

ACSC/STAT 4720, Life Contingencies II  
Fall 2021  
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/4720/2021/](http://www.mathstat.dal.ca/~tkenney/4720/2021/)

**Office Hours:** TBA

**Lectures:** TT: 13:05-14:25 Chemistry 226  
Multiple State Models, Joint Life and Last Survivor Benefits,  
Pension Mathematics, Modelling of Mortality improvement,

**Topics:** Empirical estimation, Emerging Costs in Traditional Life Insurance

**Textbook:** “Actuarial Mathematics for Life Contingent Risks” (Second Edition)  
by David C. M. Dickson, Mary R. Hardy, and Howard R. Waters  
published by Cambridge University Press, 2013

### 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 2nd November, and should cover the material in Chapters 8–9 and the two study notes. The content of this exam may be changed, depending on the progress in lectures. The final exam will be scheduled during the examination period.

There will also be (approximately) weekly homework assignments, which must usually be handed on Thursdays in the lecture. For students who are unable to attend the lectures, it is also possible to submit solutions on Brightspace. 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 weekly 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.

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.

Week	Tuesday	Thursday
6th September	Introduction and Preliminaries, <b>Supplementary Note 1: Long Term Coverages in Health Insurance</b>	<b>8 Multiple State Models</b> , 8.2 Examples, 8.4 Assumptions and Notation, 8.5 Numerical Evaluation of Probabilities
13th September	8.5 Numerical Evaluation of Probabilities (cont.), 8.6 Premiums	8.7 Policy values and Thiele's differential equation, 8.8 Multiple decrement models, 8.9 Multiple decrement tables
20th September	8.9 Multiple decrement tables (cont.), 8.10 Constructing a multiple decrement table, 8.11 Comments on multiple decrement notation	8.12 Transitions at exact ages, 8.13 Markov multiple-state models in discrete time, <b>9 Joint Life and Last Survivor Benefits</b> 9.2 Joint Life and Last Survivor Benefits, 9.3 Joint Life Notation, 9.4 Independent Future Lifetimes
27th September	9.4 Independent Future Lifetimes (cont.), 9.5 A Multiple State Model for Independent Future Lifetimes	<b>NATIONAL DAY FOR TRUTH AND RECONCILIATION</b>
4th October	9.6 A Model with Dependent Future Lifetimes, 9.7 The Common Shock Model	9.7 The Common Shock Model (cont.) <b>SN 4 Mortality Improvement Modelling</b> SN 4.1 Introduction, SN 4.2 Deterministic Mortality Improvement Modelling
11th October	SN 4.4 The Lee Carter Model, SN 4.5 The Cairns-Blake-Dowd Model	SN 4.5 The Cairns-Blake-Dowd Model (cont.), SN 4.6 Comments on Mortality Improvement Modelling, <b>LM 12 Estimation from Empirical Data</b> LM 12.1 The Empirical Distribution, LM 12.2 The Empirical Distribution for Grouped Data
18th October	LM 12.3 Empirical Estimation with Right-Censored Data	LM 12.5 Empirical Estimation with Left-Truncated Data, LM 12.7 Approximations for Large Data Sets
25th October	LM 12.7 Approximations for Large Data Sets (cont.), LM 12.9 Estimation of Transition Intensities, Revision chapters 8–9 and study notes	Revision chapters 8–9 and study notes
1st November	<b>MIDTERM EXAM</b>	<b>10 Pension Mathematics:</b> 10.3 The Salary Scale Function, 10.4 Setting the DC Contribution
8th November	10.5 The Service Table, 10.6 Valuation of Benefits	10.7 Funding the Benefits, SN 6 Retiree Health Benefits, <b>12 Emerging Costs for Traditional Life Insurance</b> 12.3 Profit Testing a Term Insurance Policy
15th November	<b>STUDY WEEK</b>	
22nd November	12.3 Profit Testing a Term Insurance Policy (cont.), 12.4 Profit Testing Principles, 12.5 Profit Measures	12.6 Using a Profit Test to Calculate Premiums, 12.7 Using the Profit Test to Calculate Reserves, 12.8 Profit Testing for Multiple-State Models
29th November	Revision	Revision
6th December		

### Sections of the text covered

We expect to cover most of the material in Chapters 8–10 and 12 in the textbook and the material in the study notes from the Society of Actuaries Website.

## **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.