Probabilistic Operations Research Models
MATH 4380/8386

1.0 Course Description

1.1 Overview of Content and Purpose: (3 hours) This is a survey course of probabilistic operations research models and algorithms. Topics include Markov chains, queueing theory, inventory models, forecasting and simulation. The main aim of this course is to demonstrate some practical applications of probability theory to real-world problems.

1.2 For Whom Intended: Students in Mathematics, Computer Science, ISQA and Engineering

1.3 Prerequisite: MATH 2050

2.0 Objectives

2.1 Performance Objectives for the Student: Students will become proficient in working with probabilistic optimization models and their applications, understand solution methods for these problems, and become proficient in using software to develop solutions.

3.0 Content and Organization

3.1 Topics

1. Review of Probability Theory
    a. random variables
    b. probability distributions
    c. conditional probability and independent events
    d. expectations
2. Markov Chains
    a. Chapman-Kolmogorov equations
    b. classifications of states of a Markov chain
    c. long-run properties
    d. absorbing states
3. Queueing Models
    a. applications
    b. basic structure of queueing models
    c. birth and death process
    d. queueing networks
4. Inventory Models
    a. components of inventory methods
    b. continuous-review models
    c. periodic-review models
5. Forecasting
    a. applications
    b. time series
    c. methods for constant-level model
    d. incorporating seasonal effects
    e. exponential smoothing

f. Box-Jenkins model

6. Simulation
   a. applications
   b. random number generation
   c. generation of random observations from a probability distribution
   d. simulation processes

4.0 Teaching Methodology

4.1 Methods To Be Used: This course will be presented by lecture and class discussions.

5.0 Evaluation

5.1 Basis for Evaluating Student Performance: Evaluation will be based on student performance on homework assignments and exams. Homework assignments will be assigned on a weekly or biweekly basis depending on the natural conclusion of each topic. There will be two exams, one approximately half way through the course and one at the end of the course. Graduate students will be required to perform additional reading, and to complete additional questions on each assignment to demonstrate a higher understanding of the course material and its applications.

6.0 Resource Materials

6.1 Textbook (s) Hillier and Lieberman, *Intro to Operations Research*, 8th Ed, Mcgraw-Hill, 2005.

6.2 Current Bibliography of Resources

1. Jensen and Bard, *Operations Research; Models and Methods*, Wiley, 2002.
2. Taha, *Operations Research: An Introduction*, 8th Ed, Prentice Hall 2006.
3. Winston, *Operations Research: Applications and Algorithms*, 4th Ed, Duxbury Press, 2003.
4. Winston, *Intro to Probability Models: Operations Research*, 4th Ed, Duxbury, 2003.
5. Grimmett and Stirzaker, *Probability and Random Processes*, 3rd Ed, Oxford University Press, 2001.
6. Karlin and Taylor, *An Introduction to Stochastic Modeling*, 3rd Ed, Academic Press, 1998.
7. Pritsker and O'Reilly, *Simulation with Visual SLAM and AweSim*, 2nd Ed, Wiley, 1999.
8. Ross, *Intro to Probability Models*, 9th Ed, Academic Press, 2006.
9. Taylor, *Intro to Management Science*, 9th Ed, Prentice Hall, 2006.
10. Tijms, *First Course in Stochastic Models*, 2nd Ed, Wiley, 2003.
11. Winston, *Simulation Modeling Using RISK*, Duxbury Press, 2000.