ACTS 4305 SYLLABUS SPRING 2023

SHORT TERM ACTUARIAL MATHEMATICS II

DESCRIPTION: The purpose of this class is to develop the students' knowledge of the construction and selection of parametric frequency and aggregate models. The students will understand and be able to construct and estimate parameters for parametric models using Maximum Likelihood estimation techniques and perform model selection using graphical procedures, hypothesis tests, including Chi-square goodness-of-fit, Kolmogorov-Smirnov and Likelihood ratio (LRT) tests. This class covers parts of SOA Exams FAM and ASTAM; CAS Exams MAS I, MAS II and 5.

Prerequisite: ACTS 4304 with grade C- or higher.

The class meets on T/Th 11:30 am – 12:45 pm in room FN 2.202.

INSTRUCTOR: Natalia A. Humphreys

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Office Hours: Tue, Thurs 1:00 pm – 2:00 pm and by appointment (In-person, MS Teams).

INSTRUCTIONAL MODE: Traditional Classroom/Laboratory Course (i.e., face-to-face) – The instructor and students are present in the classroom/laboratory each class meeting according to the class schedule.

COURSE PLATFORM: This course will be delivered in a classroom on UT Dallas Campus. Lectures will be posted on e-Learning. MS Teams might be used for off-Campus delivery of the material (e.g. mandated change of modality due to a change in the environment).

LEARNING OUTCOMES:

At the end of the course students will be able to perform the tasks listed below.

A. For Frequency Models for the Poisson, Mixed Poisson, Binomial, Negative Binomial, Geometric distribution and mixtures thereof:
   1. Calculate moments and generating functions.
   2. Describe how changes in the parameters affect the distribution.
   3. Recognize classes of distributions and their relationships.
   4. Identify the applications to which each distribution may apply and explain why.
   5. Apply the distribution to an application, given the parameters.

6. Derive and perform calculations with the zero-truncated and zero-modified versions of these distributions.

B. For Aggregate Models:
   1. Define collective and individual risk models and calculate their expectation and variance.
   2. Use the normal distribution to approximate the aggregate distribution.
   3. Use the recursive formula to calculate the values of the collective risk models with discrete distributions of severities.
   4. Calculate the expected aggregate payments in the presence of an aggregate deductible.
   5. Evaluate the effect of the coverage modifications on the expected aggregate payments.
   6. Perform the exact calculation of aggregate loss distribution in case of the normal distribution of severities, exponential and gamma (Erlang) distribution of severities and a compound model with negative binomial frequency and exponential distribution of severities.

C. For Construction and Selection of Parametric Models:
1. Estimate the parameters for severity, frequency, and aggregate distributions using Maximum Likelihood Estimation for:
   a. Complete, individual data
   b. Complete, grouped data
   c. Truncated or censored data
2. Estimate the variance of the estimators and construct confidence intervals.
3. Use the delta method to estimate the variance of the maximum likelihood estimator of a function of the parameter(s).
4. Estimate the parameters for severity, frequency, and aggregate distributions using Bayesian Estimation.
5. Perform model selection using:
   a. Graphical procedures.
   b. Hypothesis tests, including Chi-square goodness-of -fit, Kolmogorov-Smirnov and Likelihood ratio (LRT) tests.
   c. Score-based approaches, including Schwarz Bayesian Criterion (SBC), Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC).

TEXTBOOK (required): ASM Study Manual for Exam STAM, 1st Edition, 2nd printing or later, Abraham Weishaus.

ADDITIONAL TEXTS (not required, but useful):

1. Probability and Statistics for Actuaries (First Edition), 2021, Natalia Humphreys and Yuly Koshevnik at https://titles.cognella.com/probability-and-statistics-for-actuaries-9781793514271 or https://store.cognella.com/83143-1B-019
2. Loss Models: From Data to Decisions, (Fourth Edition), 2012, by Klugman, S.A., Panjer, H.H. and Willmot, G.E.
3. Introduction to Ratemaking and Loss Reserving for Property and Casualty Insurance, (Fouth Edition), 2015, Robert L. Brown, W. Scott Lennox.
4. Individual Health Insurance (Second Edition), 2015, by Bluhm and Leida

MATERIAL COVERED:

Topic Number	Topic Name		Topic Number	Topic Name
19	Discrete Distributions		**29**	Maximum Likelihood Estimators
20	Poisson/Gamma		**30**	Maximum Likelihood Estimators: Special Techniques
21	Frequency – Exposure and Coverage Modifications		**31**	Variance of Maximum Likelihood Estimators
22	Aggregate Loss Models: Compound Variance		**32**	Fitting Discrete Distributions
23	Aggregate Loss Models: Approximating Distribution		**33**	Hypothesis Tests: Graphic Comparison
24	Aggregate Loss Models: Severity Modifications		**34**	Hypothesis Tests: Kolmogorov-Smirnov
25	Discrete Aggregate Loss Models: The Recursive Formula		**35**	Hypothesis Tests: Anderson-Darling
26	Aggregate Losses: Aggregate Deductible		**36**	Hypothesis Tests: Chi-square
27	Aggregate Losses: Miscellaneous Topics		**37**	Likelihood Ratio Algorithm, Schwarz Bayesian Criterion

TABLES:

https://www.soa.org/globalassets/assets/Files/Edu/2019/2019-02-exam-stam-tables.pdf

Exam FAM Information:

https://www.soa.org/education/exam-req/edu-exam-fam/

Exam ASTAM Information:

https://www.soa.org/education/exam-req/edu-exam-astam/

98-100	A+
94-97	A
90-93	A-
85-89	B+
80-84	B
75-79	B-
70-74	C+
65-69	C
60-64	C-
55-59	D+
50-54	D
45-49	D-
0-44	F

GRADING: Your grade will be based on your attendance, homework, two midterms and a final exam. It will be assigned based on the following grade scale and weights:

WEIGHTS: In-person participation in class and Friday Actuarial Events: 5%, Homework: 15%, Midterms: 25% each, Final: 30%.

DATES: Homework – weekly or biweekly;

Midterm I – Tuesday, February 21, 2023, 11:30 am – 12:45 pm, FN 2.202;

Midterm II – Tuesday, April 11, 2023, 11:30 am – 12:45 pm, FN 2.202;

Final – Tuesday, May 9, 2023, 11:00 am - 1:45 pm, FN 2.202.

All exams are in-person, closed-book, unless directed otherwise by the University Administration.

CLASS CITIZENSHIP: Assignments should be submitted on **e-Learning** by due date specified in class **before the start** of the class period. Only the grades for the assignments correctly submitted by the due date and time to the e-Learning system and downloaded by the grader from the e-Learning system will be graded and recorded. Late assignments or assignments sent to the instructor or grader via e-mail will not be accepted for **any** reason. If you have a scheduled absence for an official UTD function or obligation, you must upload your paper in **before** the due date.

There will be **no make-up exams** unless accompanied by a note from a doctor, religious or otherwise documented official reason pertained to the University business. Undocumented cases will not be honored.

POSTING COURSE MATERIAL: It is **strictly prohibited** to upload, post and/or distribute in any form or fashion ANY course material provided to students in class and via e-Learning. Violation of this policy will constitute academic dishonesty, violation of privacy and copyright infringement and will result in immediate report to the UTD Office of the Academic Affairs.

CALCULATORS: In order to simulate an actuarial exam conditions, an SOA approved exam calculator is recommended: the battery or solar–powered Texas Instruments BA–35 model calculator, the BA II Plus*, the BA II Plus Professional*, the TI–30Xa or TI–30X II* (IIS solar or IIB battery), or TI-30X MultiView (XS Solar or XB Battery).

For additional information please see:

http://www.soa.org/education/exam-req/exam-day-info/edu-calculators.aspx

USE OF CELL PHONES or OTHER ELECTRONIC DEVISES: Unless there is a true emergency, any use of cell phones or other electronic devises unrelated to the course during the class period is **strictly prohibited**. Violators will be asked to stop using the devise immediately. Repeated violations will be reflected in the student's grade.

STUDENTS WITH DISABILITES: It is the policy and practice of The University of Texas at Dallas to make reasonable accommodations for students with properly documented disabilities. However, written notification from the Office of Student AccessAbility (OSA) is required. If you are eligible to receive an accommodation and would like to request it for this course, please discuss it with me and allow one-week advance notice. Students who have questions about receiving accommodations, or those who have, or think they may have, a disability (mobility, sensory, health, psychological, learning, etc.) are invited to contact the Office of Student AccessAbility for a confidential discussion. OSA is located in the Administration Building, suite 2.224. They can be reached by phone at 972- 883-2098, or by email at studentaccess@utdallas.edu.

COMET CREED

This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do."

UT DALLAS SYLLABUS POLICIES and PROCEDURES

The information contained in the following link constitutes the University's policies and procedures segment of the course syllabus.

Please go to http://go.utdallas.edu/syllabus-policies for these policies.

Please note: The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.