# Curriculum of Statistics for B.A./B.Sc.

## 1. Objectives of Teaching Statistics at B.A/B.Sc. Level:

The Objectives of teaching statistics at the B.A/B.Sc. level are:

1. To encourage and develop critical thinking in students in handling real world data preferably of local origin.

2. To make the students learn by conducting experiments, collecting and describing data.

3. To promote understanding of the subject for the purpose of analyzing data and drawing valid inferences.

4. To provide the students sound basic background which would enable them to pursue studies in statistics at higher levels.

5. To prepare students for taking up statistical jobs in various government/semi-government/private organizations.

6. To expose students with present day tools of analysis i.e. computers and packages.

**Course out line.**

To achieve the desired objectives on teaching of Statistics at the B.S/B.Sc. level the students must have a sound background in mathematics and there should essentially be balance mixture of theory, methods and applications. Accordingly, the following course out line is finalized.

The students would be examined in both theory and practical separately. It is recommended that the students be examined through one compulsory objective question comprising all parts of course contents and with appropriate number of questions with respect to different sections of course contents.

The figures within brackets in indicate the weight of each topic. There shall be one written and one practical in each year.

The papers out lined below are with respect to one paper for B.A/B.Sc. Part – I course and one paper for B.A/B.Sc. Part – II course and their practical. The marks distribution will be as such:

| | | |
|---|---|---|
| B.A/B.Sc. Part – I: | Paper – I | 60 Marks |
| | Practical – I | 15 Marks |
| | Total | 75 Marks |
| B.A/B.Sc. Part – II: | Paper – II | 60 Marks |
| | Practical – II | 15 Marks |
| | Total | 75 Marks |

**B.A/B.Sc. (Part – I) STATISTICS**

One objective type question (compulsory) to be set from all the course. Further, NINE questions will be set according to the weightage given below to each topic and the student should be asked to attempt any two questions from each section.

## Paper – I

### SECTION – A

**i. Descriptive Statistics (1/10)**

Definition of statistics. Use of statistics in different disciplines, descriptive and inferential statistics. Population and sample. Type of variable and their measurement scales, Description of Data by frequency tables and graphs. Measures of central tendency, location and dispersion and their properties. Moments, skew ness and kurtosis.

**ii. Sampling (1/10)**

Basic concepts. Advantages of Sampling. Probability and Non-Probability Sampling. Sampling and Non-Sampling Errors. Sampling Design of Simple Random, Stratified, Systematic and Cluster Sampling. Judgment and Quota Sampling, Random Numbers and their use in Sampling.

**iii. Index Numbers (1/10)**

Index Numbers. Simple and Composite Indices. Problems in the construction of Index Numbers. Construction of Whole Sale Price Indices. Weighted Index numbers. Laspeyres, Paasche's, Marshall-Edgeworth and Fisher's Ideal Indices. Quantity Indices. Consumer Price Index. Construction and Uses.

**iv. Time series (1/10)**

Time Series. Decomposition of Time Series. Measurement of Trend, Seasonal and Cyclic variations. Seasonal Indices.

**SECTION – B**

**v. Probability (1/10)**

Review of Sets. Operations on Sets. Cartesian Product of Sets. Random Experiments. Sample Space and Events. Definition and Axioms of Probability. Rules for counting of Points. Basic Laws of Probability. Independence of Events. Bayes' theorem. Applications of Probability.

**vi. Random Variables (2/10)**

Random Variable. Distribution Function. Discrete and Continuous Random Variables. Probability Distribution of Discrete and Continuous Random Variables. Joint Distribution of Two Discrete and Continuous Random Variables. Marginal and Conditional Distributions. Mathematical Expectation and its Properties. Covariance and Correlation of Two Random Variables. Mean, Variance and Moments of Simple Continuous Distributions.

**vii. Discrete Probability Distributions (1/10)**

Uniform, Bernoulli, Binomial, Hyper – geometric, Poisson, Negative Binomial and Geometric Distributions; their properties and applications with examples from various fields.

**viii. Continuous Probability Distributions (1/10)**

Uniform, Exponential and Normal distributions with their properties and applications with examples from various fields.

**PRACTICAL – I**

i. Construction of frequency distribution from raw data.
ii. Graphical display of frequency distribution constructed (i) above (histogram, polygon etc.)
iii. Empirical study of the shape of the frequency distribution constructed in (i).
iv. Construction of Indices.
v. Analysis of Time Series.
vi. Fitting of Binomial, Poisson and Normal Distributions to real world data.

**Note: -**

i. At least fifteen Practicals covering all the topics above must be conducted in the Laboratories using Scientific Calculators/Personal Computers.
ii. The practical examination shall be to two hours duration. Three marks shall be reserved for Viva Voce examination and another Two for the Practical Note – Book.

**BOOKS RECOMMENDED**

1. Walpole, E.R. (1990), "Introduction of Statistics", 3rd Edition, Mac million Publishing Co. Inc., New York.

2. Chaudhry, S.M. and Kamal, S. (1998), Introduction to Statistical Theory Part I & II, Ilmi Kutab Khana, Urdu Bazar, Lahore.

**REFERENCE BOOKS**

1. Spiegal, M.R., Schiller, J.L. and Srinivasan, R.L. (2000). Probability and Statistics, 2nd Ed. Schaums Outline. McGraw Hill, New York.

2. Freedman, D.,Pisani, R., Parves R. and Adhikari, A. (1997). Statistics, 3rd Edition, Norton, New York.

3. Beg: M.A. and Mirza, M.D. (1997). Statistics: Theory and Methods, Volume I and II. Carvan Book House, Kutechery Road, Lahore.

## PAPER – II

### SECTION – A

**i. Sampling Distribution (1/10)**

Sampling Distribution of a Statistics and its Standard Error. Distribution of a Sample mean and Central Limit Theorem with illustrations. Distribution of Difference between Two Sample Means. Distributions of sample Proportion and Difference between Sample Proportions.

**ii. Statistical Inference (1/10)**

Concept of Statistical Inference. Estimates and Estimators. Point Estimation of Parameter. Properties of Point Estimators: Unbiasedness, Consistency. Interval Estimation. Confidence Interval and its Interpretation. Interval Estimation of the Mean, the Proportion and the Difference between Two Proportions of Populations with known and unknown Variances Based on Large Samples. Determination of Sample Size.

**iii. Testing of Hypothesis (1/10)**

Null and Alternative Hypotheses. Two Types of Errors and the Power of Test. Acceptance and Rejection Regions. One Sided and Two Sided Tests. Level of Significance. General Steps in Hypothesis Testing. Tests of Hypotheses about the Means, Difference between Two Means, Proportion and the Difference Between Proportions in case of Large Samples and in Small Samples when Population Variances are Known.

**iv. Student's t – Distribution and Statistical Inference (1/10)**

The Student's t –Distribution. Interval Estimation of the Mean and Difference Between Two Means. Tests of Hypothesis about Mean, Difference between Two Means, Proportion and the Difference Between Proportions in case of Large Samples and in Small Samples when Population Variances are Known.

**v. Chi – Square Distribution and Chi – Square Tests (1/10)**

Chi – Square Distribution. Interval Estimation of Population Variance. Test of Hypothesis about the Variance. Pearson's Test for Goodness – of – fit. Contingency Tables and Tests for Independence. Yates' Correlation for Continuity.

**SECTION –** B

**vi. Analysis of Variance and Basis Experimental Designs (1/10)**

F – Distribution and testing the Hypotheses about the Equality of Two Variances. Analysis of variance for one – way and two – way classifications. Principles of Experimental Design. Completely Randomized, Randomized Complete Block and Latin Square designs. Description, Layout, statistical analysis, relative efficiency, advantages and limitations of these designs. Multiple comparisons tests: The least significant difference (L.S.D) and Duncan's Multiple range test (DMRT).

**vii. Regression Analysis (1/10)**

Deterministic and Probabilistic Models. Scatter Diagrams. Simple Linear Regression. Least Square Estimates. Properties of Least Square Regression Line. Standard Errors of Estimates. Interval Estimation and Test of Hypotheses about Regression. Co – efficient of Multiple determination. Statistical Inference in Multiple Regressions.

**viii. Correlation Analysis (1/10)**

Linear Correlation. Partial and Multiple Correlation for Three Variables. Test of Hypothesis about linear Correlation Co – efficient. Statistical Inference in Partial and Multiple Correlation.

**ix. Non – Parametric Methods (1/10)**

Introduction to non – parametric methods. Advantages of Non – Parametric Methods. Sign test, Runs test, Mann – Whitney U test. Test of Independence and Goodness of fit. Spearman's Correlation Method.

## PRACTICAL – II

i. Construction of Sampling Distribution: Sampling Distribution of Sample Means and Difference in means (with and without replacement).
ii. Testing of Hypotheses and construction of confidence intervals for the mean, Difference between means in small and large samples with known and unknown variances.
iii. Goodness-of-fit and testing of independence through Chi-Square test.
iv. Simple and Multiple Linear Regression with two Regressors.
v. Analysis of Variance in one-way classification and two-way classification (L.S.D test desirable).
vi. Basic Experimental Designs; Completely Randomized, Randomized Complete Block and Latin Square designs.
vii. Non-Parametric tests.

## Note.

i.. At least fifteen Practicals covering all the topics above must be conducted in the Laboratories using Scientific Calculators/Personal Computers.
ii. The practical examination shall be of two hours duration. Three marks shall be reserved for the viva-voce examination and another Two for the practical Note-Book.

## Books Recommended.

1. Walpole. E.R. (1990), "Introduction of Statistics", 3rd Edition, Mas-million Publishing Co. Inc., New York.
2. Chaudhry, S.M. and Kamal, S. (1998). Introduction to Statistical Theory Part I & II, Ilmi Kutab Khana, Urdu Bazar, Lahore.

## Reference Books

1. Freedman, D. Pisani, R. Perves, R. and Adhikari, A. (1997). Statistics, 3rd Edition, Norton, New York.
2. Beg, M.A. and Mirza, M.D. (1997). Statistics: Theory and Methods, Volumes I and II. Carvan Book House Kutechery Road Lahore.
3. Spiegal, M.R, Schiller, J.L and Srinivasan, R.L. (2000). Probability and Statistics, 2nd Edition. Schaums Outline Series. McGraw Hill, New York.

**The depth in terms of concepts in the content of the subject:**

The following points help in determining the depth to which a particular topic would be dealt with:

**1. Descriptive Statistics:**

A comprehensive discussion of descriptive statistics, which includes condensation, summarization and graphical display. Discussion about all measures of location and dispersion with examples which enable the students to decide which measures wuits best in a given situation. These topics are included for the benefit of those students who have not studied statistics at the intermediate level. However, a detailed coverage is desired so as to enable the students to appreciate the usefulness of these measures in the statistical methods to be learnt later. This part, however, carries, minimal weight for examination purposes.

**2. Sampling:**

Basic concepts in sampling be explained in detail. Students be taught to prepare FRAME, to obtain random sample for various sample designs. Use of random numbers tables be extensively taught.

**3. Time Series and Index Numbers:**

Emphasis should be placed on application of various techniques to time series data generated in Pakistan.

Methods of construction of Index Numbers, problems in their construction: selection of items, markets, quotations etc. be discussed with Index Numbers including determination of percent changes and inflation be discussed.

**4. Probability:**

Probability theory is to be presented using set notation. The classical, the relative frequency and the axiomatic approaches to probability should be discussed. Emphasis is to be placed on relative frequency approach. Laws of probability should be given with proofs. The concept of independence should be carefully explained. Simple and realistic examples should be used, emphasizing the role of probability as a tool for decision making. Examples of tossing of coins drawing of cards be related with real words situation.

**5. Random Variable:**

Concept of random variable should be explained with simple illustrations, concepts of discrete and continuous random variables to be explained with examples. Concepts of joint distribution with examples. Detailed explanation of marginal and conditional

distributions should restrict to discrete random variables. Properties of mathematical expectation should be explained in terms of distribution function. Application of mathematical expectation for simple probability functions and examples of calculation of expectations as an aid in decision making be given.

**6. Probability Distributions (Discrete and Continuous):**

Generation of various discrete and continuous probability distributions be explained through simple experiments (and/or random numbers). Their mathematical equations with their properties and use in real life problems be explained. Normal distribution is to be given detailed coverage. Extensive use of Normal Probability Tables be encouraged. Various parameters of the distributions be evaluated through expectation (or m.g.f. where convenient) comparison of probabilities as obtained by the use of Chebychev's Inequality be compared with the corresponding actual probabilities obtained for all probability distributions.

**7. Sampling Distributions:**

Distinction between sampling distribution and theoretical (Population) distribution be discussed. Generation of sampling distributions of sample statistics be explained. Chi-square, t & F-distributions be introduced without their derivations; central limit theorem be explained through taking samples of various sizes from different populations. Sampling from Normal Population be explained without proof.

**8. Statistical Inference:**

The nature of statistical inference should be discussed, explaining all the basic concepts involved, illustrated by real world examples. Emphasis should be placed on formulation of hypotheses.

Application of t-distribution should be clearly discussed in case of independent samples and paired observations. Cases with populations having unknown and unequal variances should be introduced, however, problem solving in such cases is not expected.

Construction of confidence intervals for variance should be explained. Test of hypothesis about a single variance should be done using chi-square test. F-test should be used for testing equality (ratio) of two variances with emphasis on one-tailed test.

**9. Analyses of variances and Basis Experimental Designs:**

Concept of analysis of variance, basis of partitioning of sum of squares and degrees of freedom should be explained. Basis terminology and principles, viz-a-viz randomization, replication and local control be discussed. Description, layout, statistical analysis of Completely Randomized, Randomized Complete Block and Latin square designs and their advantages and limitation should be discussed. Expectations of mean squares be stated without single observation per cell.

**10. Regressions and Correlation Analysis:**

Types of variables and linearity of models should be explained. Properties of the least squares estimation to be stated without proofs. Statistical Inference, about the regression coefficient and coefficient of determination be explained. Calculation of the least squares estimates in multiple linear regressions with two regressors. Standard error of estimates, coefficient of multiple determination. Tests of hypotheses about multiple regression coefficients. Discussion about explained and un-explained variation be made and ANOVA be used for testing of hypotheses.

**11. Non-Parametric Tests:**

Distinction between parametric and non-parametric (distribution free) tests be made. The emphasis on application of non-parametric methods (particularly) where parametric methods cannot be applied), be made. No derivations or proofs are required.

**12. Computers:**

Computers be introduced as tools of statistical analysis. Computer logic and its working; Basis of Computer programming and introduction to statistics packages be discussed.