STAT8035
Risk Theory

This course introduces the theory of compound Poisson processes, with a particular emphasis on their application to insurance portfolios (though their applicability in other areas is also noted).

Topics include: Modelling loss distributions; Skewed parametric distribution families; Method of moments, method of percentiles and maximum likelihood estimation; Pearson goodness-of-fit testing for distribution assessment; Truncated and censored data, including applications to reinsurance and policy excess schemes; Random sums, convolutions and compound distributions, particularly for modeling aggregate claim distributions; Normal and gamma approximations to compound distributions; Compound Poisson process theory, including applications to insurance portfolio surplus processes; Ultimate and finite-time ruin probabilities; Adjustment coefficients and optimal reinsurance contracts.

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>On campus</th>
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<tbody>
<tr>
<td>Prerequisites</td>
<td>STAT3004 or STAT7018 (Stochastic Modelling)</td>
</tr>
<tr>
<td>Incompatible Courses</td>
<td>N/A</td>
</tr>
<tr>
<td>Course Convener and lecturer</td>
<td>Tim Higgins</td>
</tr>
<tr>
<td>Phone:</td>
<td>6125 4507</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:tim.higgins@anu.edu.au">tim.higgins@anu.edu.au</a></td>
</tr>
<tr>
<td>Office location:</td>
<td>CBE Building Room 4.30</td>
</tr>
<tr>
<td>Office hours for student consultation:</td>
<td>To be advised</td>
</tr>
<tr>
<td>Bio and research interests</td>
<td>Tim Higgins is a Fellow of the Institute of Actuaries and worked in the Department of Treasury prior to joining RSFAS in 2002. He has a PhD in Statistics, and his research interests include income contingent loan theory and applications, retirement policy, and microsimulation modelling</td>
</tr>
<tr>
<td>Tutor(s)</td>
<td>Tutor names and contact details will be listed on Wattle when available</td>
</tr>
<tr>
<td>Student Administrator</td>
<td>Maria Lander</td>
</tr>
<tr>
<td>Email:</td>
<td><a href="mailto:maria.lander@anu.edu.au">maria.lander@anu.edu.au</a></td>
</tr>
<tr>
<td>Office location:</td>
<td>CBE Building Room 4.51</td>
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SEMESTER 1
2016

http://programsandcourses.anu.edu.au/course/STAT8035

1 | THE AUSTRALIAN NATIONAL UNIVERSITY
COURSE OVERVIEW

Learning Outcomes

- Demonstrate a superior ability to estimate using skewed distributions with and without the presence of censoring and truncation
- An in-depth knowledge of aggregation of random quantities through compound distribution theory
- To communicate Compound Poisson process theory including approximation of boundary crossing probabilities as applied to calculating risk for insurance portfolios

Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Value</th>
<th>Date</th>
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<tbody>
<tr>
<td>1. Mid-Semester Examination</td>
<td>30%</td>
<td>To be determined (Centrally timetabled)</td>
</tr>
<tr>
<td>2. Final Examination</td>
<td>70%</td>
<td>To be determined (Centrally timetabled)</td>
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Research-Led Teaching

The course convenor has numerous years of professional practice and has undertaken research in statistical and actuarial topic areas. Lectures in the course will be informed where possible by practical examples.

Feedback

Staff Feedback

Students will be given feedback in the following forms:

- Following the mid-semester examination, feedback will be given to the whole class about the general performance on the exam.
- In addition, students will have an opportunity to look over their script-book following both the mid-semester and final examinations.
- Students will also have the opportunity to speak with the lecturer and seek comments from the lecturer about their individual performance in both the mid-semester and final examinations.

Student Feedback

ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.

For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to

http://unistats.anu.edu.au/surveys/selt/students/ and
http://unistats.anu.edu.au/surveys/selt/results/learning/

Policies

ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and
implement them. You can find the University’s education policies and an explanatory
glossary at: http://policies.anu.edu.au/

Students are expected to have read the Academic Misconduct Rules 2014 before
the commencement of their course.

Other key policies include:
- Student Assessment (Coursework)
- Student Surveys and Evaluations

**Required Resources**

**Examination material or equipment**

Both the mid-semester and final examinations will be closed book exams. Students
will be permitted to bring in a non-programmable calculator and an unmarked paper
based dictionary.

**Recommended Resources**

Comprehensive lecture notes and lecture slides will be made available on Wattle. There are no prescribed texts besides the lecture notes, however, there are optional
texts listed below if you wish to read further material:

**Optional Reading**

3. Hossack, Polland and Zehnwirth (1983), *Introductory Statistics with Applications
   in General Insurance*, Cambridge University Press

**COURSE SCHEDULE**

The course notes (available on Wattle) consist of five parts:

1. – Introduction
2. – Fitting Loss Distributions (including Generalised Linear Models (GLM))
3. – Reinsurance and Policy Excesses
4. – Aggregate Claims Modelling
5. – Ruin Theory

The schedule below is a guide only. The course material covered in each week may
differ slightly from what is listed below depending on how we progress throughout
the semester.

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
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</table>
| 1 (15 – 19 Feb) | • Course overview.  
                  • Section 1 – Introduction.  
| 2 (22 – 26 Feb) | • Section 2.4.1 – Gamma distribution.  
                  • Section 2.4.2 – Log normal distribution. |
<table>
<thead>
<tr>
<th>Dates</th>
<th>Topics</th>
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| 3 (29 Feb – 4 Mar) | • Section 2.4.3 – Weibull distribution.  
• Section 2.4.4 – Mixture distributions; Deriving the Pareto distribution. |
| 4 (7 – 11 Mar)  | • Section 2.4.4 – Deriving the negative binomial distribution.  
• Section 2.5 – Generalised linear models.                  |
| 5 (14 – 18 Mar) | • Section 2.5 – Generalised linear models (continued).  
| 6 (21 – 25 Mar) | • Section 4.1-4.2 – Aggregate Claims Modelling: Collective Risk Model.  
• Compound Poisson, Binomial and Negative Binomial distributions.  
• Section 4.2.4 – Compound distributions and reinsurance. |
| 7 (28 Mar – 1 Apr) | • Section 4.3 – Approximating Compound Distributions for the Collective Risk Model. |
|               | **Teaching break**                                                     |
| 8 (18 – 22 Apr) | • Section 4.3 – Approximating Compound Distributions for the Collective Risk Model (continued)  
• Section 4.4 – Aggregate Claims Modelling: Individual Risk Model |
| 9 (25 – 29 Apr) | • Section 4.4.1 – Poisson Collective Risk Approximation to the Individual Risk Model.  
• Section 4.4.2 – Parameter Variability.  
• Section 5.1 – Ruin Theory: Introduction, the surplus process, introduction to probability of ruin. |
| 10 (2 – 6 May) | • Section 5.2 – 5.3 – Compound Poisson Process. Calculating Ruin Probabilities. |
| 11 (9 – 13 May) | • Section 5.3 – Calculating Ruin Probabilities (continued). Adjustment Coefficients. Differential equations for ruin probabilities |
| 12 (16 – 20 May) | • Section 5.3 – Differential equations for ruin probabilities (continued)  
• Section 5.4 – Finite time ruin probabilities |
| 13 (23 – 27 May) | • Section 5.5 – Ruin theory and reinsurance |

**ASSESSMENT REQUIREMENTS**

**Assessment Tasks**

**Assessment Task 1: Mid-Semester Examination**  
**Details of task:** 10 minute reading time; 1 ½ hour writing time

The mid-semster examination is redeemable.

**Assessment Task 2: Final Examination**  
**Details of task:** 15 minute reading time; 3 hour writing time
Both the mid-semester and final examinations will be closed book exams. A formula sheet will be handed out at the start of the exams. Copies of the formula sheets for the mid-semester and final examinations will be made available through Wattle prior to the exams.

**Scaling**
Your final mark for the course will be based on the raw marks allocated for each of your assessment items. However, your final mark may not be the same number as produced by that formula, as marks may be scaled. Any scaling applied will preserve the rank order of raw marks (i.e. if your raw mark exceeds that of another student, then your scaled mark will exceed the scaled mark of that student), and may be either up or down.

**Tutorial and/or Seminar Registration**
Enrolment in tutorials will be completed online using the CBE Electronic Teaching Assistant (ETA). To enrol, follow these instructions:

2. You will see the Student Login page. To log into the system, enter your University ID (your student number) and password (your ISIS password) in the appropriate fields and hit the Login button.
3. Read any news items or announcements.
4. Select "Sign Up!" from the left-hand navigation bar.
5. Select your courses from the list. To select multiple courses, hold down the control key. On PCs, this is the Ctrl key; on Macs, it is the key. Hold this key down while selecting courses with the mouse. Once courses are selected, hit the SUBMIT button.
6. A confirmation of class enrolments will be displayed. In addition, an email confirmation of class enrolments will be sent to your student account.
7. For security purposes, please ensure that you click the LOGOUT link on the confirmation page, or close the browser window when you have finished your selections.
8. If you experience any difficulties, please contact the School Office (see page 1 for contact details).
9. Students will have until 5pm February 25 to finalise their enrolment in tutorials. After this time, students will be unable to change their tutorial enrolment.

**SUPPORT FOR STUDENTS**
The University offers a number of support services for students. Information on these is available online from [http://students.anu.edu.au/studentlife/](http://students.anu.edu.au/studentlife/)