contribute to that development.

Students are expected to perform these activities in the following time frame (for the outcomes of week k):

<table>
<thead>
<tr>
<th>Week k-1</th>
<th>Week k</th>
<th>Week k+1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required readings</td>
<td>Attend lecture</td>
<td>Review relevant past quizzes and final exam questions</td>
</tr>
<tr>
<td>Have a first look at the homework problems (if possible, in a team)</td>
<td>Attempt homework problems (if possible, in a team), and prepare questions</td>
<td>Optional readings and exercises</td>
</tr>
<tr>
<td></td>
<td>Review lecture notes, and seek help if needed</td>
<td></td>
</tr>
</tbody>
</table>

Thus, you should, in a given week, work on these three different stages for their corresponding three different course weeks.

It is expected that you will spend at least ten hours per week studying this course. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment (to extra-curricular activities) has been a cause of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities. In the past, students have found the amount of content particularly challenging. Don’t allow yourself to fall behind the schedule!
4 ASSESSMENT

4.1 Formal Requirements
In order to pass the course students must complete and submit all components of assessment at or before the due times, and 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; see Part B of the Course Outline for details.

Note that students achieving an average of 65% or higher according to the following formula may be recommended for exemption from the Actuaries Institute professional course CT6:

$$\frac{1}{3} \text{ of ACTL5103 grade plus } \frac{2}{3} \text{ of ACTL5106 grade.}$$

4.2 Assessment Details
Assessment of your performance in the course will be done through a number of tasks, listed in the following table with relevant details.

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Weight</th>
<th>LO¹</th>
<th>Materials</th>
<th>Length</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-term exam</td>
<td>15%</td>
<td>A1, A2, A3, A4</td>
<td>Weeks 1-4 MW 1-4</td>
<td>60 mins</td>
<td>02/09/2015, 4.30pm-5.30pm</td>
</tr>
<tr>
<td>Assignment</td>
<td>25%</td>
<td>A1, A2, A3, A4, B5</td>
<td>Weeks 1-5 MW 1-4, 10</td>
<td>N/a</td>
<td>7/10/2010, 11am sharp</td>
</tr>
<tr>
<td>Final examination</td>
<td>60%</td>
<td>all</td>
<td>all</td>
<td>2 hours</td>
<td>TBA</td>
</tr>
</tbody>
</table>

Mid-term exam
There will be one written answer mid-term exam in week 6 of 60 minutes duration. The mid-term exam will take place on Wednesday 2nd September 2015, from 4.30pm to 5.30pm. Its venue will be advertised later. The mid-term exam will be closed book. Students will only be allowed to bring the text "Formulae and Tables for Actuarial Examinations".

Normal examination rules apply to the conduct of mid-term exams. Calculators will be allowed in the mid-term and 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.

¹ Course Learning Outcomes that are assessed
The course exams require 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 their knowledge of the material, but also the depth of their understanding of it.

**Assignment**
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.

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.

Full information about the major assignment will be released early in the session.

**Final Examination**
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.

### 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

**Course references**

Note that ALL those references are freely downloadable and/or available from the library (with the only exception of the CT6 notes).

The **main prescribed textbook** for the course is:


  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. [All outcomes but D1]
Required additional readings are:

- [EV] Valdez, E. (2004), 'Decisions and Games', Notes prepared for UNSW students [Outcome D1. This document will be made available on the course website.]

Suggested (optional) readings are:

- [C] 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*, ActEd [The formulae book that you are allowed to use, if unannotated, during the quizzes and the final exam. Most students should already have a copy.]

All these references (except for the CT6 Combined Materials Pack) are available from the library. NOTE THAT THE LINKS REQUIRE YOU TO LOG IN AND/OR TO BE ON CAMPUS.

**Formulae & Tables**
The only text students are allowed to bring into the examinations for the actuarial courses is the text "Formulae and Tables for Actuarial Examinations". It must not be annotated. All students in the actuarial courses should purchase a copy of this text if they wish to use it in quizzes and the final examinations. 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](http://www.acted.com.au).

**Course website**
The course website is available on moodle: [https://moodle.telt.unsw.edu.au/login/index.php](https://moodle.telt.unsw.edu.au/login/index.php) or via my.unsw.edu.au.

All course contents will be available from the course website (except for the module “Back to Basics” which is available on the ACTL students common 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.**

**Actuaries Institute**
The Actuaries Institute allows students to become University Subscribers free of charge. Full time university students who are members of a university student actuarial society are eligible.
To sign up, go to [http://www.actuaries.asn.au/Membership/MembershipoftheInstitute/Subscriber.aspx](http://www.actuaries.asn.au/Membership/MembershipoftheInstitute/Subscriber.aspx)

6 **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 Course and Teaching Evaluation and Improvement (CATEI) Process is one of the ways in which student evaluative feedback is gathered. 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.

A new change in this session is related to the course references. In the past, feedback from students was that the course would benefit from a unified, unique reference, as there was a different reference for almost each lecture. We finally found a good book covering almost everything, and hope it will improve the students’ experience.
# COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Wk</th>
<th>Date</th>
<th>Topic</th>
<th>Prescribed Readings</th>
<th>CT6</th>
<th>Past Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27 July 2015</td>
<td>Introduction Collective Risk Modelling</td>
<td>MW 1, MW 2</td>
<td>n/a</td>
<td>iii</td>
</tr>
<tr>
<td>2</td>
<td>3 August 2015</td>
<td>Collective Risk Modelling</td>
<td>MW 2</td>
<td>iii</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10 August 2015</td>
<td>Individual Claim Size Modelling</td>
<td>MW 3</td>
<td>ii</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>17 August 2015</td>
<td>Approximations for Compound Distributions</td>
<td>MW 4</td>
<td>iii</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>24 August 2015</td>
<td>Solvency Considerations Ruin Theory</td>
<td>MW 10, MW 5.0, 5.1, 5.2</td>
<td>n/a</td>
<td>iv</td>
</tr>
</tbody>
</table>

**31 August 2015, lecture time: Mid-term exam**

| 6   | 31 August 2015| Premium Calculation Principles Tarification| MW 6.0, 6.1, MW 7.0, 7.1, 7.2 | n/a  | n/a         | n/a |
| 7   | 7 September 2015| Generalised Linear Models (GLMs)          | MW 7.3               | vii  |             | 4 |
| 8   | 21 September 2015| Bayesian Models and Credibility Theory   | BG 1, MW 8           | v    |             | 6 |

**Mid-semester break**

**7 October 2015, 11am: Due date for the assignment**

| 10  | 12 October 2015| Claims Reserving                           | MW 9                 | vi   |             | 7 |
| 11  | 19 October 2015| Guest Lecture: Milton Lim (Taylor Fry) Claims Reserving | TM, MW 9             | vi   |             | n/a |
| 12  | 26 October 2015| Guest Lecture: Darren Robb (Allianz) Game and Decision Theory | EV                  | n/a  |             | 8 |

This timetable may be altered. Students will be advised of any changes in lectures and via the course website.