STA-HC- 5016

Stochastic Processes and Queuing Theory

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

11.1 Theory

11.1.1 Unit 1: *Probability Distributions*: (Lectures: 8)

Generating functions, Bivariate probability generating function. Stochastic Process: Introduction, Stationary Process.

11.1.2 Unit 2: *Markov Chains*: (Lectures: 18)

Definition of Markov Chain, transition probability matrix, order of Markov chain, Markov chain as graphs, higher transition probabilities. Generalization of independent Bernoulli trials, classification of states and chains.

11.1.3 Unit 3: *Poisson Process*: (Lectures: 18)

Postulates of Poisson process, properties of Poisson process, inter-arrival time.

11.1.4 Unit 4: *Queuing System*: (Lectures: 16)

General concept, steady state distribution, queuing model, M/M/1 with finite and infinite system capacity, waiting time distribution (without proof).

11.2 Practical/Lab

List of Practical

1. Calculation of transition probability matrix
2. Identification of characteristics of reducible and irreducible chains.
3. Identification of types of classes
4. Identification of ergodic transition probability matrix
5. Stationarity of Markov chain and graphical representation of Markov chain
6. Computation of probabilities in case of generalizations of independent Bernoulli trials.
7. Computation of inter-arrival time for a Poisson process.
8. Calculation of Probability and parameters for (*M/M*/1) model and change in behaviour of queue as N tends to infinity.
9. Calculation of generating function and expected duration for different amounts of stake.

SUGGESTED READING:

1. Medhi, J. (2009): Stochastic Processes, New Age International Publishers.
2. Basu, A.K. (2005): Introduction to Stochastic Processes, Narosa Publishing.
3. Bhat, B.R.(2000): Stochastic Models: Analysis and Applications, New Age International Publishers.
4. Taha, H. (1995): Operations Research: An Introduction, Prentice- Hall India.
5. Feller, William (1968): Introduction to probability Theory and Its Applications, Vol I, 3rd Edition, Wiley International.

STA-HC- 5026

Statistical Computing Using C/C++ Programming

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

12.1 Theory

12.1.1 Unit 1: *C Programming*: (Lectures: 30)

History and importance of C. Components, basic structure programming, character set, C tokens, Keywords and Identifiers and execution of a C program. Data types: Basic data types, Enumerated data types, derived data types. Constants and variables: declaration and assignment of variables, Symbolic Constants, overflow and underflow of data.

Operators and Expressions: Arithmetic, relational, logical, assignment, increment/decrement, operators, precedence of operators in arithmetic, relational and logical expression. Implicit and explicit type conversions in expressions, library functions. Managing input and output operations: reading and printing formatted and unformatted data

12.1.2 Unit 2: *Decision making and Arrays*: (Lectures: 30)

Decision making and branching - if...else, nesting of if...else, else if ladder, switch, conditional (?) operator. Looping in C: for, nested for, while, do...while, jumps in and out of loops.

Arrays: Declaration and initialization of one-dim and two-dim arrays. Character arrays and strings: Declaring and initializing string variables, reading and writing strings from Terminal (using scanf and printf only).

12.2 Practical/Lab

List of Practical

1. Plot of a graph y = f(x)
2. Roots of a quadratic equation (with imaginary roots also)
3. Sorting of an array and hence finding median
4. Mean, Median and Mode of a Grouped Frequency Data
5. Variance and coefficient of variation of a Grouped Frequency Data
6. Preparing a frequency table
7. Value of n! using recursion
8. Random number generation from uniform, exponential, normal (using CLT) and gamma distribution, calculate sample mean and variance and compare with population parameters.
9. Matrix addition, subtraction, multiplication Transpose and Trace
10. Fitting of Binomial, Poisson distribution and apply Chi-square test for goodness of fit
11. Chi-square contingency table
12. t-test for difference of means
13. Paired t-test
14. F-ratio test
15. Multiple and Partial correlation.

STA-HE- 5016

Operations Research

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

15.1 Theory

15.1.1 Unit 1: *Operations Research*: (Lectures: 20)

Introduction to Operations Research, phases of O.R., model building, various types of O.R. problems. Linear Programming Problem, Mathematical formulation of the L.P.P, graphical solutions of a L.P.P. Simplex method for solving L.P.P.

15.1.2 Unit 2: *Transportation Problem*: (Lectures: 15)

Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM).

15.1.3 Unit 3: *Game theory*: (Lectures: 10)

Game theory: Rectangular game, minimax-maximax principle.

15.1.4 Unit 4: *Inventory Management*: (Lectures: 15)

Inventory Management: ABC inventory system, characteristics of inventory system. EOQ Model and its variations, with and without shortages, Quantity Discount Model with price breaks.

15.2 Practical/Lab (Using TORA/WINQSB/LINGO)

List of Practical

1. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
2. Identifying Special cases by Graphical and Simplex method and interpretation
   a. Degenerate solution
   b. Unbounded solution
   c. Alternate solution
   d. Infeasible solution
3. Allocation problem using Transportation model
4. Networking problem
   a. Minimal spanning tree problem
   b. Shortest route problem
5. Problems based on game matrix
   a. Graphical solution to mx 2 / 2xn rectangular game
   b. Mixed strategy
6. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
7. Networking problem
   a. minimal spanning tree problem
   b. Shortest route problem
8. Problems based on game matrix
   a. Graphical solution to mx2 / 2xn rectangular game
   b. Mixed strategy

9. To find optimal inventory policy for EOQ models and its variations
10. To solve all-units quantity discounts model

SUGGESTED READING:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.
2. KantiSwarup, Gupta, P.K. and Manmohan (2007): Operations Research, 13th Edition, Sultan Chand and Sons.
3. Hadley, G: (2002) : Linear Programming, Narosa Publications
4. Hillier, F.A and Lieberman, G.J. (2010): Introduction to Operations Research- Concepts and cases, 9th Edition, Tata McGraw Hill.

STA-HE- 5026

Time Series Analysis

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

16.1 Theory

16.1.1 Unit 1: *Introduction to Time Series*: (Lectures: 15)
Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.

16.1.2 Unit 2: *Introduction to Time Series*: (Lectures: 18)
Trend Cont.: Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend.

16.1.3 Unit 3: *Moving averages*: (Lectures: 15)
Seasonal Component continued: Ratio to Moving Averages and Link Relative method, Deseasonalization.

16.1.4 Unit 4: *Forecasting and smoothing to Time Series*: (Lectures: 12)
Random Component: Variate component method. Forecasting: Exponential smoothing methods.

SUGGESTED READING:

1. Kendall M.G. (1976): Time Series, Charles Griffin.
2. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall.
3. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied

PRACTICAL / LAB WORK

List of Practical

1. Fitting and plotting of modified exponential curve
2. Fitting and plotting of Gompertz curve
3. Fitting and plotting of logistic curve
4. Fitting of trend by Moving Average Method
5. Measurement of Seasonal indices Ratio-to-Trend method
6. Measurement of Seasonal indices Ratio-to-Moving Average method
7. Measurement of seasonal indices Link Relative method
8. Calculation of variance of random component by variate difference method
9. Forecasting by exponential smoothing
10. Forecasting by short term forecasting methods.