AS 3431B / 9007B COURSE OUTLINE

Winter 2018

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	Bruce Jones
Office	WSC 221
Email	jones@stats.uwo.ca
Phone	Ext. 83149
Office hours	Monday 9:30 – 11:00, Thursday 2:00 – 3:30

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.

Learning Objectives

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

1. **Topic: Models for single and multiple lives (~~10-20%~~)**

Learning Objectives

The Candidate will understand key concepts concerning tabular or parametric survival models and single or multiple-life states.

Learning Outcomes

The Candidate will be able to:

a) Explain and interpret the effects of transitioning between states, the survival models and their interactions. Calculate and interpret standard probability functions including survival and mortality probabilities, force of mortality, ~~and complete and curtate expectation of life~~.

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

c) Using the factors mentioned in Learning Outcomes 1a and 1b, construct and interpret survival models for cohorts consisting of non-homogeneous populations, for example, smokers and non-smokers or ultimate-and-select groups.

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

e) Apply to calculations involving these models appropriate approximation methods such as uniform distribution of deaths, constant force, ~~Woolhouse~~, and Euler.

2. **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 mentioned in the Learning Outcomes of Learning Objective 1.

Learning Outcomes

The Candidate will be able to:

a) Calculate and interpret probabilities, means, ~~percentiles~~ and higher moments.

b) Calculate and interpret the effect of changes in underlying assumptions such as mortality and interest.

c) Apply to calculations involving these random variables appropriate approximation methods such as uniform distribution of deaths, constant force, ~~Woolhouse~~, and Euler.

3. **Topic: Premium Calculation (~~20-35%~~)**

Learning Objectives

The Candidate will be able to both calculate with and explain premium-calculation methodologies such as the equivalence principle, the ~~portfolio-premium principle~~, and premiums determined by specified profit objectives.

Learning Outcomes

The Candidate will be able to:

a) Calculate and interpret probabilities, means, ~~percentiles~~ and higher moments of random variables associated with these premiums, including loss-at-issue random variables.

b) Using any of the models mentioned in the Learning Outcomes of Learning Objective 1, calculate and interpret the effect of changes in policy design and underlying assumptions such as changes in mortality, benefits, expenses, interest and dividends.

c) Perform the calculations mentioned in Learning Outcomes 3a and 3b for contracts associated with specified contingent cash flows including

- Non-interest-sensitive insurances;
- Annuities;
- Universal life insurances; and
- Participating insurances.

d) Apply to calculations involving these premiums appropriate approximation methods such as uniform distribution of deaths, constant force, ~~Woolhouse~~, and Euler

4. **Topic: Reserves (~~20-35%~~)**

Learning Objectives

The Candidate will understand reserves for insurances and annuities for models mentioned in the Learning Outcomes of Learning Objectives 1 and 3.

Learning Outcomes

The Candidate will be able to:

a) Calculate and interpret any of (i) several reserve types including benefits reserves, gross premium reserves, expense reserves ~~or any of (ii) several reserve methods such as Full Preliminary Term (FPT) or modified reserves~~.

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

c) Calculate and interpret asset shares, expected profit, actual profit, gain, gain by source and period, internal rate of return and other common profit measures.

d) Calculate and interpret the effect of policy modifications.

e) Calculate and interpret contract account values, contract surrender values and profit measures on universal life insurance contracts.

f) Compare and contrast non-interest-sensitive and participating insurances with universal life insurances.

g) Calculate and interpret the effect of changes in policy design and underlying assumptions such as changes in mortality, benefits, expenses, interest and dividends.

h) Apply to calculations involving these reserves appropriate approximation methods such as uniform distribution of deaths, constant force, ~~Woolhouse~~, and Euler.

5. **Topic: Pension Plans and Retirement Benefits (~~10-20%~~)**

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) 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.

c) Given particular participant data, plan provisions, and valuation assumptions**,** apply the models mentioned in learning outcome 5b to defined benefit pension plans and calculate and interpret replacement ratios, accrued benefits, and their expected values with adjustments such as the early retirement reduction factor.

d) 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.

e) Calculate and interpret the effect of changes in underlying valuation assumptions such as mortality, salary increase changes, other decrements and interest on the quantities mentioned in learning outcomes 5c and 5d.

f) Apply to calculations involving these defined benefit pension plans 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, 13

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 **four assignments** with due dates as follows:

Assignment 1 due January 26
Assignment 2 due February 16
Assignment 3 due March 16
Assignment 4 due April 6

There will be **two 50-minute in-class midterms** held on the following dates:

February 5
March 21

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:

Assignments	10 % (2.5 % for each assignment)
Midterm 1	20 %
Midterm 2	20%
Final Exam	50 %

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.