

**Catalog Description:** Counting techniques, probability, discrete and continuous random variables and distribution functions, joint probability distributions; expected value, variance and covariance; decision making.

**Course Objectives:** After completing this course, students will be able to

1. Apply counting principles.
2. Solve classical probability problems.
3. Use general, special, and joint distributions to solve problems.

### Learning Outcomes and Performance Criteria

1. Demonstrate knowledge and understanding of sets and their operations.

Core Criteria:

- (a) Find the union or intersection of two sets; and the complement of a set.
- (b) Determine whether two sets are mutually exclusive.
- (c) Solve problems using set operations and definitions.
- (d) Determine the cardinality of a set.

2. Demonstrate knowledge and understanding of counting.

Core Criteria:

- (a) Apply the fundamental counting principle to solve problems.
- (b) Apply combinations and permutations to solve problems.

3. Demonstrate knowledge and understanding of classical probability.

Core Criteria:

- (a) Identify sample spaces, outcomes, and events.
- (b) Apply the axioms of probability.
- (c) Apply the addition rules of probability.
- (d) Find conditional probabilities.
- (e) Apply the multiplication rule for independent and dependent sets.
- (f) Apply Bayes theorem.
- (g) Give the expected value of an experiment.
- (h) Find probabilities based on sampling with and without replacement.
- (i) Construct the probability distribution for a given experiment.

4. Demonstrate knowledge and understanding of probability distributions.

Core Criteria:

- (a) Describe an event in terms of a random variable.

- (b) Verify a distribution satisfies the axioms of probability.
- (c) Find the probability of an event that is described in terms of a random variable.
- (d) Use a given distribution to find probabilities (for both discrete and continuous, pdf and cdf).
- (e) Apply definitions and theorems of random variables and their probability functions.
- (f) Compute the expected value and variance of a distribution.
- (g) Compute the expected value of a function of a random variable.
- (h) Graph a distribution (pdf and/or cdf).

5. Demonstrate knowledge and understanding of joint distributions.

Core Criteria:

- (a) Determine probabilities from discrete and continuous joint random variables.
- (b) Find the marginal probability distributions of a joint probability distribution (both discrete and continuous).
- (c) Find conditional distribution functions from a joint distribution.
- (d) Find the covariance of joint random variables.
- (e) Find the expected value of a marginal random variable from a joint distribution.
- (f) Determine whether random variables are independent.
- (g) Apply the definition of independence.

Additional Criteria:

- (a) Create a joint distribution table for two discrete random variables.
- (b) Compute transformations of joint random variables.

6. Apply special distributions.

Core Criteria:

- (a) Apply the Normal distribution.
- (b) Apply the Binomial distribution.
- (c) Apply the Geometric distribution.
- (d) Apply the Hypergeometric distribution.
- (e) Apply the Poisson distribution.
- (f) Apply the Exponential (negative geometric) distribution.
- (g) Apply the Uniform distribution.

Additional Criteria:

- (a) Apply the Bernoulli distribution.
- (b) Apply the Multinomial distribution.
- (c) Apply the Negative Binomial distribution.
- (d) Apply the Gamma distribution.