MATH 416A ACTUARIAL SCIENCE PROBLEMS II
WINTER 2023 (Jan 4 – Mar 10)

Instructor: Sahadeb Upretee, PhD
E-mail: upretees@cwu.edu
Class Time:TR 11:00 - 11:50 AM
Office Hours: MTWT 12:00 --1:00 PM or appointment
Office: Samuelson 218J
Classroom: Samuelson 103

TEXTBOOK: ACTEX Study Manual for Exam P

Note: Coaching Actuary's Adopt in Class (AiC) will be used for homework and Quizzes.

PRE OR CO-REQUISITES: MATH 411B

**COURSE CONTENT:** Review of topics in probability theory important for actuaries, including probabilities, random variables, moments, discrete, continuous, joint, and conditional distributions, and limit theorems**.**

***Chapter 1: General Probability***
Axiom of probability, permutation, combination, conditional probability, Bayes theorem.
***Learning Outcomes***
The students will be able to:

- Define set functions, Venn diagrams, sample space, and events. Define probability as a set function on a collection of events and state the basic axioms of probability.
- Calculate probabilities using addition and multiplication rules.
- Define independence and calculate probabilities of independent events.
- Calculate probabilities of mutually exclusive events.
- Define and calculate conditional probabilities.
- Calculate probabilities using combinatorics, such as combinations and permutations.
- State Bayes Theorem and the law of total probability and use them to calculate conditional probabilities

***Chapter 2: Univariate Random Variables***
Binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, and mixed distribution.
***Learning Outcomes***
The students will be able to:

- Explain and apply the concepts of random variables, probability and probability density functions, cumulative distribution functions.
- Calculate conditional probabilities.
- Explain and calculate expected value, mode, median, percentile, and higher moments.
- Explain and calculate variance, standard deviation, and coefficient of variation.
- Define probability generating functions and moment generating functions and use them to calculate probabilities and moments.
- Determine the sum of independent random variables (Poisson and normal).

***Chapter 3: Multivariate Random Variables***
Transformations of two random variables, several random variables, the moment-generating function technique, random functions associated with normal distributions.

***Learning Outcomes***

The students will be able to:

- Explain and perform calculations concerning joint probability functions, probability density functions, and cumulative distribution functions.
- Determine conditional and marginal probability functions, probability density functions, and cumulative distribution functions.
- Calculate moments for joint, conditional, and marginal random variables.
- Explain and apply joint moment generating functions.
- Calculate variance, standard deviation for conditional and marginal probability distributions.
- Calculate joint moments, such as the covariance and the correlation coefficient.
- Determine the distribution of a transformation of jointly distributed random variables.
- Determine the distribution of order statistics from a set of independent random variables.
- Calculate probabilities and moments for linear combinations of independent random variables.
- Apply the Central Limit Theorem appropriately.

REQUIRED CALCULATOR: A scientific calculator is required. Some recommended calculators are TI-30XS MultiView, TI-30Xa, TI-30X II (IIS solar or IIB battery).

IMPORTANT DATES:
First Class: Jan 4
Class End: Mar 10
Martin Luther King Jr. holiday: Jan 16 - No Class
Presidents Day: Feb 20 – No Class
Study Day: Mar 14
Midterm Exam One: Feb - 03
Midterm Exam Two: Mar- 03
Quiz One: Jan 13
Quiz Two: Jan 27
Quiz Three: Feb 10
Quiz Four: Feb 24
Quiz Five: Mar 10

EVALUATIONS:

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|---|---|
| Class Participation: | 5% |
| Weekly Assignments: | 30% |
| Midterm Exam One: | 20% |
| Midterm Exam Two: | 20% |
| Five Quizzes: | 25% |

Note: Class attendance is required. In the Class Participation, I expect your active involvement while discussing in the online class.

GRADING SCALE (MINIMUM CUTOFFS):

| A | A- | B+ | B | B- | C+ | C | C- | D+ | D | D- | F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 93 | 90 | 87 | 83 | 80 | 77 | 73 | 70 | 67 | 63 | 60 | below 60 |

**Exam P Information**: The Probability Exam is a 3-hour exam that consists of 30 multiple-choice questions and is administered as a computer-based test (CBT). The exam is offered 6 times a year. Ideally, you should be registering for the one in March, which will be administered from March 9 - 20. For the March exam, the registration deadline is on FEBRUARY 7. Please register as soon as possible, so that that you can choose your preferred exam date and location. For more information about the exam, visit https://www.soa.org/education/exam-req/edu-exam-p-detail/

EMAIL CORRESPONDENCE: I will respond to student communications during business hours (M-F, 8 am-5 pm). You can typically expect a reply within approximately 24 hours, not including weekends. If you email me with questions about specific problems, it could be nice if you send pictures of what you've tried so far.

HOMEWORK: Each week homework will be assigned, and due dates will be announced in the Canvas. I will select homework problems from both the textbook and relevant SOA sample questions. Students are encouraged to discuss with friends but do not copy others' work directly. If I find identical solutions, then both parties will get zero points. Your work should be clear, in a logical order, and provide sufficient explanation. You must upload a single pdf file of the homework into Canvas, or you may submit your work in the classroom.

EXAM POLICY: There will be two midterm exams and one comprehensive final exam. All exams are cumulative. They will be taken in classroom and closed book.

TIME INVESTMENT REQUIREMENT**:**
The information listed below illustrates the total investment of time by an average student to achieve the learning goals of the course. (30 hours/credit x 2 = 60 hours)
The amount of time that an average student should expect to spend on this class is as follows:

- 20 hours - Time spent in the classroom, online instruction, taking exams and doing worksheets, etc.
- 40 hours - Time for preparation and study for in-class worksheets, homework, monthly and final exams, discussion during office hours.

COURSE POLICIES

MENTAL HEALTH STATEMENT:

"*Stress and other life circumstances that may be out of your control can make learning and focusing difficult. If you find stress or other mental health concerns make academics difficult, Central has resources to support you. I encourage you to reach out as soon as you notice you're struggling.*"
RESOURCES FOR STUDENTS:

*CWU Counseling Center:* https://www.cwu.edu/medical-counseling/counseling-clinic

*Mental Health Crisis Support outside normal business hours:* 1-800 – 273 - 8255, Text HOME to 741741 or call 911.

*Wellness Center:* https://www.cwu.edu/wellness/ 509-963 -3213

*Student Rights and Responsibilities:* https://www.cwu.edu/student-rights/office-student-rights-responsibilities

CENTRAL WASHINGTON UNIVERSITY COVID-19 REPORTING FORM: available on http://cwu.edu/student-success/covid-form

POLICY ON ACADEMIC DISHONESTY:
Students are on their honor to follow the student conduct code as outlined in the Washington Administrative Code. Violations of this section will result in a failing grade in the course in addition to further possible university sanctions. (See http://apps.leg.wa.gov/WAC/default.aspx?cite=106-125 )

POLICY ON DIVERSITY:
University-level education is about broadening horizons and looking at academic issues from a variety of perspectives. With this in mind, the participants in this class are encouraged to bring their own life experiences and viewpoints to bear on classroom discussions and assignments. Along with the freedom to express one's own views comes the responsibility to respect the views of others. No student will be discriminated against on the basis of race, ethnicity, age, creed, religion, gender, sexual orientation, marital status, or political ideology.

DISABILITY SERVICES:
Central Washington University is committed to creating a learning environment that meets the needs of its diverse student body. If you anticipate or experience any obstacles to learning, contact Disability Services to discuss a range of available options. Student Disability Services is located in Hogue 126. Call (509) 963-2214 or email ds@cwu.edu for more information. (see https://www.cwu.edu/disability-services/ )

SUBMITTING ELECTRONIC FILES:
All electronic files must be submitted in .doc, .docx or .pdf format. If you don't have Microsoft Office, you can download it for free, using your CWU email and password from the MS Office website. Here is the guide on (https://cwu.teamdynamix.com/TDClient/2015/Portal/KB/ArticleDet?ID=9080), how to download MS Office. Mac users make sure to save documents with visible extension (.docx or .rtf).

RELIGIOUS HOLIDAY ABSENCES: In compliance with RCW 28B.137.010, CWU makes every effort to deal reasonably and fairly with students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Students must present written notice to their instructor within the first two weeks of class listing the specific dates on which accommodations are required. Contact the Dean of Student Success at (509) 963-1515 for further information or questions