Sadhana Education Society

# L. S. RAHEJA

## COLLEGE OF ARTS & COMMERCE,

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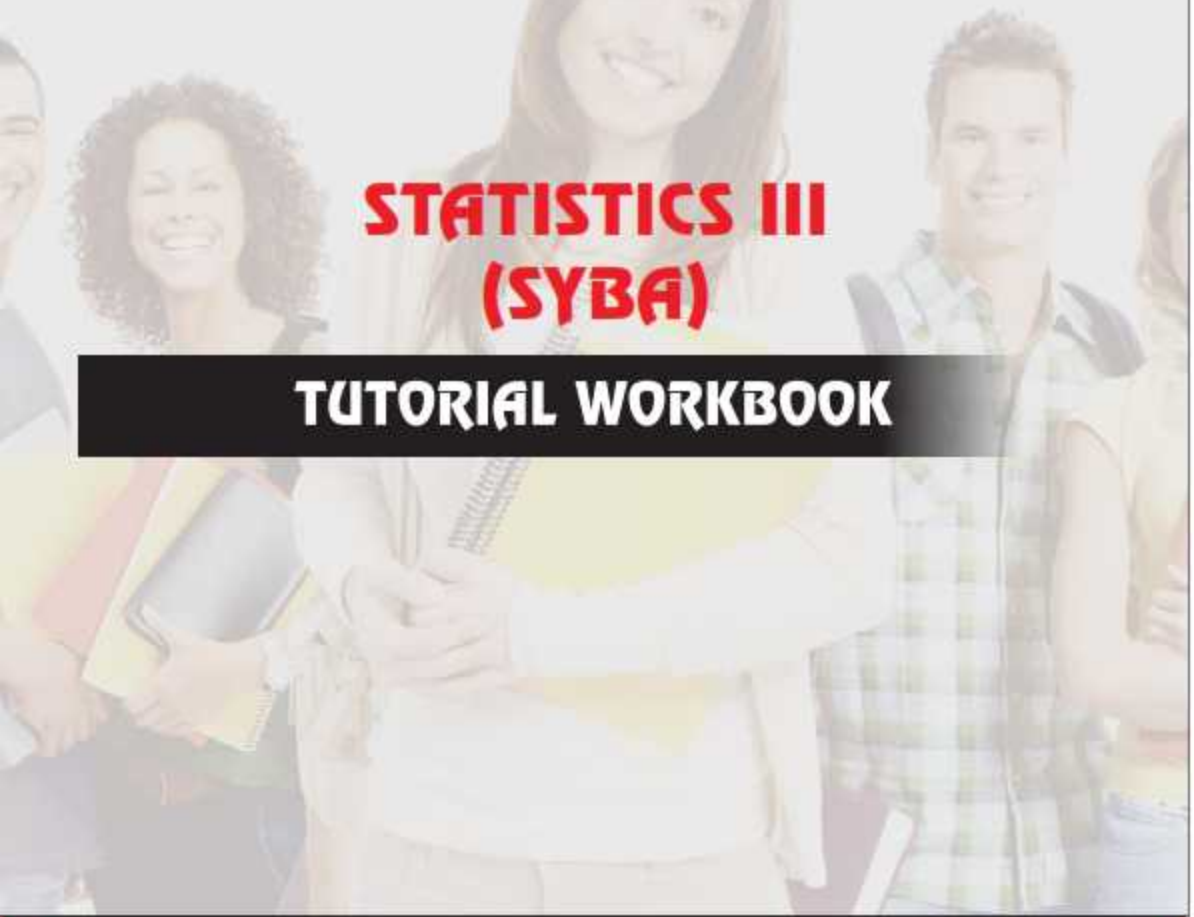

# STATISTICS III
# (SYBA)

## TUTORIAL WORKBOOK

PREPARED BY

Dr. Seema Ukidve
Chinmay Kishore Joshi

# DEPARTMENT OF MATHEMATICS, STATISTICS & COMPUTERS

## STATISTICS III

## TUTORIAL WORKBOOK


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## Why this tutorial handbook is introduced?

"Mathematics is not about numbers, equations, computations or algorithms: it is about understanding."

**_____William Paul Thurston**

"Statistics is the grammar of science."

**_____Karl Pearson**

### The Field of Statistics

The field of statistics is the science of learning from data. Statisticians offer essential insight in determining which data and conclusions are trustworthy. Statisticians know how to solve scientific mysteries and how to avoid traps that can trip up investigators.

When statistical principles are correctly applied, statistical analyses tend to produce accurate results. What's more, the analyses even account for real-world uncertainty in order to calculate the probability of being incorrect.

To produce conclusions that you can trust, statisticians must ensure that all stages of a study are correct. Statisticians know how to:

- Design studies that can answer the question at hand
- Collect trustworthy data
- Analyze data appropriately and check assumptions
- Draw reliable conclusions

It has been observed that students enrolling for F.Y.B.A lack basics of Mathematics and Statistics as some of them did not opt for Statistics in F.Y.J.C and S.Y.J.C, due to which they lose connect with mathematical concepts and rigour.

To boost the confidence of students and to make them understand Statistics lessons taught in the class and to provide them hand on practice of standard questions this tutorial handbook has been introduced.

This tutorial handbook contains:

- ✓ Latest Syllabus of Statistical techniques paper.
- ✓ Paper Pattern
- ✓ Reference Books

- ✓ Unit wise questions for practice with enough space to solve them
- ✓ Graph Papers

We hope this handbook will inculcate the problem solving aptitude among students and remove their Mathematics and Statistics phobia.

## SYLLABUS FOR STATISTICS AT SYBA

**Why Revision?**

There is a Rapid expansion of knowledge in subject matter areas and improved instructional method during last decade. There are considerable curricular revisions happening at the high school level. Application of Mathematics and Statistics are widely used in industry and business. Keeping this in mind, a revision of syllabus required in accordance with the growth of subject of at the high school level and emerging needs of industry and its application.

**Objective:**

The main objective of this course is to introduce mathematics and statistics to undergraduate students of commerce, so that they can use them in the field of commerce and industry to solve the real life problems.

**Distribution of topics and lectures**

| Course Code | Title | Credits |
|---|---|---|
| **UAST 302** | **OPERATIONS RESEARCH AND INDUSTRIAL STATISTICS-1** | **2 Credits (45 lectures )** |
| **Unit I : Linear Programming Problem (L.P.P.)** :<br><br>Definition, Mathematical Formulation( Maximization and Minimization) Concepts of Solution, Feasible Solution, Basic Feasible Solution, Optimal solution, Slack, Surplus & Artificial variable,<br><br>Standard form, Canonical form<br>Graphical Method & Simplex Algorithm to obtain the solution to an L.P.P. Problems involving Unique Solution, Multiple Solution, Unbounded Solution and Infeasible Solution.<br>Big M method.<br>Concept of Duality & its economic interpretation. | | **15 Lectures** |
| **Unit II : Transportation Problem**<br><br>Definition, Mathematical Formulation Concepts of Feasible solution, Basic feasible solution, Optimal and multiple solutions.<br>Initial Basic Feasible Solution using<br>(i) North-West Corner rule.(ii) Matrix Minima Method.<br>(iii)Vogel's Approximation Method.<br>MODI Method for optimality.<br>Problems involving unique solution, multiple solutions, degeneracy, maximization, prohibited route(s) and production costs. Unbalanced Transportation problem. | | **15 Lectures** |
| **Unit III : Assignment Problem and sequencing**<br><br>Definition, Mathematical formulation. Solution by Hungarian Method.<br>Unbalanced Assignment problems.<br>Problems involving Maximization & prohibited assignments<br><br>Travelling salesman problem<br><br>**Sequencing :**<br>Processing n Jobs through 2 and 3 Machines and 2 jobs through m Machines. | | **15 Lectures** |

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6. Operations Research: S.D.Sharma.11th edition, KedarNath Ram Nath& Company.
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# Unit 1: Linear Programing Problem

Q. 1 Answer the following questions:

1. Explain the graphical method of solving LP Problem.

2. What are the basic assumptions of linear programming?

3. What are the applications of linear programming?

4. What are the advantages and limitations of linear programming?

5. Write down the standard form of linear programming problem.

6. Define the following terms -
   Solution, feasible solution, basic solution, basic feasible solution, optimum feasible solution, degenerate solution.

Q. 2 Solve the following problems using graphical method

1. $Z = 7X_1 + 10\ X_2$
   Subject to constraints $x_1 + x_2 \leq 30000$
   $x_2 \leq 12000$

2. $Z = X_1 + 2X_2$

Subject to constraints $X_1 + 2X_2 \leq 10$

$X_1 + X_2 \leq 6$

$X_1 - X_2 \leq 2$

$X_1 - 2X_2 \leq 1$

And $x_1, x_2 \geq 0$

3. Minimize $Z = - x_1 + 2x_2$

   Subject to constraints $-x_1 + 3x_2 \leq 10$

   $x_1 - x_2 \leq 2$

   And $x_1, x_2 \geq 0$

4. A firm makes two products X and Y, and has a total production capacity of 9 tonnes per day, X and Y requiring the same production capacity. The firm has a permanent contract to supply at least 2 tonnes of X and at least 3 tonnes of Y per day to another company. Each tonne of X requires 20 machine hours of production time ad each tonne of Y requires 50 machine hours of production time, the daily maximum possible number of machine hours is 360, Al the firm's output can be sold, and the profit made is Rs. 80 per tonne of X and Rs. 120 per tonne of Y. It is required to determine the production schedule for maximum profit and to calculate this profit. (Solve using Graphical Method)

   Use the simplex method to solve the following LP problem.

Maximize $Z=4x_1+3x_2$

Subject to constraints $2x_1+3x_2 \leq 6$

$3x_1+2x_2 \leq 3$

$2x_2 \leq 5$

$2x_1 + x_2 \leq 4$

And $x_1, x_2, x_3 \geq 0$

5. Use the Big M method to solve the following LP problem:

   Maximize $Z=5x_1+3x_2$

   Subject to constraints $2x_1+4x_2 \leq 12$

   $2x_2+2x_3 = 10$

   $5x_1+2x_2 \geq 10$

   And $x_1, x_2 \geq 0$

6. Use simplex method to solve the following LP problem

   Maximize $Z=3x_1+5x_2+4x_3$

   Subject to constraints $2x_1+3x_2 \leq 8$

   $2x_2+5x_3 \leq 10$

   $3x_1+2x_2+4x_3 \geq 10$

   And $x_1, x_2, x_3 \geq 0$

## Unit 2: Transportation Problems

Q. 1 Answer the following questions:

1. What is the unbalanced transportations problem? Explain the method for solving such problem.

2. What is degeneracy in transportation problem?

3. How transportation problem is solved when demand and supply are not equal?

4. A company has three production facilities S1, S2 and S3 with production capacity of 7,9 and 18 units (in 100's) per week of product, respectively. Three units are to be shipped to four warehouses D1, D2, D3, and D4 with requirement of 5, 6, 7 and 14 units (In 100's) per week, respectively. The transportation costs (in rupees) per unit between factories to warehouses are given in the table below:

| | D1 | D2 | D3 | D4 | Capacity |
|---|---|---|---|---|---|
| S1 | 30 | 20 | 50 | 10 | 7 |
| S2 | 40 | 50 | 30 | 60 | 9 |
| S3 | 25 | 10 | 65 | 45 | 18 |
| Demand | 5 | 8 | 7 | 14 | 34 |

Solve the above Transportation problem using any two of the following:

i. North West Corner Rule
ii. Least cost Method
iii. Vogel's approximation Method (VAM)
iv. Modi method.

7. Define the following terms:
    i. Feasible solution
    ii. Basic feasible solution
    iii. Optimal solution
    iv. Non degenerate basic feasible solution

8. Describe the transportation problem with its general mathematical formulation.

9. Explain the various steps involved in
    i. North-west corner method
    ii. Least cost method
    iii. Vogel's approximation Method
    iv. Modi method

## Unit 3: Assignment Problems and Sequencing:

Q. 1 Answer the following questions:

1. What is an assignment problem? Write down it's applications.

2. Give mathematical formulation of an assignment problem.

3. Write down the steps of Hungarian method.

4. Write down the algorithm to solve as assignment problem.

5. Explain the principal assumptions made while dealing with sequencing problems.

6. Give procedure for determining an optimal sequence for processing n items on two machines.

7. Give applications of sequencing problems.

8. Write a short note on ‘sequencing problem for n jobs on 2 machines.

9. Solve the following assignment problem:

| | A | B | C |
|---|---|---|---|
| 1 | 120 | 100 | 80 |
| 2 | 80 | 90 | 110 |
| 3 | 110 | 140 | 120 |

10. A department has five employees with the five jobs to be performed. The time (in hours) each man will take to perform each job is given the effectiveness matrix.

| | | Employees | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| Jobs | A | 10 | 5 | 13 | 15 | 16 |
| | B | 3 | 9 | 18 | 13 | 6 |
| | C | 10 | 7 | 2 | 2 | 2 |
| | D | 7 | 11 | 9 | 7 | 12 |
| | E | 7 | 9 | 10 | 4 | 12 |

11. A Solicitor's firm employs typists on hourly piece-rate basis for their daily work. There are five typists and their charges and speed are different. According to an earlier understanding only one job is given to one typist and the typist is paid for a full hour even if he works for a fraction of an hour. Find the least cost allocation for the following data:

| | | P | Q | R | S | T |
|---|---|---|---|---|---|---|
| Jobs | A | 85 | 75 | 65 | 125 | 75 |
| | B | 90 | 78 | 66 | 132 | 78 |
| | C | 75 | 66 | 57 | 114 | 69 |
| | D | 80 | 72 | 60 | 120 | 72 |
| | E | 76 | 64 | 56 | 112 | 68 |

12. Find the sequence that minimizes the total elapsed time required to complete the following tasks on two machines:

| Task | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Machine I | 3 | 4 | 9 | 5 | 6 | 8 | 7 | 5 | 4 |
| Machine II | 7 | 9 | 6 | 4 | 3 | 9 | 3 | 8 | 11 |

13. Find the sequence that minimizes the total elapsed time required in performing the following jobs on three machines in the order ABC. Processing times (in hours) are given in the following table:

| Job | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Machine A | 8 | 10 | 6 | 7 | 11 |
| Machine B | 5 | 6 | 2 | 3 | 4 |
| Machine C | 4 | 9 | 8 | 6 | 5 |

14. A marketing manager has 5 salesmen and 5 sales districts. Considering the capabilities of the salesman and the nature of districts, the marketing manager estimates that sales per month (in hundred rupees) for each salesman in each district would be as follows:

| | Districts | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Salesman 1 | 32 | 38 | 40 | 28 | 40 |
| 2 | 40 | 24 | 28 | 21 | 36 |
| 3 | 41 | 27 | 33 | 30 | 37 |
| 4 | 22 | 38 | 41 | 36 | 36 |
| 5 | 29 | 33 | 40 | 35 | 39 |

Find the assignment of salesmen to districts that will result in maximum sales.