**Unified Syllabus of Statistics**

**Course Instructions-:**

**B.Sc. Part- I & Part – II** There will be three papers of 3 hours duration of 50 marks in each. Practical will be of 50 marks & three hour duration in each year.

**B.A Part- I & Part – II** There shall be two theory papers of three hour duration of 33 marks each. Practical will be of 34 marks & three hour duration in each year.

**B.Sc Part-III** There will be three theory papers of three hour duration & 75 marks each. Practical would be of 75 marks & three hour duration.

**B.A Part – III** There will be three theory paper of three hour duration & 35 marks each. Practical would be of 45 marks & three hour duration.

**UNIFIED SYLLABUS OF STATISTICS**

**B.Sc. Part- I**

**Paper I: Statistical Methods:**

**UNIT-I**

Concept of statistical population , Attributes and variables (Discrete and Continuous).

Different types of scales – nominal, ordinal, ratio and interval. Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency. Secondary data, its major sources, scrutiny of data for internal consistency and detection of errors of recording. Presentation of data: classification, tabulation, diagrammatic & graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representations, histogram, frequency polygon and ogives. Stem and Leaf plot. Box Plot.

**UNIT-II**

Measures of central tendency – arithmetic mean, median, mode, harmonic mean, geometric mean – their properties, merits and demerits. Measures of dispersion –range,

quartile deviation, mean deviation, standard deviation with their merits and demerits, coefficients of dispersion.

**UNIT-III**

Moments, Sheppard’s correction for moments for grouped data (without derivation). Skewness and Kurtosis and their measures including those based on moments and

quartiles.

**UNIT-IV**

Bivariate data, principles of least squares, fitting of polynomial curves and fitting of

curves reducible to polynomial form. Correlation and Regression, Spearman’s rank correlation. Partial and Multiple correlation and Multiple regression for trivariate data, their measures and related results.

**Paper – II : Probability**

**UNIT – I**

Random experiment, trial, sample point and sample space, events, operations of events, concepts of equally likely, mutually exclusive and exhaustive events. Definition of probability: Classical, relative frequency and axiomatic approaches. Discrete probability space, properties of probability under set theoretic approach. Independence of events, Conditional probability, total and compound probability theorems, Bayes theorem and its applications.

**UNIT – II**

Random variables – discrete and continuous, probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, marginal and conditional distributions.

**UNIT – III**

Independence of random variables. Expectation of a random variable (rv) and its properties., expectation of sum of random variables and product of independent random variables, conditional expectation and related problems.

**UNIT – IV**

Moments, moment generating function (m.g.f.) & their properties, continuity theorem for

m.g.f.(without proof). Cumulants and c.g.f., characteristics function (definition only). Chebyshev’s inequality. Weak law of large numbers and Central Limit Theorem for a sequence of independently and identically distributed random variables and their applications (statement only).

**Paper – III : Probability distributions and Theory of Attributes**

**UNIT – I**

Discrete univariate distributions : Uniform, Binomial, Poisson, Hypergeometric, Geometric and Negative Binomial distributions, fitting of Binomial and Poisson

distributions.

**UNIT – II**

Continuous univariate distributions: Uniform, Normal, Exponential, Gamma, Beta and

Cauchy distributions, fitting of normal distribution.

**UNIT – III**

Exact sampling distributions: chi-square, t and F with distribution function and their simple properties.

**UNIT – IV**

Theory of attributes: Notion and terminology, Contingency table, class frequencies, ultimate class frequencies, consistency. Association of attributes, independence, measure of association for 2x2 table, Yule’s coefficient of association. Contingency tables.

**PRACTICAL**

The practical examination will be based on papers I, II & III and will cover the following

experiments.

**List of Practical Experiments**

1. Graphical representation of data by Histogram, Frequency polygons, frequency curves and Ogives.

2. Calculation of measures of location.

3. Calculation of measures of dispersion.

4. Calculation of moments, measures of Skewness and measures of Kurtosis.

5. Fitting of curves by method of least squares.

6. Determination of regression lines and calculation of correlation coefficient –grouped and ungrouped data.

7. Calculation of multiple and partial correlation coefficients for three variables

8. Calculation of measures of association in contingency tables.

9. Testing independence of attributes in m x n contingency table.

10. Fitting of Binomial, Poisson and Normal distributions to observed data.

**REFERENCES:**

1. Goon, Gupta and Dasgupta : Fundamentals of Statistics, Vol I. The Worlds Press

Pvt. Ltd., Calcutta.

2. Yule, G.U. and Kendall, M.G.: An Introduction to the theory of statistics. Charles

Griffin & Company Ltd.

3. Gupta, S.C. and Kapoor, V.K. : Fundamentals of Mathematical Statistics, Sultan

Chand and Sons, New Delhi.

4. Parzen, E.S. : Modern Probability Theory and Its Applications.

5. Meyer, P.: Introductory Probability and Statistical Applications.

6. Mood A.M., Graybill F.A. and Boes D.C. (1974) : Introduction to the theory of

Statistics, McGraw Hill.

**B.Sc. Part- II**

**Paper I : Statistical Inference**

**UNIT – I**

Point estimation. Characteristics of a good estimator: Unbiasedness, consistency,

sufficiency and efficiency. Method of maximum likelihood and properties of maximum

likelihood estimators (without proof). Method of minimum Chi-square . Method of Least

squares and method of moments for estimation of parameters. Problems and examples.

**UNIT – II**

Sufficient Statistics, Cramer-Rao inequality and its use in finding MVU estimators. Statistical Hypothesis (simple and composite). Testing of hypothesis. Type I and Type II errors, significance level, power of a test. Definitions of Most Powerful (MP), Uniformly

Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.

**UNIT – III**

Neyman-Pearson’s lemma and its applications for finding most powerful tests for simple

hypothesis against simple alternative. Interval estimation – concept of interval estimation confidence interval for mean & variance in case of normal population only.

**UNIT-IV**

Test of significance – large sample test for proportions and means : (i) single sample, (ii) two independent samples. Tests based on chi-square, t and F distributions.

**Paper II : Survey Sampling**

**UNIT – I**

Sampling Method : Concept of population, sample, parameter and statistic, sampling versus census, advantages of sampling methods, role of sampling theory, sampling and

non-sampling errors, bias and its effects, probability sampling.

**UNIT-II**

Simple Random sampling with and without replacement, use of random number tables in selection of simple random sample, estimation of population mean and proportion. Derivation of expression for variance of these estimates. Estimates of variance. Sample

size determination.

**UNIT-III**

Stratified random sampling. Problem of allocation, proportional allocation, optimum

allocation. Derivation of the expression for the standard errors of the usual estimators

when these allocation are used. Gain in precision due to stratification.

**UNIT-IV**

Systematic sampling : estimation of population mean and population total, standard errors of these estimators. Cluster sampling with equal clusters. Estimation of population mean and their mean square error.

**Paper III : Analysis of Vari**a**nce and Design of Experiment.**

**UNIT-I**

Analysis of Variance. One way classification. Assumptions regarding model. Two way

classification with one observations per cell.

**UNIT-II**

Principles of Design of experiments: Randomization, Replication and local control. Choice of size and type of a plot using uniformity trials. Completely Randomized Design

(CRD), Randomized Block Design (RBD). Concept and definition of efficiency of

design. Comparison of efficiency between CRD and RBD.

**UNIT – III**

Latin Square Design (LSD), Lay-out, ANOVA table, Comparison of efficiencies between

LSD and CRD, LSD and RBD.

**UNIT-IV**

Factorial Experiments : general description of factorial experiments; 22, 23 and 2n

factorial. Definition of main effects and interactions in 22 and 23 factorial. Preparation of

ANOVA by Yate’s procedure. Estimates and tests for main and interaction effects.

**PRACTICAL**

The practical examination will be based on papers I, II and III and will cover the

following experiments:

**List of Practical Experiments**

1. Chi-square test for (i) (ii) Goodness of fit, (iii) independence of two attributes.

2. t – test for (i) μ = μ0 (ii) μ1= μ2 (iii) = 0

3. F-test for

4. Large sample tests.

5. ANOVA in one-way and two-way classification.

6. Analysis of LSD.

7. Drawing a simple random sample with the help of table of random numbers.

8. Estimation of population means and variance in simple random sampling.

9. Stratified random sampling for population mean (proportional and optimum allocation).

10. Factorial Experiment Practical.

**REFERENCES**

1. Hogg & Craig : Mathematical Statistics.

2. Mood, Graybill and Boes : Introduction to the theory of Statistics.

3. Goon, Gupta and Dasgupta : Fundamentals of Statistics, Vol. I and Vol. II

4. Gupta, S.C. and Kapoor, V.K. : Fundamentals of Statistics.

5. Gupta, S.C. and Kapoor, V.K. : Applied Statistics..

6. Cochran, W.G. : Sampling Techniques

7. Cochran and Cox : Experimental Design.

8. Das & Giri : Design and Analysis of Experiments (Wiley Eastern).

**B.Sc. Part- III**

**Paper 1 : Non-parametric Methods and Numerical Analysis**

**UNIT – I**

Non-parametric tests – tests for randomness and test for goodness of fit. One sample tests: sign test, Wilcoxon signed rank test. Two sample tests : run test, Kolmogorov Smirnov’s test. Median test and Mann – Whitney U test, Spearman’s rank correlation test

**UNIT – II**

Calculus of finite differences, operators, separation of symbols, examples and problems. Interpolation formulae with remainder term. Newton’s forward and backword formulae for equal intervals.

**UNIT – III**

Central difference formulae, Newton’s divided difference formula for interpolation, Lagrange’s interpolation formula.

**UNIT – IV**

Numerical integration : Derivation of general quadrature formula for equidistant ordinates. derivation of Trapezoidal, Simpson’s 1/3rd and 3/8th rules, Weddle’s rule. Numerical differentiation using Newton’s forward and backward formulae.

**Paper II : Applied Statistics**

**UNIT – I**

Time series – its different components, illustrations, additive and multiplicative models,

determination of trend-graphic, semi-average, least square and moving average methods, measures of seasonal variation-simple average, ratio to moving average, ration to trend, link related method.

**UNIT – II**

Index number – its definition, application of index number, price relative and quantity or

volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre’s, Paashe’s and Fisher’s index number, time and factor reversal tests of index numbers, consumer price index

**UNIT – III**

Demographic methods : Sources of demographic data – census, register, ad-hoc survey, hospital records, demographic profiles of Indian Censuses. Measurement of mortality, crude death rates, age specific death rates, infant mortality rates. Measurement of fertility– crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross and net reproduction rate. Standardized death rates. Complete life table, its main features and construction (Abridged life table).

**UNIT – IV**

Control charts for variables and attributes. Sampling inspection by attributes – single and double sampling plans. Producer’s and consumer’s risk, OC, ASN, ATI functions AOQL and LTPD of sampling plans. Sampling inspection by variables – simple cases.

**Paper III : Linear Programming & Computational Techniques**

**UNIT – I**

General linear programming problems and their formulations. Method for solving LPP :

Graphical Method, Simplex method. Duality in LPP.

**UNIT – II**

Transportation problem: North-west corner rule, Least cost method, Vogel’s approximation method. Optimum solution by MODI method. Assignment Problem : Hungarian Algorithm.

**UNIT – III**

Introduction to computer : What is computer, characteristics, limitations and applications

of computer, fundamentals of hardware, software and their types, number system (Binary, octal, decimal, hexadecimal), operating systems and its types. Computer language and communication : communication, its components and modes, MODEM, digital and Analog signals, introduction to networking, various topologies of network, LAN, WAN, working knowledge of internet, low level language, high level language, 4GL.

**UNIT – IV**

C Programming : Design of Algorithms and flow charts, character set, constants, variables and data types, declaration of variables, operators and expressions. Input and output operation, decision making with IF, IF-ELSE, nesting IF, ELSE IF ladder, switch structure, goto structure, loops – FOR, WHILE, DO-WHILE, BREAK, CONTINUE. Array declaration, initialization, of one dimensional and two dimensional.

**PRACTICAL**

The practical examination will be based on papers Paper I, Paper II and Paper III and will cover the following experiments:

**List of Practical experiments:**

1. Non-parametric test – Run test and Test for randomness.

2. Construction of forward difference tables and divided difference tables.

3. Interpolation by Newton’s forward difference formula for equal intervals and calculation of error.

4. Interpolation by Newton’s divided difference formula for unequal intervals.

5. Interpolation by Lagrange’s formula.

6. Approximate Integration (Trapezoidal rule, Simpson’s 1/3rd and 3/8th rules),

Weddle’s rule.

7. Time Series : Trend by moving average method & Method of least squares.

Seasonal indices.

8. Index number : Construction of various index numbers and application of

mathematical tests.

9. Vital statistics : Various birth & death rates. Life table.

10. Control charts : , R, p and c-charts.

11. Computer applications : Problems involving sequential, decision making and

looping structure. Arrays applications – searching, sorting, largest & smallest

element of array, addition, multiplication of 2 arrays. Statistical problems – mean,

variance, moments, correlations & regression.

**REFERENCES :**

1. Mood, A.M., Graybill F and Boes D.C. : Introduction to the theory of Statistics.

2. Gibbons, J.D. : Non-parametric statistical inference

3. Conover, W.J. : Practical Non-parametric Statistics

4. Freeman : Finite Differences.

5. Scarborough : Numerical Analysis.

6. S.S. Sastry : Introductory Methods of Numerical Analysis.

7. Saxena, H.C. : Calculus of Finite differences.

8. Croxton F.E. and Cowden D.J. : Applied General Statistics

9. Goon, Gupta and Dasgupta : Fundamentals of Statistics, Vol. I & II

10. Gupta, S.C. and Kapoor, V.K. : Applied Statistics.

11. Swarup Kanti, Gupta P.K. and Man Mohan : Operations Research.

12. Taha, H.A. : Operations Research.

13. Sinha, P.K. : Fundamentals of computer.

14. Yashwank Kanitkar : Let us C.

15. Balaguru Swamy : Ansi C.

**B.A. Part- I**

**Paper I: Statistical Methods and Theory of Attirbutes:**

**UNIT-I**

Concept of statistical population, Attributes and variables (Discrete and Continuous).

Different types of scales – nominal, ordinal, ratio and interval. Primary data – designing a questionnaire and schedule, collection of primary data, checking their consistency. Secondary data, its major sources, scrutiny of data for internal consistency and detection of errors of recording. Presentation of data : classification, tabulation, diagrammatic & graphical representation of grouped data. Frequency distributions, cumulative frequency distributions and their graphical representations, histogram, frequency polygon and ogives. Stem and Leaf plot. Box Plot.

**UNIT-II**

Measures of central tendency – arithmetic mean, median, mode, harmonic mean, geometric mean – their properties, merits and demerits. Measures of dispersion – range, quartile deviation, mean deviation, standard deviation with their merits and demerits, coefficients of dispersion. Moments, Sheppard’s correction for moments for grouped data (without derivation). Skewness and Kurtosis and their measures including those based on moments and quartiles.

**UNIT-III**

Bivariate data, principles of least squares, fitting of polynomial curves and fitting of curves reducible to polynomial form. Corrlation and Regression, Spearman’s rank correlation. Partial and Multiple correlation and Multiple regression for trivariate data, their measures and related results.

**UNIT-IV**

Theory of attributes : Notion and terminology, Contingency table, class frequencies, ultimate class frequencies, consistency. Association of attributes, independence, measure of association for 2x2 table, Yule’s coefficient of association. Contingency tables.

**Paper – II : Probability and Probability Distributions.**

**UNIT – I**

Random experiment, trial, sample point and sample space, events, operations of events, concepts of equally likely, mutually exclusive and exhaustive events. Definition of probability : Classical, relative frequency and axiomatic approaches. Discrete probability space, properties of probability under set theoretic approach. Independence of events, Conditional probability, total and compound probability theorems, Bayes theorem and its applications. Random variables – discrete and continuous, probability mass function (pmf) and probability density function (pdf), Cumulative distribution function (cdf). Joint distribution of two random variables, marginal and conditional distributions.

**UNIT – II**

Independence of random variables. Expectation of a random variable (rv) and its properties., expectation of sum of random variables and product of independent random variables, conditional expectation and related problems. Moments, moment generating function (m.g.f.) & their properties, continuity theorem for m.g.f. (without proof). Cumulants and c.g.f., characteristics function (definition only). Chebyshev’s inequality. Weak law of large numbers and Central Limit Theorem for a sequence of independently and identically distributed random variables and their applications (statement only).

**UNIT – III**

Discrete univariate distributions : Uniform, Binomial, Poisson, Hypergeometric, Geometric and Negative binomial distributions, fitting of binomial and Poisson distributions.

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Continuous univariate distributions : Uniform, Normal, Exponential, Gamma, Beta and Cauchy distributions, fitting of normal distribution. Exact sampling distributions : chi-square, t and F with distribution function and their simple properties.

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6. Determination of regression lines and calculation of correlation coefficient –

grouped and ungrouped data.

7. Calculation of multiple and partial correlation coefficients for three variables

8. Calculation of measures of association in contingency tables.

9. Testing independence of attributes in m x n contingency table.

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6. Mood A.M., Graybill F.A. and Boes D.C. (1974) : Introduction to the theory of

Statistics, McGraw Hill

**Paper I : Statistical Inference and Analysis of Variance.**

**UNIT – I**

Point estimation. Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Method of maximum likelihood and properties of maximum likelihood estimators (without proof). Method of minimum Chi-square. Method of Least

squares and method of moments for estimation of parameters. Problems and examples.

**UNIT – II**

Sufficient Statistics, Cramer-Rao inequality and its use in finding MVU estimators. Statistical Hypothesis (simple and composite). Testing of hypothesis. Type I and Type II

errors, significance level, power of a test. Definitions of Most Powerful (MP), Uniformly

Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.

**UNIT – III**

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**UNIT-IV**

Analysis of Variance. One way classification. Assumptions regarding model. Two way

classification with one observations per cell.

**Paper II : Survey Sampling and Design of Experiments.**

**UNIT – I**

Sampling Method : Concept of population, sample, parameter and statistic, sampling versus census, advantages of sampling methods, role of sampling theory, sampling and non-sampling errors, bias and its effects, probability sampling. Simple Random sampling with and without replacement, use of random number tables in selection of simple random sample, estimation of population mean and proportion. Derivation of expression for variance of these estimates. Estimates of variance. Sample size determination.

**UNIT-II**

Stratified random sampling. Problem of allocation, proportional allocation, optimum allocation. Derivation of the expression for the standard errors of the usual estimators when these allocation are used. Gain in precision due to stratification. Systematic sampling : estimation of population mean and population total, standard errors of these estimators. Cluster sampling with equal clusters. Estimation of population mean and their mean square error.

**UNIT-III**

Principles of Design of experiments: Randomization, Replication and local control. Choice of size and type of a plot using uniformity trials. Completely Randomized Design (CRD), Randomized Block Design (RBD). Concept and definition of efficiency of design. Comparison of efficiency between CRD and RBD.

**UNIT-IV**

Latin Square Design (LSD), Lay-out, ANOVA table, Comparison of efficiencies between

LSD and CRD, LSD and RBD. Factorial Experiments : general description of factorial experiments; 22, 23 and 2n factorial. Definition of main effects and interactions in 22 and 23 factorial. Preparation of ANOVA by Yate’s procedure. Estimates and tests for main and interaction effects.

**PRACTICAL**

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experiments:

**List of Practical Experiments**

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attributes.

2. t – test for (i) μ = μ0 (ii) μ1= μ2 (iii) = 0

3. F-test for

4. Large sample tests.

5. ANOVA in one-way and two-way classification.

6. Analysis of LSD.

7. Drawing a simple random sample with the help of table of random numbers.

8. Estimation of population means and variance in simple random sampling.

9. Stratified random sampling for population mean (proportional and optimum

allocation).

10. Factorial Experiment Practical.

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4. Gupta, S.C. and Kapoor, V.K. : Fundamentals of Statistics.

5. Gupta, S.C. and Kapoor, V.K. : Applied Statistics..

6. Cochran, W.G. : Sampling Techniques

7. Cochran and Cox : Experimental Design.

8. Das & Giri : Design and Analysis of Experiments (Wiley Eastern).