Math 417A   Loss Models I
Fall 2017
Bouillon 110, 1:00 – 1:50 (M, W, F)

Instructor: Dr. Yvonne Chueh
Office: Bouillon 107D (Tel: 963-2124)
e-mail: chueh@cwu.edu
Office hours: M-F 9:00~9:50; and by appointments
Webpage: www.cwu.edu/Faculty/Chueh

Prerequisite: Math 411A or by permission.

Text:
1. Required: Stuart A. Klugman, Harry H. Panjer, Gordon E. Willmot, <u>Loss Models</u>, Wiley 2012.
2. Optional: Samuel A. Broverman, Actex Exam C Study Manual, Fall 2017; ASM for MLC.
3. Required: Exam C Adapt online subscription:
https://checkout.coachingactuaries.com/?site=5&productskus%5b0%5d=2017FallCWUCAdaptClass

Other Resources
Tables for Exam C

All released exam papers since 2000, can be found at: Past Exam
Questions and Solutions

Exam C Sample Questions and Solutions

Corrections and Comments for *Loss Models,* Fourth Edition

The students will be introduced to useful frequency and severity models. They will be required to understand the steps involved in the modeling process and how to carry out these steps in solving business problems. The students should be able to:
  (i) analyze data from an application in a business context;
  (ii) determine a suitable model including parameter values; and
  (iii) provide measures of confidence for decisions based upon the model.
The students will be introduced to a variety of tools for the calibration and evaluation of the models.

Learning outcomes:
After taking this sequence, the students are expected to be familiar with survival, severity, frequency and aggregate probability models, and use statistical methods to estimate parameters of such models given sample data. The students are further expected to identify steps in the modeling process, understand the underlying assumptions implicit in each family of models, recognize which assumptions are applicable in a given business application, and appropriately adjust the models for impact of insurance coverage modifications.

Course outlines:
    Probability Review
        Discrete random variable: uniform, binomial, negative binomial, Poisson
        Continuous random variable: uniform, normal, gamma
        Multivariable probability: joint distribution, marginal distribution, conditional distribution,

independent, covariance, double expectation theorem, sum of independent variables
Claim Frequency Models
Binomial, Poisson, negative binomial, geometric distribution
Creating new counting models
Mixture models
Counting process
Claim severity Models
Pareto distribution
Creating new distribution
Transforming loss random variables for insurance applications
Discrete distribution formula
The collective model

LEARNING OUTCOMES for SOA Exam C (Construction and Evaluation of Actuarial Models)

Sections A–E have a combined weight of 15-20%.

A. Severity Models
1. Calculate the basic distributional quantities:
   a) moments
   b) Percentiles
   c) Generating functions
2. Describe how changes in parameters affect the distribution.
3. Recognize classes of distributions and their relationships.
4. Apply the following techniques for creating new families of distributions:
   a) Multiplication by a constant
   b) Raising to a power
   c) Exponentiation,
   d) Mixing
5. Identify the applications in which each distribution is used and reasons why.
6. Apply the distribution to an application, given the parameters.
7. Calculate various measures of tail weight and interpret the results to compare the tail weights.
8. Identify and describe two extreme value distributions.

B. Frequency Models
For the Poisson, Mixed Poisson, Binomial, Negative Binomial, Geometric distribution and mixtures thereof:
1. Describe how changes in parameters affect the distribution,
2. Calculate moments,
3. Identify the applications for which each distribution is used and reasons why,
4. Apply the distribution to an application given the parameters.
5. Apply the zero-truncated or zero-modified distribution to an application given the parameters

C. Aggregate Models
1. Compute relevant parameters and statistics for collective risk models.
2. Evaluate compound models for aggregate claims.
3. Compute aggregate claims distributions.

D. For severity, frequency and aggregate models
   1. Evaluate the impacts of coverage modifications:
        a) Deductibles
        b) Limits
        c) Coinsurance
   2. Calculate Loss Elimination Ratios.
   3. Evaluate effects of inflation on losses.

E. Risk Measures
   1. Calculate VaR, and TVaR and explain their use and limitations.

Course outlines:

Topic	Days (one day is one-hour)

I   Basic distributional quantities
        1.   Sums of random variables
        2.   Tail distributions
        3.   Measures of risk

                                                                        5

II   Characteristics of actuarial models
        1.   The role of parameters
        2.   Continuous models
        3.   Discrete distributions   7

III   Frequency and severity with coverage modifications
        1.   Deductibles
        2.   Loss elimination ratio
        3.   Effect of inflation
        4.   Policy limits
        5.   Coinsurance   8

IV   Aggregate loss models
        1.   Aggregate claims
        2.   Compound models
        3.   The individual risk model
        4.   Compound Poisson approximation   8

            TESTING   2

TOTAL   30

Class format: Mixture of lectures and in-class problem solving. Students present their solutions of the assigned problems and answer any question raised by the instructor and other students. <u>Group discussions to explain concepts and generate project ideas.</u>

Grading policy:
1. Class participation and attendance   (50 points)
2. Assignments (50 points)
3. Adapt quizzes   (100 points)
3. Two tests   (200 points)
4. Final exam   (100 points)

Final grades will be assigned according to the following scale:

A 100-93%   **A-** 92.9-90%
B+ 89.9-87%   **B** 86.9-83%   **B-** 82.9-80%
C+ 79.9-77%   **C** 76.9-73%   **C-** 72.9-70%
D+ 69.9-67%   **D** 66.9-63%   **D-** 62.9-60%
F 59.9% and below

Class Expectations

- ***Think critically***. This course will require critical thinking. People that analyze, infer, evaluate, and make reasoned judgments do better in college, make better daily decisions, and have greater professional success. Developing critical thinking should be a key goal of every student.

- ***Apply yourself.*** This course will take a lot of time and energy. If you have high learning expectations, that is what you will achieve. Success in this course will require significant effort (several hours of study time for each hour of class). Depending on your mathematical background, you may need to spend more or less study time. Attend class regularly, be on time, and budget your time to accommodate the workload.

- ***Ask questions***. Loss Modeling is fascinating, but it can be confusing, too. Ask questions. If you aren't clear on something, there are likely others who are equally unclear on the topic.

- ***Be informed***. People sometimes use information to manipulate others' behaviors and decision-making in ways not always to your benefit. If you don't understand the mathematical basis of a claim about data, you can't make an informed decision about it. Be curious; try and found out all you can about a topic before you make a decision that may profoundly affect your life.

- ***Be respectful***. We will discuss some sensitive and controversial issues in this course. Everyone will respect others' right to express their opinions even if you disagree. Respectful discourse is a minimal expectation of every student.

- ***Communicate clearly***. Effective written and oral communication indicates an intelligent mind. Clarity, proper format, spelling, and grammar are expected of every student.

- ***Use common sense***. Cheating on assignments or exams, plagiarizing others' work, and turning in late assignments is unacceptable. Any infractions may result in a zero for the assignment, a failing course grade, and the possibility of disciplinary action by the university. I won't accept *anything* late unless you have written documentation from an appropriate source or have made prior arrangements with me. If you have a problem that prohibits you from

turning something in on time, let me know ahead of time. In all instances, communicate with me so we can prevent problems.

Tentative Schedule (Any change will be announced in class.)

<u>Week</u>   <u>**Reading Assignment (Please check Canvas for other assignments)**</u>

0. 9/20-9/23   Chapter 3 (3.1~3.3)
                                       Adapt Quiz 1 (Friday 9/23)

1. 9/25-9/29   Chapter 3, 4 (3.4~3.5)
                                       Adapt Quiz 2 (Friday 9/29)

2. 10/2-10/6   Chapter 4 (4.1~4.2)
                                       Adapt Quiz 3 (Friday 10/6)

3. 10/9-10/13   Chapter 5 (5.1~5.2)
                                       Adapt Quiz 4 (Friday 10/13)

4. 10/16-10/20   Review Chapter 3~5
                                       Adapt Quiz 5 (Friday 10/16)
                                       Test 1 (Covers the above sections)

5. 10/23-10/27   Chapter 5 (5.3~5.4)
                                       Adapt Quiz 6 (Friday 10/27)

6. 10/30-11/03   Chapter 6 (6.1~6.3)
                                       Adapt Quiz 7 (Friday 11/03)

7. 11/6-11/10   Chapter 6 (6.4~6.6)
                                       Adapt Quiz 8 (Friday 11/10)

8. 11/13-11/17   Review
                                       Test 2 (Covers the above sections after Test 1)

9. 11/20- 11/24   Problem Solving

                                       THANKSGIVING!!

10. 11/27-12/01   Problem Presentations

11. 12/04-12/08   **Final Exam (comprehensive)**

The **Final Exam** will be according to the university schedule.