

King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics
AS389: Actuarial Science Problem Lab II - Term 261 3:20 – 5:10 PM U

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Office Hours: UT (10.00 - 10.50am) or by appointment via email.

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, S.A., ACTEX P/1 Study Manual, 2018 edition, ACTEX Publications Inc.

Assessment

Assessment for this course will be based on the following:

Activity	Weight
Attendance, Quiz ⁺ , Labwork, and homework	25% (5+10+5+5)%
Major 1	20%
Major 2	20%
Final Exam (Comprehensive) (as posted on registrar website)	35%

⁺ 2 announced + 1 pop quizzes - best 2 will be selected. **No make-up for quiz under any circumstances.**

IMPORTANT NOTE on GRADES:

Letter Grade	A+	A	B+	B	C+	C	D+	D	F
Cut-off	90%	85%	80%	75%	67%	60%	55%	50%	<50%

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

Exams:

Cheating in Exams: 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. Cheating in exams includes (but not restricted to)

- Looking at the papers of other students,
- Talking to other students,
- Using mobiles or any other electronic devices.

Exam Issues:

- No student will be allowed to take the exam if not having his/her KFUPM ID or National/Iqama ID.
- Students are not allowed to carry mobiles, smart watches, or electronic devices to the exam halls/rooms.
- Students must take the exam in the place assigned to them.

Missing an Exam:

In case a student misses an exam (Exam I, Exam II, or the Final Exam) for a legitimate reason (such as medical emergencies), he must bring an official excuse from Students Affairs with the "Exam Included" box checked. Otherwise, he will get zero in the missed exam.

Attendance: Students must adhere to the attendance policy of KFUPM. Students are expected to attend all lecture and recitation classes. Students are expected to arrive on time for class, consistent with expectations in professional settings. Stay seated throughout class; handle bathroom/phone needs before/after, leave quietly/quickly if unavoidable (extended absences count as absent), and only 1 student may step out at a time.

- If a student misses a class, s/he is responsible for any announcement made in that class.
- If a student misses a Lab, s/he will not be allowed to submit labwork.
- Out of the 5 marks for attendance: Absence #1: Free; Absence #2-3: 2.5-mark deduction.
- After 2 warnings, a DN grade will be awarded to any student who accumulates
 - 4 unexcused absences in lecture and labs. (20%)
 - 6 excused and unexcused absences in lecture and recitation classes. (33%)

Note:

- **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 late (**2 lates = 1 Absence**) and
- **More than 10 minutes late = Absence** (regardless of any excuse).
- Only University Blue paper Official excuses will be accepted as valid excuse.

General Notes:

- Laptops/tablets are permitted only for note-taking or assigned classwork.
- Students are required to carry **pens, note-taking equipment** and a **calculator** to **EVERY lecture and exams**. It is strongly recommended to keep a **binder** for class-notes.
- Students are also expected to bring the book, take notes and organize their solved questions 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.

Home Work:

- To successfully prepare for the SOA exams, students MUST **solve problems** regularly and with discipline. The selected assigned problems are specifically designed to prepare you for major and final exams. So, it is expected that you complete these problems **step-by-step** and **with comprehension**.
- If you happen to stumble upon a *solution manual* somewhere, remember **2 important points**. (1) Due to publishing costs and deadlines, these solutions are brief and may have mistakes and (2) in your career as an actuary and your exams and quizzes in this class, you are expected to know **every step to a problem** and to know if a solution is incorrect. Thus, the best way to solve problem is without these brief solutions.
- AI is a great study buddy. Use it to explain tricky concepts, check your work, or explore different problem-solving approaches. But don't let it do your work for you. Submissions that are copied and pasted from AI will receive no marks. Your learning matters most, rewrite, rethink, and revise to make sure the final answer is truly yours.
- Homework is due in Teams on Saturday after completing a chapter.**
- No late homework will be accepted, and**
- Actuaries don't act like the guy in the cartoon below.**



They **manage risk**.

They **don't** let risk manage them

- Never round** your intermediate results to problems when doing your calculations. This will cause you to lose calculation accuracy. Your answers may then be different from the SOA exam key even when you use the right procedure.
- For every exam, so you need to bring with you pens, pencils, a sharpener, an eraser, and a SOA approved calculator.

Honor code

Students of this course are expected to maintain the highest level of academic integrity and ethics. A KFUPM student does not cheat or tolerate those who do. Every student is expected to submit work that is entirely their own, to properly cite all sources used, and to refrain from any form of academic misconducts.

Plagiarism

Use of another person's ideas, processes, results, or words requires appropriate credit or reference to the author. Use of Generative AI tools is subject to the instructor's authorization. Submitting the same work in more than one course without the instructor's permission is not allowed.

Examinations Policies

You are expected to adhere to KFUPM policies for all examinations in this course, including quizzes, major exams, midterms, and final exams. The following policies are enacted in this course during examinations:

- Students are expected to arrive at the examination hall on time with proper University ID.
- Students are seated according to the instructor's seat assignment and may request a seat change only for legitimate reasons.
- Late arrival to the exam may result in the student being denied admission. Once any student has begun finishing the exam, no further admission will be allowed under any circumstance.
- Students are not permitted to leave the examination room to use the restroom during an exam, except in rare cases involving a documented medical condition (e.g., diabetes, kidney disease). Any excused restroom leave will be fully supervised by a same-gender proctor.
- Students must leave all smart devices outside the examination hall, including smartphones, smartwatches, earbuds, and unauthorized calculators. Possession of any unauthorized device will be considered a cheating attempt and will be handled accordingly.
- Cheating attempts will be reported according to KFUPM policy and will result in a DN grade in the course, along with potential further penalties upon investigation.

Learning Outcomes: (Extracted from SOA professional exam P objectives).

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:

- 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.

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
- 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).
- 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

- 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.
- 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.

Tentative Lecture Schedule Tentative Syllabus

Week	Chapter	Topics	Notes
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	Quiz
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	Major 1
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	Quiz
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.	Major 2
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)			