

SRI VENKATESWARA UNIVERSITY : TIRUPATI

STATISTICS

MAJOR SYLLABUS FOR SEMESTER V

Academic year 2025-26

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
III	V	12	Applied Statistics	3	3
			Applied Statistics Practical Course	2	1
		13	Computational Statistics and R Programming	3	3
			Computational Statistics and R Programming Practical Course	2	1
		14A	Operations Research	3	3
			Operations Research Practical Course	2	1
		15A	Optimization Techniques	3	3
			Optimization Techniques Practical Course	2	1
	VI	Internship			

SRI VENKATESWARA UNIVERSITY : TIRUPATI
STATISTICS MAJOR SYLLABUS FOR V SEMESTER

Academic year 2025-26

Course 12: Applied Statistics

I. Learning Outcomes

After learning this course, the student will be able to know about

1. Forecasting Techniques and its applications.
2. Interpret and use a range of index numbers commonly used in the business sector.
3. Perform calculations involving simple and weighted index numbers.
4. Understand the basic structure of the Consumer price index and perform calculations involving its use.
5. Various data collection methods enabling to have a better insight in policy making, planning and systematic implementation,
6. Construction and implementation of life tables.
7. Population growth curves, population estimates and projections,
8. Real data implementation of various demographic concepts as outlined above through practical assignments.

II. Syllabus

Unit – 1: Time Series

Time Series and its components with illustrations, additive, multiplicative and mixed models. Trend – Estimation of trend by free hand curve method, method of Semi Averages. Determination of trend by Least squares (Linear trend, parabolic trend only), Moving averages method.

Unit – 2: Seasonal Component

Determination of seasonal indices by Simple Averages method, Ratio to Moving Average, Ratio to Trend and Link Relative methods, Deseasonalization.

Unit – 3: Index numbers

Concept, construction, problems involved in the construction of index numbers, uses and limitations. Simple and Weighted index numbers – Various Weighted Aggregate Index numbers, Criterion of a good index number, Fisher's ideal index number. Cost of living index number and Wholesale price index number.

Unit – 4: Vital Statistics

Introduction, definition, and uses of vital statistics, sources of vital statistics. Measures of Mortality Rates – Crude Death Rate, Specific Death Rate, Standardised Death Rate with different populations and problems.

Unit – 5:

Life table – Columns, Construction and Uses of Life table, Proofs of life table functions. Measures of Fertility Rates – Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Total Fertility Rate. Measures of population growth – Pearls, Gross Reproduction Rate, Net Reproduction Rate and its problems.

Practical Syllabus

1. Measurement of trend by method of moving averages (odd and even period)
2. Measurement of trend by method of Least squares (linear and parabola)
3. Determination of seasonal indices by method simple averages
4. Determination of seasonal indices by method of Ratio to Moving Averages
5. Determination of seasonal indices by method of Ratio to Trend
6. Determination of seasonal indices by method of Link relatives
7. Computation of simple index numbers.
8. Computation of all weighted index numbers.
9. Computation of reversal tests.
10. Computation of various Mortality rates
11. Computation of various Fertility rates
12. Computation of various Reproduction rates.
13. Construction of Life Table.

III. References

1. Fundamentals of Applied Statistics: V. K. Kapoor & S. C. Gupta.
2. Mukopadhyay, P (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied Pvt. Ltd.
3. Brockwell, P.J. and Devis, R.A. (2003): Introduction to Time Series Analysis. Springer.
4. Chatfield, C. (2001): Time Series Forecasting., Chapman & Hall.
5. Srinivasan, K. (1998): Demographic Techniques and Applications. Sage Publications
6. Srivastava O.S. (1983): A Text Book of Demography. Vikas Publishing House.

IV. Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

I. Learning Outcomes

After learning this course the student will be able

1. Be comfortable using commercial and open source tools such as the R language and its associated libraries for data analytics and visualization.
2. Learn skills to analyze real time problems using R
3. Able to use basic R data structures in loading, cleaning the data and preprocessing the data.
4. Able to do the exploratory data analysis on real time datasets
5. Able to understand and implement Linear Regression
6. Able to understand and use - lists, vectors, matrices, data frames, etc

II. Syllabus

Unit – 1: Computer basics

Basic applications of computer, components of computer system, Central Processing Unit (CPU), input and output units, computer memory and mass storage devices. Programming languages and their applications. Concept of files and folders. Software and types of software. Operating System like Windows and Linux.

Unit – 2: Data processing

Data processing using spreadsheets – Data entry and editing features in Excel, copy, paste, paste special options, sort and filter options, auto sum, steps of finding average and standard deviation of data using statistical functions. Matrix operations like transpose, multiply and inverse using Excel functions. Simple graphs like bar chart, line chart and pie chart in Excel. Exporting Excel output to word processors like MS-Word and slide presentations like Power Point.

Unit – 3:

Scatter diagram, fitting of straight line, polynomial and power curves using Excel – Reading R-square value and equation from the graph. Predicting future values using ‘forecast’ and ‘trend’ functions. Data Analysis Pak and its features. Performing Student’s t-test and one- way Analysis of Variance using Data Analysis Pak. P-value and its interpretation.

Unit – 4: R Programming

Introduction to R, Features of R – Environment – R Studio. Basics of R-Assignment - Modes - Operators - special numbers - Logical values - Basic Functions - R help functions - R Data Structures - Control Structures. Vectors: Definition- Declaration - Generating - Indexing - Naming - Adding & Removing elements - Operations on Vectors - Recycling - Special Operators - Vectorized if- then else-Vector Equality – Functions for vectors - Missing values - NULL values - Filtering & Subsetting.

Unit – 5:

Matrices - Creating Matrices, Adding or Removing rows/columns, Operations. Creating Data Frames, Naming, Accessing, Adding, and Removing, Applying Special functions to Data Frames, Merging Data Frames Factors and Tables.

Exploratory Data Analysis – Descriptive Statistics – Central Tendency - Variability - Mean - Median - Range - Variance - Summary - Handling Missing values and Outliers - Normalization Data Visualization in R : Types of visualizations - packages for visualizations - Basic Visualizations, Advanced Visualizations and Creating 3D plots.

Practical Syllabus

1. Installing R and R studio
2. Create a folder DS_R and make it a working directory. Display the current working directory
3. installing the "ggplot2", "caTools", "CART" packages
4. load the packages "ggplot2", "caTools".
5. Basic operations in r
6. Working with Vectors:
 - a) Create a vector v1 with elements 1 to 20.
 - b) Add 2 to every element of the vector v1.
 - c) Divide every element in v1 by 5.
 - d) Create a vector v2 with elements from 21 to 30. Now add v1 to v2.
7. Using the data present in the table given below, create a Matrix "M"

	C1	C2	C3	C4	C5
C1	0	12	13	8	20
C2	12	0	15	28	88
C3	13	15	0	6	9
C4	8	28	6	0	33
C5	20	88	9	33	0

Find the pairs of cities with shortest distance.

8. Consider the following marks scored by the 6 students

Section	Student	M1	M2	M3
A	1	46	54	45
A	2	34	55	55
A	3	56	66	64
B	1	43	44	45
B	2	67	76	78
B	3	76	68	37

- a) create a data structure for the above data and store in proper positions with proper names
 - b) display the marks and totals for all students
 - c) Display the highest total marks in each section.
 - d) Add a new subject and fill it with marks for 2 sections.
9. Three people denoted by P1, P2, P3 intend to buy some rolls, buns, cakes and bread. Each of them needs these commodities in differing amounts and can buy them in two shops S1, S2. The individual prices and desired quantities of the commodities are given in the following table

	Price						
	S1	S2		Demand.quantity			
Roll	1.5	1		Roll	Bun	Cake	Bread
Bun	2	2.5	P1	6	5	3	1
Cake	5	4.5	P2	3	6	3	2
Bread	16	17	P3	3	4	3	1

- a) Create matrices for above information with row names and col names.
 - b) Display the demand. quantity and price matrices
 - c) Find the total amount to be spent by each person for their requirements in each shop
 - d) Suggest a shop for each person to buy the products which is minimal.
10. Applying summary() to find the mean, median, standard deviation, etc
 11. Implementation of Visualizations - Bar, Histogram, Box, Line, scatter plot, etc.

III. References

1. Chambers, J. (2008). Software for Data Analysis: Programming with R, Springer.
2. Crawley, M.J. (2017). The R Book, John Wiley & Sons.
3. Matloff, N. (2011). The Art of R Programming, No Starch Press, Inc.
4. Dr. Mark Gardener(2012): Beginning R The statistical Programming Languages, John Wiley & Sons.
5. Sudha G. Purohit, SharadD.Gore, and ShailajaR.Deshmukh (2008), Statistics Using R, Narosa Publishing House, India.
6. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
7. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
8. Nathan Yau, “Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics”, Wiley, 2011.
9. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.

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I. Learning Outcomes

After learning this course, the student will be able

1. To know the scope of Operations Research
2. To link the OR techniques with business environment and life sciences
3. To convert real life problems into mathematical models
4. To find a solution to the problem in different cases
5. To inculcate logical thinking to find a solution to the problem

II. Syllab**us Unit – 1:**

Introduction of OR – Origin and development of OR – Nature and features of OR –Scientific Method in OR – Modeling in OR – Advantages and limitations of Models-General Solution methods of OR models – Applications of Operation Research. Linear Programming problem (LPP) – Mathematical formulation of the problem - illustrations on Mathematical formulation of Linear Programming of problem.

Unit – 2:

Graphical solution of linear Programming problems with maximizing and minimizing objective function up to 3 variables. Finding convex hull and non-convex hull of LPP. Some exceptional cases - Alternative solutions, Unbounded solutions, non-existing feasible solutions by Graphical method.

Unit – 3:

General linear Programming Problem(GLP) – Definition and Matrix form of GLP problem, Slack variable, Surplus variable, unrestricted Variable, Standard form of LPP and Canonical form of LPP. Definitions of Solution, Basic Solution, Degenerate Solution, Basic feasible Solution and Optimum Basic Feasible Solution. Introduction to Simplex method and Computational procedure of simplex algorithm. Solving LPP by Simplex method (Maximization case and Minimization case up to three variables only)

Unit – 4:

Artificial variable technique - Big-M method and Two-phase simplex method, Degeneracy in LPP and method to resolve degeneracy. Alternative solution, Unbounded solution, Non existing feasible solution and Solution of simultaneous equations by Simplex method.

Unit – 5:

Duality in Linear Programming –Concept of duality -Definition of Primal and Dual Problems, General rules for converting any primal into its Dual, Relation between the solution of Primal and Dual problem (statements only). Using duality to solve primal problem. Dual Simplex Method.

Practical Syllabus

1. To solve Linear Programming Problem using Graphical Method with
 - i. Unbounded solution
 - ii. Infeasible solution
2. Solution of LPP with simplex method.
3. Problem solving using Big M - method.
4. Problem solving using Two Phase method.
5. Illustration of following special cases in LPP using Simplex method
 - iii. Unbounded solution
 - iv. Alternative or multiple solutions.
6. Problems based on Principle of Duality.
7. Problems based on Dual simplex method.

III. References

1. S.D. Sharma: Operations Research, Kedar Nath Ram Nath & Co, Meerut.
2. Kanti Swarup, P.K.Gupta, Manmohn: Operations Research, Sultan Chand and sons, NewDelhi.
3. J.K. Sharma: Operations Research and Application, Mc.Millan and Company, New Delhi.
4. Gass S.I: Linear Programming. Mc Graw Hill.
5. Hadly G: Linear Programming. Addison-Wesley.
6. Taha H.M: Operations Research: An Introduction : Mac Millan.

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I. Learning Outcomes

After learning this course, the student will be able

1. To solve the problems in logistics
2. To find a solution for the problems having space constraints
3. To minimize the total elapsed time in an industry by efficient allocation of jobs to the suitable persons.
4. To find a solution for an adequate usage of human resources
5. To find the most plausible solutions in industries and agriculture when a random environment exist.

II. Syllabus

Unit – 1:

Transportation Problem- Introduction, Mathematical formulation of Transportation problem. Definition of Initial Basic feasible solution of Transportation problem- North-West corner rule, Lowest cost entry method, Vogel's approximation method. Method of finding optimal solution- MODI method(U-V method). Degeneracy in transportation problem, Resolution of degeneracy, Unbalanced transportation problem. Maximization of TP.

Unit – 2:

Assignment Problem -Introduction, Mathematical formulation of Assignment problem, Reduction theorem (statement only), Hungarian Method for solving Assignment for both balanced and unbalanced Assignment Problems.

Unit – 3:

Sequencing problem: Introduction and assumptions of sequencing problem, Sequencing of n jobs and one machine problem. Johnson's algorithm for n jobs and two machines problem- problems with n-jobs on two machines, algorithm for n jobs on three machines problem- problems with n- jobs on three machines, algorithm for n jobs on m machines problem, problems with n-jobs on m- machines

Unit – 4:

Game Theory: Two-person zero-sum games. Pure and Mixed strategies. Maxmin and Minimax Principles - Saddle point and its existence. Games without Saddle point- Mixed strategies. Solution of 2×2 rectangular games. Graphical method of solving $2 \times n$ and $m \times 2$ games. Dominance Property. Matrix oddment method for $n \times n$ games. Only formulation of Linear Programming Problem for $m \times n$ games.

Unit – 5:

Network Scheduling: Basic Components of a network, nodes and arcs, events and activities– Rules of Network construction – Time calculations in networks - Critical Path method (CPM) and PERT.

Practical Syllabus

1. IBFS of transportation problem by using North- West corner rule, Matrixminimum method and VAM
2. Optimum solution to balanced and unbalanced transportation problems by MODI method(both maximization and minimization cases)
3. Solution of Assignment problem using Hungarian method (both maximization and minimization cases),
4. Solution of sequencing problem—processing of n jobs through two machines
5. Solution of sequencing problem- processing of n jobs through three machines
6. To perform Project scheduling of a given project (Deterministic case-CPM).
7. To perform Project scheduling of a given project (Probabilistic case-PERT).
8. Solution of m x n games by dominance rule.

II. References

1. S.D. Sharma: Operations Research, Kedar Nath Ram Nath & Co, Meerut.
2. Kanti Swarup, P.K.Gupta, Manmohan: Operations Research, Sultan Chand and sons, New Delhi.
3. J.K. Sharma: Operations Research and Application, Mc. Millan and Company, New Delhi.
4. Gass: Linear Programming. Mc Graw Hill.
5. Hadly: Linear Programming. Addison-Wesley.
6. Taha: Operations Research: An Introduction : Mac Millan.
7. Dr. NVS Raju: Operations Research, SMS education.

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