

ACSC/STAT 4703, Actuarial Models II  
FALL 2020  
Toby Kenney

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<b>Course Website:</b>	<a href="http://www.mathstat.dal.ca/~tkenney/4703/2021/">www.mathstat.dal.ca/~tkenney/4703/2021/</a>
<b>Office Hours:</b>	TBA
<b>Lectures:</b>	TT: 10:05-11:25 LSC C202
<b>Topics:</b>	Aggregate Loss Models, Nonparametric Estimation, Bayesian Estimation, Model Selection, Credibility Theory, Pricing and Reserving
<b>Textbook:</b>	“Loss Models: From Data to Decisions” (Fourth Edition) by S. A. Klugman, H. J. Panjer and G. E. Wilmot published by Wiley, 2012
<b>Additional References:</b>	Short-Term Actuarial Mathematics Study Note by the Society of Actuaries (2017). Available at <a href="https://www.soa.org/Files/Edu/2018/2018-ltam-loss-models-data.pdf">https://www.soa.org/Files/Edu/2018/2018-ltam-loss-models-data.pdf</a> “Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance” (Fourth Edition), by R. L. Brown and W. S. Lennox published by Actex, 2015 or (Third Edition), 2007, by R. L. Brown and L. R. Gottlieb

### Course Work and method of assessment

There will be a midterm exam and a final exam. The midterm will be held in class on Tuesday 19th October, and should cover the material in Chapters 9 and 16, along with Chapters 2 and 4 of the additional reference *Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance*. The content of this exam may be changed, depending on the progress. The final exam will be arranged online during the examination period.

There will also be 7 homework assignments, which must usually be submitted on Thursdays at the end of the lecture, or online by the deadline. After the deadline, I will put the model solutions on the course website. **No credit can be given for late homework.** The overall homework mark will be made up of an average of the homework marks, with the exception of the worst mark for each student.

The homework sheet will be divided into 2 sections: The *basic questions* section tests the basic concepts covered in the course: everyone should be able to do all these questions. The *standard questions* section has questions where the concepts covered in the course can be applied to more realistic situations, or questions which involve a stronger theoretical insight; these questions are mostly straightforward, though there may be the occasional tricky question included. There may also be some *bonus questions* which are either more challenging, or else raise interesting or important issues that are not central to this course.

Occasionally a question may be started on one sheet, but continued on the following sheet, after the relevant material has been covered. In this case, the full question will be given on the earlier sheet, but the parts that should only be attempted with the later sheet are clearly marked, and are repeated on the later sheet. For some questions, I may occasionally give out a hint, rather than a complete model solution. Revised answers to these questions may then be submitted with the following week’s homework.

Grades will be determined by performance in the exams and the weekly homeworks. The midterm exam counts for 30%, the final counts for 55%, while the homework counts for the remaining 15%. You must pass the final exam to obtain a passing grade in the course.

### **Online videos**

For students unable to make the lectures, videos from last year's course are available on Brightspace. These videos mostly go through the example questions on the Class Question handout. You should read through the relevant sections of the textbook before viewing the videos in order to get the most out of them. The videos are divided by question - one video per example question. There are also some videos explaining particular topics in more generality.

### **Weekly Readings**

Since class time is limited, I will be using it for explaining concepts and going over examples, rather than reading through the textbook. You should therefore read through the relevant sections of the textbook *before* the lecture, in order to gain the full benefit from the lecture. The sections of the textbook that will be covered each lecture will be listed on the website. This list may be updated from time to time, depending on the progress made in earlier lectures. Here is the current plan.

Week	Monday	Wednesday
6th September	Introduction and Preliminaries <b>9 Aggregate Loss Models:</b> <ul style="list-style-type: none"> <li>9.1 Introduction</li> <li>9.2 Model choices Q1</li> <li>8.3 Revision of Compound Distributions</li> <li>9.3 The compound model for aggregate claims Q2-6</li> </ul>	<ul style="list-style-type: none"> <li>9.4 Analytic results Q7-8</li> <li>9.5 Computing the aggregate claims distribution Q10</li> <li>9.6 the recursive method</li> <li>9.6.1 Applications to compound frequency models Q11-13</li> </ul>
13th September	<ul style="list-style-type: none"> <li>9.6.2 Overflow/Underflow problems Q14</li> <li>9.6.3 Numerical stability Q14</li> <li>9.6.4 Continuous severity</li> <li>9.6.5 Constructing arithmetic distributions Q15</li> <li>9.7 The impact of individual policy modifications on aggregate payments Q16-17</li> </ul>	<ul style="list-style-type: none"> <li>9.8 The individual risk model Q18-22</li> </ul>
20th September	<b>16 Model selection</b> <ul style="list-style-type: none"> <li>16.3 Graphical comparison of density and distribution functions Q23-31</li> </ul>	<ul style="list-style-type: none"> <li>16.4 Hypothesis tests Q32-35</li> <li>Score based approaches - AIC, BIC Q36</li> <li>16.5 Model Selection</li> </ul>
27th September	<b>IRLRPCI 2 Types of short-term insurance coverage</b> <ul style="list-style-type: none"> <li>2.2 Automobile Insurance</li> <li>2.3 Homeowner's Insurance Q.38</li> </ul>	NATIONAL DAY FOR TRUTH AND RECONCILIATION
4th October	<b>IRLRPCI 2 Types of short-term insurance coverage (cont.)</b> <ul style="list-style-type: none"> <li>2.4 Tenant's Package</li> <li>2.5 Worker's Compensation</li> <li>2.6 Fire Insurance</li> <li>2.7 Marine Insurance</li> <li>2.8 Liability Insurance</li> <li>2.9 Limits to Coverage Q39</li> </ul> <b>IRLRPCI 4 Loss Reserving</b> <ul style="list-style-type: none"> <li>4.2 How outstanding claim payments arise</li> <li>4.3 Definition of terms</li> <li>4.4 Professional considerations</li> <li>4.5 Checking the data</li> </ul>	<ul style="list-style-type: none"> <li>4.6 Loss reserving methods</li> <li>4.6.1 Expected Loss ratio method Q40</li> <li>4.6.2 Chain Ladder method Q41</li> <li>4.6.3 Bornhuetter-Fergusson method Q42</li> <li>Modelling frequency and severity separately Q43-44</li> <li>4.7 Discounting loss reserves Q45</li> </ul>
11th October	Revision chapters 9, 16, IRLRCPI 2, 4	Revision chapters 9, 16, IRLRCPI 2, 4
18th October	<b>MIDTERM EXAMINATION</b>	<b>17 Introduction and limited fluctuation credibility</b> <ul style="list-style-type: none"> <li>17.2 Limited fluctuation credibility theory</li> <li>17.3 Full credibility Q46-48</li> <li>17.4 Partial credibility Q49-50</li> <li>17.5 Problems with this approach Q51</li> </ul>
25th October	<b>18 Greatest accuracy credibility</b> <ul style="list-style-type: none"> <li>18.2 Conditional distributions and expectation Q52</li> <li>18.3 Bayesian methodology Q53-55</li> <li>18.4 The credibility premium Q56-58</li> </ul>	<ul style="list-style-type: none"> <li>18.5 The Buhlmann model Q59-60</li> <li>18.6 The Buhlmann-Straub model Q61-62</li> <li>18.7 exact credibility Q63-64</li> </ul>
1st November	<b>19 Empirical Bayes parameter estimation</b> <ul style="list-style-type: none"> <li>19.2 Nonparametric estimation Q65-66</li> <li>19.3 Semiparametric estimation Q67-70</li> </ul>	<b>IRLRPCI 3 Ratemaking</b> <ul style="list-style-type: none"> <li>3.1 Introduction</li> <li>3.2 Objectives of ratemaking</li> <li>3.3 Frequency and severity</li> <li>3.4 Data for ratemaking</li> <li>3.5 Premium data Q71</li> <li>3.6 The exposure unit</li> <li>3.7 The expected effective period Q72</li> </ul>
8th November	<b>STUDY BREAK</b>	
15th November	<ul style="list-style-type: none"> <li>3.8 Ingredients of ratemaking</li> <li>3.9 Rate changes Q73-75</li> </ul>	<b>IRLRPCI 5 Intermediate topics</b> <ul style="list-style-type: none"> <li>5.1 Individual risk rating plans</li> </ul>
22nd November	<ul style="list-style-type: none"> <li>5.2 Increased limits factors Q76-79</li> </ul>	<ul style="list-style-type: none"> <li>5.3 Reinsurance Q80</li> </ul>
30th November	Revision	Revision

## **Sections of the text covered**

We expect to cover most of the material in Chapters 9 and 16–20 of *Loss Models* and also the material in Chapters 1–5 of *Introduction to Ratemaking*.

## **Students with disabilities**

Students with disabilities are encouraged to register as quickly as possible at the Student Accessibility Services if they want to receive academic accommodations. To do so, please phone 494-2836, email [access@dal.ca](mailto:access@dal.ca), drop in at the Killam, G28, or visit our website at [www.studentaccessibility.dal.ca](http://www.studentaccessibility.dal.ca).

## **Plagiarism**

Plagiarism is a serious academic offense which may lead to loss of credit, suspension or expulsion from the university. Please read the Policy on Intellectual Honesty contained in the Calendar or on the Dalhousie web site at: <http://www.registrar.dal.ca/calendar/ug/UREG.htm#12>.

## **Dalhousie Writing Centre**

Writing expectations at university are higher than you will have experienced at high school (or if you are entering a master's or PhD program, the expectations are higher than at lower levels). The Writing Centre is a Student Service academic unit that supports your writing development. Make an appointment to discuss your writing. Learning more about the writing process and discipline-specific practices and conventions will allow you to adapt more easily to your field of study.