ACTS:4130
Quantitative Methods for Actuaries
(Introductory Life Contingencies)
Course Syllabus
Fall 2019

MWF, 112 MH
2:30 p.m. – 3:20 p.m.

THE UNIVERSITY OF IOWA

CAE Center of Actuarial Excellence

SOCIETY OF ACTUARIES

University of Iowa

COLLEGE OF LIBERAL ARTS & SCIENCES

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Dept. of Statistics
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1   Contact Information

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  (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:*
  Wednesday   :   3:30 p.m. – 4:30 p.m.
  Thursday   :   2:30 p.m. – 3:30 p.m.
  Friday   :   3:30 p.m. – 4:30 p.m.
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2 Course Description and Objectives

Prerequisites:
- ACTS:3080 (Mathematics of Finance I) with a minimum grade of C+
- STAT:3100 (Intro. to Math. Statistics I) with a minimum grade of B-

Corequisites: 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*, 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 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* (offered in Spring 2020), and ACTS:4280 *Life Contingencies II* (offered in Fall 2020). ACTS:4130 will cover about 40% of the exam material, with the rest being 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. 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 usually consist of 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 at or 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 must fail the entire exam!

The current syllabus of Exam LTAM can be accessed from

https://www.soa.org/globalassets/assets/files/edu/2019/fall/fall-2019-ltam-syllabus.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), except for the Fall 2018 Exam LTAM and Spring 2017 Exam MLC. The threshold for these two exams was 20 points (10 multiple-choice questions).

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

- 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. In 2020, it will be given on October 23, 2020 (Friday) (please refer to `https://www.soa.org/globalassets/assets/files/edu/2020/fall-exam-schedule.pdf`). You should aim to take the exam in October 2020 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 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 2019 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 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* (2nd Edition), 2013, by D.C.M. Dickson, M.R. Hardy, H.R. Waters, Cambridge University Press. ISBN: 9781107044074.

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

Chapter 6: Premium calculation

(Time permitting, part of) Chapter 7: Policy values (except Sections 7.3.5, 7.6, and 7.7, which are not required for Exam LTAM)

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).

- **Assignments: 18%**

  There will be weekly homework assignments usually consisting of 4 to 6 problems, assigned on Friday and due the following Friday. 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 generic 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 encouraged. 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. 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; accordingly, missed quizzes due to illness cannot be made up under any circumstances.

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

- **Midterm Examination: 25%**

  There will be a two-hour written Midterm Examination to be held in the evening (6:30 p.m. – 8:30 p.m.) of **October 28, 2019 (Monday)** at 106 GILH testing Chapters 1 to 3 of this course. It will consist of a mix of multiple-choice and written-answer questions similar in style to LTAM/MLC 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 two-hour comprehensive written Final Examination will take place in the week of December 16–20, 2019. Like the Midterm Exam, the Final Exam will comprise a mix of multiple-choice and written-answer questions similar in style to LTAM/MLC problems and/or end-of-chapter problems in the course package. 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.

All quizzes and exams in this course are closed-book. The LTAM exam tables (posted on ICON) 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 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 to perform better in this course.

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│                    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 2020.               │
│                                                          │
│   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 approximate schedule below will be updated as needed as the semester unfolds.

Teaching Week	Lecture	Date	Topic (Refer to course package)
1	1	August 26, 2019 (Mon)	Introduction and course overview
	2	August 28, 2019 (Wed)	Chapter 1
	3	August 30, 2019 (Fri)	Chapter 1
2	—	September 2, 2019 (Mon)	(University Holiday)
	4	September 4, 2019 (Wed)	Chapter 1
	5	September 6, 2019 (Fri)	Chapter 1, **Assignment 1**
3	6	September 9, 2019 (Mon)	Chapter 1, **Quiz 1**
	7	September 11, 2019 (Wed)	Chapter 1
	8	September 13, 2019 (Fri)	Chapter 1, **Assignment 2**
4	9	September 16, 2019 (Mon)	Chapter 1
	10	September 18, 2019 (Wed)	Chapter 1
	11	September 20, 2019 (Fri)	Chapter 2, **Assignment 3**
5	12	September 23, 2019 (Mon)	Chapter 2, **Quiz 2**
	13	September 25, 2019 (Wed)	Chapter 2
	14	September 27, 2019 (Fri)	Chapter 2, **Assignment 4**
6	15	September 30, 2019 (Mon)	Chapter 2
	—	October 2, 2019 (Wed)	(No class due to job fair)
	16	October 4, 2019 (Fri)	Chapter 2, **Assignment 5**
7	17	October 7, 2019 (Mon)	Chapter 3, **Quiz 3**
	18	October 9, 2019 (Wed)	Chapter 3
	19	October 11, 2019 (Fri)	Chapter 3, **Assignment 6**
8	20	October 14, 2019 (Mon)	Chapter 3
	21	October 16, 2019 (Wed)	Chapter 3
	22	October 18, 2019 (Fri)	Chapter 3, **Assignment 7**
9	23	October 21, 2019 (Mon)	Chapter 3, **Quiz 4**
	24	October 23, 2019 (Wed)	Chapter 3
	25	October 25, 2019 (Fri)	Chapter 3

10	—	October 28, 2019 (Mon)	**(No class. Midterm in evening!)**
	26	October 30, 2019 (Wed)	Chapter 4
	27	November 1, 2019 (Fri)	Chapter 4, **Assignment 8**
11	28	November 4, 2019 (Mon)[iii]	Chapter 4
	29	November 6, 2019 (Wed)	Chapter 4
	30	November 8, 2019 (Fri)	Chapter 4, **Assignment 9**
12	31	November 11, 2019 (Mon)	Chapter 4, **Quiz 5**
	32	November 13, 2019 (Wed)	Chapter 4
	33	November 15, 2019 (Fri)	Chapter 4, **Assignment 10**
13	34	November 18, 2019 (Mon)	Chapter 5
	35	November 20, 2019 (Wed)	Chapter 5
	36	November 22, 2019 (Fri)	Chapter 5, **Assignment 11**
—	—	November 25, 2019 (Mon)	
	—	November 27, 2019 (Wed)	(Thanksgiving Week—No class!)
	—	November 29, 2019 (Fri)	
14	37	December 2, 2019 (Mon)	Chapter 5, **Quiz 6**
	38	December 4, 2019 (Wed)	Chapter 5
	39	December 6, 2019 (Fri)	Chapter 5, **Assignment 12**
15	40	December 9, 2019 (Mon)	Chapter 5
	41	December 11, 2019 (Wed)	Chapter 5
	42	December 13, 2019 (Fri)	Final Review
—	—	December 16–20, 2019	**Final Examination**

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

Professor Ambrose Lo is currently Associate Professor of Actuarial Science with tenure at the Department of Statistics and Actuarial Science at 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 in August 2014 as an Assistant Professor of Actuarial Science. He is a Fellow of the Society of Actuaries (FSA) and a Chartered Enterprise Risk Analyst (CERA). 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, credibility theory, advanced probability theory, and regression and time series analysis. His emphasis in teaching is always placed on the development of a thorough understanding of the subject matter complemented by concrete problem-solving skills. Besides coauthoring the *ACTEX Study Manual for SOA Exam SRM* (Fall 2019 Edition), he is also the sole author of the *ACTEX Study Manual*

[iii]Drop date for undergraduates.

for CAS Exam MAS-I (Fall 2019 Edition), *ACTEX Study Manual for SOA Exam PA* (December 2019 Edition), and the textbook *Derivative Pricing: A Problem-Based Primer* (2018) published by Chapman & Hall/CRC Press.

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College of Liberal Arts & Sciences: Policies and Procedures

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, unavoidable circumstances, or University authorized activities (`https://clas.uiowa.edu/students/handbook/attendance-absences`). Students may use this absence form to aid communication; the instructor will decide if the absence is excused or unexcused (`https://clas.uiowa.edu/sites/default/files/ABSENCE%20EXPLANATION%20FORM2019.pdf`).

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 the UI email address (`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`.

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. For more information, see

`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. Visit

> `https://registrar.uiowa.edu/final-examination-scheduling-policies`.

Nondiscrimination in the Classroom   UI is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. 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 (`diversity.uiowa.edu`).

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/`.

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END OF COURSE SYLLABUS

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