ACTS:4130
Quantitative Methods for Actuaries (Introductory Life Contingencies)
Course Syllabus
Fall 2022

MWF, 14 SH
2:30 p.m. – 3:20 p.m.

University of Iowa

Department of Statistics & Actuarial Science

1 Contact Information

- **Instructor:** Professor Ambrose Lo, PhD, FSA, CERA
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    (Note: Please include "ACTS:4130" in your email subject. Questions about the course material, as far as possible, should be discussed during office hours.)
  - ▷ *Personal homepage:* `https://sites.google.com/site/ambroseloyp`
    (Feel free to visit it from time to time for latest updates on my courses and books!)
  - ▷ *Office hours:*
    Wednesday and Friday : 3:30 p.m. – 4:30 p.m.
    Thursday : 2:30 p.m. – 3:30 p.m.
    (Students are free to drop by during these hours to discuss questions about the course material or concerns. I am also available by appointment *if you are unable to attend my office hours*. Unless otherwise announced, office hours are held in person.)
- **Grader:** Mr. Aidan Chaffin
  - ▷ *Office:* 356 SH
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- **Departmental Executive Officer (Chair):** Professor Kung-Sik Chan, Department of Statistics and Actuarial Science
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2 Course Description and Objectives

Prerequisites:
- C+ or above in ACTS:3080 (Mathematics of Finance I)
- B- or above in STAT:3100 (Intro. to Mathematical Statistics I)
- Status as an Actuarial Science major

Building upon your prior exposure to actuarial science and preparation in mathematical statistics, this introductory course for B.S. and M.S. in Actuarial Science students develops a probabilistic foundation for *life contingencies*, which is a central subject in actuarial science concerned with *contingent* cash flows and the theme of the **long-term half** of the **Fundamentals of Actuarial Mathematics (FAM) Exam** offered by the Society of Actuaries (SOA). This subject tests skills for dealing with *random events* (because the cash flows of life insurance and annuity products are contingent on the random lifetimes of their policyholders) and the *time value of money* (because the cash flows arise in the future), which are the topics of Exams P and FM. Using tools from these two preliminary exams, we will set up a quantitative framework for doing pricing (setting the premium charged on policyholders) for common life insurance and annuity policies. For the most part, the exam topics are mathematically interesting and practically useful.

At the University of Iowa (UI), we have a total of three courses devoted to life contingencies. They are ACTS:4130 (the current course), ACTS:4180 *Life Contingencies I* (to be offered in Spring 2023), and ACTS:4280 *Life Contingencies II* (to be offered in Fall 2023). ACTS:4130 covers the following topics in Exam FAM-L:

- Topic 7: Insurance Coverages and Retirement Financial Security Programs
- Topic 8: Mortality Models
- Topic 10: Present Value Random Variables for Long-Term Insurance Coverages
- Topic 11: Premium and Policy Value Calculation for Long-Term Insurance Coverages
  (Note: Policy values will be covered in ACTS:4180.)

Topic 9: Parametric and Non-Parametric Estimation will be covered in ACTS:4150.

3 University-Earned Credit Program

In Fall 2021, the SOA initiated the University-Earned Credit (UEC) program, which allows university students in selected Centers of Actuarial Excellence (CAE) to earn credit for SOA exams by attaining a required score on coursework effective from Fall 2022.

For universities in the US, the UEC pass mark is $\boxed{85\%}$.

The University of Iowa is an SOA-recognized university authorized to administer courses for UEC. The following table shows which SOA exams can be fulfilled by UEC and the corresponding UI course(s): (Exam P is not part of the UEC program.)

SOA Exam	**UI Course(s)**
FM (Financial Mathematics)	ACTS:3080
FAM (Fundamentals of Actuarial Mathematics)	ACTS:4130, ACTS:4150
ALTAM (Advanced Long-Term Actuarial Mathematics)	ACTS:4280
SRM (Statistics for Risk Modeling)	STAT:4560, STAT:4561

The important message is:

> If you do well in each of ACTS:4130 and ACTS:4150 (to be offered in Spring 2023), then you will be able to earn credit for Exam FAM *without actually taking the exam*.

Information for students in UEC programs can be found here:

> https://www.soa.org/4a5b20/globalassets/assets/files/edu/edu-uec-program-candidate-info.pdf

4 Texts

The text of this course is

Ambrose Lo's Study Manual for SOA Exam FAM-L (Fall 2022 Edition),

which is available from:

- The Actuarial Bookstore:

  `https://www.actuarialbookstore.com/order_selection.aspx?id=453148922`.

- ACTEX Learning:

  `https://www.actexmadriver.com/orderselection.aspx?id=453148922`.

This study manual not only addresses all important topics in the FAM-L exam syllabus, but also presents lots of intuition for you to understand the subject matter deeply, and a wide variety of illustrative examples and practice problems for exam preparation. In this course, we will cover the following chapters in the manual:

> Chapter 1: Survival Models
>
> Chapter 2: Life Tables and Selection
>
> Chapter 4: Life Insurance
>
> Chapter 5: Life Annuities
>
> Chapter 6: Premiums
>
> Chapter 8: Epilogue: Life and Long-term Health Insurance (time permitting)

Chapter 3 (Estimating Survival Models) will be covered in ACTS:4150 and Chapter 7 (Policy Values) in ACTS:4180 in Spring 2023.

During lectures, the instructor will provide a framework, cover the main ideas, point out subtleties, and go over representative examples with you. You should put down additional details, work out examples together with the instructor, and take supplementary notes to better understand concepts.

An optional text for this course is:

> *Actuarial Mathematics for Life Contingent Risks* (3rd Edition), 2020, by D.C.M. Dickson, M.R. Hardy, H.R. Waters, Cambridge University Press. ISBN: 978-1-108-47808-3.

This is the required textbook for Exam FAM-L (and for ALTAM as well) and a college-style textbook geared towards practical applications instead of exam preparation. Our study manual will cover the following book chapters with a much heavier emphasis on problem solving:

Chapter 1: Introduction to life and long-term health insurance

Chapter 2: Survival models

Chapter 3: Life tables and selection (except Sections 3.11 and 3.12)

Chapter 4: Insurance benefits

Chapter 5: Annuities

Chapter 6: Premium calculation

There is an accompanying solutions manual (*Solutions Manual for Actuarial Mathematics for Life Contingent Risks*) available for purchase.

5 Grading System

Your course grade will be based on the following items and weights:

- **Attendance and Attitude: $\pm\varepsilon$%**

  You may choose to attend or not to attend classes, but everyone needs to be aware that unexcused absences from classes can adversely affect your final grade. It is also impossible for absentees to get a copy of the course material they miss, inquire about announcements made in class, or seek out-of-class help from the instructor. Likewise, your participation, preparedness, and work ethic may affect your final grade (positively or negatively).

- **Weekly Quizzes: 30%**

  There will be a total of twelve 15-minute quizzes held on Fridays. These quizzes are intended to motivate you to study regularly (instead of cramming just before the Midterm and Final Exams!) and will consist of relatively straightforward questions. The quiz with the lowest score will be dropped when it comes to computing the final grade. With this policy, missed quizzes due to illness cannot be made up under any circumstances.

- **Midterm Examination: 30%**

  There will be a 90-minute Midterm Examination to be held in the evening (6:30 p.m. – 8:00 p.m.) of **October 26, 2022 (Wednesday)**, testing Chapters 1, 2, and part of Chapter 4 of this course. It will consist of short-answer questions similar in style and difficulty to SOA exam problems and/or end-of-section problems in the study manual. You will therefore find that problems from released SOA past/sample exams and the study manual are useful in preparing for the Midterm Exam.

- **Final Examination: 40%**

  A two-hour comprehensive Final Examination will take place in the week of December 12–16, 2022. Like the Midterm Exam, the Final Exam will comprise short-answer questions similar in style and difficulty to SOA exam problems and/or end-of-section problems in the study manual. The exact date and time will be announced by the Registrar in mid-September. Please do not plan your end-of-semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the Final Exam.

Your UEC score will be based on the following weights:[i]

Weekly Quizzes	**:**	**20%**
Midterm Examination	**:**	**30%**
Final Examination	**:**	**50%**

All quizzes and exams in this course are closed-book. The FAM-L tables will be provided if needed, and you are not allowed to bring your own formula sheets (the same applies to all SOA exams as well!). Only calculators listed on Point 9 of the SOA exam rules and regulations/instructions (`https://www.soa.org/Files/Edu/edu-rules-reg-instructions.pdf`) are permitted.

A note on absence from exams. If, because of illness, you are unable to take any exams (not including quizzes) in this course as scheduled, you should inform the course instructor *within 24 hours* after the exam has ended and explain why you are medically unfit to take the exam on the scheduled date. Otherwise, a zero score will be awarded. Approval for absences for other reasons such as mandatory religious obligations, certain University activities, or unavoidable circumstances should be sought well in advance with documentation provided.

Grading scheme. Plus/minus grades will be given in this course. Here is an *approximate* guide:

A+	$[97,100]$	A	$[93,97)$	A-	$[90,93)$
B+	$[87,90)$	**B**	$[\mathbf{83},\mathbf{87})$	B-	$[80,83)$
C+	$[77,80)$	C	$[73,77)$	C-	$[70,73)$
D+	$[67,70)$	D	$[63,67)$	D-	$[60,63)$
F	$[0,60)$				

These are not completely absolute scales and the instructor reserves the right to adjust the cutoffs, depending on the difficulty of the exams. Note that with this grading scheme you are not "graded on a curve" and so you are not competing with fellow students. Therefore, you are not penalized in any way for working together to better understand concepts and perform better in this course.

IMPORTANT NOTE

1. A grade of C+ or higher in this course is a prerequisite for ACTS:4180 (*Life Contingencies I*), which will be offered in Spring 2023.
2. This is **not** an easy course for most students. Each week you should spend about 3 to 6 hours outside of class meetings reviewing the study manual and working on the end-of-section problems independently. It is fine to work harder, but working less is risky. Let me know if you encounter any problems with your learning.

[i] According to the UEC program requirements, 80% of the grading points for each UEC course must be based on proctored examinations, and the final exam must be cumulative and worth at least 50% of the grading points.

6 Tentative Teaching Schedule

The tentative schedule below will be updated as needed as the semester unfolds.

Teaching Week	Lecture	Date	Topic (Refer to the study manual)
1	1	August 22, 2022 (Mon)	Introduction and course overview
	2	August 24, 2022 (Wed)	Chapter 1
	3	August 26, 2022 (Fri)	Chapter 1
2	4	August 29, 2022 (Mon)	Chapter 1
	5	August 31, 2022 (Wed)	Chapter 1
	6	September 2, 2022 (Fri)	Chapter 1, **Quiz 1**
3	—	September 5, 2022 (Mon)	(University Holiday)
	7	September 7, 2022 (Wed)	Chapter 1
	8	September 9, 2022 (Fri)	Chapter 1, **Quiz 2**
4	9	September 12, 2022 (Mon)	Chapter 2
	10	September 14, 2022 (Wed)	Chapter 2
	11	September 16, 2022 (Fri)	Chapter 2, **Quiz 3**
5	12	September 19, 2022 (Mon)	Chapter 2
	13	September 21, 2022 (Wed)	Chapter 2
	14	September 23, 2022 (Fri)	Chapter 2, **Quiz 4**
6	15	September 26, 2022 (Mon)	Chapter 2
	—	September 28, 2022 (Wed)	(No class due to career fair)
	16	September 30, 2022 (Fri)	Chapter 4, **Quiz 5**
7	17	October 3, 2022 (Mon)	Chapter 4
	18	October 5, 2022 (Wed)	Chapter 4
	19	October 7, 2022 (Fri)	Chapter 4, **Quiz 6**
8	20	October 10, 2022 (Mon)	Chapter 4
	21	October 12, 2022 (Wed)	Chapter 4
	22	October 14, 2022 (Fri)	Chapter 4, **Quiz 7**
9	23	October 17, 2022 (Mon)	Chapter 4
	24	October 19, 2022 (Wed)	Chapter 4
	25	October 21, 2022 (Fri)	Chapter 4, **Quiz 8**
10	26	October 24, 2022 (Mon)	Chapter 4
	—	October 26, 2022 (Wed)	**(No class. Midterm in evening!)**
	27	October 28, 2022 (Fri)	Chapter 5
11	28	October 31, 2022 (Mon)[ii]	Chapter 5
	29	November 2, 2022 (Wed)	Chapter 5
	30	November 4, 2022 (Fri)	Chapter 5, **Quiz 9**
12	31	November 7, 2022 (Mon)	Chapter 5
	32	November 9, 2022 (Wed)	Chapter 5
	33	November 11, 2022 (Fri)	Chapter 5, **Quiz 10**
13	34	November 14, 2022 (Mon)	Chapter 5
	35	November 16, 2022 (Wed)	Chapter 6
	36	November 18, 2022 (Fri)	Chapter 6, **Quiz 11**

[ii] Drop date for undergraduates.

—	—	November 21, 2022 (Mon)	(Thanksgiving Recess—No class!)
	—	November 23, 2022 (Wed)	
	—	November 25, 2022 (Fri)	
14	37	November 28, 2022 (Mon)	Chapter 6
	38	November 30, 2022 (Wed)	Chapter 6
	39	December 2, 2022 (Fri)	Chapter 6, **Quiz 12**
15	40	December 5, 2022 (Mon)	Chapter 6
	41	December 7, 2022 (Wed)	Chapter 8
	42	December 9, 2022 (Fri)	Chapter 8 and Final Review
—	—	December 12–16, 2022	**Final Examination**

More about the Instructor ("Shameless" Self-introduction)

Professor Ambrose Lo, PhD, FSA, CERA, is currently Associate Professor of Actuarial Science with tenure at the Department of Statistics and Actuarial Science, The University of Iowa. He earned his B.S. in Actuarial Science (first class honors) and PhD in Actuarial Science from The University of Hong Kong in 2010 and 2014, respectively, and attained his Fellowship of the Society of Actuaries (FSA) in 2013. He joined The University of Iowa as Assistant Professor of Actuarial Science in August 2014, and was tenured and promoted to Associate Professor in July 2019. His research interests lie in dependence structures, quantitative risk management as well as optimal (re)insurance. His research papers have been published in top-tier actuarial journals, such as *ASTIN Bulletin: The Journal of the International Actuarial Association*, *Insurance: Mathematics and Economics*, and *Scandinavian Actuarial Journal*.

Besides dedicating himself to actuarial research, Ambrose attaches equal importance to teaching and education, through which he nurtures the next generation of actuaries and serves the actuarial profession. He has taught courses on financial derivatives, mathematical finance, life contingencies, and statistics for risk modeling. In addition to coauthoring the *ACTEX Study Manual for SOA Exam SRM*, he is also the sole author of the *ACTEX Study Manual for CAS Exam MAS-I*, *ACTEX Study Manual for SOA Exam PA*, and the textbook *Derivative Pricing: A Problem-Based Primer* (2018) published by Chapman & Hall/CRC Press, and, most recently, his *Study Manual for Exam FAM-L*. Although helping students pass actuarial exams is an important goal of his teaching, inculcating students with a thorough understanding of the subject and concrete problem-solving skills is always his top priority. In recognition of his exemplary teaching, Ambrose has received a number of awards and honors ever since he was a graduate student, including the 2012 Excellent Teaching Assistant Award from the Faculty of Science, The University of Hong Kong, public recognition in the *Daily Iowan* as a faculty member "making a positive difference in students' lives during their time at The University of Iowa" for seven years in a row (2016 to 2022), and the 2019-2020 Collegiate Teaching Award from the College of Liberal Arts and Sciences, The University of Iowa.

Additional Information from The College of Liberal Arts and Sciences

Course ICON site: To access the course site, log into Iowa Courses Online (ICON) https://icon.uiowa.edu/index.shtml using your Hawk ID and password.

Course Home
For Undergraduate Courses: The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the add and drop deadlines, the "second-grade only" option (SGO), academic misconduct policies, and other undergraduate policies and procedures. Other UI colleges may have different policies.
For Graduate Courses: The College of Liberal Arts and Sciences (CLAS) is the home of this course, and CLAS governs the policies and procedures for its courses. Graduate students, however, must adhere to the academic deadlines set by the Graduate College.

Academic Honesty and Misconduct
All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. Graduate academic misconduct must be reported to the Graduate College according to Section F of the Graduate College Manual.

Student Complaints
Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the Director or Chair of the school, department, or program offering the course.

Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

Communication: UI Email
Students are responsible for all official correspondences sent to their UI email address (uiowa.edu) and must use this address for any communication with instructors or staff in the UI community.

University Policies
Accommodations for Students with Disabilities
Basic Needs and Support for Students
Classroom Expectations
Exam Make-up Owing to Absence
Free Speech and Expression
Mental Health
Military Service Obligations
Non-discrimination
Religious Holy Days
Sexual Harassment/Misconduct and Supportive Measures
Sharing of Class Recordings