

King Fahd University of Petroleum and Minerals

Department of Mathematics and Statistics

AS-389: Actuarial Science Problem Lab II

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Office Hours: will be announced later

Course Objectives: This problem lab is designed to prepare Actuarial majors for the first Society of Actuaries (SOA) and Casualty Actuarial Society (CSA) Examinations, Exam P (Probability). Students are assumed to have taken the appropriate prerequisite courses (STAT301 or equivalent) prior to registering for this society exam preparation lab.

Textbook: Broverman SA, ACTEX Study Manual Program for SOA Exam P, Fall 2021 Edition, ACTEX Publications Inc. ISBN: 978-1-64756-645-6

Assessment*

Activity	Weight
Classwork (homework, quizzes, attendance, bonuses, etc.)	10%
First Major Exam	25%
Second Major Exam	25%
Final Exam (Comprehensive)	40%

Important Notes:

Excuse: Only an excuse issued by *Deanship of Student Affairs* will be accepted for not attending a class, a quiz or an exam.

Blackboard: All contacts or announcements between the instructor and the students are supposed to be through Blackboard, so the student must check his Blackboard at least once a day.

Academic Integrity: All KFUPM policies regarding ethics and academic honesty apply to this course.

Cheating and Plagiarism: This course is composed of individual assignments. It is important that your individual assignment be completed with your own efforts instead of copying it from your fellow student. KFUPM instructors follow “*zero tolerance*” approach with regard to cheating and plagiarism. During examinations (quizzes, major exams, lab tests) cheating or any attempt of cheating by use of illegal activities, techniques and forms of fraud will result in a *grade of F* in the course along with reporting the incident to the higher university administration.

General Notes:

- Students are also expected to take class notes and organize their learning material in a binder for easy retrieval to help them in study and review for class, exams, etc. It is to the student’s advantage to keep a binder for storing class notes, homework, and other graded assignments. Students who are organized will find it easier to find important materials when studying for exams.
- To effectively learn statistics, students need to solve problems and analyze data. The selected assigned problems are specifically designed to prepare you for class quizzes, lab, majors and final exam. So, it is expected that you complete these problems step-by-step and with comprehension.
- Never round your intermediate results to problems when doing your calculations. This will cause you to lose calculation accuracy. Round only your final answers and you should not round less than 4 decimal places unless required otherwise.

Important Notes:

- In accordance with University rules, 20% unexcused absences will automatically result in a grade of DN.
- Attendance on time is very important. Mostly, attendance will be checked within the first five minutes of the class. Entering the class after that, is considered as one late, and every two times late equals to one absence.

Home Work Problems:

- Homework problems will be posted on the Blackboard.
- Students are expected to solve as many problems in the manual as possible to prepare for the SOA exam.

Student Learning Objectives: (Extracted from SOA professional exam P objectives Jan 2022).

By completing this course, students should be able to prepare themselves for the SOA exam P for which the objectives are as follows:

Candidates should be able to use and apply the following concepts in a risk management context:

1. General Probability (10-17% of SOA-P Exam)*Learning Objective:*

- ❖ The Candidate will understand basic probability concepts.

Learning Outcomes:

Candidate will be able to

- a) 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.
- b) Calculate probabilities using addition and multiplication rules.
- c) Define independence and calculate probabilities of independent events.
- d) Calculate probabilities of mutually exclusive events.
- e) Define and calculate conditional probabilities.
- f) Calculate probabilities using combinatorics, such as combinations and permutations.
- g) State Bayes Theorem and the law of total probability and use them to calculate conditional probabilities.

2. Univariate Random Variables (40-47% of SOA-P Exam)*Learning Objective:*

- ❖ The candidate will understand key concepts concerning discrete and continuous univariate random variables (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, and mixed) and their applications

Learning Outcomes:

Candidate will be able to

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

3. Multivariate Random Variables (40-47% of SOA-P Exam)

Learning Objectives:

- ❖ The Candidate will understand key concepts concerning multivariate random variables (including the bivariate normal) and their applications.

Learning Outcomes:

Candidate will be able to

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

Tips on how to enhance your problem-solving abilities:

1. Please try as many questions in the manual.
2. You are urged to practice (but not memorize) more problems than assigned.
3. You should always try to solve a problem on your own before reading the solution or asking for help.
4. If you find it difficult to handle a certain type of problem, you should try more problems of that type.
5. You are encouraged to solve some of the review problems at the end of each chapter.
6. The practice you get doing homework and reviewing the class lectures and recitations will make exam problems easier to tackle.
7. Try to make good use of the office hours of your instructor.

Syllabus

Week	Chapter	Topics
1	Ch 0	Algebra and Calculus Review. Introduction. Set Theory, Graphing Inequality in 2 Dimensions, Properties of Functions, Limits and Continuity, Differentiation, Integration, Geometric and Arithmetic Progressions (series), Problem Set 0
2	Ch 1	Basic Probability Concepts. Probability Spaces and Events, Probability, Problem Set 1
3-4	Ch 2	Conditional Probability and Independence. Definition of Conditional Probability, Bayes' Theorem and the Law of Total Probability, Problem Set 2
5	Ch 3	Combinatorial Principles. Permutations and Combinations, Problem Set 3
6	Ch 4	Random variables and Probability Distribution. Discrete Random Variable, Continuous Random Variable, Mixed Distribution, Cumulative Distribution Function, Independent Random Variables, Problem Set 4.
7	Ch 5	Expectation and Other Distribution Parameters. Expected Value, Moments of a Random Variable, Variance and Standard Deviation, Moment Generating Function, Percentiles, Median, and Mode, Problem Set 5
8-9	Ch 6	Frequently Used Discrete Distributions. Discrete Uniform Distribution, Binomial Distribution, Poisson Distribution, Geometric Distribution, Negative Binomial Distribution, Hypergeometric Distribution, Multinomial Distribution, Summary of Discrete Distributions. Problem Set 6
10-11	Ch 7	Frequently Used Continuous Distributions. Continuous Uniform Distribution, Normal Distribution, Approximating a Distribution Using a Normal Distribution, Exponential Distribution, Gamma Distribution, Summary of Continuous Distributions, Problem Set 7
12-13	Ch 8	Joint, Marginal, and Conditional Distributions. Definition of Joint Distribution, Expectation of a Function of Jointly Distributed Random Variables, Marginal Distributions, Independence of Random Variables, Conditional Distributions, Covariance and Correlation Between Random Variables, Moment Generating Function for a Joint Distribution, Bivariate Normal Distribution, Problem Set 8.
14	Ch 9	Transformation of Random Variables. Distribution of a Transformation of X, Distribution of a Transformation of Joint Distribution of X and Y, Distribution of a Sum of Random Variables, Distribution of the Maximum or Minimum of Independent RV $\{X_1, X_2, \dots, X_n\}$, Order Statistics, Mixtures of Distributions, Problem Set 9.
15	Ch 10	Risk Management Concepts. Loss Distributions and Insurance, Insurance Policy Deductible, Insurance Policy Limit, Proportional Insurance, Problem Set 10.
16		Review and catchup
Final Exam (Comprehensive)		