



ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

UG PROGRAM (4 Years Honors)
CBCS - 2020-21

B. Sc
STATISTICS



Syllabus and Model Question Papers



1. RESOLUTIONS OF THE BOARD OF STUDIES

Meeting held on: 22.01.2021.Time:10 A.MAt: Adikavi Nannaya University , RJY

Agenda:

1. Adoption of revised-common program structure and revising/updating course-wisesyllabi(in the prescribed format) as per the guidelines issued by APSCHE.
2. Adoption of regulations on scheme of examination and marks/grading system of the University UG programs.
3. Preparation of Model question papers in prescribed format.
4. List of equipment/software requirement for each lab/practical
5. Eligibility of student for joining the course
6. Eligibility of faculty for teaching the course
7. List of paper-setters/paper evaluators with phone, email-id in the prescribed format

Minutes of the Meeting and Resolutions:

Outcome based UG Programmes (Non-Professional/ Conventional) with effect from 2020-2021 academic year under CBCS for implementing in all affiliated colleges of AKNU.

The U.G Board of Studies of STATISTICS was held on 21-01-2021 at 10 A.M at AKNU Conference Hall, Rajamahendravaram. The chair-Person/ Convenor and members have discussed and framed the syllabus for B.Sc/B.A (With mathematical combination) C.B.C.S Pattern for I, II, III, IV & V Semesters with effect from the academic year 2020-2021 and discussed the following Agends.

1. Framing the model question Papers for the Prescribed Syllabus for setting the model questionpapers.
2. Framing the model question papers for the Prescribed Syllabus & Scheme for setting the modelquestion papers.
3. List of Practicals with scheme
4. List of text books for the Prescribed Syllabus.
5. List of Paper Setters and Evaluators to follow the specific instructions.
6. List of Equipment/Software requirement for each lab/Practical.
7. Eligibility of Student for Joining the Course.
8. Eligibility of faculty for teaching the course.



Members Present

1. Dr. D.V. Ramana Murthy Signature of the Chair Person/Convener
Dr. D.V.Ramana Murthy
S.K.V.T. College RAJAMAHENDRAVARAM

2. Dr. N.Madhavi
Lecturer in Statistics
Govt College(A),
Rajahmundry
East Godavari Dt (AP)

3. K. Narayana Raju
B.V.Raju College
Bhimavaram
West Godavari Dt(AP)

4. G. Satish Kumar
V.S. Laksmi College (Womens)
Kakinada E.G.Dt

5. Sri G. Moses S.G. Lecturer
D.N.R. College Bhimavaram W.G.Dt

6. Mr. K. Ashok
Lecturer in Statistics
P.R.Govt Colege (A)
Kakinada
E.G.DT



ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

UG Program (4 years Honors) Structure (CBCS)

2020-21 A. Y., onwards

BACHLOR OF SCIENCE

(3rd and 4th year detailed design will be followed as per APSCHE GUIDELINES)

Subjects/ Semesters		I		II		III		IV		V		VI			
		H/W	C	H/W	C	H/W	C	H/W	C	H/W	C	H/W	C		
Languages															
English		4	3	4	3	4	3								
Language (H/T/S)		4	3	4	3	4	3								
Life Skill Courses		2	2	2	2	2+2	2+2								
Skill Development Courses		2	2	2+2	2+2	2	2								
Core Papers															
M-1	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1				
M-2	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1				
M-3	C1 to C5	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1				
M-1	SEC (C6,C7)											4+2	4+1		
M-2	SEC (C6,C7)											4+2	4+1		
M-3	SEC (C6,C7)											4+2	4+1		
Hrs/ W (Academic Credits)		30	25	32	27	32	27	36	30	36	30	0	12	4	4
Project Work															
Extension Activities (Non Academic Credits)															
NCC/NSS/Sports/Extra Curricular										2					
Yoga							1		1						
Extra Credits															
Hrs/W (Total Credits)		30	25	32	27	32	28	36	33	36	30	0	12	4	4

THIRD PHASE of APPRENTICESHIP Entire 5th / 6th Semester

FIRST and SECOND PHASES (2 spells) of APPRENTICESHIP between 1st and 2nd year and between 2nd and 3rd year (two summer vacations).

M= Major; C= Core; SEC: Skill Enhancement Courses



ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

Marks & Credits distribution: UG-Sciences

Sl. No	Course type	No. of courses	Each course teaching Hrs/wk	Credit for each course	Total credits	Each course evaluation			Total marks
						Conti-Assess	Univ-exam	Total	
1	English	3	4	3	9	25	75	100	300
2	S.Lang	3	4	3	9	25	75	100	300
3	LS	4	2	2	8	0	50	50	200
4	SD	4	2	2	8	0	50	50	200
5	Core/SE -I	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -II	5+2	4+2	4+1	35	25	75+50	150	1050
	Core/SE -III	5+2	4+2	4+1	35	25	75+50	150	1050
6	Summer-Intern	2		4	8		100	200	200
7	Internship/ Apprentice/ on the job training	1		12	12		200	200	200
		38			159				4550
8	Extension Activities (Non Academic Credits)								
	NCC/NSS/Sports/ Extra Curricular			2	2				
	Yoga			2	1	2			
	Extra Credits								
	Total	40			142				



DETAILS OF COURSE TITLES & CREDITS

Sem	Course No	Course Name	Course Type (T/P/L)	Hrs/Week	Credits	Max. Marks	Max. Marks	
				Science: 4+2	Science: 4+2	Count/Internal/ Mid Assessment	Sem- End Exam	
I	1	Descriptive Statistics	T	4	4	25	75	
		Practical	L	2	1	-	50	
II	2	Probability and Probability Distributions	T	4	4	25	75	
		Practical	L	2	1	-	50	
III	3	Statistical Inference	T	4	4	25	75	
		Practical	L	2	1	-	50	
IV	4	Sampling Techniques and Design of Experiments	T	4	4	25	75	
		Practical	L	2	1	-	50	
	5	Applied Statistics	T	4	4	25	75	
		Practical	L	2	1	-	50	
V	6A	Operations Research - I	T	4	4	25	75	
		Operations Research - I Lab	L	2	1	-	50	
	7A	Operations Research - II	T	4	4	25	75	
		Operations Research - II Lab	L	2	1	-	50	
	OR							
	6B	Statistical Process and Quality Control	T	4	4	25	75	
		Statistical Process and Quality Control Lab	L	2	1	-	50	
	7B	Computational Techniques and R Programming	T	4	4	25	75	
		Computational Techniques and R Programming Lab	L	2	1	-	50	
	OR							
	6C	Econometrics	T	4	4	25	75	
		Econometrics Lab	L	2	1	-	50	
7C	Regression Analysis	T	4	4	25	75		
	Regression Analysis Lab	L	2	1	-	50		

Note: *Course type code: T: Theory, L: Lab, P: Problem solving

Note 1: For Semester–V, for the domain subject **STATISTICS**, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A & 7A or 6B & 7B 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 field 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 field skills embedded in the syllabus citing related real field situations.



Note 3: To insert assessment methodology for Internship/ on the Job Training/Apprenticeship under the revised CBCS as per APSCHE Guidelines.

- **First internship (After 1st Year Examinations):** Community Service Project. To inculcate social responsibility and compassionate commitment among the students, the summer vacation in the intervening 1st and 2nd years of study shall be for Community Service Project (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Second Internship (After 2nd Year Examinations):** Apprenticeship / Internship / on the job training / In-house Project / Off-site Project. To make the students employable, this shall be undertaken by the students in the intervening summer vacation between the 2nd and 3rd years (the detailed guidelines are enclosed).
- **Credit For Course: 04**

- **Third internship/Project work (6th Semester Period):**
During the entire 6th Semester, the student shall undergo Apprenticeship / Internship / On the Job Training. This is to ensure that the students develop hands on technical skills which will be of great help in facing the world of work (the detailed guidelines are enclosed).
- Credit For Course:12**



Program objectives, outcomes, co-curricular and assessment methods

B. Sc	STATISTICS
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Objective of the Course:

Statistics is a key to success in the field of science and technology. Today, the students need a thorough knowledge of fundamental basic principles, methods, results and a clear perception of the power of statistical ideas and tools to use them effectively in modeling, interpreting and solving the real life problems. Statistics plays an important role in the context of globalization of Indian economy, modern technology, computer science and information technology.

The main objectives of the course are

- To build the basis for promoting theoretical and application aspects of statistics.
- To underline the statistics as a science of decision making in the real life problems with the description of uncertainty.
- To emphasize the relevance of statistical tools and techniques of analysis in the study of inter-disciplinary sciences.
- To acquaint students with various statistical methods and their applications in different fields.
- To cultivate statistical thinking among students.
- To develop skills in handling complex problems in data analysis and research design.
- To prepare students for future courses having quantitative components.

This course is aimed at preparing the students to hope with the latest developments and compete with students from other universities and put them on the right track.

Paper Wise Objectives

PAPER-I: Descriptive Statistics

- The objective of this paper is to throw light on the role of statistics in different fields with special reference to business and economics.
- It gives the students to review good practice in presentation and the format most applicable to their own data.
- The measures of central tendency or averages reduce the data to a single value which is highly useful for making comparative studies.
- The measures of dispersion throw light on reliability of average and control of variability
- The concept of Correlation and Linear Regression deals with studying the linear relationship between two or more variables, which is needed to analyze the real life problems.
- The attributes gives an idea that how to deal with qualitative data.

PAPER-II: Probability Theory and Distributions

- This paper deals with the situation where there is uncertainty and how to measure that uncertainty by defining the probability, random variable and mathematical expectation which are essential in all research areas.
- This paper gives an idea of using various standard theoretical distributions, their chief characteristics and applications in analyzing any data.



PAPER-III: Statistical Inference

- This paper deals with standard sampling distributions like Chi Square, t and F and their characteristics and applications.
- This paper deals with the different techniques of point estimation for estimating the parameter values of population and interval estimation for population parameters.
- In this paper, various topics of Inferential Statistics such as interval estimation, Testing of Hypothesis, large sample tests (Z-test), small sample tests (t-test, F-test, chi-square test) and non-parametric tests are dealt with. These techniques play an important role in many fields like pharmaceutical, agricultural, medical etc.

PAPER-IV: Sampling Techniques and Design of Experiments

- The sampling techniques deals with the ways and methods that should be used to draw samples to obtain the optimum results, i.e., the maximum information about the characteristics of the population with the available sources at our disposal in terms of time, money and manpower to obtain the best possible estimates of the population parameters
- This paper throw light on understanding the variability between group and within group through Analysis of Variance
- This gives an idea of logical construction of Experimental Design and applications of these designs now days in various research areas.
- Factorial designs allow researchers to look at how multiple factors affect a dependent variable, both independently and together.

PAPER-V: Applied Statistics

- This paper deals the time series on simple description methods of data, explains the variation, forecasting the future values, control procedures.
- It gives an idea of using index numbers in a range of practical situations, limitations and uses
- The vital statistics enlighten the students in obtaining different mortality, fertility rates thus obtaining the population growth rates and construction and use of life tables in actuarial science.



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B. Sc	Semester: I	Credits: 4
Course: 1	Descriptive Statistics	Hrs/Wk: 4

Course Learning Outcomes:

Students will acquire:

- knowledge of Statistics and its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences etc.
- knowledge of various types of data, their organization and evaluation of summary measures such as measures of central tendency and dispersion etc.
- knowledge of other types of data reflecting quality characteristics including concepts of independence and association between two attributes,
- insights into preliminary exploration of different types of data.
- Knowledge of correlation, regression analysis, regression diagnostics, partial and multiple correlations.

UNIT I:

Introduction to Statistics: Importance of Statistics. Scope of Statistics in different fields. Concepts of primary and secondary data. Diagrammatic and graphical representation of data: Histogram, frequency polygon, Ogives, Pie. Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean. Median and Mode through graph.

UNIT II:

Measures of Dispersion: Range, Quartile Deviation, Mean Deviation and Standard Deviation, Variance. Central and Non-Central moments and their interrelationship. Sheppard's correction for moments. Skewness and kurtosis.

UNIT III:

Curve fitting: Bi- variate data, Principle of least squares, fitting of degree polynomial. Fitting of straight line, Fitting of Second degree polynomial or parabola, Fitting of power curve and exponential curves.

Correlation: Meaning, Types of Correlation, Measures of Correlation: Scatter diagram, Karl Pearson's Coefficient of Correlation, Rank Correlation Coefficient (with and without ties), Bi-variate frequency distribution, correlation coefficient for bi-variate data and simple problems. Concept of multiple and partial correlation coefficients (three variables only) and properties

UNIT IV:

Regression : Concept of Regression, Linear Regression: Regression lines, Regression coefficients and it's properties, Regressions lines for bi-variate data and simple problems. Correlation vs regression.

UNIT-V

Attributes : Notations, Class, Order of class frequencies, Ultimate class frequencies, Consistency of data, Conditions for consistency of data for 2 and 3 attributes only , Independence of attributes , Association of attributes and its measures, Relationship between association and colligation of attributes, Contingencytable: Square contingency, Mean square contingency, Coefficient of mean square contingency, Tschuprow's coefficient of contingency.



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TEXT BOOKS:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. BA/BSc I year statistics - descriptive statistics, probability distribution - Telugu Academy - Dr M.Jaganmohan Rao, Dr N.Srinivasa Rao, Dr P.Tirupathi Rao, Smt.D.Vijayalakshmi.
3. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI

REFERENCE BOOKS:

1. Willam Feller: Introduction to Probability theory and its applications. Volume –I, Wiley
2. Goon AM, Gupta MK, Das Gupta B : Fundamentals of Statistics , Vol-I, the World Press Pvt.Ltd.,Kolakota.
3. Hoel P.G: Introduction to mathematical statistics, Asia Publishinghouse.
4. M. JaganMohan Rao and Papa Rao: A Text book of Statistics Paper-I.
5. Sanjay Arora and Bansi Lal: New Mathematical Statistics: Satya Prakashan , New Delhi



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B. Sc	Semester: I	Credits: 1
Course: 1(L)	Practical	Hrs/Wk: 2

List of the experiments:

1. Graphical presentation of data (Histogram, frequency polygon, Ogives).
2. Diagrammatic presentation of data (Bar and Pie).
3. Computation of measures of central tendency (Mean, Median and Mode)
4. Computation of measures of dispersion (Q.D, M.D and S.D)
5. Computation of non-central, central moments, β_1 and β_2 for ungrouped data.
6. Computation of non-central, central moments, β_1 and β_2 and Sheppard's corrections for grouped data.
7. Computation of Karl Pearson's coefficients of Skewness and Bowley's coefficients of Skewness.
8. Fitting of straight line by the method of least squares
9. Fitting of parabola by the method of least squares
10. Fitting of power curve of the type by the method of least squares.
11. Fitting of exponential curve of the type and by the method of least squares.
12. Computation of correlation coefficient and regression lines for ungrouped data
13. Computation of correlation coefficient, forming regression lines for grouped data
14. Computation of Yule's coefficient of association
15. Computation of Pearson's, Tcherprows coefficient of contingency

Note: Training shall be on establishing formulae in Excel cells and derive the results. The excel output shall be exported to MS word for writing inference.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -I

Course 1: DESCRIPTIVE STATISTICS

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Distinguish between questionnaire and schedule.
2. Write short note on Diagrams and its types?
3. Explain Standard Deviation with its merits and demerits
4. In a frequency distribution, the co-efficient of skewness based upon the quartiles is 0.6. If the sum of the upper and lower quartiles is 100 and median is 38, find the value of the upper and lower quartiles.
5. Explain Method of Least squares
6. Explain Association of attributes
7. Explain concept of Skewness
8. Correlation vs Regression

SECTION-B

Answer ALL the questions. All questions carry equal marks. 5 x 10 = 50M

9. a) What do you understand by collection of data? What are its objectives? Discuss different methods

(OR)

 b) Describe the different measures of central tendency and discuss their Merits and demerits.

10. a) Explain the methods of measuring skewness and kurtosis of a frequency Distribution.

(OR)

 b) Define the raw and central moments of a frequency distribution. Derive the Relationship between them.

11. a) Explain Karl Pearson's coefficient of Correlation

(OR)

 b) Fit a Second Degree Equation to the following data

X	2	4	6	8	10	12
y	10	14	19	25	31	36

12. a) Explain Karl Pearson's coefficient of Correlation

(OR)

 b) Explain Regression X on Y and Y on C with its Properties

13. a) The Rank of 15 students in Mathematics and Statistics are given below. Obtain rank correlation coefficient between them

Rank of Maths	1	2	6	9	11	15	10	8	4	7	5	14	13	12	3
Rank of Statistics	10	7	8	11	9	13	15	1	6	3	4	12	14	5	2

- (OR)**
- b) Explain Consistency of data for Single ,double and triple attributes



B. Sc	Semester: II	Credits: 4
Course: 2	PROBABILITY AND PROBABILITY DISTRIBUTIONS	Hrs/Wk: 4

Course Learning Outcomes:

Students will acquire:

- ability to distinguish between random and non-random experiments,
- knowledge to conceptualize the probabilities of events including frequentist and axiomatic approach. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem,
- knowledge related to concept of discrete and continuous random variables and their probability distributions including expectation and moments,
- knowledge of important discrete and continuous distributions such as Binomial, Poisson, Geometric, Negative Binomial and Hyper-geometric, normal, uniform, exponential, beta and gamma distributions,
- acumen to apply standard discrete and continuous probability distributions to different situations.

UNIT I:

Introduction to Probability: Basic Concepts of Probability, random experiments, trial, outcome, sample space, event, mutually exclusive and exhaustive events, equally likely and favourable outcomes. Mathematical, Statistical, axiomatic definitions of probability. Conditional Probability and independence of events, Addition and multiplication theorems of probability for 2 and for n events. Boole's inequality and Baye's theorem and its applications in real life problems.

UNIT II:

Random variable: Definition of random variable, discrete and continuous random variables, functions of random variable. Probability mass function. Probability density function, Distribution function and its properties. For given pmf, pdf calculation of moments, coefficient of skewness and kurtosis. Bivariate random variable - meaning, joint, marginal and conditional Distributions, independence of random variables and simple problems.

UNIT III:

Mathematical expectation : Mathematical expectation of a random variable and function of a random variable. Moments and covariance using mathematical expectation with examples. Addition and Multiplication theorems on expectation. Definitions of M.G.F, C.G.F, P.G.F, C.F and their properties. Chebyshev and Cauchy - Schwartz inequalities.

UNIT IV:

Discrete Distributions: Binomial, Poisson, Negative Binomial, Geometric distributions: Definitions, means, variances, M.G.F, C.F, C.G.F, P.G.F, additive property if exists. Poisson approximation to Binomial distribution. Hyper-geometric distribution: Definition, mean and variance.

UNIT V:

Continuous Distributions: Rectangular, Exponential, Gamma, Beta Distributions: mean, variance, M.G.F, C.G.F, C.F. Normal Distribution: Definition, Importance, Properties, M.G.F, CF, additive property.



TEXT BOOKS:

1. V.K.Kapoor and S.C.Gupta: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. BA/BSc I year statistics - descriptive statistics, probability distribution - Telugu Academy - Dr M.Jaganmohan Rao, Dr N.Srinivasa Rao, Dr P.Tirupathi Rao, Smt.D.Vijayalakshmi.
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2. Goon AM, Gupta MK, Das Gupta B : Fundamentals of Statistics , Vol-I, the World Press Pvt.Ltd., Kolakota.
3. Hoel P.G: Introduction to mathematical statistics, Asia Publishinghouse.
4. M. JaganMohan Rao and Papa Rao: A Text book of Statistics Paper-I.
5. Sanjay Arora and Bansi Lal: New Mathematical Statistics: Satya Prakashan , New Delhi
6. Hogg Tanis Rao: Probability and Statistical Inference. 7th edition. Pearson.



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B. Sc	Semester: II	Credits: 1
Course: 2(L)	Practical	Hrs/Wk: 2

List of Experiments:

1. Fitting of Binomial distribution – Directmethod.
2. Fitting of binomial distribution – Recurrence relationMethod.
3. Fitting of Poisson distribution – Directmethod.
4. Fitting of Poisson distribution - Recurrence relationMethod.
5. Fitting of Negative Binomialdistribution.
6. Fitting of Geometricdistribution.
7. Fitting of Normal distribution – Areasmethod.
8. Fitting of Normal distribution – Ordinatesmethod.
9. Fitting of Exponentialdistribution.

Note: Training shall be on establishing formulae in Excel cells and derive the results. The exceloutput shall be exported to MS word for writing inference.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SEMESTER -II

Course 2: PROBABILITY AND PROBABILITY

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Write short note on Probability
2. Explain Booles Inequality
3. Define (i) Mutually Exclusive events
(ii) Exhaustive events
(iii) Equally likely events
4. Explain Bivariate random variable
5. Define Uniform Distribution and its properties
6. Give the applications of Normal distribution
7. Explain Cauchy - Schwartz inequalities
8. Define Exponential distribution with its properties

SECTION-A

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. a) Explain Types of Probability and Explain properties of Probability
(OR)
b) Define Conditional Probability and Explain Bayes theorem with its applications
10. a) Explain types of Random Variables and Explain p.m.f and p.d.f with its properties
(OR)
b) A random variable X has the following probability function

X = x	0	1	2	3	4	5	6	7
P(X=x)	0	K	2k	2k	3k	K ²	2k ²	7k ² +k

- a) Find K, P (X < 6), P (X ≥ 6), P (0 < X < 5). b) Find Distribution function. c) Its graph.
11. a) Prove the following results
(i) $E(X + Y) = E(X) + E(Y)$, (ii) $E(XY) = E(X)E(Y)$
(OR)
b) Explain MGF and CGF with its properties
12. a) Write about Binomial distribution and its properties
(OR)
b) Write about Poisson distribution and its properties
13. a) Define Normal distribution. Mention its properties
(OR)
b) Write short note on Beta and Gamma Distribution



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B. Sc	Semester: III	Credits: 4
Course: 3	STATISTICAL INFERENCE	Hrs/Wk: 4

Course Learning Outcomes:

The students will acquire

- Concept of law large numbers and their uses
- Concept of central limit theorem and its uses in statistics
- concept of random sample from a distribution, sampling distribution of a statistic, standard error of important estimates such as mean and proportions,
- knowledge about important inferential aspects such as point estimation, test of hypotheses and associated concepts,
- knowledge about inferences from Binomial, Poisson and Normal distributions as illustrations,
- concept about non-parametric method and some important non-parametric tests.

UNIT I:

Concepts: Population, Sample, Parameter, statistic, Sampling distribution, Standard error. convergence in probability and convergence in distribution, law of large numbers, central limit theorem (statements only). Student's t- distribution, F – Distribution, χ^2 -Distribution: Definitions, properties and their applications.

UNIT II:

Theory of estimation: Estimation of a parameter, criteria of a good estimator – unbiasedness, consistency, efficiency, & sufficiency and. Statement of Neyman's factorization theorem. Estimation of parameters by the method of moments and maximum likelihood (M.L), properties of MLE's. Binomial, Poisson & Normal Population parameters estimate by MLE method. Confidence Intervals.

UNIT III:

Testing of Hypothesis: Concepts of statistical hypotheses, null and alternative hypothesis, critical region, two types of errors, level of significance and power of a test. One and two tailed tests. Neyman- Pearson's lemma. Examples in case of Binomial, Poisson, Exponential and Normal distributions.

UNIT IV:

Large sample Tests: large sample test for single mean and difference of two means, confidence intervals for mean(s). Large sample test for single proportion, difference of proportions. standard deviation(s) and correlation coefficient(s).

Small Sample tests: t-test for single mean, difference of means and paired t-test. χ^2 -test for goodness of fit and independence of attributes. F-test for equality of variances.

UNIT V:

Non-parametric tests- their advantages and disadvantages, comparison with parametric tests. Measurement scale- nominal, ordinal, interval and ratio. One sample runs test, sign test and Wilcoxon signed rank tests (single and paired samples). Two independent sample tests: Median test, Wilcoxon – Mann-Whitney U test, Wald Wolfowitz's runs test.

TEXT BOOKS:

1. BA/BSc II year statistics - statistical methods and inference - Telugu Academy by A.Mohanrao, N.Srinivasa Rao, Dr R.Sudhakar Reddy, Dr T.C. RavichandraKumar.
2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC.PHI.



ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

REFERENCE BOOKS:

1. Fundamentals of Mathematics statistics : VK Kapoor and SCGuptha.
2. Outlines of statistics, Vol II : Goon Guptha, M.K.Guptha, Das GupthaB.
3. Introduction to Mathematical Statistics : HoelP.G.
4. Hogg Tanis Rao: Probability and Statistical Inference. 7th edition.Pearson.



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

B. Sc	Semester: III	Credits: 1
Course: 3(L)	Practical	Hrs/Wk: 2

List of Experiments:

1. Large sample test for difference of means
2. Large sample test for single proportion
3. Large sample test for difference of proportions
4. Large sample test for difference of standard deviations
5. Large sample test for correlation coefficient
6. Small sample test for single mean
7. Small sample test for difference of means
8. Small sample test for correlation coefficient
9. Paired t-test (paired samples).
10. Small sample test for single variance (χ^2 - test)
11. Small sample test for difference of variances (F-test)
12. χ^2 - test for goodness of fit and independence of attributes
13. Nonparametric tests for single sample (run test, sign test and Wilcoxon signed rank test)
14. Nonparametric tests for related samples (sign test and Wilcoxon signed rank test)
15. Nonparametric tests for two independent samples (Median test, Wilcoxon –Mann-Whitney - U test, Wald - Wolfowitz' s run test)

Note: Training shall be on establishing formulae in Excel cells and deriving the results. The excel output shall be exported to MS Word for writing inferences.



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -III

Course 3: STATISTICAL INFERENCE

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5M= 25M

1. What is MLE and write its properties
2. Explain Confidence Intervals.
3. Explain Null hypothesis and Alternative hypothesis.
4. Explain the difference between Parametric tests, Non-parametric tests
5. Explain paired t- test.
6. Explain chi-square test for independence of attributes.
7. Write the assumptions of non parametric tests
8. Explain testing procedure for hypothesis in large sample case

SECTION-B

Answer ALL the questions. All questions carry equal marks.5 x 10M = 50M

9. a) Explain about chi-square distribution and its properties
(OR)
b) Explain about f-distribution and its properties.
10. a) Explain the criteria of a good estimator.
(OR)
b) Explain different Methods of Estimation
11. a) State and prove Neyman-Pearson's Lemma.
(OR)
b) How do you apply Neyman's Pearson's lemma in case of Binomial distribution?
12. a) Explain the test procedure for (i) Testing of Mean and (ii) Equality of two means
(OR)
b) The following data obtained from a survey conducted about 320 families who are having five children. Fit a Binomial distribution for the data with $p = \frac{1}{2}$ and test the goodness of fit.

No. of boys	0	1	2	3	4	5
No. of families	14	56	110	88	40	12

13. a) Explain the test procedure for Median test
(OR)
b) What are non-parametric tests and explain difference between parametric, non-parametric tests



B. Sc	Semester: IV	Credits: 4
Course: 4	SAMPLING TECHNIQUES AND DESIGN OF EXPERIMENTS	Hrs/Wk: 4

Course Learning Outcomes

The students shall get

- Introduced to various statistical sampling schemes such as simple, stratified and systematic sampling.
- an idea of conducting the sample surveys and selecting appropriate sampling techniques,
- Knowledge about comparing various sampling techniques.
- carry out one way and two way Analysis of Variance,
- understand the basic terms used in design of experiments,
- use appropriate experimental designs to analyze the experimental data.

UNIT I:

Simple Random Sampling (with and without replacement): Notations and terminology, various probabilities of selection. Random numbers tables and its uses. Methods of selecting simple random sample, lottery method, method based on random numbers. Estimates of population total, mean and their variances and standard errors, determination of sample size, simple random sampling of attributes.

UNIT II:

Stratified random sampling: Stratified random sampling, Advantages and Disadvantages of Stratified Random sampling, Estimation of population mean, and its variance. Stratified random sampling with proportional and optimum allocations. Comparison between proportional and optimum allocations with SRSWOR.

Systematic sampling: Systematic sampling definition when $N = nk$ and merits and demerits of systematic sampling - estimate of mean and its variance. Comparison of systematic sampling with Stratified and SRSWOR.

UNIT III:

Analysis of variance : Analysis of variance(ANOVA) –Definition and assumptions. One-way with equal and unequal classification, Two way classification.

Design of Experiments: Definition, Principles of design of experiments, CRD: Layout, advantages and disadvantage and Statistical analysis of Completely Randomized Design(C.R.D).

UNIT IV:

Randomized Block Design (R.B.D) and Latin Square Design (L.S.D) with their layouts and Analysis, Missing plot technique in RBD and LSD. Efficiency of RBD over CRD, Efficiency of LSD over RBD and CRD.

UNIT V:

Factorial experiments – Main effects and interaction effects of 2^2 and 2^3 factorial experiments and their Statistical analysis. Yates procedure to find factorial effect totals.

TEXT BOOKS:

1. Telugu Academy BA/BSc III year paper - III Statistics - applied statistics - Telugu academy by Prof.K.Srinivasa Rao, Dr D.Giri. Dr A.Anand, Dr V.Papaiah Sastry.
2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC.PHI.

REFERENCE BOOKS:

1. Fundamentals of applied statistics : VK Kapoor and SC Gupta.
2. Indian Official statistics - MR Saluja.
3. Anuvarthita Sankhyaka Sastram - Telugu Academy.



B. Sc	Semester: IV	Credits: 1
Course: 4(L)	Practical	Hrs/Wk: 2

List of Experiments:

Sampling Techniques:

Estimation of population mean and its variance by

1. Simple random sampling with and without replacement. Comparison between SRSWR and SRSWOR.
2. Stratified random sampling with proportional and optimum allocations. Comparison between proportional and optimum allocations with SRSWOR.
3. Systematic sampling with $N=nk$. Comparison of systematic sampling with Stratified and SRSWOR.

Design of Experiments:

4. ANOVA - one - way classification with equal and unequal number of observations
5. ANOVA Two-way classification with equal number of observations.
6. Analysis of CRD.
7. Analysis of RBD Comparison of relative efficiency of CRD with RBD
8. Estimation of single missing observation in RBD and its analysis
9. Analysis of LSD and efficiency of LSD over CRD and RBD
10. Estimation of single missing observation in LSD and its analysis
11. Analysis of 2^2 with RBD layout
12. Analysis of 2^3 with RBD layout

Note: Training shall be on establishing formulae in Excel cells and deriving the results. The excel output shall be exported to MS Word for writing inferences.



ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -IV

Course 4: SAMPLING TECHNIQUES AND DESIGN OF EXPERIMENTS

Time: 3 Hrs.

Max Marks: 75

SECTION-B

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Distinguish between census survey and sample surveys.
2. Differences between SRSWR and SRSWOR.
3. Explain the purpose of ANOVA.
4. Explain about CRD
5. What are different types of sampling
6. Explain types of allocation in stratified sampling.
7. Explain about Yates procedure to find factorial effectotals
8. Explain about methods of drawing random samples from Simple random Sampling

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. a) What are principal steps in a sample survey.
(OR)
b) Discuss Sampling and non-sampling errors.
10. a) Derive the variance of the sample mean in SRSWOR.
(OR)
b) If the population consists of linear trend, then prove that $V(Y_{st}) \leq V(Y_{sys}) \leq V(Y_n)_R$
11. b) Discuss about basic principles of experimentation
(OR)
b) Explain Two way ANOVA Classification
12. a) Explain LSD and merits, demerits of LSD
(OR)
b) Explain the analysis of RBD with one missing observation.
13. a) Explain about Main effects and interaction effects of 2^2
(OR)
b) Main effects and interaction effects of 2^3 factorial experiments



B. Sc	Semester: IV	Credits: 4
Course: 5	APPLIED STATISTICS	Hrs/Wk: 4

Course Learning Outcomes

After completion of this course, the students will know about

- Time series data, its applications to various fields and components of time series,
- Fitting and plotting of various growth curves such as modified exponential, Gompertz and logistic curve, Fitting of trend by Moving Average method,
- Measurement of Seasonal Indices by Ratio-to-Trend , Ratio-to-Moving Average and Link Relative methods,
- Applications to real data by means of laboratory assignments.
- Interpret and use a range of index numbers commonly used in the business sector
- Perform calculations involving simple and weighted index numbers
- Understand the basic structure of the consumer price index and perform calculations involving its use
- Various data collection methods enabling to have a better insight in policy making, planning and systematic implementation, Construction and implementation of life tables, Population growth curves, population estimates and projections,
- Real data implementation of various demographic concepts as outlined above through practical assignments.

UNIT I:

Time Series: Time Series and its components with illustrations, additive, multiplicative 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 II:

Seasonal Component: Determination of seasonal indices by simple averages method, ratio to moving average, Ratio to trend and Link relative methods, Depersonalization.

UNIT III:

Growth curves: Modified exponential curve, Logistic curve and Gompertz curve, fitting of growth curves by the method of three selected points and partial sums. Detrending. Effect of elimination of trend on other components of the time series

UNIT IV:

Index numbers: Concept, construction, problems involved in the construction of index numbers, uses and limitations. Simple and weighted index numbers. Laspeyres's, Paasche's and Fisher's index numbers, Criterion of a good index number, Fisher's ideal index numbers. Cost of living index number and wholesale price index number.

UNIT V:

Vital Statistics: Introduction, definition and uses of vital statistics, sources of vital statistics. Measures of different Mortality and Fertility rates, Measurement of population growth. Life tables: construction and uses of life tables.



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TEXT BOOKS:

1. Fundamentals of applied statistics : VK Kapoor and SCGupta.
2. BA/BSc III year paper - III Statistics - applied statistics - Telugu academy by prof.K.Srinivasa Rao, Dr D.Giri. Dr A.Anand, Dr V.PapaiahSastry.

REFERENCE BOOKS:

1. Anuvarthita Sankyaka Sastram - TeluguAcademy.
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



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B. Sc	Semester: IV	Credits: 1
Course: 5(L)	Practical	Hrs/Wk: 2

List of Experiments:

Time Series:

1. Measurement of trend by method of moving averages(odd and evenperiod)
2. Measurement of trend by method of Least squares(linear andparabola)
3. Determination of seasonal indices by method simpleaverages
4. Determination of seasonal indices by method of Ratio to movingaverages
5. Determination of seasonal indices by method of Ratio totrend
6. Determination of seasonal indices by method of Linkrelatives

Index Numbers:

7. Computation of simple indexnumbers.
8. Computation of all weighted index numbers.
9. Computation of reversaltests.

Vital Statistics:

10. Computation of various Mortalityrates
11. Computation of various Fertilityrates
12. Computation of various Reproductionrates.
13. Construction of LifeTables

Note: Training shall be on establishing formulae in Excel cells and deriving the results. The excel outputshall be exported to MS Word for writing inferences.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -IV

Course 5: APPLIED STATISTICS

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain the method of Simple averages
2. Explain Cost of living Index numbers
3. Explain Graphical Method
4. What are the sources of vital statistics
5. Explain the use of index numbers
6. Explain Gross reproduction rate and Net reproduction rate.
7. Explain Method of least squares in time series.
8. Explain about logistic curve

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. a) Explain the components of Time series
(OR)
b) Explain methods of trend
10. a) Explain the problems involved in the construction of index numbers
(OR)
b) Explain the criteria of a good index number.
11. a) Explain Link Relative Method with its merits and demerits
(OR)
b) Explain about seasonal components methods
12. a) Explain about various death rates
(OR)
b) Explain life tables and its construction.
13. a) Explain about Growth curves
(OR)
b) Explain fitting of growth curves by the method of three selected points and partial sums



Theory Examination Pattern:

Theory Examination Question Paper ----- 75 Marks

Section---A----- 50 Marks

Section –B----- 25 Marks

Section-A-----Each Unit Consists of 10 Marks with internal choice

Section-B----- Consists of 25 Marks out of which the questions must be framed from all units.

Scheme of Practical Examination:

Practical Examinations will be conducted at the end of Odd Semesters with internal examiners and the End of even Semesters by the external examiners.

Practical Examination : 50 Marks

1 out of 5 Practical Problems the student has to answer/solve 3 questions. Each question problem carries 12 Marks-- $12 \times 3 = 36$

Marks

Splitting of marks for each problem:

Aim---2 Marks

Method and Formulae ----- 4 Marks

Solution----- 5 Marks

Conclusion/Inference-- 1

Mark

Maintenance &

Record-- 10

Marks Viva

..... 4 Mark



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 6A	Operations Research - I	Hrs/Wk: 4

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 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

Syllabus

UNIT I:

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. Graphical solution of linear programming problems. Some exceptional cases - Alternative solutions, Unbounded solutions, non-existing feasible solutions by Graphical method.

UNIT II:

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)

UNIT III:

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 IV:

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

UNIT V:

Post Optimal Analysis - Changes in cost Vector C , Changes in the Requirement Vector b and changes in the Coefficient Matrix A . Structural Changes in a LPP.



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. GassS.I : Linear Programming. Mc Graw Hill.
5. HadlyG : Linear programming. Addison-Wesley.
6. Taha H.M: Operations Research: An Introduction : Mac Millan.



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6A	Operations Research - I Lab	Hrs/Wk: 2

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

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

Practical's Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Solve LPP using Graphical method
2. Solve the LPP using Simplex method, Big M method and Two Phase method
3. Solve the problems using principle of duality
4. Solve the Problems using Dual Simplex method
5. Solve the problems for Post Optimal Analysis

Co-Curricular Activities:

a) Mandatory:

1. For Teacher:

Teacher shall train students in the following skills for 15 hours, by Taking relevant outside data (Field/Web).

1. To Solve the LPP using Graphical method
2. To Solve the LPP using Simplex method, Big M method and Two Phase Methods
3. To solve the LPP using Dual Simplex method

2. For Student: Fieldwork; Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.

1. Collecting the data and to perform OR techniques-Simplex method
(or)
2. Collecting the data and and to conduct post optimal analysis



3. Max.marks for Field WorkReport:05.

4. Suggested Format for Fieldwork Report: Titlepage, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.

5. Unittests(IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collectionofdata,Seminar,Quiz,Groupdiscussions/Debates
2. Visitst any specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SEMESTER -V (Skill Enhancement Course- Elective)

Course 6A: Operations Research - I

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain the advantages and limitations of OR.
2. Explain graphical solution of LPP.
3. Explain Canonical and standard forms of LPP.
4. Discuss basic solution and degenerate solution.
5. Explain artificial variable technique.
6. Discuss degeneracy in LPP.
7. Explain the general rules for converting primal into its dual.
8. Explain deletion of existing constraint.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Explain the origin and development of OR.

(OR)

- (b) Solve the following LPP graphically.

$$\begin{aligned} \text{Maximize } Z &= 45X_1 + 80X_2 \\ \text{Subject to constraints } &5X_1 + 20X_2 \leq 400 \\ &10X_1 + 15X_2 \leq 450 \\ &\text{and } X_1, X_2 \geq 0 \end{aligned}$$

10. (a) Explain simplex algorithm.

(OR)

- (b) Solve the following LPP using simplex method

$$\begin{aligned} \text{Maximize } Z &= 5X_1 + 3X_2 \\ \text{Subject to constraints } &3X_1 + 5X_2 \leq 15 \\ &5X_1 + 2X_2 \leq 10 \\ &\text{and } X_1, X_2 \geq 0 \end{aligned}$$

11. (a) Explain Big- M method.

(OR)

- (b) Solve the following LPP using Big – M method

$$\begin{aligned} \text{Maximize } Z &= 2X_1 + 3X_2 \\ \text{Subject to constraints } &X_1 + X_2 \geq 5 \\ &X_1 + 2X_2 \geq 6 \\ &\text{and } X_1, X_2 \geq 0 \end{aligned}$$



12. (a) Explain the concepts of duality and obtain the dual of the following LPP.

$$\begin{aligned} \text{Maximize } Z &= X_1 + 2X_2 + 3X_3 \\ \text{Subject to constraints } &3X_1 + X_2 - 2X_3 \leq 7 \\ &2X_1 + 4X_2 \geq 12 \\ &4X_1 - 3X_2 + 3X_3 \leq 10 \\ \text{and } &X_1, X_2, X_3 \geq 0 \end{aligned}$$

(OR)

(b) Explain dual simplex method and solve the following problem by it.

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

13. (a) Explain the changes in the coefficient of the objective function.

(OR)

(b) Discuss the changes in the components a_{ij} of the vector $a_j \in B$ for the given LP.

$$\begin{aligned} \text{Max } Z &= CX \\ AX &= b \\ X &\geq 0 \end{aligned}$$

*** ** ***



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 7A	Operations Research - II	Hrs/Wk: 4

Objective: *To enrich the knowledge of students with advanced 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 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 exists.

Syllabus

UNIT I:

Transportation Problem - Introduction, Mathematical formulation of Transportation problem. 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 II:

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.

UNIT III:

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 IV:

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.

UNIT V:

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 x 2 rectangular games. Graphical method of solving 2 x n and m x 2 games. Dominance Property.



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.
7. Dr.NVS Raju; Operations Research, SMS education,



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7A	Operations Research - II Lab	Hrs/Wk: 2

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

1. IBFS of transportation problem by using North- West corner rule, Matrix minimum 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. Graphical method of solving form $m \times 2$ and $2 \times n$ games.
9. Solution of $m \times n$ games by dominance rule.
10. Linear programming method for solving $m \times n$ games.

Practical's Skills Outcomes:

On successful completion of this practical course, students shall be able to:

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

Co-Curricular Activities:

a) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15hours,by Taking relevant outside data(Field/Web).
 1. To find IBFS by using North- West corner rule, Matrix minimum method and VAM for the given Transportation Problem.
 2. To Find Optimum solution to balanced and unbalanced transportation problems by MODI method (both maximization and minimization cases).
 3. To find the Assignment of n jobs to n persons using Hungarian method



4. To find processing of n jobs through two machines and three machines using Sequencing
 - a. Problem
5. To solve network problems using PERT and CPM techniques
6. To Solve form $x \times 2$ and $2 \times n$ games using Graphical method
7. To Find Solution of $m \times n$ games by dominance rule.
8. Solve $m \times n$ games by Linear programming method
2. **For Student: Fieldwork;** Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
 1. Collecting the data and to perform OR techniques
(or)
 2. Visiting Transportation places and Companies
3. **Max.marks for Field Work Report:05.**
4. **Suggested Format for Fieldwork Report:** Title page, Student Details, Index page, Step wise work-done, Findings, Conclusions and Acknowledgements.
5. **Unittests(IE).**

b) Suggested Co-Curricular Activities:

1. Assignments/collectionofdata,Seminar,Quiz,Groupdiscussions/Debates
2. Visits to any specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -V (Skill Enhancement Course- Elective)

Course 7A: Operations Research - II

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain transportation table.
2. Explain MODI method.
3. Explain assignment problem as a particular case of LPP and TP.
4. Explain the concepts of sequencing problem.
5. Explain the procedure of Graphical method for two jobs on m – machines.
6. Discuss rules for drawing net-work diagram.
7. Explain the method of dominance.
8. Discuss travelling sales man problem.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Define Mathematical formulation of T.P and explain algorithm of least – cost entry method.

(OR)

- (b) Obtain IBFS by using VAM to the following TP.

		Destinations				Capacities
		D1	D2	D3	D4	
Origins	O1	6	6	4	4	5
	O2	7	9	1	2	7
	O3	6	5	16	7	8
	O4	11	9	10	2	10
Requirement		10	5	10	5	

10. (a) Define Assignment problem and explain algorithm of Hungarian Method.

(OR)

- (b) Obtain the optimum assignment schedule to the following matrix.

		Machines			
		I	II	III	IV
Jobs		15	14	12	16
		23	22	25	24
		31	34	32	33
		21	32	44	53

11. (a) Explain Johnson’s algorithm to obtain optimum sequence for n jobs and two machines.

(OR)

- (b) A company has six jobs on hand, coded A to F/ All the jobs have to go through two machines and I and II. The time required for the jobs on each machine in hour is given below.

Jobs	A	B	C	D	E	F
Machine - I	1	4	6	3	5	2
Machine – II	3	6	8	8	1	5

Draw a sequence table scheduling the six jobs on the two machines.

12. (a) Explain the basic steps in PERT/ CPM techniques and its applications.



(OR)

(b) Discuss the rules for drawing network diagram.

13. (a) Find optimal strategy of the following game.

		B		
		I	II	III
A	I	-3	-2	6
	II	2	0	2
	III	5	-2	-4

(OR)

(b) Solve the following 2x4 game.

		I	II	III	IV
		I	2	2	3
A	II	4	3	2	6

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ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 6B	Statistical Process and Quality Control	Hrs/Wk: 4

Course Objectives: To understand the concept of quality, process control and product control using control chart techniques and sampling inspection plan. To have an idea about quality management, quality circles, quality movement and standardizations for quality.

Learning Outcomes:

After learning this course, the student will be able

1. To define 'quality' in a scientific way
2. To differentiate between process control and product control
3. To speak about quality awareness in industry
4. To pave a path to an industry to meet the standards
5. To effectively implement various plans to control the quality standards at various stages of an industry.

Syllabus

UNIT I:

Meaning of quality, concept of total quality management (TQM) and six-sigma, ISO, comparison between TQM and Six Sigma, Meaning and purpose of Statistical Quality Control (SQC), Seven Process Control Tools of Statistical Quality Control (SQC) (i) Histogram (ii) Check Sheet, (iii) Pareto Diagram (iv) Cause and effect diagram(CED), (v) Defect concentration diagram (vi) Scatter Diagram (vii) Control chart. (Only introduction of 7 tools is expected).

UNIT II:

Statistical basis of She whart control charts, use of control charts. Interpretation of control charts, Control limits, Natural tolerance limits and specification limits. Chance causes and assignable causes of variation, justification for the use of 3-sigma limits for normal distribution, Criteria for detecting lack of control situations:

- (i) At least one point outside the control limits
- (ii) A run of seven or more points above or below central line.

UNIT III:

Control charts for Variables: Introduction and Construction of \bar{X} and R chart and Standard Deviation Chart when standards are specified and unspecified, corrective action if the process is out of statistical control.

Control charts for Attributes: Introduction and Construction of p chart, np chart, C Chart and U charts when standards are specified and unspecified, corrective action if the process is out of statistical control.

UNIT IV:

Acceptance Sampling for Attributes: Introduction, Concept of sampling inspection plan, Comparison between 100% inspection and sampling inspection. Procedures of acceptance sampling with rectification, Single sampling plan and double sampling plan.

Producer's risk and Consumer's risk, Operating characteristic (OC) curve, Acceptable Quality Level (AQL), Lot Tolerance Fraction Defective (LTFD) and Lot Tolerance Percent Defective (LTPD), Average Outgoing Quality (AOQ) and Average Outgoing Quality Limit (AOQL), AOQ curve, Average Sample Number (ASN), Average Total Inspection (ATI).



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

UNIT V:

Single Sampling Plan: Computation of probability of acceptance using Binomial and Poisson approximation, of AOQ and ATI. Graphical determination of AOQL, Determination of a single sampling plan by: a) lot quality approach b) average quality approach.

Double Sampling Plan: Evaluation of probability of acceptance using Poisson distribution, Structure of OC Curve, Derivation of AOQ, ASN and ATI (with complete inspection of second sample), Graphical determination of AOQL, Comparison of single sampling plan and double sample plan.

TEXT BOOKS:

1. **Montgomery, D. C. (2008):** Statistical Quality Control, 6thEdn., John Wiley, New York.
2. **ParimalMukhopadhyay:** Applied Statistics, New Central Book Agency.
3. **Goon A.M., Gupta M.K. and Das Gupta B. (1986):** Fundamentals of Statistics, Vol. II, World Press, Calcutta.
4. **S.C. Gupta and V.K. Kapoor:** Fundamentals of Applied Statistics – Chand publications.

REFERENCES:

1. **R.C. Gupta:** Statistical Quality Control.
2. **Duncan A.J. (1974):** Quality Control and Industrial Statistics, fourth edition D.B. Taraporewala Sons and Co. Pvt. Ltd., Mumbai.
3. **Grant, E. L. and Leavenworth (1980):** Statistical Quality Control, fifth edition, Mc-Graw Hill, New Delhi.



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6B	Statistical Process and Quality Control Lab	Hrs/Wk: 2

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

1. Construction of \bar{X} and R Charts.
2. Construction of \bar{X} and σ Charts.
3. Construction of p Charts for fixed sample size.
4. Construction of p Charts for variable sample size.
5. Construction of np Charts.
6. Construction of C charts.
7. Construction of U charts.
8. Single sampling plan for attributes (OC Curve, Producer's and Consumer's risks, AOQ, AOQL, ATI).
9. Determination of single sampling plan by: a) lot quality approach b) average quality approach.
10. Double sampling plan for attributes (OC curve, AOQ, AOQL, ATI, ASN using Poisson distribution).

Practical's Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Construct Control Charts for Variables (\bar{X} bar, R and σ) charts using R.
2. Construct Control Charts for Attributes (p, np,c and u charts with fixed and varying sample sizes)
3. Draw (OC Curve, Producer's and Consumer's risks, AOQ, AOQL, ATI).for Single sampling plan for attributes
4. Determination of single sampling plan by: a) lot quality approach b) average quality approach.
5. Draw (OC curve, AOQ, AOQL, ATI, ASN using Poisson distribution). For Double Sampling Plan for attributes
6. Determine single sampling plan by: a) lot quality approach b) average quality approach.

Co-Curricular Activities:

a) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15 hours, by Taking relevant outside data (Field/Web).
 1. Construct Control Charts for Variables (\bar{X} bar, R and σ) charts for the data Construct Control Charts for Attributes (p, np,c and u charts with fixed and varying sample sizes) for the data
 2. Draw (OC Curve, Producer's and Consumer's risks, AOQ, AOQL, ATI).for Single sampling plan for attributes.
 3. Determination of Single sampling Plan and Double Sampling plan for the data
2. **For Student: Fieldwork;** Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
 1. Collecting the data and construct Control charts for Variables and Control charts for Attributes
(or)
 2. Collecting the data and construct OC curve, producers risk, consumers risk, AOQ, AOQL and ATI for single and Double sampling Plans



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

- 3. Max. marks for Field Work Report:05.**
- 4. Suggested Format for Field work Report:** Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.
- 5. Unittests(IE).**

b) Suggested Co-Curricular Activities:

1. Assignments/collectionofdata,Seminar,Quiz,Groupdiscussions/Debates
2. Visits to any specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SEMESTER -V (Skill Enhancement Course- Elective)

Course 6B: Statistical Process and Quality Control

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Concept of six sigma limits.
2. Explain natural and specification limits.
3. Explain standard deviation chart.
4. How do you construct c- chart.
5. What is a producer and consumer risk.
6. What is ASN and ATI.
7. How do you compare single sample plan and double sample plan.
8. How do you determine AOQL by graphically.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Explain the meaning and purpose of SQC.
(OR)
(b) Discuss seven process control tools for SQC.
10. (a) Discuss the statistical basis of Stewart control charts.
(OR)
(b) Justify the use 3 – sigma limits for normal distribution.
11. (a) Explain the control charts for variables.
(OR)
(b) How do you construct P and nP charts.
12. (a) Explain single sampling plan.
(OR)
(b) Discuss about AQL, LTFD and LTPD.
13. (a) Discuss double sampling plan.
(OR)
(b) Discuss about structure of oc curve and ASN function.

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ADIKAVI NANNAYA UNIVERSITY:: RAJAHMAHENDRAVARAM
B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 7B	Computational Techniques and R Programming	Hrs/Wk: 4

Course Objectives: To learn the statistical analysis with the help of the statistical software R

Learning Outcomes:

After learning this course the student will be able

1. Know about basics of computer
2. Know about Organization of digital computers
3. Know about Computer Programming and flow charts
4. Know and study about R Programming
5. Know about the usage of R in Descriptive Statistics

Syllabus

UNIT I:

Computer basics: Introduction and brief history of evolution of computers, Classification of computers: special purpose and general purpose; analog, digital and hybrid; Super, main-frame etc.

UNIT II:

Organization of general purpose digital computers: CPU, main memory and peripherals. Mass storage devices and other I/O devices. Computer languages: Machine code language (machine language), assembly language and high level languages. Software: Operating systems, linker, loader, compiler, interpreter and assembler.

UNIT III:

Computer programming: Algorithm and flow-chart. Storage of information: concepts of records and files. File organization: sequential, relative and indexed.

UNIT IV:

Programming with R: Introduction to R, Data types in R (numeric, logical, character, complex etc.), R objects: vector, matrix, array, list, data frame, factor, and time series. Arithmetic, logical and relational operators, explicit and implicit looping, functions and functional programming in R, Lexical scoping rules in R, benefits of Lexical scoping, other scoping rules, debugging facility in R. Few important mathematical, statistical and graphical functions in R.

UNIT V:

Descriptive Statistics with R software: : Calculations with R software such as descriptive statistics, frequency distribution, Graphics and plots, statistical functions of central tendency, variation, skewness and kurtosis and illustration with examples.

REFERENCE BOOKS:

1. Chambers, J. (2008). Software for Data Analysis: Programming with R, Springer.
2. Crawley, M.J. (2017). The R Book, John Wiley & Sons.
3. Eckhouse, R.H. and Morris, L.R. (1975). Minicomputer Systems Organization, Programming and Applications, Prentice-Hall.
4. Matloff, N. (2011). The Art of R Programming, No Starch Press, Inc.
5. Peter N. (1986). Inside the IBM PC, Prentice-Hall Press.



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6. Dr. Mark Gardener(2012): Beginning R The statistical Programming Languages, John Wiley & Sons.
7. Sudha G. Purohit, SharadD.Gore, and ShailajaR.Deshmukh (2008), Statistics Using R, Narosa Publishing House, India.
8. Crawley, M.J. (2006). Statistics – An introduction using R. John Wiley London.
9. Purohit, S.G., Deshmukh, S.R. and Gore, S.D., (2015): Statistics using R, Alpha Science International.
10. Verzani, J., (2018): Using R for introductory statistics. CRC press.
11. Schumacker, R.E., (2014): Learning statistics using R. Sage Publications.
12. Michale J. Crawley (2009), THE R BOOK, John Wiley & Sons.



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7B	Computational Techniques and R Programming Lab	Hrs/Wk: 2

Practical/Lab to be performed on a computer using R Software

1. Data visualization using R - frequency polygon, Ogives, Histogram.
2. Data visualization using R - simple and multiple bar diagram, pie chart.
3. Computation of Descriptive Statistics using R - Central Tendencies, Dispersions, Moments, Skewness and Kurtosis.
4. Computation of Karl Pearson's Coefficient of Correlation and Rank Correlation using R.
5. Construction of Control Charts for variables (\bar{X} , R and σ) charts using R.
6. Construction of Control Charts for attributes (p, np charts with fixed and varying sample sizes) using R.
7. Construction of Control Charts using R - C and U charts.

Practical's Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Draw frequency polygon, ogives, Histogram, Simple and multiple bar diagrams and Pie chart using R
2. Compute Descriptive statistics using R
3. Compute Coefficient of Correlation and Rank Correlation using R
4. Construct Control Charts for Variables (\bar{X} , R and σ) charts using R.
5. Construct Control Charts for Attributes (p, np charts with fixed and varying sample sizes) using R.
6. Construction of Control Charts using R - C and U charts.

Co-Curricular Activities:

a) Mandatory:

1. **For Teacher:** Teacher shall train students in the following skills for 15hours,by Taking relevant outside data(Field/Web).
 1. To draw Frequency Polygon, Histogram, Ogives, bar diagrams and pie charts using R for the collected data.
 2. To calculate Descriptive Statistics using R for the data.
 3. To calculate Correlation coefficient and rank correlation coefficient using R for the collected data.
 4. To Construct Control charts for Variables and Attributes using R for the data
2. **For Student: Fieldwork;** Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
 1. Collecting the data and construct charts-Histogram, bar diagrams and pie chart, and to calculate Descriptive statistics, Correlation, Rank correlation for the collected data using R

(or)

 2. Collecting the data and construct Control charts for Variables and Control charts for Attributes using R



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

3. **Max.marks for Field WorkReport:05.**
4. **Suggested Format for Field work Report:** Title page, Student Details, Index page, Step wise work-done, Findings, Conclusions and Acknowledgements.
5. Unittests(IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collectionofdata,Seminar,Quiz,Groupdiscussions/Debates
2. Visitstoany specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -V (Skill Enhancement Course- Elective)

Course 7B: Computational Techniques and R Programming

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain mass storage devices.
2. Explain matrix operation using Excel functions.
3. Discuss Bar chart and pie chart in Excel.
4. Explain filtering of straight line.
5. Explain Performing students t – test.
6. Explain Arithmetical logical operators in R.
7. Explain the lexical scoping rule in R.
8. Discuss graphics and plots.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Explain the types of software with examples.
(OR)
(b) Explain Block diagram of computer.
10. (a) Discuss data entry and editing features in Excel.
(OR)
(b) Explain the how to create power point presentation in detail.
11. (a) Explain polynomial and power curves using Excel.
(OR)
(b) Discuss data analysis pak and its features.
12. (a) Explain the data type in R – programming.
(OR)
(b) Explain the statistical and graphical function in R.
13. (a) Discuss skewness and kurtosis along with their illustrated examples.
(OR)
(b) Explain statistical functions of central tendency.



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B.Sc Statistics Syllabus (w.e.f:2020-21 A.Y)

B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 6C	Econometrics	Hrs/Wk: 4

Learning Outcomes:

The course on econometrics will primarily focus on the use of statistical modelling 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, some inferential aspects on heteroscedasticity, practical aspects and real data illustration of the related problems.

Syllabus:

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, simple regression models, two variable linear regression model, assumptions estimations of parameters.

UNIT II:

Models and Estimations: Gauss marcoff theorem, OLS estimations, partial and multiple correlations coefficients. The general linear model assumptions, estimation and properties of estimators, BLUEs, and tests of significance of estimators, R square and ANOVA.

UNIT III:

Problems in OLS Estimators: Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity.

UNIT IV:

Autocorrelation: concept, consequences of auto correlated disturbances, detection and solution of autocorrelation.

UNIT V:

Heteroscedastic disturbances: Concepts, Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity, specification error, Errors of measurement.

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.



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 6C	Econometrics Lab	Hrs/Wk: 2

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. Problems related to consequences Heteroscedasticity.
11. Diagnostics of Heteroscedasticity.
12. Estimation of problems of General linear model under Heteroscedastic distance terms.

Practical's Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Solve the General Linear Model Problems, Testing of Parameters of General linear Model and forecasting of General linear model
2. Solve the problems concerning Specification errors
3. Solve the problems related to multicollinearity and its Diagnostics
4. Solve the problems related to Autocorrelation and its Diagnostics and to estimate problems of General linear model under Autocorrelation
5. Solve the problems related to Heteroscedasticity and its Diagnostics and to estimate problems of General linear model under Heteroscedasticity.

Co-Curricular Activities:

a) Mandatory:

1. **For Teacher:** Teachers shall train students in the following skills for 15 hours, by Taking relevant outside data (Field/Web).
 1. Solving the problems related to General Linear Problems
 2. Solving the problems related to Specification errors
 3. Solving the problems related to Multicollinearity
 4. Solving the problems related to Autocorrelation
 5. Solving the problems related to heteroscedasticity
2. **For Student: Fieldwork;** Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
 1. Collecting the data and frame General linear model and draw the conclusions by solving it

(or)

 2. Collecting the data and finding the relationship between the variables using Multicollinearity and to draw conclusions from it.



3. **Max.marks for Field WorkReport:05.**
4. **Suggested Format for Fieldwork Report:** Title page, Student Details, Index page,Stepwise work-done, Findings, Conclusions and Acknowledgements.
5. Unittests(IE).

b) Suggested Co-Curricular Activities:

1. Assignments/collectionofdata,Seminar,Quiz,Groupdiscussions/Debates
2. Visits to any specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -V (Skill Enhancement Course- Elective)

Course 6C: Econometrics

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain the concept of econometrics.
2. Discuss the importance of measurement in econometrics.
3. Write about simple regression model.
4. Explain BLUE's.
5. Explain R square.
6. Discuss about specification errors.
7. How do you measure VIF.
8. Explain Durbin Watson test.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Explain the nature of econometrics and economic data.
(OR)
(b) Discuss the structure of economic data.
- 10.(a) Explain two variable linear regression model.
(OR)
(b) Derive Gauss Markoff theorem.
(c)
11. (a) Explain the tests of significance of estimators.
(OR)
(b) Discuss the concepts and consequences heteroscedasticity.
12. (a) Explain cause and effects of multicollinearity.
(OR)
(b) Explain any one method of reducing the influence of multicollinearity.
- 13.(a) Explain disturbance term in econometric models and its assumptions.
(OR)
(b) Discuss the sources of autocorrelation.

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B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 4
Course: 7C	Regression Analysis	Hrs/Wk: 4

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.

Syllabus

UNIT I:

Correlation: Bivariate data, Scatter diagram and interpretation. Karl Pearson's correlation coefficient, Properties. Spearman's rank correlation coefficient, with ties and without ties, limits. Regression, difference between correlation and regression.

UNIT II:

Steps in Regression Analysis: Assumptions of regression models. Simple linear regression model, Estimation of regression parameters by least squares method (fitting of regression model), Interpretation of parameters. Concept of residual, Residual plots. Multiple linear regression: Estimation of regression parameters by least square method, Interpretation of parameters. Concept of coefficient of determination.

UNIT III:

Regressions with Qualitative Independent Variables: Dummy variable technique — Testing structural stability of regression models comparing two regressions, interaction effects, seasonal analysis.

UNIT IV:

Regressions with Qualitative Dependent Variables: Piecewise linear regression, use of dummy variables, regression with dummy dependent variables; The LPM, Logit, Probit and Tobit models — Applications.

UNIT V:

Best Model: Selecting 'Best' regression model. All possible regressions – R^2 , Adjusted R^2 , MS_{Res} , Mallow's statistic. Sequential selection – forward selection, backward elimination.



REFERENCES:

1. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis. 3rd 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. 5th Edition. Wiley.
4. Neter, J., Kutner, M. H., Nachtsheim, C.J. and Wasserman, W. (1996). Applied Linear Statistical Models, 4th Edition, Irwin USA.
5. Gujarati, D. and Sangeetha, S. (2007). Basic Econometrics, 4th Edition



B. Sc	Semester: V (Skill Enhancement Course- Elective)	Credits: 1
Course: 7C	Regression Analysis Lab	Hrs/Wk: 2

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

1. Correlation coefficient
2. Rank correlation Coefficient
3. Regression Lines
4. Linear Models
5. Structural stability
6. Selecting best regression model by R^2
7. Selecting best regression model by Adjusted R^2
8. Selecting best regression model by MS_{Res}
9. Selecting best regression model by Mallows's statistic
10. Selecting best regression model by forward selection
11. Selecting best regression model by backward elimination.

Practicals Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. Calculate Correlation Coefficient, RankCorrelation Coefficient, Regression lines and Linear models for the data
2. Select best regression model by R^2 , Adjusted R^2 , MS_{Reg} , Mallows's Statistic
3. Select best regression model by forward selection and backward elimination

Co-Curricular Activities:

c) Mandatory:

1. **For Teacher:** Teachers shall train students in the following skills for 15 hours, by Taking relevant outside data (Field/Web).
 1. Solving the problems related to General Linear Problems
 2. Solving the problems related to Specification errors
 3. Solving the problems related to Multicollinearity
 4. Solving the problems related to Autocorrelation
 5. Solving the problems related to heteroscedasticity
2. **For Student: Fieldwork;** Each student individually shall undertake field work and submit a report not exceeding 10 pages in the given format on the work-done in the areas like the following, by choosing any one of the aspects.
 1. Collecting the data and frame General linear model and draw the conclusions by solving it
(or)
 2. Collecting the data and finding the relationship between the variables using Multicollinearity and to draw conclusions from it.
3. **Max.marks for Field Work Report:05.**
4. **Suggested Format for Fieldwork Report:** Title page, Student Details, Index page, Stepwise work-done, Findings, Conclusions and Acknowledgements.
5. Unit tests (IE).

d) Suggested Co-Curricular Activities:

1. Assignments/collection of data, Seminar, Quiz, Group discussions/Debates
2. Visits to any specified areas for doing survey and data collection
3. Invited lectures and presentations on related topics by experts in the specified area.



MODEL QUESTION PAPER (Semester End)

B. Sc DEGREE EXAMINATIONS

SMESTER -V (Skill Enhancement Course- Elective)

Course 7C: Regression Analysis

Time: 3 Hrs.

Max Marks: 75

SECTION-A

Answer any FIVE questions. All questions carry equal marks.

5 x 5= 25M

1. Explain regression.
2. Explain the properties of least square estimation.
3. Explain the concept of residual plots.
4. Discuss the concept of coefficient of determination.
5. Explain the use of dummy variable in regression.
6. Distinguish comparing the slopes of two regressive models.
7. Explain Binary logistics regression.
8. Write about Mallow's statistics.

SECTION-B

Answer ALL the questions. All questions carry equal marks.

5 x 10 = 50M

9. (a) Explain simple linear regression model.
(OR)
(b) Explain testing significance of regression and analysis of variance.
10. (a) Discuss multiple linear regression model.
(OR)
(b) Explain least square estimation of regression coefficients.
11. (a) Explain testing the structure stability of regression models.
(OR)
(b) Explain multiple linear regression with interaction effects.
12. (a) Discuss evaluating the Odds Ratio (OR) and its interpretation.
(OR)
(b) Discuss the concepts of piecewise linear regression.
13. (a) Define selection of variables forward selection procedure backward elimination stepwise method.
(OR)
(b) Discuss 'Best' regression model.

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