

**SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE, UJIRE-574240**

**(Autonomous)**

**(Re-Accredited by NAAC at 'A' Grade with CGPA 3.61 out of 4)**



# **DEPARTMENT OF STATISTICS**

*Syllabus of*  
**Bachelor's Degree in  
STATISTICS**

**(CREDIT BASED SEMESTER SCHEME)  
2016- 2017 onwards.**

**Approved by the: BOS meeting held on 16<sup>th</sup> July 2016  
Approved by the Academic Council meeting, held on 05-10- 2016**



## STATISTICS AS A DISCIPLINE

Statistics is the study of the collection, analysis, interpretation, presentation, and organization of data. In applying statistics to a scientific, industrial, biological, agricultural or social problem, it is conventional to begin with a statistical population or a statistical model process to be studied. Statistics deals with all aspects of data including the planning of data, collection in terms of the design of surveys and experiments.

When census data cannot be collected, statisticians collect data by developing specific experiment designs and survey samples. Representative sampling assures that inferences and conclusions can safely extend from the sample to the population as a whole. Two main statistical methods are used in data analysis: descriptive statistics, which summarizes data from a sample using indexes such as the mean or standard deviation, and inferential statistics, which draws conclusions from data that are subject to random variation. Inferences on mathematical statistics are made under the framework of probability theory, which deals with the analysis of random phenomena.

### Course Objectives

- Principles of study design and data collection.
- Interpretation of the data using graphical tools.
- Interpret numerical summary statistics .
- Study of properties of the normal curve.
- Study of correlation and regression models.
- Inferential properties of a population from a sample.
- Study of optimization problems
- Application of statistics in agricultural experiments



## PAPER DESCRIPTION

Sl.No	Semester	Paper	Title
1	I	Paper 1 Practical 1	Exploring data and probability theory
2	II	Paper 2 Practical 2	Regression and discrete probability distribution
3	III	Paper 3 Practical 3	Continuous Probability distributions and Estimation
4	IV	Paper 4 Practical 4	Sampling theory and sampling distribution
5	V	Paper 5 Practical 5	Interval Estimation and tests of hypothesis
6	V	Paper 6 Practical 6	Design of Experiments
7	VI	Paper 7 Practical 7	Operations Research
8	VI	Paper 8 Practical 8	Applied Regression Analysis

## SCHEME OF EXAMINATION

Sl.No	Semester	Paper	Credits	Marks		
				IA	Sem End	Total
1	I	Paper 1	2	20	80	100
		Practical 1	1	10	40	50
2	II	Paper 2	2	20	80	100
		Practical 2	1	10	40	50
3	III	Paper 3	2	20	80	100
		Practical 3	1	10	40	50
4	IV	Paper 4	2	20	80	100
		Practical 4	1	10	40	50
5	V	Paper 5	2	20	80	100
		Practical 5	1	10	40	50
6	V	Paper 6	2	20	80	100
		Practical 6	1	10	40	50
7	VI	Paper 7	2	20	80	100
		Practical 7	1	10	40	50
8	VI	Paper 8	2	20	80	100
		Practical 8	1	10	40	50
<b>Total</b>			<b>24</b>	<b>240</b>	<b>960</b>	<b>1200</b>



**I SEMESTER - Paper I**  
**EXPLORING DATA AND PROBABILITY THEORY**  
**Teaching Hours : 3hrs per week**

**Rationale/ Learning Objectives:**

- Identify the relevant population, sample, study units (subjects), variables, and factors.
- To know various types of data, methods of collection and presentation of the data.
- Identify the different types of averages suitable to different situations.
- Probability is used to measure chance of occurrence of an event.
- Introduction to R software.

**Unit 1:**

Basic statistical concepts- Population, Parameter, sample, statistic, variable, attribute. Types of Data – Qualitative and Quantitative, Scales of measurement –nominal, ordinal, interval and ratio. Classification, Tabulation, Diagrammatic presentation of data.- bar diagrams and pie charts. Univariate & bivariate frequency distributions Stem and Leaf charts, Graphical presentation of frequency Distribution- Histogram, frequency polygon, frequency curve, Ogives and Box Plot.

**Unit 2 :**

Measures of Central tendency – Mean, median, Mode, G.M., H.M., weighted averages, Quartiles, algebraic properties of Mean. Derivation of formula for computation of Median & Mode, Statement of combined mean, G.M. and H.M. Merits and demerits of each average.

Measures of dispersion, Skew ness and kurtosis – Absolute and relative measures, average Deviation from mean and Median, Q.D., variance, S.D., C.V., Bowley's measure of skew ness, Moments(relationship between raw moments and central moments- statement only), Karl Pearson's measures of skew ness and kurtosis. Correlation- positive, negative, linear and curvilinear correlations- methods of study- scatter Diagram, Karl Pearson and Edward Spearman's coefficient – derivation of Spearman's formula (without ties) – computation with and without ties.



**Unit 3** : Introduction to Classical Probability – Basic concepts, Axioms of probability, justification of Axioms using properties of relative frequency, a priori probability-a posteriori probability, Addition theorem (proof based on axiomatic approach), conditional probability, independent events, Necessary and sufficient condition for independence of 2 and 3 events, multiplication rule, Baye’s Rule - computation of probabilities under finite sample space.

### **Practical – I**

1. Introduction to R
2. Exercises on graphic presentation of data – Histogram, Ogives, stem and leaf chart and box Plot
3. Measures of Central Tendency - 1 ( R)
4. Measures of Central tendency -2 (R)
5. Measures of dispersion -1 (R)
6. Measures of Dispersion -2 (R)
7. Measures of moments, skew ness, kurtosis
8. Exercises on Probability theory
9. Correlation for ungrouped and grouped data (R)
10. Computation of spearman’s rank correlation with and without ties. (R)

#### **Student Activities:**

- Seminar on selected topics
- Power point presentation
- Quiz
- Assignments



**Books for Reference:**

1. Goon A.M., Gupta,M.K., and Das Gupta (1986), *Fundamentals of Statistics* , Vol-1, 6<sup>th</sup> edition, World Press, Kolkatta
2. S.C. Gupta and V.K. Kapoor , *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
3. V.K. Rohatgi, *Introduction to probability theory & mathematical statistics*, Wiley Eastern, New Delhi
4. Hogg & Craig, *Introduction to mathematical statistics*, Macmillan, New York
5. Irwin Miller,Maryless Miller:, John E. Freund's, *Mathematical Statistics*, Prentice Hall .

**Additional reference books:**

1. Spiegel,M.R.(1961),*Theory and problems of statistics*,Schaum Publishing Co.
2. Pitman J (1993), *Probability*, Narosa Publishing House
3. Peter Dalgad, *Introductory statistics using R*, online education, Spring Street, New York.



**II SEMESTER - Paper II**  
**REGRESSION AND DISCRETE PROBABILITY DISTRIBUTIONS**  
**Teaching Hours : 3hrs per week**

**Rationale /Learning Objectives:**

- To distinguish between bivariate and trivariate regression
- Fit simple linear regression models.
- Use a simple linear regression model to predict the value of one variable based on the value of an associated variable.
- To understand the concept of random variables, pmf, pdf,mgf,cgf etc.
- Study of standard discrete probability distributions and their relationship, applications.

**Unit 1:**

Scatter diagram, simple linear regression model, method of least squares, an example of least squares calculations, determining a line of average relationship, the method of graphic analysis,

Multiple and partial correlation coefficients- related results of partial and multiple correlations.

**Unit 2:**

Random variable: Discrete and continuous random variables- Definition of pmf, pdf, cdf. Definition of Mgf and its properties, Cgf. Marginal and Conditional distributions of two random variables, independence of random variables, expectation, Rules of expectation, addition and multiplication theorem on expectation- Variance, Covariance and Correlation coefficient, mean and variance of a linear Combination of random variables.

**Unit 3:**

Discrete distributions – Bernoulli distribution – definition, examples, moments & mgf. Binomial distribution, definition, examples, mgf, moments using mgf, recurrence relation



for central Moments, mode, relationship between Bernoulli and Binomial. Poisson distribution – definition, Examples. mgf, cgf, moments using mgf, recurrence relation for central moments, mode(expression only), P.D. as an approximation to B.D. - Additive property of B.D. and P.D. Fitting of Binomial and Poisson to the given data. Geometric distribution, definition, Examples, mgf, moments using mgf, cdf, lack of memory property and its physical interpretation- Negative B.D. definition, examples, moments, mgf, recurrence relation for central moments. Mode, (expression only) Relationship Between negative B.D. and G.D. N.B.D as an approximation to B.D, Additive property of N.B.D Hyper geometric distribution, definition, example, mean and variance, B.D. as an approximation to h.g.d. – relationship between h.g.d. and Bernoulli.

16 Hours

### Practical II

1. Regression for ungrouped data (EXCEL)
2. Computation of partial, multiple correlation coefficients
3. Computation of mean and variance of random variables (EXCEL)
4. Computation of moments and Karl Pearson's coefficient of correlation for discrete bivariate probability Distributions. (EXCEL)
5. Exercises on discrete probability distributions-1
6. Exercises on discrete probability distributions-2
7. Fitting of Binomial Distribution and draw cdf (R)
8. Fitting of Poisson distribution and draw cdf (R)
9. Fitting of Negative Binomial distribution(R)
10. Generating random observations from B.D., P.D, G.D.( R)

### Students Activities

- Seminar
- Power point presentation
- Quiz
- Assignments





### **Books for References:**

1. Bali N P(2007), *Golden statistics*, Laxmi publication Pvt. Ltd.
2. Gupta S C & Kapoor V K(1984),*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
3. Hogg & Craig(1970), *Introduction to mathematical statistics*, Macmillan, New York.
4. Irwin Miller, Maryless Miller & John E. Freund's(2014), *Mathematical Statistics*, Prentice Hall.
5. Levin R(2013), *Statistics for management*, Prentice hall India.
6. Pitman J (1993), *Probability*, Narosa Publishing House.
7. Rohatagi V K(2001), *Introduction to probability theory & mathematical statistics*, Wiley eastern, New Delhi.

### **Additional books for reference:**

1. Montgomery D C(2012), *Applied Statistics and Probability for Engineers*, John Wiley and sons.
2. Parimal Mukhopadhyay (2000) , *Mathematical statistics* , Books & Allied Pvt. Ltd., Kolkatta.



**III SEMESTER - Paper III**  
**CONTINUOUS PROBABILITY DISTRIBUTIONS AND ESTIMATION**  
**Teaching Hours : 3hrs per week**

**Rationale /Learning Objectives**

- Able to understand the various probability modules for continues random variable and computation of various probabilities.
- Understand properties of the normal curve
- Able to understand the relationship between different distributions using Jacobean of transformation technique
- To study the Application of various continuous probability distribution

**Unit 1 :**

Normal distribution, definition, examples – normal curve – properties – mgf, cgf, moments, - M.D. & Q.D. –Mode & median, Additive property- fitting of normal distribution. Standard normal curve And its properties – area property of S.N.D. , Points of inflexion of normal curve.

Continuous Uniform distribution – definition, c.d.f., moments, mgf., median, distribution of distribution Function of continuous rvs,

Exponential distribution- single parameter exponential distributions – definition, moments, Mgf , cgf, cdf , median, lack of memory property. Single and double parameter gamma distribution- Definition, mgf, moments, mode, Beta distributions, mean and variance. Cauchy distribution: c.d.f. median, mode, Q.D. Points of inflexion (statement only). Its relationship with uniform and normal (Statement only)

**Unit 2:**

Transformation of continuous random variables. Distribution function technique, mgf technique, & use of Jacobian of transformation- Applications–Distributions discussed in Unit1.



### Unit 3 :

Point estimation: Estimator and estimate. Criteria of estimation – unbiased ness, asymptotic unbiasedness, consistency of estimators. Sufficient condition for consistency. Relative efficiency. Maximum Likelihood and moment methods of estimation – properties of these methods(without proof)-Problems on Bernoulli, B.D. P.D., G.D , N.B.D., Exponential (single parameter with range free of parameter), Beta 1 and Beta2, uniform and normal distributions.

### Practical III

1. Exercises on normal distribution
2. Fitting of normal distribution
3. Generating random Observations from Normal distribution. (R)
4. Checking for normality for the given data (R)
5. Generating random observations from exponential distribution (R)
6. Generating random observations from Cauchy distributions. (R)
7. Fitting of exponential distribution to the given data. (R)
8. Estimation by the method of maximum likelihood -1
9. Estimation by the method of maximum likelihood -2
10. Estimation by the method of moments.



## Students Activities

- Power Point Presentations
- Quiz
- Assignments
- Articles on current national and state issues
- Sample survey
- Small Research Projects

## Books for Reference:

1. Gupta S.C. & V.K. Kapoor ,*Fundamentals of applied statistics* , Sultan Chand & Sons
2. Goon A.M. Gupta M.K. Das Gupta (2001), *Fundamentals of statistics*, Vol. I & Vol. II
3. Goon A.M. and others, *Outline of Statistical theory*, Vol. I
4. Parimal Mukhopadhyay , *Mathematical statistics*, Books & Allied Pvt. Ltd.
5. Gupta S.C. & V.K. Kapoor , *Fundamentals of mathematical Statistics*, Sultan Chand & Sons.
6. Pitman J (1993), *Probability*, Narosa Publishing House

## Additional books for reference:

1. S.M. Ross, *Introduction to Probability Models*, Tenth Edition, University of Southern California
2. Spiegel, M.R.(1961) – *Theory and problems of statistics* (Schaum Publishing Co.)



**IV SEMESTER – Paper IV**  
**SAMPLING THEORY AND SAMPLING DISTRIBUTION**  
**Teaching hours: 3hrs per week**

**Rationale /Learning Objectives:**

- To know about sample and census surveys .
- Describe basic sampling schemes (simple random sampling, stratified sampling, systematic sampling ,census versus sample), their merits and demerits.
- To study the different types of sampling distributions and their applications in the real life.

**Unit 1: Sampling theory:**

Introduction to sampling – Brief comparison of complete enumeration and Sample surveys Design of sample survey, Guidelines for framing the questionnaire– sampling and non-sampling errors – Sampling distribution, Simple random sample – with & without replacement, drawing random sample using lottery method, selection of samples using random number Tables. Drawing samples from finite population with and without replacement. Unbiased estimators of mean and total – derivation of Expression for variance & S.E. of estimates – their estimation. f.p.c.- sampling for proportion, Unbiased estimate of population mean and population proportion and its variance – S.E. of estimate and its estimator, Estimation of sample size given the precision, both in the general case and in the case of proportion.

**Unit 2:**

Stratified sampling - definition, need for stratification, advantages, Stratified sample under SRSWOR. Variance and S.E. of these estimators and their Estimation – problems of allocation – proportional, Neyman and optimum allocations for a given Cost function and fixed precision (w.r.t SRSWOR stratifications) . Comparison of SRSWOR, stratified random sampling – gain in precision due to stratification. Systematic sampling – description, advantages, linear systematic sample and circular systematic sample – description Only- variance of the estimator of the mean in terms of  $S^2_{wsy}$  and in terms of intra class correlation. Comparison of SRSWOR, stratified random sampling with



SRSWOR, systematic sample designs. Cluster sampling –reasons for cluster sampling, multistage sampling (2stage) - merits and demerits

**Unit - 3:** Sampling distribution – order statistics, sampling distributions of extreme order statistics, Definition of student t, chi-square and F distributions and their properties, inter relationship Between these distributions, normal approximation to student t distribution, distribution of sample mean, Sample variance, assuming independence of sample mean and variance Tchebycheff's inequality, Sequence of rvs, and convergence in probability-basic results (without proof). WLLN. CLT for iid rvs. Application of CLT.

#### **Practical-IV**

1. Listing all possible SRSWR & SRSWOR from a given population & verifying the estimators of the mean, total and Sampling variance of the estimators is unbiased.
2. Drawing of random sample under SRSWOR & SRSWR designs from a given population & estimation of mean total and sampling distribution of S.E. of estimators.
3. Estimation of the proportion and S.E. of estimators based on a random sample under SRSWR & SRSWOR designs.
4. Estimation of sample size given the precision.
5. Estimation of mean, total, & S.E. of estimators under stratified random sample.
6. Stratified random sampling with allocations.
7. Comparison of precision of estimators under stratified sampling with proportional & optimal allocation & that under SRSWOR.
8. Listing all possible systematic samples from a given population (with  $N=nk$ ) & computation of variance of estimator and its comparison with that of SRSWOR.
9. Exercises on Tchebycheff's inequality
10. Applications of CLT.



## Students Activities

- Power Point Presentations
- Quiz
- Assignments
- Seminars
- Sample survey

## Books for Reference:

1. Cochran W G and Cox(1977), *Sampling techniques*, 3<sup>rd</sup> edition, Wiley eastern.
2. Goon A M & others(1980), *Outline of statistical theory*, Vol. II - World Press Kolkatta.
3. Gupta S C & Kapoor V K(1984), *Fundamentals of mathematical statistics*, Sultan Chand & Sons.
4. Gupta S C & Kapoor V K (1984), *Fundamentals of applied statistics* , Sultan Chand & Sons.
5. Mood A M & Graybill F(1974), *Introduction to theory of statistics*, Mc Graw Hill.
6. Rohatagi V K(2001), *Introduction to probability theory and mathematical statistics*, Wiley Eastern, New Delhi.
7. Sampath S (2000), *Sampling theory*, Narosa.

## Additional books for reference:

1. Murthy M N(1967) , *Sampling theory and methods*, Statistical publishing society, Calcutta.
2. Parimal Mukhopadhyay(2000), *Theory and methods of survey sampling*, Phi learning Pvt. Ltd.



**V SEMESTER - Paper V**  
**INTERVAL ESTIMATION AND TESTS OF HYPOTHESES**  
**Teaching Hours : 3hrs per week**

**Rationale /Learning Objectives:**

- Able to understand interval estimation and their applications in the practical life.
- Able to understand the basic concepts of hypothesis testing
- Constructing confidence intervals and performing hypothesis tests for means and proportions within a group
- To find the BCR for testing  $H_0$  against  $H_1$

**Unit 1:**

Interval estimation – Need and meaning, confidence coefficient, confidence interval, meaning of pivotal Quantity. Large sample Confidence interval for mean, difference between means, proportion and difference between Proportion Confidence interval for mean, difference between means, variance and ratio of variances(mean known and unknown Cases) , confidence interval for difference between means for paired data under normality.

Tests of hypotheses: null & alternative, simple& composite, critical region-two types of errors. Level of significance, & P-value. Power of a test – power function & power curve. MP- test. Statement of Neyman-Pearson Lemma and Its use in testing parameters of normal, exponential (range independent of parameter).

**Unit 2:**

Likelihood ratio tests – derivation of tests for normal distribution( single mean, equality of means, variance and equality of variances) with two sided alternatives.

test for independent samples, Paired-t test, t-test for correlation coefficient. Properties of LRTP without proof.

Large sample test for mean, difference between two means, test for proportion, difference between proportions Fisher's Z-transformation & its applications. Chi-square test for goodness of fit & for independence of attributes in a Contingency table. Brandt-Snedecor formula. Chi-square test in a 2x2 table. Yates correction for continuity.





### Unit 3:

Sequential testing: Need for sequential test. Strength of sequential tests. Wald's SPRT applied to Bernoulli, Poisson, Normal and exponential distributions (range independent of parameter). Expressions to stopping bounds to be Given without proof.

Non parametric tests: Meaning & need. Advantages. One sample and two sample Sign test, Median test, Run test for Randomness, Mann Whitney U test, Wilcoxon sign rank test, Mcmmar test for comparing two proportions.

#### Practical - V

1. Large sample confidence interval for variables and attributes
2. Confidence interval for mean, difference between means, for paired data. variance and ratio of variances (mean known & unknown cases) under normality.
3. Computation of size and power of the test and drawing power curves
4. Testing for mean, equality of means, variance, ration of variances
5. Large sample test for significance of mean, proportion, equality of means and equality of proportions.
6.  $\chi^2$  test of goodness of fit.
7.  $\chi^2$  test of independence in a Contingency table.
8. Sequential Probability Ratio test Procedure
9. One sample and two sample sign test (small and large samples) 8. Wilcoxon sign rank test
10. Median test (small and large samples) Run test for randomness (small & large samples) & Mann whitney test
11. Gibbons – Non parametric test.



**Students activities:**

- Power Point Presentations
- Quiz
- Assignments
- Seminars
- Data analysis
- Sample survey

**Books for Reference:**

1. Goon A.M. & others ,*Fundamentals of statistics*, Vol. II ,World Press, Kolkatta.
2. S.C. Gupta & V.K. Kapoor , *Fundamentals of mathematical statistics* ,Sultan Chand & sons.
3. Parimal Mukhopadhyay , *Mathematical statistics*, Books and Allied Pvt. Ltd.
4. Mood A.M. Gray Bill F., & Boes D.C., *Introduction to theory of statistics*.
5. V.K. Rohatagi , *Introduction to probability theory & mathematical statistics*,Wiley Eastern.
6. Sidney Siegel, *Non parametric statistics for behavioral sciences*, McGraw- Hill, Kogakusha, Ltd.

**Additional books for reference:**

1. Sprent P, *Applied non parametric Statistical Methods*, Chapman and Hall
2. B.K. Kale (1999), *A first course on parametric inference*, Narosa



**V SEMESTER - Paper VI**  
**DESIGN OF EXPERIMENTS**  
**Teaching Hours : 3hrs per week**

**Rationale /Learning Objectives:**

- To understand the analysis of different types of designs.
- Describe the impact of randomization in study design.
- To Study the application of these designs in agricultural experiments.
- To study the different types of Factorial experiments and their applications.

**Unit 1: Analysis of variance:**

Meaning, basic assumptions, Gauss Markov model and Gauss Markov Theorem (Statement only), fixed effect model. Analysis of one way two way and three way classified data with one Observation per cell, Mathematical model, least square estimates, splitting of total sum of squares, expectation of sums of squares and mean sums of squares (under appropriate hypotheses) and ANOVA table. Least significant difference and Comparison of any two treatment means.

**Unit 2: Design of experiments:**

Meaning and terminology – experiment, treatment, experimental unit, Experimental error, efficiency of a design, size and shape of plots, uniformity trials, Principles of experimental Design.

CRD, RBD, & LSD: Layout, model, splitting of various sums of squares, least square estimates of effects, ANOVA Tables, comparison of treatment means. Advantages and disadvantages of each design. Efficiency of RBD over CRD & LSD over RBD.

**Missing plot technique:** Estimation of one or two missing observations in RBD and LSD (least square estimates).

Iterative procedure for estimation of multiple missing observations. ANOVA in case of missing observations.

**Unit 3: Factorial experiments:**

Contrasts and orthogonal contrasts.  $-2$  square,  $2 -$  cube experiments Conducted in RBD,



Main and interaction effects. Yates method of computing factorial effect totals, ANOVA tables And inferences.

### **Practical – VI**

1. Analysis of CRD
2. Analysis of RBD
3. Analysis of LSD
4. Missing plot technique- RBD–single value missing
5. Missing plot technique- LSD–single value missing
6. Missing plot technique- RBD –two values missing
7. Missing plot technique- LSD- two values missing
8. Missing plot technique –RBD – iterative procedure for multiple observations missing
9. Analysis of 2 – square factorial experiment
10. Analysis of 2 – cube factorial experiment



### **Learner Participation Activities**

- Seminar
- Power Point Presentation
- Quiz
- Current affairs
- Assignments
- Projects
- Data analysis

### **Books for references:**

1. S.C. Gupta & V.K. Kapoor , *Applied Statistics* ,Sultan Chand & Sons.
2. W.T. Federer , *Experimental Designs*, Oxford & IBH Publishing Co.
3. Cochran W.G. & Cox G.M., *Experimental Designs*, Wiley Eastern
4. Goon A.M. & others , *Fundamentals of statistics*, Vol. II , World Press, Kolkatta.
5. Applied Statistics, *Parimal Mukhopadhyaya*, books and applied pvt ltd.

### **Additional books for reference:**

1. Montgomery D.C. (1991), *Design and analysis of Experiments*, John Wiley.
2. Das M. N.and Giri N. C. (1977), *Design and analysis of Experiments*, Wiley Eastern.



**VI SEMESTER - Paper VII**  
**OPERATIONS RESEARCHS**  
**Teaching Hours : 5hrs per week**

**Rationale /Learning Objectives:**

- Able to understand the concept of OR, phases of OR, LPP.
- Able to understand the concept of T.P. and A.P
- To understand the applications of different EOQ models
- To study the different types of replacement policies

**Unit 1: Operations Research (OR) :**

Origin, definition, phases of OR, Iconic, analogue and symbolic models. Linear Programming problem: General model, formulation, graphical solution of two variables LPP, Simplex Algorithm(without proof), Charne's Big-M method – Two phase method, indication of unique solution, multiple Solution, degeneracy and cycling, case of unrestricted variables – Dual LPP and its properties(without Proof)

**Unit 2: Transportation problem :**

General description and statement of T.P. Balanced and Unbalanced T.P.- initial Bfs by north-west corner rule, matrix minima(maxima) method, Vogel's method, MODI method of optimization (without proof), degeneracy, maximization T.P.

**Assignment Problem:** General description & statement of A.P. Hungarian method of solving maximization & minimization Problems. Solving commercial airline problem using assignment technique.

**Unit 3: Inventory theory:**

Basic concepts, deterministic models with instantaneous/finite production without shortages.

Model with instantaneous replenishment of stock with shortages. (Derivations for continuous case), Purchase inventory



Models with one & two price breaks, Stochastic inventory model with time independent costs both discrete and Continuous cases. News paper Boy problem with profit maximization.

Replacement Model – Replacement of items which deteriorate with time (with and without cash discount), Individual Replacement and Group replacement Models.

### **Practical VI**

1. LPP formulation and graphical solution.
2. LPP –Simplex method (slack variables only)
3. LPP- Big M Method and two phase methods.
4. Solving balanced & unbalanced TP. (minimization and maximization Problem)
5. Solving assignment problem-1(minimization, balanced & unbalanced Problems)
6. Solving assignment problem-2(maximization problems and commercial air-line problems)
7. Deterministic inventory models with & without shortages.
8. Inventory models with one & two price breaks and Stochastic inventory models – News paper Boy problem
9. Replacement problems for deteriorating items with & without discount.
10. Individual and group replacement problems.

### **Students Activities**

- Power Point Presentations .
- Quiz
- Assignments
- Seminars
- Data analysis



**Books for references:**

1. Gupta P K & Hira D S (2002), *Operations Research*, Sultan Chand & Co., New Delhi.
2. Kanthiswarup, Manmohan & Gupta (2002), *Operation Research*, Sultan Chand & Co., New Delhi.
3. Sharma S D (2001), *Operations Research*, Kedarnath, **Rozonnath**.
4. Taha H A (2002), *Operations Research*, An introduction, Mac Millan.
5. P.Rama Murthy(2007), *Operations Research*, New Age international Pvt Ltd.

**Additional books for reference:**

1. Mittal. K V(1996), *Optimization models*, Newage publishing company.
4. Ravindran, Philips & Solberg(2007), *Operations Research*, Wiley Student Addition.





**VI SEMESTER - Paper VIII**  
**ELECTIVE PAPER**  
**INDUSTRIAL STATISTICS**  
**Teaching Hours : 3 hrs per week**

**Rationale /Learning Objectives:**

- To understand the concept of statistical quality control, the different types of charts.
- Study of different types of control limits, concepts of rational subgroups.
- Study of control chart for variables and attributes.

**Unit 1:**

Statistical Quality Control – chance & assignable causes of variation – quality characteristics – variables and Attributes, quality control, process control, and product control, Dimensions of quality, Quality of Design, Quality of conformance, Quality of Performance, uses of statistical quality control.

General theory of CC – statistical basis – role of CC in process control – philosophy of CC – criteria of lack of Control – Specification limits, natural tolerance limits, control limits, probability limits,  $3\sigma$  limits, action limits & Warning limits, charts with and without standard values. Concept of rational subgroups.

**Unit 2:** Control char for variables – outline of steps involved in X-bar and R charts –X-bar & sigma charts derivation of control limits with& without standards. Interpretation of process in control. Process capability studies(two sided specification given) Modified control limits for mean, CC for individual measurements, group CC, Sloping control chart for mean.

**Unit 3:** CC for attributes – p & np charts (sub group size constant and variable cases ) C & U charts – derivation of Control limits. Outline of steps in their in construction, analysis and interpretation. –Comparison of variables and Attributes charts.

Acceptance sampling Plans – need for sampling plans, SSP by attributes. Construction of SSP by attributes given PR, CR, AQL, LTPD. And minimum ATI for most likely



incoming lot quality. Derivation of OC, ASN & ATI & AOQ functions for SSP. AOQL, indifference quality. Double sampling plan by attributes Description and Advantages. SSP by variables – advantages and limitations. Derivation of OC – known sigma and unknown sigma cases (single specification only) Construction of SSP.

### **Practical - VIII**

1. Construction of  $\bar{X}$  – bar R charts
2. Construction of  $\bar{X}$ - bar S charts
3. Construction of Group Control charts
4. Construction of sloping control charts for mean
5. Construction of p and np charts
6. Construction of C and U charts
7. Drawing OC, AOQ, ASN ATI curves for ssp by attributes
8. Construction of SSP by attributes
9. Construction of SSP by variables (known sigma case)
10. Construction of SSP by variables (unknown sigma case)

### **Students Activities**

- Power Point Presentations .
- Quiz
- Assignments
- Seminars
- Data analysis

### **References**

1. E.L. Grant & Richard S. Leavenworth– Statistical Quality Control - 7<sup>th</sup> edition – Tata McGraw Hill Ltd., New Delhi
2. Gupta S.C. & V.K. Kapoor – Applied Statistics - Sultan Chand & Sons
3. A.M. Goon & Others – Fundamentals of Statistics – Vol. II –World Press , Kolkatta

### **Additional books for reference:**

1. Douglas C. Montgomery – Introduction to Statistical Quality Control -John Wiley & Sons
2. Amitav Mitra (2001) – Fundamentals of quality control & improvement – Pearson Education, Asia



**VI SEMESTER - Paper VIII**  
**ELECTIVE PAPER**  
**APPLIED STATISTICS**  
**Teaching Hours : 3 hrs per week**

**Rationale /Learning Objectives:**

- To know the concept of Index numbers, methods of computation of Index numbers
- Study of vital statistics – methods of fertility and mortality
- To understand the Methods of computation of moving averages.

**Unit 1:**

Index Number – definition, example, computation of index numbers. Criteria of good index numbers. Consumer price index number – definition and methods of computing consumer price index number, reversibility test, chain base index numbers, circular test. Time series – definition, examples, components, determination of trend by the method of moving averages, seasonal indices by the method of simple averages and ratio to moving averages, least square methods – linear, quadratic and exponential trend.

**Unit 2:**

Vital statistics- meaning sources, measures of fertility, CBR, GFR, ASFR, TFR measures of mortality, CDR, ASDR, STDR (both direct and indirect methods), IMR, MMR, cause of death rate. Life tables – components, construction. Measurement of population growth, GRR and NRR.

**Unit 3:**

Association of Attributes:

Notations, consistency of the data, coefficient of association, Yule's coefficient of association, coefficient of colligation, partial association.

**Interpolation an Extrapolation**

Definition, methods of interpolation, divided differences, binominal method, Newton's forward interpolation formula, Newton's Gregory backward formula, Newton's method of divided differences.



### **Practicals:**

1. Computation of laspeyre's, Paasche's, Marshall Edgeworth's , Dorbish Bowley's and Fisher's index numbers
2. Tests for index numbers
3. Computation of CPI and its interpretation
4. Computation of trend values by moving averages
5. Computation of values by least square method
6. Computation of seasonal variation by (i) simple averages ii) ratio to moving average method
7. Computation of mortality rate
8. Computation of fertility rates
9. Construction of life tables
10. Computation of yule's coefficient of colligation.

### **Students Activities**

- Power Point Presentations .
- Quiz
- Assignments
- Seminars
- Data analysis

### **Books for Reference :**

1. Goon A.M., Gupta, M.K., and Das Gupta (1986), *Fundamentals of Statistics* , Vol-1, 6<sup>th</sup> edition, World Press, Kolkatta
2. S.C. Gupta and V.K. Kapoor , *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons.
3. Gupta S.C. & V.K. Kapoor ,*Fundamentals of applied statistics* , Sultan Chand & Sons



**VI SEMESTER - Paper VIII**  
**ELECTIVE PAPER**  
**APPLIED REGRESSION ANALYSIS**  
**Teaching Hours : 3 hrs per week**

**Rationale /Learning Objectives:**

- Application of regression models in data analysis.
- Data analysis using scatter diagram.
- Fitting of linear regression models.

**Unit 1: Introduction to Least Squares Regression Theory :**

Population regression equation, rationale for the disturbance term, the disturbance term and the conditional disturbance of Y, Statistics assumptions about the disturbance term, least squares estimators of population regression coefficients, deriving the least squares estimators, properties of least squares estimators, estimating the variance of a regression coefficient, estimating  $\sigma^2$  from sample data, standard deviation of the estimated coefficient, the intercept term, hypothesis testing on the regression coefficients, ANOV, the confidence interval for the regression coefficients and  $\sigma^2$ , mean response, prediction of new observation.

**Unit II : Correlation: A measure of association in Regression Analysis**

Experimental versus non experimental research, multiple regression computation of K=2,multiple regression computations: an example. Fitting the Multiple linear regression using method of least squares. Testing the significations of regression Coefficient and overall regression (t-test and ANOVA).

**Unit III:**

Correlation coefficient, the rationale, one measure of co variation, the Pearson correlation coefficient, correlation and regression, decomposition of sum of squares,  $R^2$  as a measure of explained variance, adjusted coefficient of determination, are low  $R^2$  a problem?.



### Practicals using R / Excel

1. Scatter plot, identification of the nature of relationship between variables.
2. Fitting simple linear regression using software
3. Confidence interval for regression coefficient and predicted values.
4. Developing a multiple linear regression model with two covariates using software.
5. Fitting a multiple linear regression model with two covariates using software.
6. Testing of regression coefficient and overall fit of the regression model through ANOVA
7. Use of correlation coefficient in multiple linear regression. Identification of important predictors.
8. Examination of residuals to check the assumption – graphical method.

### Students Activities

- Power Point Presentations .
- Quiz
- Assignments
- Seminars
- Data analysis

### Books for reference:

1. The book titled “ Econometrics” Basic and Applied, 1989, By authors Aaron C. Johnson, Jr., Marvin B. Johnson and Rueben C. Buse, Macmillian Publishing Company, New York: Collier Macmillan Publishers, London.
2. D.C. Montgomery (2007), Introduction to linear regression analysis, John Willey & sons.



**I SEMESTER - Paper I**  
**BUSINESS STATISTICS & MATHEMATICS**  
**Teaching Hours : 3hrs per week**

**Rationale/ Learning Objectives:**

- Data analysis using descriptive statistics.
- Study of commercial airthmatic
- Framing questionnaire.

**Unit I:** Meaning Definition, functions and Limitations of statistics primary and secondary data meaning and their sources.

**Unit II:** Measures of central tendency meaning and types:

- Arithmetic Mean
- Geometric Mean
- Harmonic Mean
- Partition values:- median & Quartiles
- Mode (Grouping & Analysis Tables Not Required)

**Unit III:** Measures of Variation – Meaning Absolute & relative measures

- Range
- Quartile Deviation
- Standard Deviation
- Coefficient of Variation

**Unit IV:** Annuity & perceptivity: futures value, present value, Deferential Installment annuity due & annuity Immediate, perpetuity due and perpetuity immediate.



**Students activities:**

- Quiz
- Assignments
- Current affair
- Value education
- Seminar

**Reference books:**

1. Sancheti & Kapoor V.K(1998), *Business Mathematics*, Sulthan Chand & Sons
2. Rajmohan(2014),*Business Statistics and Mathematics*
3. N.G. Das(2009),*Statistical Methods*, Tata McGraw Hill education Pvt Ltd.
4. Allice Mani(2007), *Business Statistics*,Swapna book house
5. S.P. Gupta, *Advanced Statistics*.
6. S.P. Gupta & Indra Gupta, *Business Statistics*.

**Additional reference books:**

1. B.V.Raaghunandan (2007),*Business Statistica and Mathematics*, Shushrutha books
2. K. Nagabhushan & others(2008), A classic text book of *statistics*, S.D.M Excellent publications





**II SEMESTER - Paper I**  
**Business Statistics & Mathematics**  
**Teaching Hours : 3hrs per week**

**Rationale/ Learning Objectives:**

- Study of relationship between the two variables
- Fitting of the regression equation and estimation
- Study of commercial arithmetic

**Unit I: Correlation**

– Meaning, Types of correlation, Scatter Diagram, Karl Pearson's Product Movement correlation coefficient – its properties, Spearman's Rank Correlation coefficient.

**Unit II: Bivariate Regression**

–Meaning, Regression equations, Regression coefficients, properties of Regression coefficients and regression lines,

Index numbers: Need and meaning, steps in the construction of general price indices, computation of aggregative and average of price relative indices, Laspeyre's, Paasche's, Marshall-Edgeworth's and Fisher's indices. Time reversal and factor reversal tests. Consumer Price Index, need meaning and computation.

**Unit III:**

Interpolation and Extrapolation-Methods of interpolation- Binomial method and Newton's method. (Advanced difference method only)

**Unit IV: Commercial Arithmetic**

Trade discount and cash discount simple and compound interest appreciation and depreciation Bankers discount & Bankers Gain, True discount, Equated due date.



**Students activities:**

- Quiz
- Assignments
- Current affair
- Value education
- Seminar

**Books for reference:**

1. Sancheti & Kapoor V.K(1998), *Business Mathematics*, Sulthan Chand & Sons
2. Rajmohan(2014), *Business Statistics and Mathematics*
3. N.G. Das(2009), *Statistical Methods*, Tata McGraw Hill education Pvt Ltd.
4. Aalice Mani(2007), *Business Statistics*, Swapna book house
5. S.P. Gupta, *Advanced Statistics*.
6. S.P. Gupta & Indra Gupta, *Business Statistics*.

**Additional reference books:**

7. B.V.Raaghunandan (2007), *Business Statistica and Mathematics*, Shushrutha books
8. K. Nagabhushan & others (2008), *A classic text book of statistics* , S.D.M Excellent publications.



**III SEMESTER**  
**BUSINESS STATISTICS & MATHEMATICS**  
**Teaching Hours : 4hrs per week**

**Rationale/ Learning Objectives:**

- Data analysis using descriptive statistics.
- Study of commercial arithmetic.
- Framing questionnaire.

**UNIT I**

Introduction to statistics, definition, functions, scope and limitations

Collection of Data: types of data, primary and secondary, methods of collection, Questionnaire, rules for drafting.

Presentation of data: classification and tabulation of data

**UNIT II**

Measures of central value: mean, median, mode, geometric mean and harmonic. Mean, combined arithmetic mean( definition, computation, and relative merits And demerits)

Measures of dispersion: range, mean deviation, standard deviation, coefficient of Variation, variance- combined standard deviation( definition, computation and relative merits and demerits)

**UNIT III**

Matrices: determinants- value of determinants- solution to simultaneous equations,

Matrix- basic concepts- addition- subtraction- multiplication, inverse of a matrix- solving simultaneous equations by using matrix- rank of a matrix.

**UNIT IV**

Commercial arithmetic-I: percentages- simple and compound interest- equated due date- compound interest- nominal rate and effective rate of interest.



**Students activities:**

- Quiz
- Assignments
- Current affair
- Value education
- Seminar

**Books for references:**

1. Dorairaj S. N. (2006), *Business statistics and business mathematics*, United publications
2. B.L.Agarwal (2009), *Basic Statistics*, New age international Pvt Ltd.
3. Sancheti & Kapoor V.K (1998), *Business Mathematics*, Sulthan Chand & Sons
4. N.G. Das (2009), *Statistical Methods*, Tata McGraw Hill education Pvt Ltd.

**Additional reference books:**

1. B.V.Raaghunandan (2007), *Business Statistica and Mathematics*, Shushrutha books
2. K. Nagabhushan & others(2008), *A classic text book of statistics*, S.D.M Excellent publications.



**VI SEMESTER**  
**BUSINESS STATISTICS & MATHEMATICS**  
**Teaching Hours : 4hrs per week**

**Rationale/ Learning Objectives:**

- Study of relationship between the two variables
- Fitting of the regression equation and estimation
- Study of commercial arithmetic

**UNIT I:**

Correlation and Bivariate regression: meaning, types of correlation, scatter diagram, Karl Pearson's product moment correlation coefficient – its properties, Spearman's Rank correlation coefficient

Bivariate regression, meaning, regression equations, regression coefficients, properties of regression coefficients and regression lines

**UNIT II:**

Time series and Index Numbers: Meaning of time series, components of time series, examples, measurement of secular trend, method of moving averages and method of least squares (fitting of linear trend only)

**Index numbers:** Need and meaning, steps in the construction of general price indices, computation of aggregative and average of price relative indices, Laspeyre's, Paasche's, Marshall-Edgeworth's and Fisher's indices. Time reversal and factor reversal tests. Consumer Price Index, need meaning and computation.

**UNIT III:**

Interpolation and extrapolation: -Methods of interpolation – Binomial method and Newton's Method (Advanced difference method only)



#### **UNIT IV:**

Commercial Arithmetic – II : Trade discount and Cash discount – appreciation and depreciation – Bankers discount and Bankers gain, True discount.

#### **Students activities:**

- Quiz
- Assignments
- Current affair
- Value education
- Seminar

#### **Books for references:**

1. Dorairaj S. N.(2006),*Business statistics and business mathematics* , United publications
2. B.L.Agarwal(2009), *Basic Statistics*,New age international Pvt Ltd.
3. Sancheti & Kapoor V.K(1998), *Business Mathematics*, Sulthan Chand & Sons
4. N.G. Das(2009),*Statistical Methods*, Tata McGraw Hill education Pvt Ltd.

#### **Additional reference books:**

1. B.V.Raaghunandan (2007),*Business Statistica and Mathematics*, Shushrutha books
2. K. Nagabhushan & others(2008), A classic text book of *statistics* , S.D.M Excellent publications.



**QUESTION PAPER PATTERN  
DEPARTMENT OF STATISTICS**

<b>Marks</b>	<b>No. of questions to be set</b>	<b>No. of questions to be answered</b>	<b>Total Marks</b>
2	12	10	20
6	8	5	30
10	6	3	30
		<b>Total:</b>	<b>80</b>

**NOTE:**

1. Four – two mark questions should be asked from each unit.
2. At least two – six mark questions should be asked from each unit.
3. Two – ten mark questions should be asked from each unit.



**B.Com. Semester examination  
Question Paper Pattern**

Time: 3 HRS

MAX Marks: 80

**Section –A**

2x5=10

Answer **Any five** Questions.

- 1) -----
- 2) -----
- 3) -----
- 4) -----
- 5) -----
- 6) -----
- 7) -----

**Section – B**

10x4=40

Answer Any **FOUR** Questions

- 8) -----
- 9) -----
- 10) -----
- 11) -----
- 12) -----

**Section – C**

Answer Any **Two** Questions

15x2=30

- 13) -----
- 14) -----
- 15) -----

Note: Maximum theory marks 80, internal assessment 20 and total 80+20=100.





**B.B.M Semester examination Question Paper Pattern**  
**Department of Business Management**

Time: 3 HRS

MAX Marks: 80

**Section –A**

3x5=15

Answer **All** Questions.

- 1) -----
- 2) -----
- 3) -----
- 4) -----
- 5) -----

**Section – B**

Answer any **FOUR** Questions

5x4=20

- 6) -----
- 7) -----
- 8) -----
- 9) -----
- 10) -----
- 11) -----

**Section – C**

Answer any **THREE** Questions

15x3=45

- 12) -----
- 13) -----
- 14) -----
- 15) -----
- 16) -----

Note: Mamimum theory marks 80, internal assessment 20 and toatal 80+20=100.

