

ST. JOSEPH'S COLLEGE OF SCIENCE AND ARTS

Three year B.Sc. Course

REGULATIONS AND SYLLABUS IN STATISTICS

CHOICE BASED CREDIT SYSTEM (SEMESTER SCHEME)

With effect from academic year 2015-16 onwards

Syllabus in the subject of Statistics (optional subject), for the B.Sc, course (Semester scheme) is effective from the year 2016-17. As approved by the Board of studies in Mathematics in the meeting held on 13-01-2016.

ELIGIBILITY:

1. To be eligible to take Statistics as one of the optional subjects in B.Sc. course, a student must have passed Pre-University course or an equivalent course with Mathematics /Business Mathematics / Basic Mathematics/Applied Mathematics as one of the optional subject.
2. Any student taking Statistics as one of the optional subjects in the B.Sc. Course must have Mathematics as another optional subject.

SCHEME OF INSTRUCTION / EXAMINATION:

1. The subject of Statistics in this course has to be taught by a master degree holder in Statistics / Applied Statistics.
2. The theory question paper should cover all the topics in the syllabus with proportional weightage to the number of hours of instruction allotted.
3. The list of practicals is given under each paper in the syllabus
4. The practicals are to be conducted in batches as per university norms for science faculty (ordinarily 10 students per batch per teacher)
5. Two teachers are to be assigned for each batch with not more than 20 students for giving instructions, supervision, and correction of records.
6. It is expected that each student collects and uses real life data for the practical classes.
7. Students are required to use the Statistical software, run the programmes and computer outputs obtained in practical classes are to be enclosed in the practical record for computer based practicals.

SCHEME FOR THEORY AND PRACTICALS

Semester	Code number and Title of the paper (Theory / Practical)	Lecture/ Practical hours per week	Credits	Duration of exam	Maximum marks		
					Internals	Final exam	Total
I	ST 116: Basic Statistics	04	4	2.5 hrs	30	70	150
	ST 1P1: Practical's on ST 116 and applications of R-Software	03	1	2.5 hrs	15	35	
II	ST 216: Theoretical Probability Distributions and Limit theorem	04	4	2.5 hrs	30	70	150
	ST 2P1: Practical's on ST 216 and applications of R-Software	03	1	2.5 hrs	15	35	
III	ST 316: Estimation and Testing of hypotheses	04	4	2.5 hrs	30	70	150
	ST 3P1: Practical's on ST 316 and applications of R-Software	03	1	2.5 hrs	15	35	
IV	ST 416: Tests of significance (Core paper)	02	2	1.15 hrs	15	35	150
	ST: OE416 Descriptive Statistics (Open elective)	02	2	1.15 hrs	15	35	
	ST 4P1: Practical's on ST 416 and applications of R-Software	03	1	2.5 hrs	15	35	
V	ST 5116: Sampling Theory and Design of Experiments	03	3	2.5 hrs	30	70	150
	ST 5P1: Practical's on ST 5116 and applications of R-Software	03	1	2.5 hrs	15	35	
V	ST 5216: Statistical Methods for Quality Management	03	3	2.5 hrs	30	70	150
	ST 5P2: Practical's on ST 5216 and applications of R-Software	03	1	2.5 hrs	15	35	
VI	ST 6116: Applied Statistics	03	3	2.5 hrs	30	70	150
	ST 6P1: Practical's on ST 6116 and applications of R-Software	03	1	2.5 hrs	15	35	
VI	ST 6216: Operations Research	03	3	2.5 hrs	30	70	150
	ST 6P2: Practical's on ST 6216 and applications of R-Software	03	1	2.5 hrs	15	35	



B.Sc. Course in Statistics

First Semester

ST 116: Basic Statistics

4 hours lecture +3 hours practical per week

55 hours

Unit- 1: Introduction to Statistics

12 hrs

1. Definition of Statistics, Functions, Scope and Limitations (3)
2. Basic concepts – Population, Sample, Types of data – Primary and Secondary data; qualitative, quantitative, cross sectional, time series, variables and attributes, discrete and continuous variables. Types of scales - nominal, ordinal, ratio and interval. (4)
3. Frequency distribution and Graphical presentation – Histogram, Frequency curves, Cumulative frequency curves, Stem and leaf diagram and Box plot (5)

Unit-2: Analysis of data:

20 hrs

1. Univariate data analysis (10)
 - a. Measures of Central tendency and its applications, mean, weighted mean, median, mode, geometric and harmonic mean, properties and merits and demerits, relation between these measures.
 - b. Measures of Location – Partition values, quantiles, deciles, percentiles.
 - c. Measures of Dispersion, range, quartile deviation, mean deviation and standard deviation and their relative measures, properties.
 - d. Moments – Raw, central and factorial moments, relation between them. Skewness and Kurtosis – their measures.
2. Bivariate data analysis (10)
 - a. Correlation - Scatter diagram, Karl Pearson's correlation coefficient and its properties. Spearman's Rank correlation coefficient. (3)
 - b. Regression - Simple linear regression analysis, least squares principles, regression coefficients and its properties, Interpretations of slope and intercept. Fitting of linear, quadratic, exponential and geometric curves. (5)

- c. Multiple Linear Regression – Fitting multiple linear regression models of the form $Y=a+bX+cZ$ (involving two regressors), prediction, regression coefficients and coefficient of determination. (2)

Unit-3: Probability:

8 hrs

Random experiment, trial, sample space, events, classical, empirical and axiomatic approaches to probability. Properties of probability. Additive law, conditional probability, multiplicative law and their applications. Independence of events, Bayes' theorem- applications.

Unit- 4: Univariate Probability Distribution

8 hrs

Definition of random variable, Discrete and continuous random variables. Probability mass function and probability density function. Discrete probability distribution and continuous probability distribution, Distribution function and its properties. Mathematical expectation and properties ($E(x)$, $E(a)$, $E(ax)$, $E(ax\pm b)$, $Var(x)$, $Var(a)$, $Var(ax)$, $Var(ax\pm b)$), MGF and its properties. Transformation of univariate random variables.

Unit-5: Bivariate Probability Distribution

7 hrs

Two dimensional random variables. mean, variance, conditional expectation, covariance and correlation coefficient. Independence of random variables. Addition and multiplication theorems of expectation. Mean and variance of a linear combination of random variables. MGF and property of MGF for bivariate random variable, $M_{x+y}(t)$

ST 1P1: Practical's on ST:116 and applications of R-Software:- List of assignments

1. Introduction and demonstration of usage of R- software.
2. Construction of frequency distribution and graphical representation of data using MS Excel and R software.
3. Measures of central tendency -1: (AM, GM, HM, Combined mean and weighted means).
4. Measures of central tendency-2: (Median, Mode and Partition values)

5. Measures of dispersion: (Range, Standard deviation, Mean deviation, Quartile deviation & coefficient of variation).
6. Moments, measures of skewness and kurtosis.
7. Correlation analysis and Regression analysis (simple and multiple linear regression)
8. Curve Fitting (quadratic, exponential and geometric curves)
9. Computation of probabilities (application of probability, conditional probability and Bayes theorem)
10. Random variables - Expectation, moments, skewness and kurtosis.
11. Bivariate probability distribution – marginal and conditional distributions and computation of moments, conditional expectation.

Books for Study

1. Croxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics., PHI.
2. Freund JE and Walpole RE (1987) Mathematical Statistics (4th edition) PHI.
3. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics Vol.I, World Press, Calcutta.
4. Gupta, S.C., and V.K.Kapoor (2001): Fundamentals of Mathematical Statistics: Sultan Chand & Sons.
5. Medhi J (1992): Statistical Methods: An introductory text. New Age.
6. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)

References:

1. Anderson T.W. and Sclove S.L (1978) An Introduction to the Statistical Analysis of Data, Houghton Mifflin & Co.
2. Cooke, Cramer and Clarke: Basic Statistical Computing, Chapman and Hall.
3. Mood A.M. Graybill F.A. and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
4. Snedecor G.W. and Cochran W.G. (1967): Statistical Methods. Iowa State University Press.
5. Spiegel, M.R. (1967): Theory & Problems of Statistics, Schaum's Publishing Series.
6. KVS Sarma, Statistics Made Simple: Do it yourself on PC (PHI)

7. Purohit S.G. et.al. Statistics using R:
8. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC
9. The Cartoon Guide to Statistics By Larry Gonick (Author) , Woolcott Smith (Author)
10. Bhat B.R, Srivenkatramana T and Rao Madhava K.S.(1996): Statistics: A Beginner's Text, Vol. I, New Age International(P) Ltd.
11. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997):Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.

B.Sc. Course in Statistics

Second Semester

ST 216: Theoretical Probability Distributions and Limit theorems

4 hours lecture +3 hours practical per week

55 hours

Unit -1: Discrete Probability distributions.

18 hrs

Discrete Uniform, Bernoulli, Binomial, Geometric, Negative-binomial, Hyper geometric, and Poisson distributions – definition, examples of variates following these distributions, mean, variance, moments, skewness, kurtosis and m.g.f. Additive property of Binomial, Poisson and Geometric distributions. Lack of memory property of geometric distribution and its interpretation. Inter relationship between Bernoulli, Binomial, Poisson, Negative binomial & Hyper Geometric – statement of conditions only.

Unit- 2: Continuous Probability distributions.

18 hrs

Uniform, Gamma, Beta and Exponential distributions – definition through p.d.f.s. Mean, variance, moments and m.g.f. Normal distribution and its properties. Cauchy distribution. Chi-square, t and F distributions- Definitions through p.d.f's, their, mean, variance properties and uses. Additive property of Exponential and Gamma variates. Lack of memory property of Exponential distribution, its interpretation.

Unit- 3: Sampling Distributions:

8 hrs

Definition of a random sample, Basic concepts of Statistic and parameter. Sampling distribution and Standard error. Sampling distribution of sample mean, sample variance, & their independence under normality assumption. Sampling distribution of t and F statistic under normality assumption.

Unit -4: Simulation:

5 hrs

Introduction to simulation. Monte Carlo method. Generation of random Observations from Uniform, Exponential, Normal, Cauchy, Binomial, Poisson, distributions. Simple illustrations.

Unit -5: Limit theorems:

6 hrs

Convergence in probability and convergence in distributions. Basic results only (without proof), Chebychev's inequality, Weak Law of Large Numbers, Central Limit Theorems. (statements only) and applications.

ST 2P1: Practical's on ST 216 and applications of R-Software:- List of assignments

1. Applications of Chebyshev's inequality and Central Limit theorem
2. Application of R-software (probability, simulation)
3. Computation of probabilities based on Binomial distribution, fitting of binomial distribution and computation of expected frequencies.
4. Computation of probabilities based on Poisson distribution, fitting of Poisson distribution and computation of expected frequencies.
5. Computation of probabilities based on negative binomial distribution geometric, hyper geometric, discrete uniform distribution,
6. Fitting of Negative binomial distribution and discrete uniform. Computation of expected frequencies.
7. Computations involving Normal probabilities.
8. Fitting of normal distribution by area method and computing expected frequencies.
9. Computation of probabilities based on rectangular and exponential distribution.
10. Drawing random samples and Construction of sampling distribution of sample mean and sample variance.
11. Drawing random samples from discrete probability distributions.
12. Drawing random samples from continuous probability distributions.

Books for Study:

1. Chandra.T.K.and Chatterjee. D (2001) A First course in Probability. Narosa
2. Hogg.R.V. and Craig.A.T. (1978) Introduction to Mathematical Statistics- 4/e. Macmillan.
3. Mukhopadhyay. P.(1996): Mathematical Statistics. Calcutta Publishing House.
4. Gupta. S.C, and V.K.Kapoor (2001): Fundamentals of Mathematical Statistics. Sultan Chand & Co.
5. Walpole,R.E and Myers, R.H and Myers.S.L (1998) : Probability and Statistics for Engineers and Scientists. 6th Edition. Prentice Hall, New Jersey.
6. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)
7. Ross S.M (2003) Introduction to Probability Model, 5/e

References:

1. Bhattacharya and N.L. Johnson (1986): Statistical concepts. John Wiley.
2. Dudewicz.E.J. and Mishra.S.N.(1980). Modern Mathematical Statistics. John Wiley.
3. Lindgren, B.W. (1996): Statistical Theory .Collier Macmillan Int. Ed, 3rd Ed.
4. Rohatgi. V.K. and A.K. Md. Ehsanes Saleh (2002). An Introduction to Probability theory and Mathematical Statistics. John Wiley. (WSE)
5. Schaum Series: Probability and Statistics.
6. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

B.Sc. Course in Statistics

Third Semester

ST 316: *Estimation and Testing of hypotheses*

4 hours lecture +3 hours practical per week

55 hours

Unit -1:Point Estimation:

15 hrs

Family of distributions-Location and scale family. Single parameter exponential family. Point estimation. Concepts of estimator and estimate. Criteria for a good estimator- Unbiasedness, Consistency, criteria for consistency, Invariance property of consistent estimator. Efficiency, Relative efficiency. Minimum variance unbiased estimator. Mean square error as a criterion for comparing estimators. Sufficient Statistic. Statement of Neyman – Factorization theorem. Fisher information function. Statement of Cramer – Rao inequality and its applications.

Unit-2: Methods of Point Estimation:

07 hrs

Maximum likelihood Estimator (m.l.e) and Moment Estimator- Properties and examples. Illustration for non-uniqueness and invariance property of m.l.e

Unit -3: Interval estimation:

10 hrs

Confidence interval, Confidence coefficient, shortest confidence interval. Pivotal quantity method of constructing Confidence interval. Construction of confidence intervals for mean, difference between two means, variance and ratio of variances, proportion, difference of proportions and correlation coefficient.

Unit -4:Testing of Hypotheses:

15 hrs

Definition of Statistical hypotheses and types - null and alternative, simple and Composite hypotheses. Type-I and Type-II Errors, size of the test, level of significance, power of the test and power function. Test function, Randomized test and non randomized test (definition only). Critical region. P-value, its interpretation.

Most Powerful (MP) test. Statement of Neyman – Pearson Lemma and its applications.
MP test for proportion of Bernoulli, mean of Bernoulli, Poisson, Normal derivations.

Unit -5:UMP and Likelihood ratio tests:

08 hrs

Monotone likelihood ratio (MLR) property. Uniformly most powerful (UMP) test.
Statement of the theorem on UMP tests for testing one sided hypotheses for distributions with MLR property.

Likelihood ratio tests (LRT) and properties of LRT statistic. LRT's for mean of normal distribution (one sample problems).

ST 3P1: Practical's on ST 316 and applications of R-Software:- List of assignments

1. Comparison of estimators by plotting mean square error.
2. Estimation of parameters by Maximum Likelihood method
3. Estimation of parameters by method of moments.
4. Interval Estimation - Construction of confidence intervals (small & large samples)
5. Evaluation of probabilities of Type-I and Type-II errors and power of tests.
6. Construction of M.P. tests and computation of power.
7. MP test for parameters of Binomial and Poisson distributions.
8. MP test for parameters of Exponential and Normal distributions.
9. UMP test for the mean of exponential, normal distribution and power curve.
10. Likelihood Ratio Test for mean of Normal distribution
11. Application of R-software

Books for Study

1. Freund J.E. (2001): Mathematical Statistics, Prentice Hall of India.
2. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
3. Hogg R.V. and Tannis E.A. (1988): Probability and Statistical Inference, Collier MacMillan.

4. Hodges J.L and Lehman E.L (1974): Basic Concepts of Probability and Statistics, Holden Day.
5. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
6. Gupta. S.C. and V.K.Kapoor (2001): Fundamentals of Mathematical Statistics. Sultan Chand & Co.
7. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)

References

1. Bhattacharya and Johnson (1986): Statistical Concepts, Wiley Int. Ed.
2. Rohatgi. V.K. and A.K. Md. Ehsanes Saleh (2002). An Introduction to Probability theory and Mathematical Statistics. John Wiley (WSE).
3. Ross S.M: Introduction to Probability and Statistics., John Wiley & Sons
4. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

B.Sc. Course in Statistics

Fourth Semester

ST 416: Tests of significance (Core paper)

2 hours lecture +3 hours practical per week

30 hours

Unit -1: Tests of Significance:

15 hrs

Large and small sample tests of significance. Tests for single mean, equality of two means, single variance and equality of two variances. Tests for proportions. Test for correlation coefficient and regression coefficient. Fisher's Z-transformation and its applications. Analysis of categorical data- contingency table. Various measures of association and odds ratio. Chi square test, goodness of fit, independence of attributes in contingency table, and equality of many proportions.

Unit – 2: Analysis of variance:

7 hrs

Analysis of Variance: Meaning and assumptions. Analysis of variance (fixed effects model)-Analysis of one-way and two-way classified data-expected mean squares, ANOVA tables. Least significant difference

Unit – 3: Non-Parametric tests:

8 hrs

Need for non parametric tests, Kolmogorov-Smirnov one sample test, Sign test for one sample and two samples, Wilcoxon signed rank test, Median test, Wald Wolfowitz run test, Mann Whitney U test, Run test for randomness, test for independence based on Spearman's rank correlation coefficient(small and large samples), Normal probability plot QQ Plot

ST 4P1: Practical's on ST 416 and applications of R-Software:- List of assignment

1. Tests concerning single population means (small and large samples)
2. Tests concerning two population means (small and large samples)
3. Tests for single variance and equality of two variances under normality
4. Tests for correlation coefficients and Regression coefficient.
5. Tests for independence of attributes and
6. Analysis of categorical data.
7. Tests for goodness of fit.(uniform, Binomial, Poisson and Normal)
8. ANOVA (one way, two way classified data)
9. Nonparametric tests – 1 (one sample problems)
10. Nonparametric tests – 2 (two sample problems)
11. Various tests for normality, Histogram, Normal probability plot, QQ Plot
12. Applications of R-software in tests of significance

Books for Study:

1. Hogg,R.V. and Craig, A.T. (1978): Introduction to Mathematical Statistics- 4/e, Macmillan, New York.
2. Goon,A.M., Gupta, M.K, and Das Gupta.B. (1986) Fundamentals of Statistics. Vol. I, 6/e. World Press Calcutta.
3. Mood.A.M., Graybill F and Boes (1974): Introduction to the theory of Statistics. McGrawHill.
4. Mukhopadhyay. P (1996). Applied Statistics. Calcutta Publishing House.
5. Gupta. S.C. and V.K.Kapoor (2001): Fundamentals of Mathematical Statistics. Sultan Chand & Co.
6. Peter Dalgaard: Introductory statistics for R, Springer.
7. Venables W.N. , Smith D.M. and the R-development core team, An Introduction to R
8. Montgomery, D.C.: Design and analysis of experiments. John Wiley.
9. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)
10. Purohit S.G. et.al. Statistics using R:

References:

1. Bhattacharya and N.L. Johnson: Statistical concepts. John Wiley.

2. Dudewicz.E.J. and Mishra.S.N. (1980). Modern Mathematical Statistics. John Wiley.
3. Kale B.K (2005) A First Course on Parametric Inference, Narosa 2nd Edition.
4. Randles R.H and Wolfe DA (1979): Introduction to the Theory of nonparametric Statistics, John Wiley
5. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC
6. Rohatgi. V.K. and A.K. Md. Ehsanes Saleh (2002). An Introduction to Probability theory and Mathematical Statistics. John Wiley. (WSE)

ST OE416: Descriptive Statistics

2 hours lecture

30 hours

Unit-1: Basic Statistics:

1. Statistics: Meaning and role as a decision making science (1)
2. Basic concepts: Population, Sample, Types of data, Types of scales - nominal, ordinal, ratio and interval. Variables and attributes, discrete and continuous variables. (2)
3. Representation of data: frequency tables and pivot tables. stem and leaf diagram, bar plots, histogram, pie chart, scatter plots (3)

Unit-2: Probability theory:

1. Probability: Random experiment, trial, sample space, events, classical, definition of probability. Properties of probability. Additive law, Multiplicative law and their applications (3)

Unit-3: Data collection methods:

1. Sample surveys: Sources of data collection, Principal steps in a sample survey, sampling and Non-sampling error, Requisites of a good questionnaire. Drafting of questionnaires and schedules and their pre-test. Pilot surveys. (3)
2. Basic concepts: Census and Sampling, Types of Sampling, non – probability sampling, Subjective and Judgement sampling. Probability sampling, Simple random sampling, stratified random sampling, systematic sampling and cluster sampling (only definitions and their applications) and procedures of selecting a sample by above techniques. (3)

Unit-4: Univariate data analysis:

1. Central Tendency: Measures of Central tendency, Arithmetic mean, weighted mean, combined mean, median, mode, Geometric Mean, Harmonic Mean and their applications (4)
2. Dispersion: Measures of Dispersion, range, quartile deviation, mean deviation, standard deviation and their applications. Relative Measures of Dispersion, Coefficient of Variation and their applications (4)

Unit-5: Bivariate data analysis:

1. Correlation: measures of correlation, Scatter diagram, Karl Pearson's correlation coefficient, Spearman's Rank correlation coefficient and their properties with their applications (3)
2. Regression: Simple linear regression analysis, regression coefficients and their properties, Interpretations of slope and intercept. Fitting straight line. Coefficient of determination. Meaning of Multiple regression analysis (4)

Books for Study

1. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics Vol.I, World Press, Calcutta.
2. Gupta, S.C., and V.K.Kapoor (2001): Fundamentals of Mathematical Statistics: Sultan Chand & Sons.
3. Medhi J (1992): Statistical Methods: An introductory text. New Age.
4. Rajmohan: A Textbook of Statistics Vol -1, Benaka Books

References:

1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S.(1996): Statistics: A Beginner's Text, Vol. I, New Age International(P) Ltd.
2. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997):Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.

B.Sc. Course in Statistics

Fifth Semester

ST 5116: Sampling Theory and Design of Experiments

3 hours lecture +3 hours practical per week

40 hours

Unit-1: Basics of sampling

02 hrs

Concepts of population and sample. Need for sampling- complete enumeration vs sample surveys. Probability and Non-probability sampling –meaning, need and illustrations. Methods of drawing random samples-Lottery system, Use of random numbers. Bias, accuracy and precision of the estimates.

Unit-2: Survey methods:

03 hrs

Survey methods-principal steps in a sample survey, planning, execution, analysis and reporting stages. Requisites of a good questionnaire. Drafting of questionnaires and schedules and their pre-test. Pilot surveys. Non-sampling errors and simple methods of controlling them.

Unit-3: Simple random sampling

07 hrs

Sampling with and without replacement. Unbiased estimators of population mean and total. Sampling for proportions and total. Derivation of the variances of the estimators and their estimation. Standard errors of the estimators. Construction of confidence intervals. Determination of sample size.

Unit-4: Stratified and Systematic sampling

10 hrs

Stratified random sampling-Need for stratification. Unbiased estimators of population mean and total. Derivation of the variance of the estimators and their estimation. Proportional, Optimum and Neyman allocations. Comparison of variances with SRSWOR. Estimation of gain in precision due to stratification.

Linear Systematic sampling - Advantages and limitations. Estimation of mean, total and variance of the estimator. Circular systematic sampling.

Unit-5: Design and Analysis of experiment:

09 hrs

Principles of design of experiments. Completely randomized, Randomized block and Latin square designs-layout, models, least squares estimates of parameters, hypotheses, test procedures and ANOVA tables. Efficiency of a design. Missing plot technique- Estimation of single missing observation in RBD and LSD and analysis.

Unit-6: Factorial experiment:

09 hrs

2^2 and 2^3 factorial experiments- Main effects and interactions, their best Estimates and orthogonal contrasts. Yates method of computing factorial effects. Total and partial confounding in a 2^3 factorial experiment- analysis and testing the significance when underlying design is RBD.

ST 5P1: Practical's on ST 5116 and applications of R-Software:- List of assignments

1. Applications of R-software (Sampling and design of experiments)
2. Drawing of random sample under SRSWR and SRSWOR from a given population and estimation of the mean and total and the standard error of the estimators. Construction of confidence intervals
3. Listing out all possible SRSWR and SRSWOR from a given population and verifying that the estimators of the mean, total and the sampling variance of the estimator are unbiased.
4. Estimation of the proportion, total and the standard error of the estimator based on a random sample under SRSWR and SRSWOR designs.
5. Estimation of the mean, total and the standard error of the estimators under stratified random sampling.
6. Allocation problems under stratified random sampling. Comparison of the precisions of the estimators under stratified random sampling with proportional and optimum allocations and that under SRSWOR and Estimation of gain in precision due to stratification.
7. Listing of possible systematic samples from a given population and computation of variance of the estimator and its comparison with that of SRSWOR and stratified sampling.
8. Analysis of CRD
9. Analysis of RBD and Missing plot technique.
10. Analysis of LSD and Missing plot technique.

11. Analysis of 2^n factorial experiment using RBD layout.
12. Analysis of 2^3 factorial experiment using RBD layout. (Complete confounding)
13. Analysis of 2^3 factorial experiment using RBD layout. (Partial confounding)

Books for Study:

1. Cochran, W.G. (1984): Sampling Techniques. (3rd ed.)(Wiley Eastern)
2. Singh, D and Chaudhary, F.S (1986): Theory and Analysis of sampling survey design. (Wiley Eastern).
3. Goon, A.M et.al.: Fundamentals of Statistics Vol II (World Press, Calcutta).
4. Gupta, S.C and V.K. Kapur: Fundamentals of Applied Statistics. (Sultan Chand and Co.)
5. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)

References:

1. Murthy, M.N. (1967): Sampling theory and methods. (Statistical Society, ISI, Calcutta)
2. Des Raj and Chandok (1998): Sampling Theory, Narosa, New Delhi.
3. Sukhatme, P.V. et.al (1984): Sampling theory of surveys with applications (Indian Society of Agricultural Statistics, New Delhi)
4. Mukhopadhyay. P (1996). Applied Statistics. Calcutta Publishing House.
5. Mukhopadhyay. P (1996). Sample surveys. Calcutta Publishing House.
6. Montgomery, DC (2001). Design and Analysis of Experiments, John Wiley and Sons, Inc
7. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

B.Sc. Course in Statistics

Fifth Semester

ST 5216: Statistical methods for Quality Management

3 hours lecture +3 hours practical per week

40 hours

Unit-1: Basics of Statistical Quality Control:

07 hrs

Introduction-quality, quality control, Quality assurance, quality costs. Seven QC tools. Chance and assignable causes of variation. Statistical quality control (SQC)-. Aims and objectives. Process control and product control. Control charts and basis for its construction, Probability and k sigma limits, action and warning limits. Various tools of SQC. Rational subgroups.

Unit-2: Control Charts for variables:

05 hrs

Derivation of control limits, basis, construction and interpretation of mean, range and standard deviation charts. Revised control charts. Criteria for detecting lack of control. OC and ARL for mean and range charts

Unit-3: Control Charts for attributes:

05 hrs

Need for attribute charts, derivation of control limits, basis, construction and interpretation of np-chart, p-chart, stabilized p-chart, c-chart, u-chart and their applications.

Unit-4 : Special control charts:

04 hrs

Need for special control charts, moving average and moving range charts (without derivation), need for EWMA charts, EWMA charts (without derivation), and their applications.

Unit-5 : Process Capability:

04 hrs

Natural tolerance limits and specification limits. Process capability study-process capability and PCR. Quality standards –BIS and ISO. Six-sigma and TQM.

Unit- 6: Lot Acceptance Sampling:

07 hrs

Acceptance sampling-Introduction. Sampling inspection, 100 percent inspection and Rectifying inspection. AQL, LTPD, Producer's risk and consumer's risk. Acceptance Sampling plans – single and double sampling plans by attributes. Derivation of O.C, A.O.Q, A.S.N and A.T.I, functions. Construction of single sampling plans by attributes given AQL, LTPD, producer's risk, consumer's risk.

Unit – 7: Sequential Probability Ratio Test:

04 hrs

Sequential Probability Ratio Test; concept and operational definition. Determination of stopping bounds A and B, OC and ASN functions of SPRT for testing the mean of a normal distribution with known variance. Statement of the optimal property of SPRT.

Unit-8: Reliability:

04 hrs

Reliability, hazard rate, mean time to failure, Lifetime distributions – exponential, gamma and weibul, reliability of system of components- Series, parallel and k-out-of-n systems.

ST 5P2: Practical's on ST 5215 and applications of R-Software:- List of assignments

1. $\bar{X}$ – R charts. (Standard values known and unknown)
2. $\bar{X}$ – s charts. (Standard values known and unknown)
3. np and p charts. (Standard values known and unknown).
4. c and u charts. (Standard values known and unknown).
5. OC and ARL curves for $\bar{X}$ and R charts.
6. Moving average and range charts, EWMA charts
7. Construction of single sampling plans by attributes and drawing OC, AOQ, ASN, and ATI curves for single sampling plans by attributes.
8. Drawing OC, AOQ, ASN, and ATI curves for double sampling plans by attributes.
9. System Reliability Evaluation, Sketching Reliability and Hazard function.
10. SPRT
11. Applications of R-software

Books for Study:

1. Grant, E.L and Leavenworth,R.S (1988): Statistical Quality control. 6th edition, McGrawHill.
2. Gupta,R.C: Statistical Quality control. (Khanna Pub. Co.)
3. Montgomery,D.C (1985): Introduction to Statistical Quality control. (Wiley Int. Edn.)
4. Goon,A.M et.al.: Fundamentals of Statistics Vol II (World Press, Calcutta
5. Gupta,S.C and V.K. Kapur: Fundamentals of Applied Statistics. (Sultan Chand and Co.)
6. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)

References:

1. John, S.Oakland and Followell,R.F (1990): Statistical Process Control. (East West Press, India)
2. Wetherill,G.B and D.W.Bfown: Statistical Process Control theory and practice. (Chapman and Hall)
3. Mahajan,M (2001): Statistical Quality Control. Dhanpat Rai & Co. (P) Ltd.
4. Donne,C.S. (1997): Quality. Prentice Hall.
5. Sinha S.K. and Kale B.K.(1980) Life testing and Reliability (New age)
6. Duncan A.J (1974): Quality Control and Industrial Statistics, Taraporewala and Sons.
7. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

B.Sc. Course in Statistics

Sixth Semester

ST 6116: Applied Statistics

3 hours lecture +3 hours practical per week

40 hours

Unit-1: Official Statistics

04 hrs

Various agencies responsible for the data collection in India – MOSPI, DES, C.S.O, N.S.S.O, their main functions and publications. Estimation of national income: product approach, income approach, and expenditure approach. Measuring inequality in incomes: Lorenz curve, Gini-coefficient, Theil's measure.

Unit-2: Vital Statistics

06 hrs

Sources of demographic data. Measurement of mortality: crude, specific and standardized death rates, infant mortality rate. Maternal mortality rate. Morbidity, Fecundity and fertility, measurement of fertility: crude, age specific general and total fertility rates. Measurement of population growth. Natural growth rate, vital index, Reproduction rates. Life table- components of a life table, central mortality rate, force of mortality and expectation of life, construction of a life table. Uses of a life table.

Unit-3: Psychological and Educational statistics:

05 hrs

Scaling of Mental tests and Psychological data, Scaling of scores on a test – Z-score, and scaling, standardized scores, normalized scores, computation of T-scores for a given frequency distribution, comparison of T- scores and standardized scores, scaling of rankings and ratings in terms of normal curves, concepts of reliability and validity and their comparison. Intelligent tests- intelligent quotient and educational quotient

Unit-4: Application of statistics in medical research:

06 hrs

Introduction to clinical trials, phases in clinical trials. Therapeutic trails, Prophylactic trails. Observational studies-Cross sectional studies, Prospective studies, retrospective studies, randomized control studies, odds ratio and its confidence interval, Measurement of potential impact. Diagnostic efficacy- Application of Bayes' theorem. Sensitivity specificity, False negative rate, False positive rate, Predictive value positive predictive value negative, Receiver operating characteristic (ROC) curve.

Unit-5: Time Series Analysis:

05 hrs

Components of Time series. Additive and multiplicative models. Measurement of trend by moving averages and by least squares. Construction of seasonal indices by simple averages and ratio to moving averages.

Unit-6: Index Numbers:

07 hrs

Meaning and Applications. Price and quantity relatives, link and chain relatives. Construction of Index numbers: their computation and interpretation. Simple, aggregative and weighted average methods. Laspeyre's, Paasche's, Marshall – Edge worth's, Drobish – Bowley and Fisher's Index numbers. Time and factor reversal tests, Consumer price Index. Problems involved in the construction of general and consumer price index numbers.

Unit -7: Demand analysis:

07 hrs

Law of supply and demand, Demand and supply functions, Giffens paradox, Equilibrium price, Price elasticity of demand and supply-Pareto distribution and application, graphical test, fitting of Pareto's law, log-normal distribution and its properties. Estimation of elasticity from time series data. Partial elasticity of demand, Engel's law and Engel's curve, Pareto's law of Income distribution. Utility and utility functions, Law of diminishing Marginal utility and equimarginal utility.

ST 6P1: Practical's on ST 6116 and applications of R-Software:- List of assignments

1. Official Statistics, Computation of national income and income inequalities
2. Vital statistics-1 Computation of various fertility and reproduction rates

3. Vital statistics-2 Construction of mortality rates, life table, expectation of life and force of mortality.
4. Psychological and educational statistics.
5. Clinical statistics
6. Determination of secular trend by moving averages and least squares methods.
7. Measurement of seasonal variation by simple averages and ratio to moving averages.
8. Construction of Index numbers and tests for consistency of index numbers.
9. Construction of Consumer Price Index - interpretation.
10. Demand analysis.
11. Application of R-Software (time series, income inequalities, clinical statistics)

Books for Study:

1. Goon,A.M et.al.: Fundamentals of Statistics Vol II (World Press, Calcutta).
2. Gupta,S.C and V.K. Kapur: Fundamentals of Applied Statistics. (Sultan Chand and Co.)
3. Sundar Rao P.S.S. and Richard J, Introduction to Biostatistics and research Methods (PHI 2006)
4. Clinical Trials "A practical Approach" by Stuart J. Pocock
5. Guide to Current Indian Official Statistics: Central Statistical Organization, Govt. of India, New Delhi.

References:

1. Mukhopadhyay. P (1996). Applied Statistics. Calcutta Publishing House
2. Veerarajan T: Probability, Statistics and Random process (Tata Mc Gran Hill)
3. Clinical Trials -A practical Guide to Design , Analysis and Reporting- by Duolao Wang, Ameet Bakhai
4. Chakravarti I.E., Laha and Roy: Handbook of methods of Applied Statistics.
5. Asthana and Shrivastava: Applied Statistics of India.
6. Saluja M.P, Indian Official statistical Systems, Statistical Publishing Society,Calcutta.
7. CSO (1980). National Accounts Statistics – Sources and Health.
8. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

B.Sc. Course in Statistics
Sixth Semester
ST 6216: Operations Research

3 hours lecture +3 hours practical per week

40 hours

Unit-1:Introduction to O.R and L.P.P:

09 hrs

Definition and scope of operations research (OR). Modeling and solution. Linear programming problem (L.P.P) – Definition, Standard and canonical forms. Formulation of LPP. Basic solutions, Degenerate and non degenerate solution. Graphical solution and Simplex algorithm for solving an LPP, Criteria for unbounded, multiple and infeasible solutions. Artificial variable, Charnes' Big- M Method.

Unit-2:Transportation problem and Assignment problem:

06 hrs

Transportation problem: Mathematical formulation, finding an initial basic feasible solution by North West corner rule, and Vogel's method. Test for optimality by u-v method. Transportation algorithm (MODI method). Problem of Degenerate solution and its resolution. Assignment problem: Mathematical formulation and Hungarian algorithm

Unit-3: Statistical Decision Theory and Game theory:

06 hrs

Statistical decision problem and essential elements. Decision making under certainty, uncertainty and risk. Game theory-Basic concepts. Two-person zero sum game, Pure and mixed strategies. Maximin–Minimax principle, Games with saddle point. Principle of dominance. Games without Saddle point.-mixed strategies, Determination of optimum solution for (2x2) game. Solution by graphical method for (2xn) and (mx2) games.

Unit-4: PERT and CPM:

06 hrs

Basic elements of Network, Drawing of project network. Project planning with CPM and PERT. Critical path calculation. Critical path, slack time, floats. PERT three estimate approach. Calculation of probabilities of completing a Project within a specified period.

Unit-5: Inventory Theory:

05 hrs

Description of an inventory system. Inventory costs. Demand, lead time and reorder level. Inventory models. EOQ model with and without shortages.

Unit-6: Queuing theory:

05 hrs

Basic elements, description of a queuing system and measures of effectiveness. statement of steady state solution of M/M/1 queuing system. Waiting time distributions. Little's formula Derivation of expressions for Queue length, and system size(length) and waiting times. Description of M/M/C queuing system.

Unit-7: Replacement theory:

03 hrs

Replacement model for items which deteriorate with time. Group replacement of items

ST 6P2: Practical's on ST 6215 and applications of R-Software:- List of assignments

1. Formulation of Linear programming problem (L.P.P)- Graphical solution
2. Solution of L.P.P -using simplex algorithm.
3. Solution of L.P.P -using Big M Method
4. Transportation problem
5. Assignment problem
6. Decision theory problems.
7. Game theory problems.
8. PERT and CPM
9. Queuing Problems
10. Inventory problems and Replacement problems
11. Applications of R-software

Books for Study

1. Kanthiswarop, Manmohan and P.K. Gupta (2003) Operations Research. Sultan Chand & Co.
2. Veerarajan T: Probability , Statistics and Random process (Tata Mc Gran Hill)
3. Churchman, C.W, Ackoff,R.L and Arnoff, E.L. (1957): Introduction to Operations Research. John Wiley.
4. Shenoy, G.V., Srivastava, U.K and Sharma, S.C: Operations Research for management. New Age Publications.
5. Kalavathy S - Operations Research (Vikas Publishers)

References:

1. Mustafi, C.K. Operations Research methods and practice. New Age. Pub.
2. Mital, K.V. Optimization method. New Age Pub.
3. Narag.A.S. Linear Programming and Decision making. Sultan Chand & Co.
4. Kapoor,V.K. Operations Research. Sultan Chand & Co.
5. N. D. Vohra: Quantitative Techniques in Management (Tata McGraw Hill)
6. John Verzani (2005): Using R for Introductory Statistics, CHAPMAN & HALL/CRC

