

ACSC/STAT 3703, Actuarial Models I(Further Probability with Applications to Actuarial Science)

Winter 2025
Toby Kenney

Instructor:	Toby Kenney Department of Mathematics and Statistics Chase Building, Room 102 email: tkenney@mathstat.dal.ca
Course Website:	www.mathstat.dal.ca/~tkenney/3703/2025/
Office Hours:	
Lectures:	TT: 13:05-14:25 LSC 332 Insurance and Reinsurance Coverages, Basic Distributional Quantities, Characteristics of Actuarial Models, Continuous Models, Discrete Distributions, Frequency and Severity with Coverage Modifications, Aggregate Loss Models, Pricing and Reserving for Short-Term Insurance Coverages, Limited Fluctuation Credibility Theory.
Topics:	“Loss Models: From Data to Decisions” (Fifth Edition, 2019 or Fourth Edition, 2012 by S. A. Klugman, H. J. Panjer and G. E. Wilmot published by Wiley,
Textbook:	Short-Term Actuarial Mathematics Study Note by the Society of Actuaries (2017). Available at https://www.soa.org/Files/Edu/2018/2018-ltam-loss-models-data.pdf “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
Additional References:	

Course Work and method of assessment

There will be a midterm exam and a final exam. The midterm will be held in class on Thursday 13th February, and should cover the material in Chapters 1–5.1 of the additional reference *Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance*, and Chapters 2–4 of the main textbook. The content of the exam may be changed, depending on the progress in lectures. The final exam will be scheduled by the Registrar’s Office during the examination period: Wednesday 9th to Saturday 26th April.

There will also be approximately weekly homework assignments (a total of 8 are planned, but this could be adjusted), which must be submitted on Thursdays by the end of the lecture, either in-person or via Brightspace. Brightspace only allows annotation of pdf and image (e.g. jpeg) files, so **please submit any computer output in pdf format**. For handwritten work, you may submit photographs or scans in jpeg format. Some questions may involve using R. Credit for these questions is based on the output from R, not on the code used. You may submit your R code as a reference, but **I will not attempt to run any submitted R code, so ensure all output is submitted**. 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. (So if there are indeed 8 homework assignments, this will be the average of the best 7 scores.)

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.

Sometimes a question will 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.

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, with corresponding question numbers from the class questions.

Week beginning	Monday	Wednesday
6th January	Introduction and Preliminaries, IRLRPCI 1 Why insurance? , 1.3 Insurance and Utility Q.1 , 1.4 Insurable Risks	IRLRPCI 2 Types of short-term insurance coverage: 2.2 Automobile Insurance Q.2 , 2.3 Homeowner's Insurance Q.3
13th January	IRLRPCI 2 Types of short-term insurance coverage (cont.) 2.4 Tennant's Package, 2.5 Worker's Compensation, 2.6 Fire Insurance, 2.7 Marine Insurance, 2.8 Liability Insurance, 2.9 Limits to Coverage Q.4–5 IRLRPCI 5 Intermediate topics 5.3 Reinsurance Q.6	IRLRPCI 4 Ratemaking 4.1 Introduction, 4.2 Objectives of ratemaking, 4.3 Data for ratemaking, 4.4 Premium data Q.7 , 4.5 The exposure unit, 4.6 The expected effective period Q.8–9 , 4.7 Ingredients of ratemaking, 4.8 Rate changes Q.10–12
20th January	IRLRPCI 3 Loss Reserving 3.2 How outstanding claim payments arise, 3.3 Definition of terms, 3.4 Professional considerations, 3.5 Checking the data, 3.6 Loss reserving methods	3.6.1 Expected Loss ratio method Q13 , 3.6.2 Chain Ladder method Q14 , 3.6.3 Bornhuetter-Fergusson method Q15
27th January	2 Random Variables: Q16–19, 3 Basic Distributional Quantities: 3.1 Moments Q20–22 , 3.2 Percentiles Q.23–25 , 3.3 Generating Functions and Sums of Random Variables Q26–27 ,	3.4 Tail Weight Q28–33 , 3.5 Measures of Risk Q34–40 ,
3rd February	4 Characteristics of Actuarial Models: 4.2 The Role of Parameters Q41–42 , 4.3 Semiparametric and Non-Parametric Methods Q43–48 ,	Revision IRLRPCI & Chapters 2–4
10th February	Revision IRLRPCI & Chapters 2–4	MIDTERM EXAM
17th February	STUDY WEEK	
24th February	5 Continuous Distributions: 5.2 Creating New Distributions Q49–53 , 5.2.4 Mixture Distributions Q54–65 ,	5.3 Selected Distributions and their Relationships , 5.3.2 Two Parametric Families Q66 , 5.3.3 Limiting Distributions Q67–68 , 5.4 The Linear Exponential Family Q69–70 ,
3rd March	6 Discrete Distributions: 6.2 The Poisson Distribution (revision) Q71–72 , 6.4 The Binomial Distribution (revision) Q73–74 , 6.3 The Negative Binomial Distribution Q75–78 ,	6.5 The (a,b,0) Class Q.79-80 , 6.6 Truncation and Modification at Zero Q81–84 ,
10th March	8 Frequency and Severity with Coverage Modifications: 8.2 Deductibles Q85 , 8.3 Loss Elimination Ratio and Inflation Q86–87 , 8.4 Policy Limits Q88 ,	8.5 Coinsurance, Deductibles and Limits Q89–90 , 9 Aggregate Loss Models: 9.1 Introduction,
17th March	9.2 Model Choices Q91 , 9.3 The Compound Model for Aggregate Claims Q92–96 ,	9.3 The Compound Model for Aggregate Claims (cont.),
24th March	9.8 The Individual Risk Model Q97-100 ,	17 Limited Fluctuation Credibility Theory : 17.3 Full Credibility Q101–103 , 17.4 Partial Credibility Q104–105 , 17.5 Problems with this approach Q106 ,
30th March	Revision	Revision

Sections of the text covered

We expect to cover most of the material in Chapters 2–6, 8, 9.1–9.3, 9.8, and 17 in the main textbook, and Chapters 1–4 and 5.1 in the additional reference.

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, drop in at the Killam, G28, or visit our website at 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.