

A.G & S.G SIDDHARTHA DEGREE COLLEGE OF ARTS & SCIENCE
VUYYURU – 521165
Reaccredited at 'A' level by NAAC
Autonomous -ISO 9001 – 2015 Certified



Department of Statistics

Minutes of the meeting of Board of Studies

18-10-2023

Minutes of the meeting of BOS in Statistics for B.Sc(MSCs) Degree Courses of AG & SG Siddhartha Degree College of Arts & Science, Vuyyuru, held at 2.30 PM on 18-10-2023 through online mode.

N. Siva Naga Raju

Presiding

Members Present:

- | | | |
|--|--------------------|--|
| 1) <u><i>N. Siva Naga Raju</i></u>
(N. Siva Naga Raju) | Chairman | Head, Department of Statistics,
AG & SG S Degree College. |
| 2) _____
(P. Ravi Kumar) | University Nominee | Department of Statistics,
Pavitra Degree College,
Machilipatnam. |
| 3) _____
(G. Chakravarthi) | Subject Expert | Head, Department of Statistics,
P. B. Siddhartha College,
Vijayawada |
| 4) <u><i>N.V. Srinivasa Rao</i></u>
(N.V.Srinivasa Rao) | Member | Head, Department of Mathematics
AG & SG S Degree College. |
| 5) <u><i>D. Sunitha</i></u>
(D.Sunitha) | Member | Lecturer in Mathematics
AG & SG S Degree College. |
| 6) <u><i>A. Bhargavi</i></u>
(A.Bhargavi) | Member | Lecturer in Mathematics
AG & SG S Degree College. |
| 7) <u><i>Noor Mohammad</i></u>
(Noor Mohammad) | Member | Lecturer in Mathematics
AG & SG S Degree College. |

Agenda of B.O.S Meeting:

1. To discuss and recommend the Syllabi, Model Question Papers and Guidelines to be followed by question paper setters in Statistics for 3rdSemester as per the guidelines and instructions prescribed APSCHE and Krishna University from the Academic Year 2023-24.
2. To discuss and recommend the Syllabi, Model Question Papers and Guidelines to be followed by question paper setters in Statistic for 5thSemester as per the guidelines and instructions prescribed APSCHE and Krishna University from the Academic Year 2023-24.
3. Discussed and recommended the teaching and evaluation methods for approval of Academic Council
4. Any other matter.

Resolutions.

1. Discussed and recommended that no changes are required in Syllabi. Changes are required in Model Question Papers and Guidelines to be followed by the question paper setters in Statistics for 3rdSemester from the Academic year 2023-24.
2. To recommend the teaching and evaluation methods to be followed under Autonomous status. The maximum marks for IA is 30 and SE is 70. Each IA written examination is of 1 Hr. 30 min duration for 30 marks. The tests will be conducted centrally. To reduce two IA tests and is calculated for 20 marks. 5 marks will be allotted for attendance and 5 marks are allotted for Assignment/ Activity. There is no minimum passing for IA and there is no provision for improvement in IA. Even though the candidate is absent for two IA exams/obtain zero marks the external marks are considered (if he/ she gets 40 out of 70) and the result shall be declared as 'PASS' from the Academic year 2023-24.
3. To introduce new Syllabi, Model Question Papers and Guidelines to be followed by the question paper setters in Statistics of 5thSemester from the Academic year 2023-24. The maximum marks for IA is 25 and SE is 75. Each IA written examination is of 1 Hr. duration for 15 marks. The tests will be conducted centrally. The average of two such IA is calculated for 15 marks. 5 marks will be allotted basing on Assignment and 5 marks are allotted for activity. There is no minimum passing for IA and there is no provision for improvement in IA. Even though the candidate is absent for two IA exams/obtain zero marks the external marks are considered (if he/ she gets 40 out of 75) and the result shall be declared as 'PASS' from the Academic year 2023-24.
4. Discussed and recommended for organizing seminars, Guest lecturers, Online Examinations and Workshops to upgrade the knowledge of students for Competitive Examinations for the approval of the Academic Council.

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Domain Subject: **STATISTICS**

Offered to: **MSCs**

Semester: **III**

Course Type: Core (Theory)

Course Code	22STAT31	Course Delivery Method	Class Room / Blended Mode - Both
Credits	04	CCIA Marks	30
No. of Lecture Hours / Week	04	SEE Marks	70
Total No. of Lecture Hours	60	Total Marks	100
Year of Introduction :2022-23	Year of Offering: 2023-24	Year of Revision: 2023-24	Percentage of Revision: 0%

Title of the paper: **Statistical Inference**

Course Prerequisites (if any): Student required basic knowledge in Probability and Distribution Theory

Course Description: This course helps the students to familiarize with the ways in which we talk about uncertainty and estimate their situations in which probability arises. Also this course aims at providing basic knowledge about theoretical and application to test according to situations.

Course Objectives:

- 1) To describe many of the important estimation methods and characteristics of the estimators.
- 2) To understand the problem of statistical inference with specific reference to point estimation and interval estimation.
- 3) To differentiate between large and small samples and apply apt testing procedures.

Learning Outcomes: At the end of the course, the student will

- 1) Students will understand the distinguish between the parametric and Non Parametric situations.
- 3) The parameters describe an underlying physical setting in such a way that their value affects the distribution of the measured data..

S. No	Program Outcomes
PO1.	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology
PO2.	Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO3.	Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO4.	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development
PO5.	Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO6:	Specialized Skills / Transferable Skills: Acquisition of communication and soft, analytical and technological skills that aid in enhancing
PO7.	Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Course Outcomes:		
Course Outcome	Upon successful completion of this course, students should have the knowledge and skills to:	Program Outcomes Mapping
CO 1	Obtain the knowledge on Exact sampling distributions and their application towards real world examples	PO - 5
CO 2	knowledge of point and interval estimation procedures and different methods of point estimation	PO - 6
CO3	Obtain the knowledge on various testing hypothetical statements and finding Uniformly Most Powerful Test	PO - 6
CO 4	a fundamental understanding of Parametric models for developing relevant inferences on associated parameters large and small samples.	PO - 6
CO 5	To obtain the knowledge and to know the applications of various Non-Randomized tests	PO - 6

Syllabus

Course Details

Unit	Learning Units	Lecture Hours
I	Exact Sampling Distributions Concepts of Population, Sample, Parameter, Statistic, Sampling distribution, Standard error. law of large numbers, central limit theorem (statements only). Student's t- distribution, F – Distribution, χ^2 - Distribution: Definitions, properties and their applications.	9
II	Theory of estimation Introduction, criteria of a good estimator – unbiasedness, consistency, efficiency, & sufficiency. Statement of Neyman's factorization theorem. Estimation of parameters by the method of moments and maximum likelihood (M.L), properties of MLE's (statements only). Binomial, Poisson & Normal population parameters estimate by MLE method. Interval estimation – construction of confidence intervals for population mean using normal distribution.	15
III	Testing of Hypothesis Concepts of Statistical hypotheses, Null and Alternative hypothesis, Critical region, Type I and II errors, level of significance and Power of a test. One and two tailed tests, p-value. Neyman-Pearson's lemma. Examples in case of Binomial, Poisson, Exponential and Normal distributions.	12
IV	Large sample Tests Test for single mean and difference of two means, test for single proportion and difference of proportions. Simple Problems. Small Sample tests - I t-test for single mean, difference of means and paired t-test. F-test for equality of population variances. Simple Problems.	12
V	Small Sample tests - II χ^2 -test for goodness of fit and independence of attributes Non – Parametric Tests Non-parametric tests- Advantages and Disadvantages, Measurement scales - Nominal, Ordinal, Interval and Ratio. One sample tests – Sign and Run test. Two sample tests - Median test, Wilcoxon–Mann-Whitney U test, Kruskal – Wallis test or H- test, Run test. Simple Problems.	12

Text Book:

Fundamentals of Mathematical Statistics, 11th Edition, 2010, S. C. Gupta and V. K. Kapoor, Sultan Chand & Sons, New Delhi

Reference Books:

1. B.A/B.Sc. Second Year Statistics(2010) , Telugu Akademi, Hyderabad.
2. Mathematical Statistics with Applications, 2009, K.M.Ramachandran and Chris P.Tsokos Academic Press(Elsevier), Haryana .
3. Probability and Statistics, Volume I & II, D. Biswas, New central book Agency (P) Ltd, New Delhi.
4. An outline of Statistical theory, Volume II, 3rd Edition, 2010 (with corrections) A.M.Goon, M.K. Gupta, B.Dasgupta , The World Press Pvt.Ltd., Kolakota.
 Sanjay Arora and Bansilal: New Mathematical Statistics, SatyaPrakashan , New Delhi.

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Model Question Paper Structure for SEE

Course Code: **22STAT31**
Max Time: **3hrs**

Max.: **70** Marks
Min.Pass : **28** Marks

Statistical Inference

Section – A

Answer the following

5 x 4M = 20Marks

1. (a) Write the statements of Weak Law of large numbers and Central limit theorem. (L-1, CO-1)
(OR)
(b) Define F-distribution and write its applications. (L-1, CO-1)
2. (a) Prove that sample mean is an unbiased estimator of population mean in normal Distribution (L-2, CO-2)
(OR)
(b) Write the properties of MLE's (L-1, CO-2)
3. (a) Define the following terms: (i) Null hypothesis (ii) Alternative hypothesis (L-1, CO-3)
(OR)
(b) Explain Type I and Type II errors. (L-2, CO-3)
4. (a) Write the procedure for single mean in large sample tests. (L-1, CO-4)
(OR)
(b) Write the procedure for single mean in large sample tests (L-1, CO-4)
5. (a) Write the procedure of F-test for equality of population variances. (L-1, CO-5)
(OR)
(b) Explain the procedure of Sign test for single mean. (L-2, CO-5)

Section – B

Answer the following

5 x 10M = 50Marks

6. a. Define student's t-distribution. Write its applications and their properties. (L-2, CO-1)
(OR)
b. Define chi-square distribution. Write its applications and their properties. (L-2, CO-1)
7. a. Explain the characteristics of a good estimator (L-2, CO-2)
(OR)
b. Find Maximum likelihood estimator for μ and σ^2 in normal population. (L-2, CO-2)
8. a. State and prove Neyman-Pearson's lemma. (L-3, CO-3)
(OR)
b. If $x \geq 1$ is the critical region for testing $H_0: \theta = 2$ vs $H_1: \theta = 1$ on the basis of the single observation from an exponential distribution with probability density function $f(x, \theta) = \theta e^{-\theta x}$. Obtain the value of Type I and Type II errors. (L-3, CO-3)
9. a. In a Survey of buying habits, 400 women shoppers are chosen at random on supermarket 'A' located in a certain section of the city. Their average weekly food expenditure is Rs.250 with a S.D. of Rs. 40. For 400 women shoppers are chosen at random on Supermarket 'B' in another section of the city, the average weekly food expenditure is

Rs.220 with a S.D.ofRs 55.Test at 1% level of significance whether the average weekly food expenditure of the populations of shoppers are equal. (L-3, CO-4)

(OR)

b. Explain the procedure of t- test for difference of means. (L-2, CO-4)

10. a. Out of 8,000 graduates in a town 800 are females, out of 1,600 graduate employees 120 are females. Use χ^2 to determine if any distinction is made in appointment the basis of sex. (L-4, CO-5)

(OR)

b. Explain the procedure of Wald-Wolfowitz run test for two samples. (L-2, CO-5)

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Domain Subject: **STATISTICS**

Offered to: **MSCs**

Semester: **III**

Course Type: **Core (Practical)**

Course Code	22STAP31	CCIA Marks	10
Credits	01	SEE Marks	40
Practical Hrs./week	02	Total Marks	50

Statistical Inference

Course Prerequisites (if any): Student required basic knowledge in computers

Course Description: This course gives a working knowledge of Excel to students with the aim of getting to use data analysis and testing.

Course Objectives

- 1) To train students in SPSS Software
- 2) To expose the students to the analysis of statistical data and comparing data sets.

Learning Outcomes: At the end of the course, the student will

- 1) able to do data analysis using Excel
- 2) known to choose the data to test various types.

S. No	Programme Outcomes
PO1.	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology
PO2.	Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO3.	Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO4.	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development
PO5.	Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO6:	Specialized Skills / Transferable Skills: Acquisition of communication and soft, analytical and technological skills that aid in enhancing

PO7.	Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes
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Course Outcomes:		
Course Outcome	Upon successful completion of this course, students should have the knowledge and skills to:	Programme Outcomes Mapping
CO 1	To Apply statistical analysis that can test hypotheses under parametric approaches.	PO –6
CO 2	To Apply statistical analysis that can test hypotheses under non-parametric approaches.	PO –6

List of practical's

1. Small sample test (t-test): One Sample, Independent Sample and Paired Sample.
2. Large sample tests: One Sample, Independent Sample, Paired Sample (Using Excel)
3. Small sample test (F-test): Equality of population variances (Using Excel)
4. Chi square Test: Test of Independence
5. Chi square Test: Goodness of fit
6. Chi square Test: Test of Independence, 2X2, 3X3, ..., mXn Cross tabulation (Using Excel)
7. Non Parametric Tests: Mann Whitney U test and Wilcoxon Signed ranks test
8. Non Parametric Tests: Kruskal Wallis Test and Friedman test (Using Excel)

Structure of Practical Paper

Total Marks: 50 Marks

- (i) For Continuous Evaluation : 15 marks (Internal Evaluation)
(ii) For semester end Practical Examination : 35 marks (External Evaluation)

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Domain Subject: **STATISTICS**

Semester: **V**

Offered to: **MSCs**

Course Type: Core (Theory)

Course Code	STASET01	Course Delivery Method	Class Room / Blended Mode - Both
Credits	04	CCIA Marks	25
No. of Lecture Hours / Week	03	SEE Marks	75
Total No. of Lecture Hours	45	Total Marks	100
Year of Introduction :2023-24	Year of Offering: 2023-24	Year of Revision: 2023-24	Percentage of Revision: 0%

Title of the paper: OPERATIONS RESEARCH - I

Type of the Course: **Skill Enhancement Course** (Elective Theory),

Course Outcomes: **Students at the successful completion of the course will be able to:**

CO1: Develop the basic knowledge in Operation research (O.R.,) and describe the Nature, Scientific methods and Decision making (O.R.,)able to understand the application of OR and frame a Linear Programming Problem (LPP) with solution using graphical methodology.(PO-5)

CO2: Knowledge to minimize or maximize the objective function value of LPP using simplex method.(PO-5)

CO3: know to solve the LPP by using Big- method and Two phase methods(PO-6)

CO4: To solve the problems in logistics (PO-5)

CO5: To minimize the total elapsed time in an industry by efficient allocation of jobs to the suitable persons. (PO-6)

Syllabus

(Total Theory Hours: 45)

UNIT-I

(9 Periods)

Operations Research - An overview

Origin, Nature and features of O.R. Advantages and limitations of models, General solution methods for O.R. models, Applications.

Linear Programming Problem – Mathematical formulation and graphical solution

Definition, components, basic assumptions, Mathematical formulation of the problem, Illustrations on mathematical formulation of L.P.P. (two and three variables) L.P.P - graphical solution method (search approach method). solution and infeasible solution

UNIT-II

(9 Periods)

Linear Programming Problem-Simplex Method-I

General LPP-Objective function, constraints, non-negative restrictions, Solution of LPP, feasible solution and optimum solution, Canonical and Standard forms of LPP. Basic solution-definition, degenerate solution, basic feasible solution. Associated cost vector, improved basic feasible solution, optimum basic feasible solution and net evaluation. The computational procedure- Simplex Algorithm. Simple linear programming problems on 2 and 3 variables using Simplex Method

UNIT-III

(9 Periods)

Linear Programming Problem-Simplex Method-II

Artificial Variable Technique (2 and 3 variables only). The Big M Method or Method of Penalties. The Two-phase Simplex Method. Special cases in simplex method (2 and 3 variables only) – Degeneracy, Alternative optima, Unbounded solutions and Non existing or infeasible solutions

UNIT-IV

(9 Periods)

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 TP. Transshipment Problem.

UNIT-V

(9 Periods)

Assignment Problem -Introduction, Mathematical formulation of Assignment problem, Reduction theorem (statement only), Hungarian Method for solving Assignment problem, Unbalanced Assignment problem. The Traveling salesman problem, Formulation of Traveling salesman problem as an Assignment problem and Solution procedure.

Text Book:

1. Kanti Swarup, P.K. Gupta, Man Mohan, Operations Research, 15th Edition, 2010, Sultan Chand & Sons, New Delhi.

List of Reference Books:

1. Quality, Reliability & Operations Research, First Edition (2010), Published by Telugu Akademi, Hyderabad.
2. Operations Research Theory, Methods and Applications, S.D. Sharma, Himanshu Sharma, improved and enlarged edition, Kedar Nath Ram Nath & Co., Meerut.
3. Kirshna's Operations Research, Dr. R. K. Gupta, 27th Edition, 2010, Krishna Prakashan Media (P) Ltd., Meerut.

4. Operations Research: Theory and Applications, J.K.Sharma, 5th Edition, 2013, Macmillan.
5. Operations Research: An Introduction, Hamdy. A. Taha, 9th edition ,2010, Prentice Hall.

Co-Curricular Activities

(a) Mandatory: (Training of students by teacher in field related skills:

(lab:10 + field: 05)

For Teacher: Training of students by the teacher (if necessary, by a local expert) in laboratory/field for a total of not less than 15 hours on the field techniques/skills on the familiarization of various operating systems and program softwares.

For Student: Students shall (individually) operating the computers and execution of their programmes for data analysis

Student shall write the observations and submit a hand-written Fieldwork/Project work not exceeding 10 pages in the given format to the teacher.

1. Max marks for Fieldwork/Project work: 10.
2. Suggested Format for Fieldwork/Project work: Title page, student details,
3. index page, details of place visited, observations, findings and acknowledgements.
4. Comprehensive Continuous Internal Assessment (CCIA): (2 tests will be conducted, each carries 15 Marks, consider Average Mark: 15)

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Model Question Paper Structure for SEE

Course Code: **STASET01**

Max Time: **3hrs**

Max.: **75 Marks**

Min.Pass : **30 Marks**

OPERATIONS RESEARCH - I

SECTION A

Answer any FIVE questions.

5 X5M = 25M

1. What are the characteristics of a good model for O.R? .(CO-1,L-1)
2. What are the advantages and disadvantages of operational research model..(CO-1,L-1)
3. Explain graphical procedure in solving linear programming problems..(CO-1,L-2)
4. Explain the slack variables and surplus variables..(CO-2,L-2)
5. Explain about transportation problem..(CO-4,L-2)
6. Explain mathematical formulation of assignment problem.(CO-5,L-2)
7. Explain i) north- west corner ii) least cost methods.(CO-4,L-4)
8. Explain balance and unbalance transportation method..(CO-4,L-4)

SECTION B

Solve any FIVE problems.

5 X 10M =50M

9. (a) Explain the various phases in solving an OR problem..(CO-1,L-4)

(OR)

- (b) Use the graphical method to solve the following L.P.P.(CO-1,L-4)

$$\text{Min } Z = 1.5x_1 + 2.5x_2$$

Subject to conditions

$$x_1 + 3x_2 \geq 3$$

$$x_1 + x_2 \geq 2$$

$$\text{and } x_1, x_2 \geq 0.$$

10. (a) Using simple method to.(CO-2,L-3)

$$\text{Minimum } z = x_2 - 3x_3 + 2x_5$$

subject to the constraints:

$$3x_2 - x_3 + 2x_5 \leq 7,$$

$$-2x_2 + 4x_3 \leq 12,$$

$$-4x_2 + 3x_3 + 8x_5 \leq 10,$$

$$x_2, x_3, x_5 \geq 0$$

(OR)

- (b) Using simplex method to .(CO-2,L-3)

$$\text{Maximize } Z = 2x_1 + 4x_2 + x_3 + x_4$$

Subject to the constraints

$$x_1 + 3x_2 + x_4 \leq 4,$$

$$2x_1 + x_2 \leq 3,$$

$$x_2 + 4x_3 + x_4 \leq 3,$$

$$x_1, x_2, x_3, x_4 \geq 0$$

11. (a) Solve the following LPP by penalty (BIG-M) .(CO-3,L-3)

Maximize $Z = 3x_1 - x_2$

Subject to the constraints

$$2x_1 + x_2 \geq 2$$

$$x_1 + 3x_2 \leq 3$$

$$x_2 \leq 4$$

$$x_1, x_2 \geq 0$$

(OR)

- (b) Use Two - phase simplex method to Maximize $Z = 5x_1 + 2x_2 - 3x_3$.(CO-3,L-3)

Subject to the constraints:

$$2x_1 + 2x_2 - x_3 \geq 2,$$

$$3x_1 - 4x_2 \leq 3,$$

$$x_2 + 3x_3 \leq 5,$$

$$x_1, x_2, x_3 \geq 0$$

12. (a) Solve the following transportation problem in which cell entries represent unit costs .(CO-4,L-3)

	DI	DII	D III	Availability
A	2	7	4	5
B	3	3	1	8
C	5	4	7	7
D	1	6	2	14
Requirement	7	9	18	

(OR)

- (b) Determine the optimum basic feasible solution to the following transportation Problem.(CO-4,L-3)

	A	B	C	Availability
A	50	30	220	1
B	90	45	170	3
C	250	200	50	4
Requirement	4	2	2	

13. (a) a department head has four subordinates, and four tasks have to be performed. Subordinates differ in efficiency and tasks differ in their intrinsic difficulty. Time each man would take to perform each task is given in effectiveness matrix. How the task should be allotted to each person so as to minimize the total man-hours? .(CO-5,L-3)

	Subordinates			
	I	II	III	IV
A	8	26	17	11
B	13	28	4	26
C	38	19	18	15

D	19	26	24	10
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(OR)

(b) A certain equipment needs five repair jobs which have to be assigned to five machines. The estimated time (in hours) that each machine requires to complete the repair job is given in the following table .(CO-5,L-3)

MAN\JOB	I	II	III	IV	V
A	2	9	2	7	1
B	6	8	7	6	1
C	4	6	5	3	1
D	4	2	7	3	1
E	5	3	9	5	1

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Domain Subject: **STATISTICS**

Semester: **V**

Offered to: **MSCs**

Course Type: Core (Practical)

Course Code	STASEP01	CCIA Marks	10
Credits	01	SEE Marks	40
Practical Hrs./week	03	Total Marks	50

OPERATIONS RESEARCH - I

Practical No	Theme	Key Topics
SPSS TECHNIQUES		
1	Univariate Analysis of data (categorical variable)	Data Entry, Frequency table, Chart Builder – Bar Chart and Pie Chart
2	Univariate Analysis of data (Continuous variable)	Data Entry, Frequency table, Descriptive, Exploratory, Chart Builder - Histogram, Box Plots, Cluster Bar, Stacked Bar, Editing graphs and axes
3	Bivariate Analysis of Data	Data Entry, Descriptive, Relation between variable through Scatter diagram and correlation coefficient. Linear Regression.
4	Bivariate Analysis of Data (Categorical Variables)	Data Entry, Frequency table, Cross Table, Spearman Correlation, Association between variables
OPERATION RESEARCH TECHNIQUES		
5	Linear Programming Problem – I	Simplex Method – Minimization and Maximization with all constraints are less than or equal to type
6	Linear Programming Problem – II	Big - M and Two Phase Methods
7	Transportation problem	Minimization and Maximization
8	Assignment problem	Minimization and Maximization

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Domain Subject: **STATISTICS**

Offered to: **MSCs**

Semester: **V**

Course Type: Core (Theory)

Course Code	STASET02	Course Delivery Method	Class Room / Blended Mode - Both
Credits	04	CCIA Marks	25
No. of Lecture Hours / Week	03	SEE Marks	75
Total No. of Lecture Hours	45	Total Marks	100
Year of Introduction :2023-24	Year of Offering: 2023-24	Year of Revision: 2023-24	Percentage of Revision: 0%

Title of the paper: **OPERATIONS RESEARCH - II**

Type of the Course: **Skill Enhancement Course** (Elective Theory),

Course Outcomes: **Students at the successful completion of the course will be able to:**

CO1: Obtain the knowledge and applications of sequencing models.(PO-5)

CO2: Understand the concepts of replacement.(PO-5)

CO3: Develop the different models of game strategies(PO-6)

CO4: Develop skills in construction of network diagram, apply the techniques of CPM and PERT
(PO-5)

CO5: Explain clearly the Distinguishes features of Queuing models. (PO-6)

Syllabus

(Total Theory Hours: 45)

UNIT-I

(9 Periods)

Problem of Sequencing:

Introduction, Principal Assumptions, Solution of Sequencing Problem- Processing n jobs through 1-Machine, Processing n jobs through 2-Machines and Processing n jobs through 3-Machines- Johnson's Optimal sequence Algorithm. Processing n jobs through k-Machines- Johnson's Optimal sequence Algorithm. Simple problems.

UNIT-II

(9 Periods)

Replacement Problem

Introduction, Replacement of items that deteriorate- Replacement policy for items whose maintenance cost increases with time and money value is constant. And money Value changes with constant rate. Replacement of items that fail completely - Group replacement of items that fail completely.

UNIT-III

(9 Periods)

Game Theory

Two-person zero-sum games. Pure and Mixed strategies. Maximin and Minimax Principles - Saddle point and its existence. Games without Saddle point-Mixed strategies. Solution of 2 x 2 rectangular games. Graphical method of solving 2 x n and m x 2 games. Dominance Property.

UNIT-IV

(9 Periods)

Network Scheduling by PERT/CPM

Basic steps in PERT/CPM techniques, Basic components, Logical sequencing (errors in drawing networks), Rules for network construction, Critical path analysis, Forward pass Method, Backward pass Method Determination of floats and slack times. Probability considerations in PERT (Project Evaluation and Review Technique). Distinction between PERT and CPM, Applications of network techniques, Limitations and difficulties in using Network. Simple problems.

UNIT-V

(9 Periods)

Queuing theory

Classification of queuing models- Probabilistic Queuing Models, Solution of Queuing models, Limitation for application of Queuing models, Poisson queuing systems-**Model I:**(M/M/1):(∞ / FIFO)- Birth and Death Model. Characteristics of (M/M/1): (∞ / FIFO), $E(L_q)$, $E(L_s)$, $E(L/L > 0)$, $V(\text{Queue Length})$. PDF of Waiting time distribution for (M/M/1): (∞ / FIFO), Characteristic of waiting time distribution(M/M/1): (∞ / FIFO), 1. $E(W_q)$, $E(W_s)$, 2. $E(W/W > 0)$. Inter- Relationship between $E(L_q)$, $E(L_s)$, $E(W_q)$, $E(W_s)$ Simple problems.

Text Book:

1. KantiSwarup, P.K.Gupta , Man Mohan, Operations Research, 15th Edition, 2010, Sultan Chand & Sons, New Delhi.

List of Reference Books:

1. Quality, Reliability & Operations Research, First Edition (2010), Published by Telugu Akademi, Hyderabad.
2. Operations Research Theory, Methods and Applications, S.D. Sharma, Himanshu Sharma, improved and enlarged edition, Kedar Nath Ram Nath & Co., Meerut.

3. Kirshna's Operations Research, Dr. R. K. Gupta, 27 thEdition , 2010, Krishna Prakashan Media (P) Ltd., Meerut.
4. Operations Research: Theory and Applications, J.K.Sharma, 5th Edition, 2013, Macmillan.
5. Operations Research: An Introduction, Hamdy. A. Taha, 9th edition ,2010, Prentice Hall.

Co-Curricular Activities

(b) Mandatory: (Training of students by teacher in field related skills:

(lab:10 + field: 05)

For Teacher: Training of students by the teacher (if necessary, by a local expert) in laboratory/field for a total of not less than 15 hours on the field techniques/skills on the familiarization of various operating systems and program softwares.

For Student: Students shall (individually) operating the computers and execution of their programmes for data analysis

Student shall write the observations and submit a hand-written Fieldwork/Project work not exceeding 10 pages in the given format to the teacher.

5. Max marks for Fieldwork/Project work: 10.
6. Suggested Format for Fieldwork/Project work: Title page, student details,
7. index page, details of place visited, observations, findings and acknowledgements.
8. Comprehensive Continuous Internal Assessment (CCIA): (2 tests will be conducted, each carries 15 Marks, consider Average Mark: 15)

A.G & S.G SIDDHARTHA DEGREE COLLEGE OF ARTS & SCIENCE
VUYYURU – 521165
Reaccredited at ‘A’ level by NAAC
Autonomous -ISO 9001 – 2015 Certified

Model Question Paper Structure for SEE

Course Code: **STASET02**
Max Time: **3hrs**

Max.: **75 Marks**
Min.Pass : **30 Marks**

OPERATIONS RESEARCH - II

SECTION A

Answer any FIVE questions.

5 X 5M=25M

1. Describe the method of processing n jobs through two machines?
2. What are the objectives of sequencing problem?
3. Write a short note on i) PERT ii) CPM iii) project duration evaluation.
4. Write a short note on characteristics of Game theory.
5. Write a short note on individual replacement and group replacement?
6. Define (i) Competitive Game, (ii) Payoff Matrix, (iii) Pure and Mixed Strategies
7. Write the basic characteristics of queue system
8. What are Transient and Steady states cases in queuing theory?

SECTION B

Solve any FIVE problems.

5 X 10M =50M

9. (a) five jobs have to processed through two machines in the order AB. Determine the optimal sequence.

Job	1	2	3	4	5
Machine A	1	9	5	3	8
Machine B	2	5	6	8	4

(OR)

- (b) What is a sequencing analysis? Illustrate with some practical examples.

10. (a) A manufacturer is offered two machines A and B. A is priced at Rs.5,000, and running costs are estimated at Rs.800 for each of the first five years, increasing by Rs.200 per year in the sixth and subsequent years. Machine B, which has the same capacity as A, costs Rs.2,500 but will have running costs of Rs.1,200 per year for six years, increasing by Rs.200 per year thereafter. If money is worth 10% per year, which machine should be purchased? (Assume that the machine will eventually sold for scrap at a negligible price.)

(OR)

- (b) The following failure rates have been observed for a certain type of light bulbs:

week	:	1	2	3	4	5
% failing by end of week:		10	25	50	80	100

There are 1,000 bulbs in use, and it costs Rs 2 to replace an individual bulb which has

burnt out. If all bulbs were replaced simultaneously, it would cost 50 paisa per bulb. It is proposed to replace all bulbs at fixed intervals, whether or not they have burnt out, and to continue replacing burnt out bulbs as they fail. At what interval should all the bulbs be replaced?

11. (a) Solve the following game using dominance property

		<i>player B</i>			
		<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>
<i>Player A</i>	<i>I</i>	3	2	4	0
	<i>II</i>	3	4	2	4
	<i>III</i>	4	2	4	0
	<i>IV</i>	0	4	0	8

(OR)

(b) Solve the game whose payoff matrix is given by

$$\begin{bmatrix} -2 & 0 & 0 & 5 & 3 \\ 3 & 2 & 1 & 2 & 2 \\ -4 & -3 & 0 & -2 & 6 \\ 5 & 3 & -4 & 2 & -6 \end{bmatrix}$$

12. (a) A project consists of a series of tasks A,B,...H,I with the following relationships (W<X, Y means X and Y cannot start until W is completed; X,Y< W means W cannot start until both X and Y are completed). With this notation construct the network diagram having the following constraints:

A < D, E;	B, D < F;	C < G;	B, G < H;	F, G < I
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Find also the minimum time of completion of the project, when the time of completion of each task is as follows:

TASK	A	B	C	D	E	F	G	H	I
TIME	23	8	20	16	24	18	19	4	10

(OR)

(b) A small project consists of seven activities, the details of which are given below:

Activity	A	B	C	D	E	F	G
Most likely	3	6	3	10	7	5	4
Optimistic	1	2	3	4	3	2	4
Pesimistic	7	14	3	22	15	14	4
Preceding Activities	-	-	B	C	A, D	D	A, D
Duration	6	5	2	2	2	1	6

(i) Draw the network, number the nodes, find the critical path, the expected project completion time and the next most critical path.

(ii) What project duration will have 95% confidence of completion?

13. (a) Prove that (i) $E(L_q)$ (ii) $E(L_s)$, for model (M/M/1): (∞ /SIRO)

(OR)

(b) In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter - arrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average 36 minutes. If the yard can admit 9 trains at a time (there being 10 lines, one of which is reserved for shunting purposes), calculate the probability that the yard is empty and find the average queue length.

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Domain Subject: **STATISTICS**

Semester: **V**

Offered to: **MSCs**

Course Type: Core (Practical)

Course Code	STASEP02	CCIA Marks	10
Credits	01	SEE Marks	40
Practical Hrs./week	03	Total Marks	50

OPERATIONS RESEARCH - II

Practical No	Theme	Key Topics
SPSS TECHNIQUES		
1	Parametric Tests	One Sample, Independent Samples and Paired test
2	Multiple Comparison Tests	One way ANOVA and Two way ANOVA
3	Chi-Square Test	Independence of attributes and Goodness of Fit
4	Non-Parametric Test	Mann Whitney U test, Wilcoxon Signed ranks test, Kruskal Wallis Test and Friedman test
OPERATION RESEARCH TECHNIQUES		
5	Queuing theory	Based on (M/M/1):(∞/FIFO)
6	Game Theory	Solve the game problem by using LPP method, Algebraic Method and graphical method
7	Networking	1. Finding of critical path 2. Project evaluation technique
8	Replacement Problem	Replacement policy for items whose maintenance cost increases with time and money value changes with constant rate and replacement of items that fail completely
