

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; find 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 variables.
- (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.