AS 3431B / 9007B COURSE OUTLINE

Winter 2019

1. General Course Information

Course Name

Life Contingencies III

Class Schedule

Mondays, Wednesdays and Fridays from 8:30 to 9:20 in WSC 240

Prerequisite Requirements

A minimum mark of 60% in Actuarial Science 3429A/B and in Statistical Sciences 3657A/B. Restricted to students enrolled in any Actuarial Science module.

2. Instructor Information

Instructor	Xiaoming Liu
Office	WSC 215
Email	xliu@stats.uwo.ca
Phone	Ext. 88233
Office hours	Wednesday 1:00 – 2:30 pm

3. Course Description/Syllabus

Calendar Description

Analysis of probability distributions and present values associated with multiple life models, multiple decrement models and more general multi-state models and applications to other long term coverages or benefits.

Learning Objectives

The following three pages provide the relevant Society of Actuaries Exam MLC Learning Objectives.

1. Topic: Long-term insurance coverages (2-8%)
Learning Objectives
The Candidate will understand the key features of long-term insurance coverages.
Learning Outcomes
The Candidate will be able to: a) Describe the long-term coverages in insurance (life, health, and general), annuities, and retirement benefits (e.g. pensions, retiree health care, etc.) b) Describe the similarities and differences between the long-term coverages identified in Learning Outcome 1a. c) Describe the appropriate models to be used to calculate expected present values, premiums or contributions, and reserves for each long-term coverage.

2. Topic: Survival models and their estimation (15-25%)

Learning Objectives

The Candidate will understand key concepts concerning parametric and non-parametric (tabular) and multi-state models including single life, or multiple life, and multiple decrements.

Learning Outcomes

The Candidate will be able to:

a) Explain and interpret survival models and transitioning between states.

b) Calculate and interpret standard functions including survival and mortality probabilities, force of mortality, and complete and curtate expectation of life.

c) Calculate nonparametric estimates of survival models using the Kaplan-Meier and Nelson-Aalen formulas for seriatim data and adaptations for grouped data.

d) Calculate, using both seriatim and grouped data, maximum likelihood estimates of transition probabilities assuming constant transition intensity during fixed age intervals.

e) Calculate the variances of and construct confidence intervals for the estimators in parts c) and d).

f) Calculate transition intensities exactly, or estimate transition intensities using large sample approximations.

g) Describe and apply simple longevity models.

h) For models dealing with multiple lives and/or multiple states, explain the random variables associated with the model and calculate and interpret marginal and conditional probabilities.

i) Construct and interpret select and ultimate survival models.

j) Describe the behavior of Markov chain models, identify possible transitions between states, and calculate and interpret the probability of being in a particular state and transitioning between states.

k) Apply to calculations involving these models appropriate approximation methods for fractional ages based on uniform distribution of deaths or constant force.

3. **Topic: Present Value Random Variables (10-20%)**
Learning Objectives
The Candidate will be able to perform calculations on the present value random variables associated with benefits and expenses for any of the models in Learning Objective 2.
Learning Outcomes
The Candidate will be able to: a) Calculate and interpret probabilities, means, variances, and percentiles. b) Calculate and interpret the effect of changes in underlying assumptions such as mortality and interest. c) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

4. **Topic: Premium Calculation (15-30%)**
Learning Objectives
The Candidate will be able to use and explain premium-calculation methodologies.
Learning Outcomes
The Candidate will be able to: a) Calculate and interpret probabilities, means, variances, and percentiles of random variables associated with a premium, including loss-at-issue random variables. b) Calculate premiums based on the equivalence principle, the portfolio percentile premium principle, and profit testing. c) Using the models in Learning Objective 2, calculate and interpret the effect of changes in benefits or underlying assumptions such as decrements, morbidity, expenses, and interest. d) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

5. **Topic: Reserves (20-30%)**

Learning Objectives

The Candidate will understand reserves for insurances and annuities for models in Learning Objectives 2 and 4.

Learning Outcomes

The Candidate will be able to:

a) Calculate and interpret the following reserve types:

- Net premium
- Modified
- Gross premium
- Expense

b) Calculate and interpret probabilities, means, variances, and percentiles of random variables associated with these reserves, including future-loss random variables.

c) Calculate and interpret common profit measures such as expected profit, actual profit, gain, gain by source and period, internal rate of return, profit margin, and break-even year.

d) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

6. **Topic: Pension Plans and Retirement Benefits (10-15%)**

Learning Objectives

The Candidate will understand how the models from previous Learning Objectives apply to pension plans and retirement benefits.

Learning Outcomes

The Candidate will be able to:

a) Describe and compare defined contribution and defined benefit pension plans including final salary and career average earning plans.

b) Describe retiree health care plans.

c) Identify and interpret the common states and decrements for pension plans, and the parametric and tabular models, including Markov chain models, associated with these decrements.

d) Given particular participant data, plan provisions, and valuation assumptions**,** apply the models mentioned in learning outcome 6c to defined benefit pension plans and calculate and interpret replacement ratios, accrued benefits, gain or loss, and their expected values with adjustments such as the early retirement reduction factor.

e) Given particular participant data, plan provisions, and valuation assumptions**,** calculate and interpret the actuarial accrued liability and the normal cost for a defined benefit plan under the projected unit credit (PUC) cost method and the traditional unit credit (TUC) cost method.

f) Identify and interpret the assumptions and methods for retiree health care plans. Given particular participant data, plan provisions, and valuation assumptions**,** calculate and interpret the expected present value of future benefits, accumulated postretirement benefit obligation (APBO), and the normal cost or service cost for retiree health care plans.

g) Calculate and interpret the effect of changes in underlying valuation assumptions such as mortality, discrete salary increase changes, other decrements and interest on the quantities mentioned in learning outcomes 6d, 6e, and 6f.

h) Apply appropriate approximation methods such as uniform distribution of deaths, constant force, Woolhouse, and Euler.

4. Course Materials

Actuarial Mathematics for Life Contingent Risks by Dickson, C.M.D., Hardy, M.R., and Waters, H.R., (2nd Edition), 2013, Cambridge: Cambridge University Press (relevant chapters: 8, 9, 10, 12)

LTAM Supplementary note (Hardy) (relevant chapters: 1, 2, 3, 6)

Teaching order:
Roughly before reading week: AMLCR 8-8.7, 8.13, and **12**, mixed with selected topics from LTAM note;
Roughly after reading week: LCR 8.8-8.12, 9, 10

Students should check OWL (http://owl.uwo.ca) on a regular basis for news and updates. This is the primary method by which information will be disseminated to all students in the class. Students are responsible for checking OWL on a regular basis.

5. Methods of Evaluation

There will be **three tests** with the scheduled dates as follows:
Test 1 on February 1
Test 2 on March 1
Test 3 on March 22

There will be **one computation project** to be held during the week of March 4-8

There will be **a three-hour final exam** during the final examination period (to be scheduled by the Office of the Registrar).

Your **final marks** will be based on the following:

Tests 45 % (15 % for each test)
Project 10 %
Final Exam 45 %

CIA Actuarial Exam Accreditation

This course is accredited under the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP) for the 2016-2017 academic year. Achievement of the established exemption grade in this course may qualify a student for exemptions from writing certain preliminary exams. Please note, a combination of courses may be required to achieve a single exemption. Please see the following link for full details:
http://www.cia-ica.ca/membership/uap/information-for-students

6. Accommodation and Accessibility

If you are unable to meet a course requirement due to illness or other serious circumstances, you must provide valid medical or supporting documentation to the Academic Counselling Office of your home faculty as soon as possible. If you are a Science student, the Academic Counselling Office of the Faculty of Science is located in WSC 140, and can be contacted at scibmsac@uwo.ca.

For further information, please consult the university's medical illness policy at http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

7. Academic Policies

The website for Registrarial Services is http://www.registrar.uwo.ca.

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, the centrally administered e-mail account provided to students will be considered the individual's official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at his/her official university address is attended to in a timely manner.

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at this website: http:// www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

8. Support Services

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 ext. 82147 if you have questions regarding accommodation.

The policy on Accommodation for Students with Disabilities can be found here: www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_disabilities.pdf

The policy on Accommodation for Religious Holidays can be found here: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Students who are in emotional/mental distress should refer to Mental Health@Western (http://www.health.uwo.ca/mental_health) for a complete list of options about how to obtain help.