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SYLLABUS OF BASIC EDUCATION

2023

Probability

Exam 1

The syllabus for this basic education requirement is defined in the form of learning objectives that set forth, usually in broad terms, what the candidate should be able to do in actual practice.

Please check the “*Syllabus Updates*” section of the CAS Web Site for any changes to the *Syllabus*. The options for obtaining credit for this basic education requirement are listed below and in Examination Rules, C. Grades and Accreditation, [Waivers of Examinations](#) section of the *Syllabus*.

The purpose of the syllabus is to develop knowledge of the fundamental probability tools for quantitatively assessing risk. The application of these tools to problems encountered in actuarial science is emphasized. A thorough command of the supporting calculus is assumed. Additionally, a very basic knowledge of insurance and risk management is assumed.

The Learning Objectives and Outcomes to follow have been sourced directly from the Syllabus: Probability Exam — September 2023, published by the Society of Actuaries.



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LEARNING OUTCOMES

1. Topic: General Probability (23-30%)

Learning Objectives

The Candidate will understand basic probability concepts, combinatorics, and discrete mathematics.

Learning Outcomes

The 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.



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2. Topic: Univariate Random Variables (44-50%)

Learning Objectives

The Candidate will understand key concepts concerning discrete and continuous univariate random variables (including binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, normal, lognormal, and beta) and their applications.

Learning Outcomes

The Candidate will be able to:

- a) Explain and apply the concepts of random variables, probability, probability density functions, and cumulative distribution functions.
- b) Calculate conditional probabilities.
- c) Explain and calculate expected value and higher moments, mode, median, and percentile.
- d) Explain and calculate variance, standard deviation, and coefficient of variation.
- e) Apply the concepts of deductibles, coinsurance, benefit limits, and inflation to convert a given loss amount from a policyholder into the corresponding payment amount for an insurance company.
- f) Calculate the expected value, variance, and standard deviation of both the loss random variable and the corresponding payment random variable upon the application of policy adjustments.
- g) Determine the sum of independent random variables (Poisson and normal).



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3. Topic: Multivariate Random Variables (23-30%)

Learning Objectives

The Candidate will understand key concepts concerning multivariate discrete random variables, the distribution of order statistics, and linear combinations of independent random variables, along with associated applications.

Learning Outcomes

The Candidate will be able to:

- a) Explain and perform calculations concerning joint probability functions and cumulative distribution functions for discrete random variables only.
- b) Determine conditional and marginal probability functions for discrete random variables only.
- c) Calculate moments for joint, conditional, and marginal discrete random variables.
- d) Calculate variance and standard deviation for conditional and marginal probability distributions for discrete random variables only.
- e) Calculate joint moments, such as the covariance and the correlation coefficient for discrete random variables only.
- f) Determine the distribution of order statistics from a set of independent random variables.
- g) Calculate probabilities for linear combinations of independent normal random variables.
- h) Calculate moments for linear combinations of independent random variables.
- i) Apply the Central Limit Theorem to calculate probabilities for linear combinations of independent and identically distributed random variables.



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Options for Obtaining Exam 1 Credit

The CAS will grant credit for Exam 1 to those who have successfully completed one of the following examinations. To obtain credit, candidates should follow the procedures outlined on the [Waivers of Examination](#) page of the CAS website.

Organization	Examination
Actuarial Society of South Africa	A111, Actuarial Statistics
Actuaries Institute (Australia)	CS1, Actuarial Statistics 1
Canadian Institute of Actuaries (CIA)	University Accreditation Program credit for Probability ¹
China Association of Actuaries	CAA, A1 Probability
Institute of Actuaries of India	CS1, Actuarial Statistics 1
Institute and Faculty of Actuaries (U.K.)	CS1, Actuarial Statistics 1
Society of Actuaries	P, Probability

1. For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.