ACSC/STAT 4703, Actuarial Models II
FALL 2023
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/4703/2023/`
Office Hours:	TBA
Lectures:	TT: 13:05-14:25 LSC C216
Topics:	Continuous Distributions, Aggregate Loss Models, Extreme-Value Distributions, Model Selection, Credibility Theory, Pricing and Reserving
Textbook:	"Loss Models: From Data to Decisions" (FourthFifth Edition) by S. A. Klugman, H. J. Panjer and G. E. Wilmot published by Wiley, 2012 or (Fifth Edition), 2019, by S. A. Klugman, H. J. Panjer and G. E. Wilmot
Additional References:	"Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance" (Fourth), by R. L. Brown and W. S. Lennox published by Actex, 2015 or (Third/Fifth Edition), 2007/2021, by R. L. Brown and L. R. Gottlieb Society of Actuaries Study note: Addendum to Loss Models (4th Edition) to discuss Information Criteria `https://www.soa.org/globalassets/assets/Files/Edu/2018/2018-stam-loss-models-data.pdf` Society of Actuaries Study note: Outstanding Claims Reserves, 2022, Hardy, M.R. `https://www.soa.org/4aa5da/globalassets/assets/files/edu/2023/2023-exam-astam-21-23.pdf` Society of Actuaries Study note: ASTAM-22-23: Chapter 5 of Quantitative Enterprise Risk Management, 2022, by Hardy, M.R. and Saunders, D. Cambridge University Press, ISBN : 978-1009098465 `https://www.soa.org/4aa5ef/globalassets/assets/files/edu/2023/2023-exam-astam-22-23.pdf`

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 19th October, and should cover the material in Chapters 5, 7, 8, 9 and 16, along with the Society of Actuaries Study Note on Extreme Value Theory (Chapter 5 of Quantitative Enterprise Risk Management, 2022). The content of this exam may be changed, depending on the progress. The final exam will be scheduled during the examination period 8–19th December.

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 the 2020 course will be made available on Brightspace. Because the syllabus has changed since 2020, **these videos do not cover all topics in the course**. These videos mostly go through the example questions on the Class Question handout. The videos include references to question numbers from 2020, not current question numbers. 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
4th September	Introduction and Preliminaries **5 Continuous Distributions:** • 5.2 Creating New Distributions — Transformation Q1-3.	• 5.2 Creating New Distributions — Convolution Q4. • 5.2.4 Mixture Distributions Q5-6. **8 Frequency and Severity with Coverage Modifications:** • 8.2–8.4 Deductibles and Limits (Revision) • IRLRPCI 5.2 Increased Limits Factors Q7
11th September	• IRLRPCI 5.2 Increased Limits Factors (cont.) Q8–12 **SN2 Extreme Value Distributions** • SN2 5.2 Introduction. • SN2 5.3 Block Maxima and Generalised Extreme Value Distributions Q13.	• SN2 5.3 Block Maxima and Generalised Extreme Value Distributions (cont.) Q14–17.
18th September	• SN2 5.3.4 Estimating GEV Parameters Q18. • SN2 5.4 Points over Threshold. • SN2 5.4.2 Generalised Pareto Distribution Q19–22. • SN2 5.4.2 The Hill Estimator Q23–24.	**7 Advanced Discrete Distributions** • 7.3 Mixed Frequency Distributions Q25. • 7.1 Compond Frequency Distributions Q26–29.
25th September	• 7.2 The Compound Poisson Distribution Q30–32. **9 Aggregate Loss Models:** • 9.1 Introduction. • 9.3 The compound model for aggregate claims Q33. • 9.4 Analytic results Q34.	• 9.4 Analytic results (cont.) Q35. • 9.5 Computing the aggregate claims distribution Q36. • 9.6 the recursive method. • 9.6.1 Applications to compound frequency models Q37-39.
2nd October	**IRLRPCI 4 Loss Reserving** • 9.6.2 Overflow/Underflow problems Q40. • 9.6.3 Numerical stability Q41. • 9.6.4 Continuous severity • 9.6.5 Constructing arithmetic distributions Q42.	**16 Model selection** • 16.3 Graphical comparison of density and distribution functions Q43–51. • 16.4 Hypothesis tests Q52
9th October	• 16.4 Hypothesis tests (cont.) Q53–55 • Score based approaches - AIC, BIC Q56 • 16.5 Model Selection	Revision chapters 9, 16, IRLRCPI 2, 4
16th October	Revision chapters 9, 16, IRLRCPI 2, 4	MIDTERM EXAMINATION
23rd October	**18 Greatest accuracy credibility** • 18.2 Conditional distributions and expectation Q57. • 18.3 Bayesian methodology Q58–60	• 18.4 The credibility premium Q61–63. • 18.5 The Buhlmann model Q64–65. • 18.6 The Buhlmann-Straub model Q66–67.
30th October	• 18.7 exact credibility Q68–69. **19 Empirical Bayes parameter estimation** • 19.2 Nonparametric estimation Q70–71.	• 19.2 Nonparametric estimation (cont.) Q72. • 19.3 Semiparametric estimation Q73–76.
6th November	**SN1 Loss Reserving** • 1 Introduction (Revision) • 2 Run-Off Triangles (Revision) • 2.2 Chain-Ladder Method (Revision) Q77. • 2.3 Inflation-adjusted Chain-Ladder Method Q78. • 3 Statistical Foundations for Chain-Ladder Method. • 3.2 Testing Chain-Ladder Assumptions Q79–80. • 3.3 Bornhuetter-Fergusson Method (Revision) Q81.	• 3.4 Buhlman-Straub credibility model Q82. • 3.5 Poisson model Q83. • 4 Mack's Model Q84.
13th November	STUDY BREAK	
20th November	• 5 Overdispersed Poisson Model Q85. • 6 Separate Modelling of Frequency and Severity Q86. **IRLRPCI 3 Ratemaking** • 4.8 Rate Change with Differentials Q87.	• 4.8 Rate Change with Differentials (cont.) Q88–89.
27th November	Revision	Revision

Sections of the text covered

I expect to cover most of the material in Chapters 5.2, 7, 9, 16, 18 and 19 of *Loss Models*; the material in the study notes, and Chapter 5.2 of *Insurance Ratemaking & Loss Reserving for Property and Casualty Insurance*.

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, plese '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.