

**SRI VENKATESWARA UNIVERSITY**  
**B.A/B.Sc. DEGREE COURSE IN STATISTICS (WM)**  
**SEMESTER SYSTEM WITH CBCS**

**SEMESTER V**

W.E.F. 2022-2023

**Skill Enhancement Courses (SECs) for V Semester, from 2022-23**  
**(Syllabus-Curriculum)**

**Structure of SECs for Semester – V**

*(To choose One pair from the Two alternate pairs of SECs)*

Paper	Title	No. of Theory Hours per Week	IE Marks	EE Marks	Total	Credits
6A	OPERATION RESEARCH -I	3	25	75	100	3
	Practicals	3	-	50	50	2
7A	OPERATION RESEARCH - II	3	25	75	100	3
	Practicals	3	-	50	50	2

OR

6C	ECONOMETRICS	3	25	75	100	3
	Practicals	3	-	50	50	2
7C	REGRESSION ANALYSIS	3	25	75	100	3
	Practicals	3	-	50	50	2

**Note-1:** For Semester-V, for the domain subject Statistics (WM), any one of the two pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6C & 7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).

**Note-2:** One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.

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**Skill Enhancement Courses (SECs) for V Semester, from 2022-23  
(Syllabus-Curriculum)**

**COURSE 6A: OPERATION RESEARCH - I**

**(Skill Enhancement Course(Elective), 05 Credits**

**Max.Marks: Theory :100 + Practicals: 50**

**Objective: The objective of the paper is to introduce the basic concepts of operational Research and linear programming to the students.**

**Learning Outcomes:**

After learning this course, the student will be able

1. To acquire knowledge and develop analysis skills on industrial experimentation and quality related data using advance statistical methods
2. To know 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 problem.

**UNIT-I**

**Introduction of OR** – Origin and development of OR – Nature and features(Characterstics) of OR –Scientific Method in OR – Modeling in OR – Advantages and limitations of Models-General Solution methods of OR models – Applications of Operation Research.

**UNIT-II**

**Linear programming problem (LPP)** -Mathematical formulation of the problem - illustrations on Mathematical formulation of Linear programming of problem. Graphical solution of linear programming problems with maximizing and minimizing objective function up to 3 variables

**UNIT-III**

**Simplex Method** – Solution- Feasible Optimum solutions – Basic feasible solution – Non-Degenerate, Degenerate and un bounded solutions- Canonical or Standard form of LPP – Characterstics - Slack and Surplus variable - Simplex Algorithm - Problems

**UNIT-IV**

**Artificial variable technique-** Big-M method – Steps involved for getting optimum solution  
- Two-phase simplex method -Steps involved for getting optimum solution - problems

## **UNIT-V**

**Simulation:** Definition, Types of simulation, Random variable, Random number, Pseudo-random numbers, Monte-Carlo Technique, Generation of random numbers and problems.

### **Reference Books:**

1. S.D. Sharma, Operations Research, KedarNath Ram Nath& Co, Meerut.
2. KantiSwarup, P.K.Gupta, Manmohn, 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 :Linrar programming. Addison-Wesley.
6. Taha : Operations Research: An Introduction : Mac Millan.

### **Practical/Lab to be performed on a computer using OR/Statistical packages**

1. Formulation of LPP
2. Graphical Method for maximization
3. Graphical Method for minimization
4. Graphical Method for Unbounded Solution
5. Simplex method for maximization
6. Simplex method for minimization
7. Big M- Method
8. Two – Phase Simplex method .
9. Monte -carlo technique of simulation

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Skill Enhancement Course(Elective)

**COURSE 6A: OPERATIONS RESEARCH - I**

(Under CBCS New Regulations w.e.f. 2020-21)

(Scientific calculators are allowed)

**Time:3 Hours**

**MODEL QUESTION PAPER**

**Max.Marks:75**

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**PART -A**

Answer any FIVE of the following questions. Each question carries 5 Marks 5X5=25M

1. Give various definitions of OR ?
2. Discuss the limitations of OR
3. Explain the procedure to formulate LPP?
4. Define Feasible, Basic feasible and Unbounded solutions?
5. Define Canonical form of LPP and give its characteristics ?
6. Explain the following terms ?  
(1) Slack Variable (2) Surplus Variable with examples
7. Explain Big M-Method ?
8. Explain about simulation?

**PART-B**

Answer ALL questions. Each question carries 10 Marks. 5X10=50M

**UNIT - I**

9. Explain different characteristics of Operation Research ?

**(OR)**

10. What is a OR model? Discuss the various Characteristics and classification scheme of models?

**UNIT - II**

11. A paper mill produces two grades of papers namely X and Y. Because of raw material restrictions it cannot produce more than 400 tones of grade X and 300 tones of grade Y in a week. There were 160 production hours in a week. It requires 2 and 4 hours to produce a tone of products X and Y respectively with corresponding profits of Rs.2000/-and Rs.5000/-per tone. Formulate the above as LPP to maximize the profit?

(OR)

12. Solve the following LPP by using graphical method.

$$\begin{aligned} \text{Maximize} \quad & Z=2X_1+X_2 \\ \text{Subject to} \quad & X_1+2X_2 \leq 10 ; X_1+X_2 \leq 6 ; X_1-X_2 \leq 2; X_1-2X_2 \leq 1 \\ \text{and} \quad & X_1, X_2 \geq 0 \end{aligned}$$

**UNIT - III**

13. Describe the Computational Procedure of the Simplex method for the solution of LPP?

(OR)

14. Solve the following LPP by Simplex method

$$\begin{aligned} \text{Max} \quad & Z=X_1+X_2+ 3X_3 \\ \text{Subject to} \quad & 3X_1+2X_2+X_3 \leq 3 \\ & 2X_1+X_2+2X_3 \leq 2 \\ \text{and} \quad & X_1, X_2, X_3 \geq 0 \end{aligned}$$

**UNIT - IV**

15. Describe Two-Phase Simplex method for the solution of LPP?

(OR)

16. Solve the following LPP by using Big M Method

$$\begin{aligned} \text{Min} \quad & Z = 4X_1+X_2 \\ \text{Subject to} \quad & 3X_1+X_2 =3 \\ & 4X_1+3X_2 \geq 6 \\ & X_1+2X_2 \leq 3 \\ \text{and} \quad & X_1, X_2 \geq 0 \end{aligned}$$

**UNIT - V**

17. Write the algorithm for Monte-Carlo Technique of simulation ?

**OR**

18. A manufacturing company keeps stock of a special product. Previous experience indicates the daily demand as given below.

Daily Demand	5	10	15	20	25	30
Probability	0.01	0.20	0.15	0.50	0.12	0.02

Simulate the demand for the next 10 days. Also find the daily average demand for the product on the basis of simulated data ?

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**SEMESTER V**  
**W.E.F. 2022-2023**  
**COURSE 7A: OPERATION RESEARCH - II**  
**(Skill Enhancement Course(Elective), 05 Credits**  
**Max.Marks: Theory :100 + Practicals: 50**

**Objective:** To enrich the knowledge of students with advance techniques of linear programming problem along with real life applications

**Learning Outcomes:**

After learning this course, the student will be able

1. To solve the problem in logistics
2. To find a solution for the problems having space constraints
3. To minimize the total elapsed time in a 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 industries and agriculture when a random environment exists.

**UNIT -I**

**Transportation problem** - Introduction, Mathematical formulation of Transportation problem, Tabular representation, Definitions, 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). Unbalanced transportation problem. Maximization Transportation problem

**UNIT-II**

**Assignment problem** - Introduction, Mathematical formulation of Assignment problem, Reduction theorem(statement only), Hungarian Method for solving Assignment problem, Unbalanced Assignment problem. Traveling salesman problem

**UNIT-III**

**Sequencing problem:** Introduction, assumptions of sequencing problem, Johnson's algorithm for n jobs on 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 k machines, problems with n-jobs on k-machines.

#### **UNIT-IV**

**Network Scheduling** -Basic components of a network - nodes and arcs – events and activities - Rules of Network construction- Time calculation in networks - Critical path method(CPM) and PERT.

#### **UNIT –V**

**Game Theory** - Two- person zero-sum game. Pure and Mixed strategies. Maxmin and Minmax Principles - Saddle point and its existence - Games without saddle point- Mixed strategies- Solution of 2x2 rectangular games -Graphical method for solving  $2 \times n$  and  $m \times 2$  games - Dominance property –Solution of game by Dominance method

#### **Reference Books:**

1. S.D. Sharma, Operations Research, KedarNath Ram Nath& Co, Meerut.
2. KantiSwarup, P.K.Gupta, Manmohn, 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 :Linrar programming. Addison-Wesley.
6. Taha : Operations Research: An Introduction : Mac Millan.

#### **Practical/Lab to be performed on a computer using OR/Statistical packages**

1. IBFS of Transportation problem by using North- West corner rule
2. IBFS of Transportation problem by using Matrixminimum method
3. IBFS of Transportation problem by using VAM
4. Solution of Assignment problem using Hungarian method
5. Traveling salesman problem
6. Solution of sequencing problem—processing of n jobs through two machines
7. Solution of sequencing problem - processing of n jobs through three machines
8. To perform Project scheduling of a given project (Deterministic case-CPM).

9. To perform Project scheduling of a given project (Probabilistic case-PERT).
10. Solution of  $m \times n$  games by dominance rule

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Skill Enhancement Course(Elective)

**COURSE 7A: OPERATIONS RESEARCH -II**

(Under CBCS New Regulations w.e.f. 2020-21)

(Scientific calculators are allowed)

**Time:3 Hours**

**MODEL QUESTION PAPER**

**Max.Marks:75**

**PART -A**

Answer any FIVE of the following questions. Each question carries 5 Marks 5X5=25M

1. Explain Transportation problem?
2. Describe procedure for finding IBFS by North West corner rule ?
3. What is an assignment Problem? Explain mathematical representation of Assignment problem ?
4. Explain the assumptions of sequence theory?
5. Define the terms Network, Activity, Event ?
6. Explain rules of network construction?
7. Describe Payoff Matrix ?
8. Explain Maximin - Minimax principle?

**PART-B**

Answer **ALL** questions. Each question carries 10 Marks. 5X10=50M

**UNIT - I**

9. Explain the algorithm for finding optimum solution by using Modi Method ?

**(OR)**

10. Find IBFS for the following T.P by using North West Corner rule and Least cost entry method ?

Origins	Destinations	Supply/ Available
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	D	E	F	G	
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand/ requirement	200	225	275	250	

**UNIT - II**

11. Explain Hungarian method of solving assignment problem?

**OR**

Solve the following Assignment Problem ?

Jobs	Persons				
	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>
J <sub>1</sub>	3	8	2	10	3
J <sub>2</sub>	8	7	2	9	7
J <sub>3</sub>	6	4	2	7	5
J <sub>4</sub>	8	4	2	3	5
J <sub>5</sub>	9	10	6	9	10

**UNIT - III**

12. Describe the method of Processing n 'jobs through three machines.?

**(OR)**

13. Determine the optional sequence of jobs that minimize the total elapsed time based on the following information Processing time on machines is given in hours and passing is not allowed.

Job :	A	B	C	D	E	F	G
M <sub>1</sub> :	3	8	7	4	9	8	7
M <sub>2</sub> :	4	3	2	5	1	4	3
M <sub>3</sub> :	6	7	5	11	5	6	12

**UNIT - IV**

14. Describe the algorithm for finding Total Float by using PERT – CPM Method

**(OR)**

15. A small maintenance project consist of the following jobs whose precedence relationships is given below. Draw an arrow diagram representing the project (ii)Find the total float for each activity?

Job	1-2	1-3	2-3	2-5	3-4	3-6	4-5	4-6	5-6	6-7
Duration(days)	15	15	3	5	8	12	1	14	3	14

## UNIT – V

16. Explain graphical method of  $2 \times n$  or  $m \times 2$  games ?

(OR)

17. Solve the following payoff matrix, determine the optimal strategies and the value of game

$$A \begin{matrix} & B \\ \begin{matrix} 5 & 1 \\ 3 & 4 \end{matrix} \end{matrix}$$

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**SEMESTER V**

W.E.F. 2022-2023

**COURSE 6C: ECONOMETRICS**

(Skill Enhancement Course(Elective), 05 Credits)

Max. Marks: Theory :100 + Practicals: 50

### Learning Outcomes:

The course on econometrics will primarily focus on the use of statistical modeling and the relevant analyses to economic data problems. After learning this course the student will be able

1. various important econometric models and relevant model building concepts in econometrics
2. general linear models and estimation of inherent model parameters
3. Multicollinearity, its detection and consequences and related inferential aspects
4. some advanced concepts of Generalised least squares estimation, autocorrelation, its consequences, detection and strategy for reducing autocorrelation,
5. Heteroscedasticity and its inherent concepts including its consequences,
6. some inferential aspects on heteroscedasticity,
7. practical aspects and real data illustration of the related problems.

### UNIT-I

**Basic Econometrics:** Nature of econometrics and economic data, concept of econometrics, steps in empirical economic analysis, econometric model, importance of measurement in economics, the structure of econometric data, cross section, pooled cross section, time series and paired data

### UNIT-II

**Models and Estimations:** Simple Regression models – Two variable linear regression model – Assumptions – Estimation of parameters -Gauss Markoff theorem, OLS estimations, partial and multiple correlations coefficients. The general linear model assumptions, estimation and properties of estimators, BLUEs,

### UNIT-III

**Heteroscedastic disturbances: Tests of** significance of estimators –  $R^2$  and ANOVA - Concepts, Consequences of heteroscedasticity - Tests and solutions of heteroscedasticity - Specification error- Errors of measurement.

### UNIT- IV

**Multicollinearity :** The concept of multicollinearity and its consequences – Detection and measure of multicollinearity - Variance Inflation Factor and tolerance, formula and interpretation – Methods of reducing the influence of multicollinearity.

### UNIT - V

**Autocorrelation:** Disturbance term in econometric models and assumptions - Auto correlated disturbances and their consequences on the model parameters – Detecting the presence of autocorrelation – Hypothesis tests for autocorrelation – Durbin Watson test and its interpretation.

### References:

1. Gujarati, D. and Sangeetha, S. (2007). Basic Econometrics, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972). Econometric Methods, 2nd Edition, McGraw Hill International.
3. Koutsoyiannis, A. (2004). Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited.
4. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons.

### Practical/Lab to be performed on a computer using Statistical packages

1. Problems based on estimation of General linear model.
2. Testing of parameters of General linear model.
3. Forecasting of General linear model.
4. Problems concerning specification errors.
5. Problems related to consequences of Multicollinearity.
6. Diagnostics of Multicollinearity.
7. Problems related to consequences of Autocorrelation (AR(I)).
8. Diagnostics of Autocorrelation.
9. Estimation of problems of General linear model under Autocorrelation.
10. Diagnostics of Heteroscedasticity.

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Skill Enhancement Course(Elective)

**COURSE 6C: ECONOMETRICS**

(Under CBCS New Regulations w.e.f. 2020-21 )

(Scientific calculators are allowed)

**Time:3 Hours**

**MODEL QUESTION PAPER**

**Max.Marks:75**

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**PART –A**

Answer any FIVE Questions

5X5=25M

1. Define Econometrics. Explain the nature of Econometrics?
2. Derive OLS estimator of the variance of error term and show that it is unbiased?
3. What are the sources and consequences of Heteroscedasticity ?
4. Discuss various diagnostic tests of Heteroscedasticity ?
5. Explain how to overcome the problem of Multicollinearity?
6. What are the methods for reducing the influence of Multicollinearity?
7. What are the sources and consequences of Autocorrelation?
8. How to detect the problem of autocorrelation?

**PART – B**

Answer ALL Questions

5X10=50M

**UNIT – I**

9. What are different steps in empirical Economic Analysis?

**OR**

10. Explain about data for Econometric Analysis?

**UNIT – II**

11. Explain two variable linear regression model and its estimation?

**OR**

12. Describe about Gauss-Markoff theorem?

**UNIT – III**

13. Describe Goldfield-Quandt test for detection of Heteroscedasticity?

**OR**

14. Describe an estimation method of GL Munder Hereroscadasticity error terms?

**UNIT - IV**

15. Explain the nature , sources and consequences of Multicollinearity problem in a GLM?

**OR**

16. Describe various diagnostic tests of Multicollinearity?

**UNIT - V**

17. Explain the Problem of Autocorrelation .What are its Uses?

**OR**

18. Explain Durbin-Watson test for detection of Auto-Correlation in a Regression model and discuss the limitations of the test?

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**COURSE 7C: REGRESSION ANALYSIS**  
(Skill Enhancement Course(Elective), 05 Credits  
Max. Marks: Theory :100 + Practicals: 50

**Learning Outcomes:**

After learning this course the student will be able

1. To know about correlation and regression techniques, the two very powerful tools in statistics,
2. To get an idea of Linear and Multiple Linear regression,
3. To learn about regression diagnostics, multicollinearity, residual plots and estimation and tests for regression coefficients.
4. To study concept of coefficient of determination and inference on partial and multiple correlation coefficients.
5. To learn the regression with qualitative independent and dependent variables by dummy variable technique.
6. To learn the selection of the best regression model.

**UNIT - I**

**Simple Linear Regression:** Least-squares estimation of the parameters – Estimation of  $\beta_0$  and  $\beta_1$   
Properties of the least-squares estimators and the fitted regression model- Hypothesis testing on the slope and intercept – Use of t- tests.

**UNIT -II**

**Multiple linear regression:** Estimation of model parameters – Least squares estimation of the regression coefficients – Properties of the least-squares estimators – Concept of residual, Test for significance of individual regression coefficients and subsets of coefficients.

**UNIT - III**

**Regressions with Qualitative Independent Variables:** Use of Dummy variable to handle categorical independent variables in regression.- Estimation of model parameters with dummy variables – Testing of structural stability of regression models, comparing slopes of two regression models- Multiple linear regression with interaction effects.

#### UNIT -IV

**Regressions with Qualitative Dependent Variables:** Binary logistic regression with several independent variables, estimation of coefficient, evaluating the Odds Ratio(OR) and its interpretation. The concept of piecewise linear regression, The Logit, Probit and Tobit models and their applications.

#### UNIT - V

**Best Model:** Selecting ‘Best’ regression model. All possible regressions –  $R^2$ , Adjusted  $R^2$ , Sequential selection of variables –Criteria for including and eliminating a variable - forward selection, backward elimination and stepwise regression

#### References:

1. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis. 3<sup>rd</sup> Edition. John Wiley.
2. Hosmer, D. W., Lemeshow, S. and Sturdivant R.X. (2013). Applied Logistic Regression, Wiley Blackwell.
3. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2013). Introduction to Linear Regression Analysis. 5<sup>th</sup> Edition. Wiley.
4. Neter, J., Kutner, M. H., Nachtsheim, C.J. and Wasserman, W. (1996). Applied Linear Statistical Models, 4<sup>th</sup> Edition, Irwin USA.
5. Gujarati, D. and Sangeetha, S. (2007). Basic Econometrics, 4th Edition

#### Practical/Lab to be performed on a computer using Statistical packages

1. Least squares estimates of slope and intercept
2. Plotting of two regression lines
3. Finding  $R^2$  value of linear models
4. Student’s t-test for regression coefficient
5. ANOVA for Multiple Linear Regression model
6. Selecting best regression model by  $R^2$
7. Selecting best regression model by Adjusted  $R^2$
8. Selecting best regression model by forward selection
9. Selecting best regression model by backward elimination.

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Skill Enhancement Course(Elective)  
**COURSE 7C: REGRESSION ANALYSIS**  
(Under CBCS New Regulations w.e.f. 2020-21)  
(Scientific calculators are allowed)

**Time:3 Hours**

**MODEL QUESTION PAPER**

**Max.Marks:75**

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**PART -A**

Answer any FIVE of the following questions. Each question carries 5 Marks 5X5=25M

1. Explain about Simple Linear Regression?
2. What are the properties of OLS estimators  $\alpha$ ,  $\beta$  and  $\sigma^2$ ?
3. What are the assumptions of Multiple Linear Regression Model?
4. What is Dummy variable technique?
5. What is Multiple Linear Regression with interaction effects?
6. Explain Comparison between Regression with qualitative dependent and independent variables?
7. Briefly explain How to select Best Regression Model?
8. How do you interpret Mallow's CP Statistic?

**PART -B**

**Answer ALL Questions. Each question carry 10 marks**

**5X10=50M**

**UNIT - I**

9. Explain test for complete Regression?

**OR**

10. Explain tests of Significance of parameters using Lease Square Estimation?



## UNIT - II

11. What is BLUE? Explain the test of significance of Multiple Linear Regression Model?

**OR**

12. Explain completely Multiple Linear Regression Model?

## UNIT - III

13. Explain the estimation of Model parameters with dummy variables?

**OR**

14. How do you test the structural stability of regression model?

## UNIT - IV

15. What are limited dependent variable models – Explain?

**OR**

16. Explain logistic regression with estimation. Also evaluate the odd ratio and its interpretation?

## UNIT - V

17. Explain  $R^2$  Criteria and Adjusted  $R^2$  criteria for model selection?

**OR**

18. Describe about forward, Backward and stepwise Regression in detail with equation?