40. STATISTICS

Paper-A	75 marks
Paper-B	75 marks
Paper-C (Practical)	50 marks
Total : ..	200 marks

PAPER - A

Candidates are required to attempt at least two questions from each Section.

SECTION - I

DESCRIPTIVE STATISTICS (Weight 2/10)

Meaning of Descriptive and Inferential statistics. Population and Sample. Types of variables, Measurement Scales. Sources of Statistical data in Pakistan. Description of data by frequency tables and graphs. Stem and Leaf plots and Box plots. Measures of *Central Tendency*. A.M. H.M. G.M, Mode, Median, Quantiles. Properties of Mean with proofs. Weighted Arithmetic Mean. Empirical Relation between Mean. Median and Mode. Relative Merits and Demerits of various averages. Measures of *Dispersion* : Absolute and Relative Measures, Range. Semi-Inter Quartile Range, Mean Deviation, Variance, Standard Deviation. Coefficient of Variation, Coefficient of Mean Deviation, Coefficient of Quartile Deviations, Properties of Variance and Standard Deviation with proofs. Standardized variables, Moments, Moment Ratios, Sheppards Correction, Kurtosis and Skewness.

INDEX NUMBERS AND TIME SERIES (Weight 2/10)

(*a*) Construction and application of wholesale price Index Numbers. Fixed and chain base methods. Weighted Index Numbers (Laspeyre's, Paasche's Fisher's Ideal and Marshall-Edgeworth Indices). Tests for the consistency of Index Numbers Construction of Consumer price Index Numbers. Sensitive price Indicator.

(*b*) Time Series. Components of a time series. Analysis of time series. Measurement of secular trend and seasonal variations by various methods. Deseasonalization of data.

SIMPLE REGRESSION AND CORRELATION (Weight 1/10)

Logic of regression and correlation. Scatter diagram, simple linear regression model, least square estimators and their properties, standard error of estimate. Meaning and application of linear correlation coefficient. Properties of correlation co-efficient. Correlation coefficient for bi-varlate frequency distribution. Meaning derivation and application of Rank correlation, tied ranks.

SECTION - II

PROBABILTY (Weight 2/10)

Random experiments, sample space and events. Counting techniques. Definitions and axioms of probability. Basic laws of probability. Independence of events. Bayes Theorem (proof not required) and its application.

DISCRETE RANDOM VARIABLE AND DISCRETE PROBABILITY DISTRIBUTIONS (Weight 2/10)

Random variable, distribution function, discrete random variable. Probability distribution of a discrete random variable. Joint distribution of two discrete random variables, marginal and conditional distributions, mathematical expectation and its properties, mean, variance and moments. Concept of m.g.f. and its properties. Uniform, Bernoulli, Binomial, Hyper-geometric and Poisson distributions, mean, variance and shape of these distributions and their properties. Application of these distributions with exammples from various fields. Multinomial distribution (only application).

CONTINUOUS RANDOM VARIABLES AND CONTINUOUS PROBABILITY DISTRIBUTIONS (Weight 1/10)

Continuous random variables. Probability distribution of a single continuous random variable, probability density function and distribution function. Mean, variance and moments of continuous random variables Uniform and Normal distributions. Mean, variance and shape of these distributions and their properties. Application of these distributions. Normal approximation to the Binomial and Poisson distribution (just application). Fitting of Normal distribution by area method.

PAPER - B

Candidates area required to attempt at least two questions from each Section.

SECTION - I

SAMPLING AND SAMPLING DISTRIBUTION (Weight 2/10)

Sampling designs of Simple random, Stratified, Systematic and Cluster sampling, Judgment and Quota Sampling. Random Numbers and their uses in sampling. Advantages of sampling.

Probability and non-probability sampling, sampling and non-sampling error. Calculation of sample mean, proportion and variance of simple random samples and stratified random samples. Sampling distribution of a statistic and its standard error. Distribution of sample mean, sample proportion, difference between two proportions and means. Central limit theorem with illustration (Proof not required).

STATISTICAL INFERENCE (Weight 2/10)

Nature of statistical inference, point and interval estimation of parameter, properties of point estimator, confidence interval and its interpretation. Null and alternative hypothesis, simple and composite hypothesis. Type I and Type II errors. Level of significance. P-value and power of test (only concept and definition), Acceptance and rejection regions, one sided and two sided tests, test procedure. Inference about single mean and difference between means for paired and un-paired observations. Inference about proportion and difference between two proportions. Determination of sample size. (Application of Normal distribution and t-distribution).

INFERENCE ABOUT VARIANCE (Weight 1/10)

Introduction and application of Chi-square distribution: Interval estimation and test of hypothesis about population variance (Interval estimation for variance - single sample).

Introduction and application of F-distribution: test of hypothesis for equality of two variances.

SECTION - II

ANALYSIS OF COUNT DATA (Weight 1/10)

Chi-square test of Independence, Cl Chi square test of goodness of fit, Chi-square test of homogeneity.

REGRESSION AND CORRELATION ANALYSIS (Weight 2/10)

Multiple linear regression with two regressors, coefficient of multiple determination Partial and multiple correlation up to three variables. Inference of simple correlation and regression, partial and multiple correlation. Interval estimates and tests of hypothesis about parameters, mean prediction and individual prediction.

ANALYSIS OF VARIANCE RND BASIC EXPERIMENTAL DESIGNS (Weight 2/10)

Analysis of variance for one-way classification and two-way classification. Multiple comparison tests; least significant difference and Duncans multiple range test. Basic principles of experimental design. Completely randomized, Randomized Complete Block and Latin Square Designs. Descriptions, layout, statistical analysis, advantages and limitations of these designs. Application of these designs (Analysis of all these designs for single observation in each cell).

PAPER - C (Practical)

Candidates are required to attempt one question from each Section.

SECTION - I

One question from each section of Paper A should be set

SECTION - II

One question from each section of Paper B should be set

Each question of 18 marks	i.e. 18—18		..	...		36 marks
Practical Note Book :	..	..	..	..		05 marks
Viva Voce :	..	..	..	..	..	09 marks
			Total :	..		**50 marks**

Recommended Books

1. Clarke G. & Cooke D (1998). A basic Course in Statistics, Arnold Publisher, London, 4th Edition.
2. Chase W Bown F (1997) General Statistics, 3rd Edition, John Willy & Sons, New New York.
3. Wonnacott T.H. and Wonnacott R.J. (1981). Introductory Statistics, John Willy & Sons, New York.
4. Graybill, Iyer & Burdick (1998). Applied Statistics, A first course in inference. Prentice Hall, New Jersy.
5. Chaudhey, S.M. & Kamal, S. (1999) Introduction to Statistical Theory Parts I & II, Ilmi Kitab Khana, Urdu Bazar, Lahore.
6. Beg. M.A. and Mirza, M.D. (1997). Statistics, Theory and Methods, Volumes I & II Carvan Book House, Kutechery Road, Lahore.
7. Moore D.S., McCabe G.R., (1997). Introduction to the Practice of Statistics, 3rd Edition, Will Freeman & Co., New York.
8. Blumen (1997), Elementary Statistics, 3rd Edition, McGraw Hill, New York.
9. Chaudhry, R.M. (1998). Polymer Modern Statistics, Polymers.

FOR TEACHERS ONLY

THE DEPTH IN TERMS OF CENCEPTS IN THE CONTENT OF THE SUBJECT FOR TEACHERS ONLY

1. Descriptive Statistics

A brief 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 suits best in a given situation. These topics are included for the benefit of these 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. Sources of statistical data in Pakistan.

2. Index Numbers and Time Series

Methods of construction of Index Numbers, problems in their construction: selection of items, markets, quotations etc, be discussed. Application of Index Numbers including determining per cent changes and inflation be discussed.
Emphasis should be placed on application of various techniques to time series data generated in Pakistan.

3. Probability

Probability theory is to be prsesented 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. Basic 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 avoided where possible.

4. Random Variable and Discrete Probability Distribution

Concept of a discrete random variable should be explained with simple illustrations, Concepts of joint distributions with examples. Detailed explanation of marginal and conditional distributions of 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.
Generation of various discrete and continuous probability distributions be explained through simple experiments (and or uniform random numbers). Their mathematical equations with their properties and use in real life problems be explained.

5. Continuous Random Variable and Continuous Probability Distribution

Concept of a single continuous random variable should be explained with simple illustrations.
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).

6. Sampling and Sampling Distribution

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

Distinction between sampling distribution and theoretical (poulation) distribution be discussed. Generation of sampling distributions of simple statistics be explained Central limit theorem be explained through taking samples various sizes from different populations. Sampling from Normal Population be explained without proof.

7. **Statistical Inference**

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

Application of` distribution should be clearly discussed in case of independent sample 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.

3. **Analysis of Variance and Basic Experimental Designs**

Concept of analysis of variance, basis of partitioning of sum of squares and degrees of freedom should be explained. Basic terminology and principles, viz-a-viz randomization, replication and local control be discussed. Desription layout, statistical analysis of Completely Randomized. Randomized Complete Block and Latin Square designs and their advantages and limitations should be discussed. Expectations of mean squares be stated without derivation. All designs to be studied with single observation per cell.

9. **Regression and Correlation Analysis**

Types of variable, linearity of model should be explained. Properties of the least squares estimation. Statistical inference, about the regression coefficient. Coefficient. of determination, explained and unexplained variations. Calculation of the least squares estimates in multiple linear regression with two regressors. Standard error of estimate, coefficient of multiple determination.

Tests of hypotheses about multiple regression coefficients. ANOVA may be used for testing of hypotheses. Mean prediction, individual prediction and their uses should be carefully explained.