Stat 155 : Introduction to Techniques of Operations Research

California State University, Sacramento · Department of Mathematics & Statistics

This course offers an introduction to non-deterministic techniques of operations research, including the formulations of stochastic models, probabilistic dynamic programming models, dynamic programming in Markov Chains, waiting line models, and tools for computer simulation of these models.

Catalog Description

Formulation and analysis of mathematical models with emphasis on real systems applications. Introduction to queueing theory and Markov processes for application. **Graded**: Graded Student. **Units**: 3.0.

Prerequisites

Math 31; Stat 50, Stat 103, or Stat 115A; Math 31 may be taken concurrently.

Learning Objectives

- Understand the concept of Mathematical Modeling for applications.
- Understand the concept of decision making under uncertainty, stochastic modeling.
- Learn the use of discrete distributions such as Binomial, Poisson, Geometric, Hypergeometric and Multinomial distributions in solving applied problems.
- Learn the use of continuous distributions such as Uniform, Exponential, Gamma, Beta, Weibull and Normal distributions as models for applied problems.
- Understand the notion of a stochastic process and define the concepts of Markov Chain, Markov Process and the Poisson process; learn the applications of these processes to Queuing Theory, Operations Research, and Waiting Time models.
- Understand the principle of simulation of random phenomena using computers; learn the simulation of a variety of distributions for statistical applications.

Topics

I. Formulation and Solution of Linear Optimization Models (2 Weeks)

   A. Importance of model-building
   B. Dynamic planning
   C. Transportation networks
   D. Canonical forms for linear optimization

II. Stochastic Models (2 Weeks)

   A. Decision making in uncertain environments
   B. Two-stage linear models
   C. Chance-constrained models

D. Multistage linear models
E. Linear Decision Rule

III. Probabilistic Dynamic Programming (2 Weeks)

A. Elementary inventory model
B. Optimal batch size model
C. Stochastic regeneration model
D. Computational feasibility

IV. Dynamic Programming in Markov Chains (1 Week)

A. Stochastic shortest-route model
B. Unbounded horizon with discounting
C. Equivalent average return
D. Markov chain version of equipment

V. Probabilistic Inventory Models (2 Weeks)

A. Static model
B. Economic-order quantity models
C. Stochastic dynamic continuous review model
D. Stochastic dynamic periodic review model

VI. Waiting Line Models (2 Weeks)

A. Probability distributions of interarrival times
B. Probability distributions of service times
C. Single-server model with Poisson input
D. Multiple-server model with Poisson input
E. Birth and death process

VII. Computer Simulation (1 Week)

A. Simulation in perspective
B. Building a simulation model
C. Design of simulation experiments
D. Generating random phenomena

VIII. Advanced Techniques (2 Weeks)