



**St Aloysius College (Autonomous)**  
**Mangaluru**

**Re-accredited by NAAC "A" Grade**

**Course structure and syllabus of**

**B. Sc.**

**STATISTICS**

**CHOICE BASED CREDIT SYSTEM**

**(2019 – 20 ONWARDS)**



ಸಂಕ ಅಲೋಷಿಯಸ್ ಕಾಲೇಜು  
(ಸ್ವಾಯತ್ತ)  
ಮಂಗಳೂರು- 575 003



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Re-accredited by NAAC with 'A' Grade - CGPA 3.62

Recognised by UGC as "College with Potential for Excellence"

College with 'STAR STATUS' conferred by DBT, Government of India

3<sup>rd</sup> Rank in "Swacch Campus" Scheme, by MHRD, Govt of India

No: SAC 40/Syllabus 2019-20

Date: 18-07-2019

### NOTIFICATION

Sub: Syllabus of **B.Sc. Statistics** under Choice Based Credit System.

- Ref: 1. Decision of the Academic Council meeting held on 02-05-2019 vide  
Agenda No: 22(2019-20)  
2. Office Notification dated 18-07-2019

Pursuant to the above, the Syllabus of **B.Sc. Statistics** under Choice Based Credit System which was approved by the Academic Council at its meeting held on 02-05-2019 is hereby notified for implementation with effect from the academic year 2019-20.

  
PRINCIPAL



  
REGISTRAR

To:

1. The Chairman/Dean/HOD.
2. The Registrar Office
3. Library

**Scheme of Instruction & Examination: B.Sc. Statistics-(Theory and Practical)**

| Semester | Title of the Paper   | Hrs. of instruction | Duration of Exam | Maximum Marks Theory + IA | No. of Credits |
|----------|--|---------------------|------------------|---------------------------|----------------|
| I        | G 506.1: Descriptive Statistics & Probability Theory             | 04                  | 03               | 70+30=100                 | 2              |
|          | G 506.1a: Descriptive Statistics & Probability Theory Practical. | 03                  | 03               | 40+10=50                  | 1              |
|          | <b>G 506.1E: Applied Statistics</b>                              | 02                  | 1.5              | 40+10=50                  | 1              |
| II       | G506.2:Probability Distributions                                 | 04                  | 03               | 70+30=100                 | 2              |
|          | G506.2a: Probability Distributions Practical.                    | 03                  | 03               | 40+10=50                  | 1              |
|          | <b>G 506.2E: Data Analysis using Ms Excel</b>                    | 02                  | 1.5              | 40+10=50                  | 1              |
| III      | G506.3: Statistical Inference I                                  | 04                  | 03               | 70+30=100                 | 2              |
|          | G506.3a: Statistical Inference I Practical.                      | 03                  | 03               | 40+10=50                  | 1              |
|          | <b>G 506.3E: Probability Distributions</b>                       | 02                  | 1.5              | 40+10=50                  | 1              |
| IV       | G506.4: Statistical Inference II                                 | 04                  | 03               | 70+30=100                 | 2              |
|          | G506.4a: Statistical Inference II Practical.                     | 03                  | 03               | 40+10=50                  | 1              |
|          | <b>G 506.4E: Statistical Data Analysis using SPSS</b>            | 02                  | 1.5              | 40+10=50                  | 1              |
| V        | G506.5a.: Designs of Experiments                                 | 03                  | 03               | 70+30=100                 | 2              |
|          | G506.5 b: Elective (1) - <b>Total Quality Management</b>         | 03                  | 03               | 70+30=100                 | 2              |
|          | <b>OR</b><br>Elective (2) - Regression Analysis                  | 04                  | 04               | 80+20=100                 | 2              |
|          | G506.5a: Practical based on G506.5 and G506.5a                   |                     |                  |                           |                |
| VI       | G506.6a: Sampling Theory   | 03                  | 03               | 70+30=100                 | 2              |
|          | G506.6: Elective (1) - <b>Operation Research</b>                 | 03                  | 03               | 70+30=100                 | 2              |
|          | <b>OR</b><br>Elective (2) - Simulation                           | 04                  | 04               | 80+20=100                 | 2              |
|          | G506.6a.: Practical based on G506.6 and G506.6a                  |                     |                  |                           |                |

**B.Sc. DEGREE- FIRST SEMESTER**

**G 506.1: DESCRIPTIVE STATISTICS AND PROBABILITY THEORY**

## UNIT-I

**Curve Fitting:** Principle of least squares- Fitting of linear, quadratic, exponential and geometric curves.

**Correlation Analysis:** Concept of correlation, Scatter diagram, Karl Pearson's coefficient and its properties. Proof of limits of correlation coefficient and results related to correlation. Rank correlation coefficient, proof of limits of Rank correlation coefficient, Properties and derivation of the expression for the case where there are no ties. Applications of correlation. **-10 hrs.-**

## UNIT-II

**Regression Analysis:** Bivariate regression- derivation of regression lines- properties- derivation of expression for standard error of estimate and its interpretation- correlation between observed and theoretical value obtained from the linear regression- Regression coefficient and its properties. Multiple linear regression for three variates. Derivation of trivariate regression equations and applications of regression theory. **-13 hrs.-**

## UNIT-III

**Demand Analysis:** Introduction to demand analysis, law of demand and supply-statement and meaning with examples, Price elasticity of supply and demand, Partial and crossed elasticity's of demand, Methods of determining demand and supply curves, Engel curves, Pareto's law of income distribution and applications of all these. **-12hrs.-**

## UNIT-IV

**Probability and Random Variables:** Basic concepts of probability theory, definitions and applications of three approaches of definitions of probability, Addition theorem of probability- proof based on axiomatic approach, Multiplication theorem of probability and their applications. Statement and proof of Baye's theorem and its applications. Random variables (discrete and continuous), its properties. p.m.f., p.d.f., with properties. Distribution function with properties. Bivariate p.m.f.'s, p.d.f.'s, marginal and conditional probability distributions for two random variable, independence of random variables. Pairwise and mutually independent events. Statement and proof related to these.

**-15hrs.-**

**B.Sc. DEGREE- FIRST SEMESTER**

### **G 506.1: DESCRIPTIVE STATISTICS AND PROBABILITY THEORY- PRACTICAL**

1. Curve fitting-1 Fitting linear and quadratic curves.
2. Curve fitting-2 Fitting curves of the form  $y=ab^x$ ,  $y=ae^{bx}$ ,  $y=ax^b$ .
3. Correlation- Spearman's rank Correlation Coefficient and Karl Pearson's Product Moment.
4. Analysis of Correlation Coefficient.
5. Bivariate Regression.
6. Trivariate Regression.
7. Demand Analysis I.
8. Demand Analysis II.
9. Application of Addition and Multiplication and Baye's theorems of probabilities.
10. Exercises on Random variables.

#### **References:**

1. S.C. Gupta and V.K. Kapoor (2018), Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
2. Parimal Mukhopadhyay P. (2014), Mathematical Statistics- Books and Allied (P) Ltd. Kolkata.
3. R. V. Hogg and E. A. Tanis (2001), Probability and Statistics, Pearson Education Asia.

## APPLIED STATISTICS

### Objectives:

1. To understand the applications of Statistics through these measures.
2. To give a broad idea about applications of Statistics in governance.

### UNIT I

**Vital Statistics:** Uses and Methods of obtaining vital statistics. Rates & Ratios. Measurement of Mortality: Crude, Specific & Standardized death rates. Life Table: Stationary & Stable population, Construction of life tables. Fertility: Crude, General, Specific & Total fertility rates. **10 hrs.**

### UNIT II

**Index Numbers:** Definition, construction of index numbers and problems related to weighted and un weighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Consumer price index numbers. Index of industrial and agriculture production, usage and limitations of index numbers.

**10 hrs.**

### UNIT III

**Time Series:** Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi-averages, fitting various mathematical curves and growth curves.

**10 hrs.**

### References:

1. S. C. Gupta & V. K. Kapoor (2018), Fundamentals of Applied Statistics, Sultan Chand and Co. New Delhi.
2. Parimal Mukhopadhyay P. (2014), Applied Statistics, Books & Allied Ltd. ISBN: 8187134380.

**B.Sc. DEGREE- SECOND SEMESTER**  
**G 506.2: PROBABILITY DISTRIBUTIONS**

**UNIT I**

**Mathematical Expectation:** Rules of expectation, Addition and Multiplication Theorems of expectation. Variance, Covariance, Coefficient of Correlation. Mean and Variance of linear combination of random variables. Applications of mathematical expectation.

**-4hrs.-**

**UNIT II**

**Standard Discrete Distribution:** Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric and Discrete Uniform Distribution- Definition, examples of variates following these distributions. Mean and Variance of these distributions. Mode of a Binomial, Poisson and Negative Binomial Distribution, Moment Generating Function (wherever they exist). Lack of memory property of Geometric Distribution and its physical interpretation. Recurrence Relation for Central Moments of Binomial, Poisson and Negative Binomial Distribution.

**-20hrs.-**

**UNIT III**

**Continuous Univariate Distribution:** Uniform, Exponential, Gamma, Beta, Normal and Cauchy distributions.-Definition through p.d.f., distribution function of Uniform, Exponential and Cauchy distribution. Computation of moments (wherever they exist). Moment generating function for Exponential, Gamma and Normal distributions. Application of these distributions. Finding mode and points of inflexions of Normal distribution. Finding median for Uniform, Normal and Cauchy distribution. Additive property of Binomial, Poisson, Gamma and Normal distribution.

**-20 hrs.-**

**UNIT IV**

**Functions of Random Variables:** Distribution functions of random variables using mgf, Distribution function technique, Jacobian of transformation and applications.

**-4hrs.-**

**B.Sc. DEGREE- SECOND SEMESTER**



### **G 506.2: PROBABILITY DISTRIBUTIONS - PRACTICAL**

1. Exercises on Mathematical expectation of Probability distributions.
2. Exercises on Binomial and Poisson distributions.
3. Fitting of Binomial distribution.
4. Fitting of Poisson distribution.
5. Generating Random Observations from Binomial and Poisson distribution.
6. Generating Random Observations from Negative Binomial and Geometric distributions.
7. Exercises on Normal distribution.
8. Fitting of Normal distribution.
9. Generating random observations from Normal and Exponential distribution.
10. Generating random observations from Cauchy distribution.
11. Fitting of Exponential distribution.

#### **References:**

1. Goon A.M., Gupta M.K. and Das Gupta (2014), Fundamentals of Statistics. Vol.1, 6<sup>th</sup> Edn. World Press, Kolkata.
2. S.C. Gupta and V.K. Kapoor (2019), Fundamentals of Mathematical Statistics. Sultan Chand and Sons.
3. Hogg R.V and Graig A.T. (2015), Introduction to Mathematical Statistics. Macmilan N.Y.
4. Parimal Mukhopadhyay P. (2014), Mathematical Statistics, Books and Allied (P) Ltd. Kolkata.

## DATA ANALYSIS USING MS EXCEL

### Objective:

1. To develop the Data Processing skill in MS Excel.
2. To develop the Data Analysis and Data Visualization skill.

### UNIT I

Introduction to MS Excel, MS Excel Options-Ribbon-Sheets- Saving Excel File as PDF, CSV and Older versions - Using Excel Shortcuts - Copy, Cut, Paste, Hide, Unhide, and Link the Data in Rows, Columns and Sheet - Using Paste Special Options - Formatting Cells, Rows, Columns and Sheets - Protecting & Un protecting Cells, Rows, Columns and Sheets with or without Password - Page Layout and Printer Properties. **10 hrs.**

### UNIT II

Charts:- Simple Bar Chart, Multiple Bar Chart, Subdivided Bar Chart, Pie Chart, Donut Chart, Line Chart and Histogram. Scatter Plot, Radar Chart, Bubble Chart, Plotting Density Function and Distribution Function. **10 hrs.**

### UNIT III

Statistical measures – Mean, Variance, Percentiles, Quartiles - Pearson correlation, Spearman's, Rank correlation and Regression equations and Multiple Linear regression.

**10 hrs.**

### References:

1. Curtis Frye (2016), Microsoft Excel, Step by Step.
2. Bernd Held and Brain Morairty (2016), Microsoft Excel Functions & Formulas.
3. William Fischer (2016), Excel: QuickStart Guide- From Beginners to Expert (Excel, Microsoft Office).

## UNIT I

**Sampling Distribution:** Concept of Statistic, sampling distribution of statistic and its standard error. Definition and derivation of Student t, Chi-Square and F-distributions-their properties, mean and variance. Distribution of sample mean, sample variance under normality assumption. Distribution of sampling variance from normal population under the assumption of independence of sample mean and variance. Inter-relationship between the sampling distributions.

**Order statistic:** Definition of order statistic, derivation of the distribution of 1<sup>st</sup> and n<sup>th</sup> order statistic.

-15hrs.-

## UNIT II

**Probability inequality and Convergence concepts:** Markov's inequality (Statement only), Chebysheve's inequality (with proof). Sequence of r.v's, Convergence in probability. Basic results (without proof), WLLN for i.i.d. r.v's, applications. Convergence in distribution, C.L.T and its applications.

-8 hrs.-

## UNIT III

**Point Estimation:** Estimator and estimate. Unbiasedness, asymptotic unbiasedness and consistency of estimators. Sufficient condition for consistency, Relative efficiency, Sufficiency. Statement of Fisher Neyman criterion and its applications. Maximum likelihood and moment methods of estimation. Properties of these methods (without proof). Discussion of examples to be restricted to the standard distributions studied during 2<sup>nd</sup> and 3<sup>rd</sup> semesters.

-15 hrs.-

## UNIT IV

**Interval Estimation:** Confidence coefficient, confidence interval using Pivotal Quantity method. Confidence interval for mean, difference between means, variance and ratio of variances under normality. Large sample confidence interval for mean and proportion, difference between proportions of Normal population. Confidence interval for paired observations.

-10 hrs.-

**B. Sc .DEGREE-THIRD SEMESTER**

**G 506.3: STATISTICAL INFERENCE-I PRACTICAL**

1. Applications of Chebysheve's inequality.
2. Applications of C.L.T.
3. Estimating parameters of Binomial, (p unknown), Poisson, and Uniform (Continuous), Exponential, Normal and Beta distribution by the method of MLE.
4. Estimating parameters of Binomial, Negative Binomial, Poisson, Uniform, Exponential, Normal, Beta, and Gamma by the method of moments.
5. Large sample confidence intervals for proportions and difference of proportions.
6. Interval estimation of mean of normal population (variance known and unknown cases).
7. Interval estimation of variance of normal population (variance known and unknown cases) (mean known and unknown cases).
8. Interval estimation of difference in means of two independent normal populations (with known and unknown means).
9. Interval estimation of ratio of variances of independent normal populations (with known and unknown means) .

**References:**

1. S.C.Gupta and V.K.Kapoor (2019), Fundamentals of Mathematical Statistics, Sultan Chand and Co. New Delhi.
2. Goon A.M., Gupta M.K. and Das Gupta B. (2016), Fundamentals of statistics Vol I and Vol II World press Kolkatta.
3. Hogg R.V and Craig A.T. (2015), Introduction to Mathematical Statistics Mac Milan, New York.
4. Mood A.M., Gray bill F and Bose D.C. (2013), Introduction to the theory of Statistics.
5. Parimal Mukhopadhyay P (2014), Mathematical Statistics, Books and Applied (P) Ltd. Kolkata.
6. D.W. Wackerly, L. Mendenhall, R.L. Scheafres (2002), Mathematical Statistics with Applications, Duxbury Advance Series.
7. R.V. Hoggand E.A. Tanis (2001), Probability and Statistics, Pearson Education Asia.

**CBCS-III SEMESTER**  
**PROBABILITY DISTRIBUTIONS**

**Objective:**

1. Providing students with a formal treatment of probability theory.
2. Equipping students with essential tools for statistical analyses at the graduate level.
3. Fostering understanding through real-world statistical applications.

**UNIT I**

**Mathematical Expectation:** Definition, Rules of expectation, Addition and Multiplication theorems of expectation. Variance, Covariance and Coefficient of correlation. **3 hrs.**

**UNIT II**

**Standard Discrete Distributions:** Bernoulli, Binomial, Poisson, Negative Binomial, Geometric, Hyper geometric and Discrete Uniform Distribution. Definition, examples of variates following these distributions. Mean and Variance of these distributions. Lack of memory property of Geometric distribution. Applications of all these distributions. **15 hrs.**

**UNIT III**

**Continuous Univariate Distribution:** Uniform, Exponential, Gamma, Beta of first kind and second kind, Normal and Cauchy distributions. Definition through p.d.f. Application of these distributions. **12 hrs.**

**References:**

1. S.C.Gupta and V.K.Kapoor (2018), Fundamentals of Mathematical Statistics, Sultan Chand and Co. New Delhi.
2. Goon A.M., Gupta M.K. and Das Gupta B. (2013), Fundamentals of statistics, Vol I and Vol II World press Kolkatta.
3. V.K. Rohutgi (2014), Introduction to the Theory of Probability and Mathematical Statistics.
4. Parimal Mukhopadhyay P. (2014), Mathematical Statistics, Books and Applied (P) Ltd. Kolkata.

**B. Sc. DEGREE-FOURTH SEMESTER  
G 506.4: STATISTICAL INFERENCE II**

**UNIT I**

**Testing of Hypothesis:** Statistical Hypothesis, Null and alternative, Simple and composite hypothesis. Critical region and Critical function. Concepts of type I, type II errors, level of significance, P-Value (descriptive level), power of test and power function-power curve. Relationship between testing of hypothesis and interval estimation. MP-test, Statement of Likelihood ratio tests, Derivation of the test for normal distribution, with two sided alternatives for mean, equality of means with unknown common variance and equality of variance. LRT for ratio of variances with proof. Application of these tests for one sided alternatives, paired t-test. Test for correlation coefficient. Properties of LRTP (without proof).

-20 hrs.-

## UNIT II

**Large Sample Tests:** Large sample test for mean, difference between two means, test for proportion, difference between proportions. Fisher's Z transformation and its applications.

**Chi-square tests:** Test of goodness of fit and independence of attributes in contingency tables, Derivation of Brandt-Snedecor's formula, Chi-square test for 2X2 contingency table. Yates correction for continuity.

10hrs.-

## UNIT III

**Sequential testing:** Need for sequential test, Strength of sequential tests. Wald's SPRT applied to Bernoulli, Poisson, Exponential and Normal distributions. Expressions for constants to be given without proof. Applications of SPRT.

-8 hrs.-

## UNIT IV

**Non-parametric tests:** Advantages and limitations. Sign test for one sample problem and f or pairs of observations. Two sample median test. Run test for randomness. Two sample run test. Null distribution of test statistic to be derived in each case. Large sample approximation to these tests.

-10

hrs.-

**B.Sc DEGREE-FOURTH SEMESTER**  
**G 506.4: Statistical Inference-II PRACTICAL**

1. Evaluation of probability of type I and type II errors and power of tests. Power function and Power curve (this practical is based on distributions studied during 3rd SEM.)
2. Large Sample Tests.
3. t Tests.
4. Tests for single variance and equality of variances under normality.
5. Test for goodness of fit.
6. Test for independence of attributes in contingency tables.
7. SPRTTP-(1) Bernoulli and Poisson distribution.
8. SPRTTP-(2) Normal distribution (Mean and Variance).
9. Non-parametric test-(1) Sign test and Median test. (Small and Large samples).
10. Non-parametric test-(2) Run test. (Small and Large samples)

**Reference Books:**

1. S.C. Gupta and V.K. Kapoor (2014), Fundamentals of Mathematical Statistics, Sultan Chand and Co. New Delhi.
2. Hogg R.V and Craig (2014), AT Introduction to Mathematical Statistics Mac Milan, New York.
3. Parimal Mukhopadhyay P (2014), Mathematical Statistics, Books and Applied (P) Ltd. Kolkata.
4. D.W. Wackerly, L. Mendenhall, R.L. Scheafres (2002), Mathematical Statistics with Applications, Duxbury Advance Series.
5. R.V. Hogg and E.A. Tanis (2001), Probability and Statistics, Pearson Education Asia.

**CBCS-IV SEMESTER**  
**DATA ANALYSIS USING SPSS**

**Objectives:**

1. To train students in SPSS Software.
2. To expose the students to the analysis of statistical data.

**UNIT I**

**Descriptive Statistics:** Measures of averages, Measures of variation, Kurtosis. Correlation: Karl Pearson's and Spearman's Rank Correlation, Regression analysis: Simple Regression Analysis. **10 hrs.**

**UNIT II**

**Introduction to SPSS:** Description of SPSS menu, import from other data source, data entry, labelling for dummy numbers, recoding of the variables, and transpose of data, insert variables and cases merge variables and cases. **10 hrs.**

**UNIT III**

**Data handling:** Split, select cases, transform, compute total scores and table looks, changing column, font style and sizes. Diagrammatic representation: Simple bar diagram, Multiple bar diagram, Sub-divided bar diagram, Percentage bar diagram, Pie diagram, Frequency table, Histogram, Scatter diagram, Box plot. **10 hrs.**

**References:**

1. Darren George & Paul Mallery (2019), IBM SPSS Statistics 25 Step by Step, 15<sup>th</sup> Ed., ISBN: 978-1-138-49104, Taylor & Francis.
2. Ronald D. Yockey (2018), SPSS Demystified-A Simple Guide and Reference, 3<sup>rd</sup> Ed., Taylor & Francis.
3. Ajay S. Gaur & Sanjana S. Gaour (2009), Statistical Methods for Practice and Research: A Guide to Data Analysis using SPSS, ISBN: 9788132101000.



## PAPER-V

### UNIT I

**Analysis of variance:** Meaning, basic assumptions Gauss Markov model and Gauss Markov and Cochran's 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 hypothesis) and ANOVA table. Critical difference and comparison of treatment means.

-15 hrs.-

### UNIT II

**Designs of experiments:** Meaning and terminology-experiment, treatment, experimental unit, experimental error and precision, uniformity trials. Principles of experimental design, choice of size of plot, shape of blocks and plot.

**CRD, RBD and LSD:** Layout, model, splitting of total sums of squares, least square estimates of effects, ANOVA tables, comparison of treatment means. Advantages and limitations of each design. Efficiency of a design, efficiency of RBD over CRD and LSD over RBD.

-10 hrs.-

### UNIT III

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

-5 hrs-

### UNIT IV

**Factorial experiments:** Meaning and advantages.  $2^2$  and  $2^3$  factorial experiments in RBD and LSD, main and interaction effects. Yates's method of computing factorial effect totals, ANOVA table and inferences. Contrasts and orthogonal contrasts.

-10 hrs.-

B.Sc. DEGREE – FIFTH SEMESTER

## G 506.5 b: TOTAL QUALITY MANAGEMENT (ELECTIVE-1)

### UNIT I

**Essentials of TQM:** Customer satisfaction, leadership, quality policy, organizational structure, employee involvement, quality cost, supplier selection and development, recognition and reward.

-5 hrs.-

### UNIT II

**Tools and Techniques of TQM:** Statistical Process control and Acceptance Sampling Plan, Quality characteristics – variables and attributes, quality control – offline quality control, process control, product control. Causes of variation in quality, uses of statistical quality control.

**General theory of control charts:** Criteria of lack of control, control limits, action limits, warning limits and probability limits. Concepts of rational subgroups. Charts with and without standard values.

-10 hrs.-

### UNIT III

**Control charts for variables:** Outline of steps involved in  $\bar{X}$ -R charts. Derivation of trial control limits. Derivation of limits, interpretation of a process in control, process capability studies, continuing the use of charts, actions to be taken on the process, actions to be taken on the specifications, modified control limits or reject limits for  $\bar{X}$

**Control charts for attributes:** p and np- charts (subgroup size constant and variable cases), c and u – charts. Derivation of control limits, outline of steps in their construction, analysis and their interpretations.

-13 hrs.-

### UNIT IV

**Acceptance sampling plan:** Need for sampling plans, single sampling by attributes given PR, CR, AQL and LTPD. Derivation of OC, ASN, ATI and AOQ functions for single sampling plans. AOQL, indifference quality. Construction of SSP by attributes. (Given AQL, LTPD, PR or CR method and minimum ATI method. Double sampling plan- description and its advantage over single sampling plans.

**Single sampling plans for variables:** Advantages and limitations, derivation of expression for OC – sigma known and unknown cases. (Single specification only) Construction of SSP.

-12 hrs.-

B.Sc. DEGREE – FIFTH SEMESTER

## **G 506.5 a: DESIGN OF EXPERIMENTS & G 506.5 b: TOTAL QUALITY MANAGEMENT**

### **(ELECTIVE -1) PRACTICAL**

1. Analysis of CRD.
2. Analysis of RBD.
3. Analysis of LSD.
4. Missing plot technique-RBD & LSD Single value missing.
5. Missing plot technique-RBD & LSD-two values missing.
6. Analysis of  $2^2$  factorial experiments.
7. Analysis of  $2^3$  factorial experiments.
8.  $\bar{X} - R$  charts (standards known and unknown).
9. np chart and p-chart.
10. C- Chart and U-chart.

### **References:**

1. S.C. Gupta and V.K. Kapoor (2018), Applied Statistics, Sultan Chand & Co.
2. M.N. Das and N.C. Giri (1997), Design and analysis of experiments, New Age International (P) Ltd. Publishers.
3. B. L. Agarwal, (2010), Theory and Analysis of Experimental Designs, CBS Publishers and Distributors.
4. R. P. Mohanty and R. R. Lakhe (2002), Hand book of Total Quality Management, Jaico Publishing House.
5. Dale H. Besterfield, Carol Besterfield, Glen H. Besterfield and Mary Besterfield- Sacre (2001), Total Quality Management, Pearson Education Asia.
6. P. L. Jain (2001), Quality Control and Total Quality Management, Tata McGraw- Hill Publishing Co. Ltd.
7. Montgomery, D. C. (2010), Introduction to Statistical Quality Control, John Wiley & Sons Inc. International Edition.

**B.Sc. DEGREE – FIFTH SEMESTER**

**g 506 b: REGRESSION ANALYSIS (ELECTIVE - 2 )**

**UNIT I**

**Regression Models:** Simple linear regression model, least squares method, coefficient of determination, model assumptions, testing for significance of model parameters, point and interval estimation using the regression equation, prediction, residual analysis. -10 hrs.-

**UNIT II**

**Multiple Regression Models:** Estimation of model parameters, hypothesis testing and confidence intervals, prediction, regression diagnosis. -10 hrs.-

**UNIT III**

**Regression Analysis:** Model building, general linear model, addition or deletion of variables. -10 hrs.-

**UNIT IV**

**Variable Selection Procedures:** Stepwise regression, forward and backward elimination procedures, best- subsets regression, Mallows's  $^2C_p$ , residual analysis. Multiple regression approach to analysis of variance and experimental design. -15 hrs.-

**B.Sc. DEGREE – FIFTH SEMESTER**

**G 506.6 b: REGRESSION ANALYSIS (ELECTIVE-2) PRACTICAL**

1. Exercise on Simple Linear Regression.
2. Regression Diagnostics for Simple Linear Regression.
3. Exercise on Multiple Linear Regression.
4. Regression Diagnostics for Multiple Linear Regressions.
5. Exercise on Residual Analysis.
6. Variable selection procedure.
7. ANOVA using Multiple Regression approach.

**References:**

1. Douglas G. Montgomery (2001), Design and Analysis of experiments, John Wiley & sons.
2. Fred L. Ramsey and Daniel W. Schafer (1997), The statistical Sleuth: a course in methods of Data Analysis, Duxbury Press.
3. D. C. Montgomery, E. A. Peck, G. G. Vining (2003), Introduction to Linear Regression Analysis, John Wiley & sons.

**B.Sc. DEGREE – SIXTH SEMESTER**

**G 506.6a: SAMPLING THEORY**

**UNIT I**

**Statistical Investigation:** Complete enumeration v/s sample surveys – merits and demerits, framing of the questionnaire. Probability sampling and Judgment sampling, Principles of sample surveys. Principal steps in sample survey, Errors in sampling. Concepts of parameters and estimators. Bias, mean square error, accuracy and precision of estimators. Selection of samples using random numbers. Drawing samples from finite populations with and without replacement. Sampling from frequency distributions and contingency Tables. Determination sample size: Obtaining Estimate with Specified Coefficient of Dispersion and Given Margin of Error in Estimate and the Confidence coefficient.

**-10 hrs.-**

**UNIT II**

**Simple random sampling with and without replacement:** Unbiased estimators of population mean, variance and population total. Sampling variances, standard errors and their estimation in SRSWR and SRSWOR, proof of the sample mean square is an unbiased estimate of the population variance under SRSWR and population mean square under SRSWOR. Comparison of SRSWR with SRSWOR, merits and demerits of simple random sampling. Simple random sampling of attributes, Estimation of population proportion and its standard error.

**-10 hrs.-**

**UNIT III**

**Stratified random sampling:** Meaning and applications of stratified random sampling, need for stratification, Stratified sampling under SRSWOR, Unbiased estimators of mean and total. Variances of these estimators and their estimation. Allocation of sample size – proportional and optimum allocation (w.r.t. SRSWOR stratification only), Neyman's allocation, proof of variance of the sample mean under proportional and optimum allocation, minimising the variance with the given cost functions. Comparison of SRSWOR and stratified sampling. Gain in efficiency due to stratification, merits and demerits of stratified random sampling.

**-10 hrs.-**

**UNIT IV**

**Linear systematic sampling:** Meaning and applications of systematic sampling, Estimation of mean, variance of the estimated mean in terms of  $S^2_{wsy}$  and intra class correlation. Comparison of SRSWOR,

stratified sampling and systematic sampling, systematic sampling in the presence of general linear trend, merits and demerits of systematic sampling.

**Cluster Sampling:** Meaning and applications, cluster sampling with equal number of unit, Estimation of population total and variance of the estimate, merits and demerits of cluster sampling.

-10 hrs.-

## B.SC. DEGREE – SIXTH SEMESTER

### G 506.6b: OPERATION RESEARCH (ELECTIVE - 1)

#### UNIT I

**Operations Research (OR):** Origin, definition, phases of OR – types of models.

**Linear Programming Problem:** General model, formation, graphical solution, Simplex algorithm (without proof), Charne's big M method – indication of unique solution, multiple solution, unbounded solution, no solution and degeneracy – dual LPP and its properties.

-15 hrs.-

#### UNIT II

**Transportation Problem:** General description and Statement of T.P., Balanced and unbalanced TP – initial solution by NWCR, matrix minima and Vogel's method, MODI method of optimization (without proof), degeneracy.

-10 hrs.-

#### UNIT III

**Assignment Problem:** General description and Statement of A.P., Hungarian method, maximization and minimization problems.

**Game Theory:** Nature of games, Two person zero sum games – Pay off Matrix – Pure and mixed strategies – Showing A's Problem as the Dual of the B's Problem – Principles of Dominance – Algebraic solution of rectangular games (Zero sum) – Solution of  $2 \times n$  and  $m \times 2$  games.

-10 hrs.-

#### UNIT IV

**Inventory Theory:** Basic concepts, deterministic models with instantaneous/finite production with/without shortages, Models with one/two price breaks, stochastic model with pre-fixed time (discrete case) and newspaper boy problem.

-5 hrs.-

**G 506.6 a: SAMPLING THEORY & G 506.6b : OPERATION RESEARCH (ELECTIVE - 1) PRACTICAL**

1. Drawing random samples from frequency tables and contingency tables. Estimation of mean and variance.
2. Drawing random samples from finite population – SRSWR, Estimation of mean, total and variance of the estimate.
3. SRSWOR.
4. Stratified sampling under SRSWOR.
5. Linear systematic sampling.
6. LPP Formulation and graphical solution.
7. LPP Simplex- slack variables only.
8. Big M method.
9. Solving balanced/unbalanced TP.
10. Exercise on Game Theory.
11. Deterministic inventory models with/without shortages- instantaneous/finite production rate.
12. Inventory models with one/two price breaks.

**References:**

1. Cochran W. G. (1984), Sampling Techniques – 3<sup>rd</sup> edition, Wiley Eastern.
2. Singh D. Chaudhary F. S. (1986), Theory and Analysis of Sampling Survey Design – Wiley Eastern.
3. S. C. Gupta & V. K. Kapoor (2014) Fundamentals of Applied Statistics, Sultan Chand & Co.
4. Sampath (2001), Sampling theory and methods, Narosa Publishing House.



5. P. V. Sukhatne and B. R. Sukhatne (1978), Sampling theory and techniques, ISBN-10: 021022519X, ISBN-13: 978-0210225196.
6. Kantiswarup, Manmohan and Gupta (2002), Operations Research, Sultan Chand & Co., New Delhi.
7. S.D. Sharma (2014), Operations Research, WordPress.com.
8. P.T. Gupta and D.S. Hira (2000), Operations research, S. Chand & Co., New Delhi.
9. Taha H.A. (2000), Research- An Introduction, Macmillan.

**B. Sc. DEGREE – SIXTH SEMESTER**  
**G 506.6 b: SIMULATION (ELECTIVE - 2)**

**UNIT I**

**Introduction to simulation:** Meaning and need for simulation, advantages and disadvantages of simulation, areas of applications, systems and system environment, components of a system, discrete and continuous systems, models of a system, types of models, discrete event system simulation, steps in simulation study. **-10 hrs.-**

**UNIT II**

**Random number generation:** Properties of random numbers, generation of pseudo random numbers, techniques of generating random numbers – linear congruential method. Tests for random numbers – frequency test, run tests, test for auto correlation, gap test, poker test. **-10 hrs.-**

**UNIT III**

**Random variate generation:** Inverse transformation technique – exponential, uniform, Weibull, triangular distributions, empirical continuous distributions without closed form inverse . Discrete distributions, Box – Muller method for normal distribution, convolution method, acceptance – rejection method – Poisson and geometric distribution. **-15 hrs.-**

**UNIT IV**

**Variance Reduction Technique.** **-5 hrs.-**

**B.Sc. DEGREE – SIXTH SEMESTER**  
**G 506.6 b : SIMULATION (ELECTIVE - 2) PRACTICAL**

1. Simulation of queuing systems (single and two servers).

2. Simulation of continuous queuing systems.
3. Simulation of Inventory systems.
4. Generation of random numbers and tests of random numbers.
5. Generation of random variates from continuous distributions.
6. Generation of random variates from empirical distributions.
7. Generation of random variates using acceptance – rejection techniques.

**Reference Books:**

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol (2002), Discrete Event System Simulation, Prentice – Hall of India, Pvt. Ltd., New Delhi.
2. Sheldon Ross (2002), A first course in Probability, Pearson Education Asia.

**QUESTION PAPER PATTERN (THEORY)**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**

**STATISTICS**

**TIME: 1.5 HOURS**

**MAX MARKS: 50**

I. ANSWER ANY FIVE OF THE FOLLOWING

5 / 7 x 2 = 10 MARKS

II. ANSWER ANY FOUR OF THE FOLLOWING

4 / 5 x 5 = 20 MARKS

III. ANSWER ANY TWO OF THE FOLLOWING

2 / 3 x 10 = 20 MARKS

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