ACTS:4130
Quantitative Methods for Actuaries (Introductory Life Contingencies)
Course Syllabus
Fall 2020

MWF, 110 MLH*
2:30 p.m. – 3:20 p.m.

University of Iowa

Dept. of Statistics
and Actuarial Science

* We will meet in person in the first thirteen weeks of this semester. All UI courses, including ours, will be delivered virtually after the Thanksgiving Recess.

1   Contact Information

- **Instructor:** Professor Ambrose Lo, PhD, FSA, CERA

  ▷ *Office:* 368 SH

  ▷ *Phone:* (319) 335-1915

  ▷ *Email:* ambrose-lo@uiowa.edu **(Note: Please put "ACTS:4130" in the subject line)**

  ▷ *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:* 3:30 p.m. – 4:30 p.m., Monday, Wednesday, Friday. Also available by appointment.

- **Grader:** Mr. Jiantong Li

  ▷ *Office:* 223 SH

  ▷ *Email:* jiantong-li@uiowa.edu **(Note: Please put "ACTS:4130" in the subject line)**

- **Departmental Executive Officer (Chair):** Professor Kung-Sik Chan

  ▷ *Office:* 241 SH

  ▷ *Email:* kung-sik-chan@uiowa.edu

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 Actuarial Science major

Corequisite: STAT:4100 (Mathematical Statistics I) or STAT:5100 (Statistical Inference I)

Building upon students' 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 Actuarial Mathematics (LTAM) Exam** offered by the Society of Actuaries (SOA). Using the future lifetime random variable as the basic building block, we will set up a quantitative framework for doing pricing and reserving for common life insurance products. This requires skills for dealing with random events (cash flows of life insurance and annuity products are *contingent* on the random lifetimes of their policyholders) and time value of money, the topics of Exams P and FM.

At the University of Iowa (UI), we have three courses devoted to life contingencies and, for that matter, Exam LTAM. They are ACTS:4130 (current course), ACTS:4180 *Life Contingencies I* (to be offered in Spring 2021), and ACTS:4280 *Life Contingencies II* (to be offered in Fall 2021). ACTS:4130 will cover about 30-40% of the exam material, with the rest to be covered in the two follow-up courses, ACTS:4180 and ACTS:4280.

3   Exam LTAM

Exam LTAM is a four-hour 96-point exam consisting of a mix of multiple-choice and written-answer questions (the only exam with such a hybrid structure). It consists of two sections:

- *Section A (Multiple-Choice):* 20 multiple-choice questions, each worth 2 points for a total of 40 points. Each question includes five answer choices identified by (A) to (E).

- *Section B (Written-Answer):* 6 to 7 written-answer questions, worth a total of 56 points. These questions are usually divided into several parts and span multiple topics in the exam syllabus. In addition to doing calculations, some questions may require that you derive formulas, make interpretations, and give verbal explanations.

Note that your written-answer paper will be graded only if your score in Section A is above a threshold set after the examination is administered. The threshold varies from one exam administration to another, but is usually **24 points**[i] in Section A (or **12 out of 20 multiple-choice questions correct**). A consequence is that if you get 11 or fewer multiple-choice questions correct, you will fail the entire exam!

The current syllabus of Exam LTAM can be accessed from

https://www.soa.org/globalassets/assets/files/edu/2020/fall/syllabi/fall-2020-exam-ltam-syllabus.pdf.

There you can find a link to the LTAM Introductory Study Note, whose appendix contains the links to the LTAM sample multiple-choice and written-answer questions. For your convenience, the links to the sample questions are given below:

- Multiple-choice questions: https://www.soa.org/Files/Edu/2018/edu-spring-ltam-ques.pdf

- Multiple-choice solutions: https://www.soa.org/Files/Edu/2018/edu-spring-ltam-sol.pdf

- Written-answer questions: https://www.soa.org/Files/Edu/2018/edu-spring-ltam-wa-ques.pdf

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[i]Ever since written-answer questions were introduced to Exam MLC (the predecessor of Exam LTAM) in Spring 2014, the threshold has always been 24 points (12 multiple-choice questions correct), except for the Fall 2019 LTAM (22 points), Fall 2018 LTAM (20 points), and Spring 2017 MLC exams (20 points).

- Written-answer solutions: https://www.soa.org/Files/Edu/2018/edu-spring-ltam-wa-sol.pdf

In this course, we will go over many of these sample questions as well as past exam questions to consolidate our understanding. As the Introductory Study Note says,

> "knowledge and understanding of life contingency concepts are significantly enhanced through working out problems based on those concepts, including textbook problems and other sources of sample problems."

Finally, unlike most ASA-level exams, Exam LTAM is offered only two times (in late April and late October) every year. You should aim to take the exam in **October 2021** right after completing ACTS:4280, which is an off-cycle course that ends in late October.

4 Texts

There are no required textbooks in this course. We shall follow closely the instructor's comprehensive course notes, regarded as a mini-textbook, which will be made available on ICON (`http://icon.uiowa.edu`) chapter by chapter:

> Lo, A., *Course Package for ACTS:4130 Quantitative Methods for Actuaries (Fall 2020 Edition)*.

These notes not only provide in-depth coverage of all important topics in the introductory part of Exam LTAM, but also present a wide variety of illustrative examples and practice problems for exam preparation. *Please print out and bring a copy of the relevant portions of the course notes for each class meeting.* 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: 9781108478083.

This is the official textbook for Exam LTAM. Our course notes will cover the following required chapters (our treatment will be more geared towards problem solving):

Chapter 2: Survival models

Chapter 3: Life tables and selection

Chapter 4: Insurance benefits

Chapter 5: Annuities

(Time permitting, part of) Chapter 6: Premium calculation

There is a solutions manual (*Solutions Manual for Actuarial Mathematics for Life Contingent Risks*) that accompanies this book.

5   Grading System

Assessment in this course comprises the following items:

- **Attendance and Attitude:** $\pm\varepsilon\%$[ii]

  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).

- **Homework Assignments: 18%**

  There will be weekly homework assignments usually consisting of 5 to 7 end-of-chapter problems in the course package, assigned on Friday and due the following Friday. Please refer to the course schedule on pages 6 and 7. Any exceptions will be announced in class or in ICON. These assignments will be central to consolidating your understanding of the course materials and are an integral part of this course. Late homework will be severely penalized (see the assignment instructions on ICON). For students' guidance, illustrative solutions will be posted on ICON shortly after each homework is due.

  A note on collaboration: Discussion with other students on homework problems is allowed. However, you should always write up your own solutions.

- **Short Quizzes: 17%**

  There will be a total of six 15-minute quizzes held on Mondays (except Quiz 1). These quizzes are intended to motivate you to study regularly (not just cram 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: 25%**

  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, 2020 (Monday)** at 1505 SC testing Chapters 1, 2 and part of Chapter 3 of this course. It will consist of 12 to 15 multiple-choice questions similar in style to Exam LTAM problems and/or end-of-chapter problems in the course package. You will therefore find that problems from released LTAM/MLC past/sample exams and the course package are useful in preparing for the Midterm Exam.

- **Final Examination: 40%**

  A comprehensive Final Examination will take place in the week of December 14–18, 2020 and will be delivered in a virtual, open-book format due to the special circumstances of this fall semester. The exact date and time will be announced by the Registrar in mid-September. More details about the Final Exam will be given as the exam date approaches.

With the exception of the Final Exam, all quizzes and exams in this course are closed-book. The LTAM exam tables (also available on the real LTAM exam) will be provided if needed, and you

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[ii]In mathematics, ε usually denotes a small positive number.

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, and undergraduate and graduate students will be treated as two separate groups when it comes to assigning final grades. An *approximate* guide is as follows:

Undergraduate students						
A-	$[85, 90)$	A	$[90, 95)$	A+	$[95, 100]$
B-	$[70, 75)$	B	$[75, 80)$	B+	$[80, 85)$
C-	$[55, 60)$	C	$[60, 65)$	C+	$[65, 70)$
D-	$[40, 45)$	D	$[45, 50)$	D+	$[50, 55)$
F	$[0, 40)$				

Graduate students						
A-	$[86.5, 91)$	A	$[91, 95.5)$	A+	$[95.5, 100]$
B-	$[73, 77.5)$	B	$[77.5, 82)$	B+	$[82, 86.5)$
C-	$[59.5, 64)$	C	$[64, 68.5)$	C+	$[68.5, 73)$
D-	$[46, 50.5)$	D	$[50.5, 55)$	D+	$[55, 59.5)$
F	$[0, 46)$				

These are not completely absolute scales and the instructor reserves the option 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 do 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 2021.

2. This is *not* an easy course for most students. Each week you should spend at least 3 hours outside of class meetings reviewing the course notes and working on the end-of-chapter problems independently. It is fine to work harder, but working less is risky. Let me know if you encounter any problems with your learning.

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6 Tentative Teaching, Assignment, and Quiz Schedule

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

Teaching Week	Lecture	Date	Topic (Refer to course package)
1	1	August 24, 2020 (Mon)	Introduction and course overview
	2	August 26, 2020 (Wed)	Chapter 1
	3	August 28, 2020 (Fri)	Chapter 1
2	4	August 31, 2020 (Mon)	Chapter 1
	5	September 2, 2020 (Wed)	Chapter 1
	6	September 4, 2020 (Fri)	Chapter 1, **Assignment 1**
3	—	September 7, 2020 (Mon)	(University Holiday)
	7	September 9, 2020 (Wed)	Chapter 1, **Quiz 1**
	8	September 11, 2020 (Fri)	Chapter 1, **Assignment 2**
4	9	September 14, 2020 (Mon)	Chapter 1
	—	September 16, 2020 (Wed)	(No class due to job fair)
	10	September 18, 2020 (Fri)	Chapter 1, **Assignment 3**
5	11	September 21, 2020 (Mon)	Chapter 2, **Quiz 2**
	12	September 23, 2020 (Wed)	Chapter 2
	13	September 25, 2020 (Fri)	Chapter 2, **Assignment 4**
6	14	September 28, 2020 (Mon)	Chapter 2
	15	September 30, 2020 (Wed)	(No class due to job fair)
	16	October 2, 2020 (Fri)	Chapter 2, **Assignment 5**
7	17	October 5, 2020 (Mon)	Chapter 2, **Quiz 3**
	18	October 7, 2020 (Wed)	Chapter 3
	19	October 9, 2020 (Fri)	Chapter 3, **Assignment 6**
8	20	October 12, 2020 (Mon)	Chapter 3
	21	October 14, 2020 (Wed)	Chapter 3
	22	October 16, 2020 (Fri)	Chapter 3, **Assignment 7**
9	23	October 19, 2020 (Mon)	Chapter 3, **Quiz 4**
	24	October 21, 2020 (Wed)	Chapter 3
	25	October 23, 2020 (Fri)	Chapter 3, **Assignment 8**
10	—	October 26, 2020 (Mon)	**(No class. Midterm in evening!)**
	26	October 28, 2020 (Wed)	Chapter 3
	27	October 30, 2020 (Fri)	Chapter 3, **Assignment 9**
11	28	November 2, 2020 (Mon)[iii]	Chapter 4
	29	November 4, 2020 (Wed)	Chapter 4
	30	November 6, 2020 (Fri)	Chapter 4, **Assignment 10**
12	31	November 9, 2020 (Mon)	Chapter 4, **Quiz 5**
	32	November 11, 2020 (Wed)	Chapter 4
	33	November 13, 2020 (Fri)	Chapter 4, **Assignment 11**
13	34	November 16, 2020 (Mon)	Chapter 4
	35	November 18, 2020 (Wed)	Chapter 4
	36	November 20, 2020 (Fri)	Chapter 4, **Assignment 12**
—	—	November 23, 2020 (Mon)	
	—	November 25, 2020 (Wed)	(Thanksgiving Recess—No class!)
	—	November 27, 2020 (Fri)	

[iii]Drop date for undergraduates.

14	37	November 30, 2020 (Mon)	Chapter 5, **Quiz 6**
	38	December 2, 2020 (Wed)	Chapter 5
	39	December 4, 2020 (Fri)	Chapter 5, **Assignment 13**
15	40	December 7, 2020 (Mon)	Chapter 5
	41	December 9, 2020 (Wed)	Chapter 5
	42	December 11, 2020 (Fri)	Chapter 5 and Final Review
—	—	December 14–18, 2020	**Final Examination**

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More about the Instructor ("Shameless" self-introduction...)

Professor Ambrose Lo, Ph.D., 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 Ph.D. in Actuarial Science from The University of Hong Kong in 2010 and 2014, respectively. 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, 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* (Fall 2020 Edition), he is also the sole author of the *ACTEX Study Manual for CAS Exam MAS-I* (Spring 2020 Edition), *ACTEX Study Manual for SOA Exam PA* (Fall 2020 Edition), and the textbook *Derivative Pricing: A Problem-Based Primer* (2018) published by Chapman & Hall/CRC Press. 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 five years in a row (2016 to 2020), and, most recently, the 2019-2020 Collegiate Teaching Award from the College of Liberal Arts and Sciences, The University of Iowa.

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UI and the College of Liberal Arts and Sciences Information for Undergraduates

Absences and Attendance

Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, military service obligations, unavoidable circumstances, or University authorized activities. Students may use the CLAS absence form to aid communication with the instructor who will decide if the absence is excused or unexcused. The form is on ICON in the top banner under "Student Tools." More information is at `https://clas.uiowa.edu/students/handbook/attendance-absences`.

Academic Integrity

All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty. Misconduct is reported to the College, resulting in suspension or other sanctions, with sanctions communicated with the student through UI email. Visit this page for information: `https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code`.

Accommodations for Disabilities

UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at `https://sds.studentlife.uiowa.edu/`.

Administrative Home of the Course

The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: `https://clas.uiowa.edu/students/handbook`.

Class Behavioral Expectations

Students are expected to comply with University policies regarding appropriate classroom behavior as outlined in the Code of Student Life. This includes the policies and procedures that all students have agreed to regarding the Steps Forward for Fall 2020 in response to the COVID-19 pandemic. Particularly, all students are required to wear a face covering when in a UI building, including a classroom. In addition, the density of seats in classrooms has been reduced; in some instances, this will allow 6 feet or more between students while other cases, it may be less. Regardless, wearing a face covering and maintaining as much distance as possible are vital to slowing the spread of COVID19. In the event that a student disrupts the classroom environment through their failure to comply with the reasonable directive of an instructor or the University, the instructor has the authority to ask that the student immediately leave the space for the remainder of the class period. Additionally, the instructor is asked to report the incident to the Office of Student Accountability for the possibility of additional follow-up. Students who need a temporary alternative learning arrangement related to COVID-19 expectations should contact Student Disability Services

Class Recordings: Privacy and Sharing

Some sessions of a course could be recorded or live-streamed. Such a recording or streaming will only be available to students registered for the course. These recordings are the intellectual property of the faculty, and they may not be shared or reproduced without the explicit written consent of the faculty member. Students may not share these sessions with those not in the class; likewise, students may not upload recordings to any other online environment. Doing so is a breach of the Code of Student Conduct and, in some cases, a violation of the Federal Education Rights and Privacy Act (FERPA).

Communication and the Required Use of UI Email

Students are responsible for official correspondences sent to their UI email address (uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

Complaints

Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences; see this page for more information: `https://clas.uiowa.edu/students/handbook/student-rights-responsibilities`.

Final Examination Policies

The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals with very few exceptions made (for labs, ESL and some world language courses, and off-cycle courses): `https://registrar.uiowa.edu/final-examination-scheduling-policies`.

Nondiscrimination in the Classroom

The University of Iowa is committed to making the classroom a respectful and inclusive space for people of all gender, sexual, racial, religious, and other identities. Toward this goal, students are invited in MyUI to optionally share the names and pronouns they would like their instructors and advisors to use to address them. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race, class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (`https://diversity.uiowa.edu/eod`; +1 319 335-0705).

Sexual Harassment

Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see `https://osmrc.uiowa.edu/`.

END OF COURSE SYLLABUS