SYLLABUS FOR THE SUBJECT OF STATISTICS
PAPER– I

Total Marks: 100

Descriptive Statistics: (15%)

Nature and scope of Statistics. Organizing and classification of data. Population and sample. Variables, Measurement scales. Descriptive and Inferential Statistics. Description of data by frequency tables and graphs. Stem and leaf plot and Box and whisker plot. Arithmetic Mean, Geometric Mean, Harmonic Mean, Mode, Median, Quartiles. Properties of Mean with proofs. Relative Merits and Demerits of various averages. Weighted Arithmetic Mean. Empirical Relation between Mean, Median and Mode. Absolute and Relative Measures of dispersion: Range, Semi-Inter Quartile Range, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation, Coefficient of Mean Deviation, Coefficient of quartile Deviation. Properties of Variance and Standard Deviation with proofs. Standardized Variables. Moments, Moments Ratios, Sheppard's Correction, Skewness and Kurtosis. Chebechev's theorem and its application.

Concepts of Probability: (05%)

Operation in sets. Cartesian product set. Random experiment. Sample space and events. Rules of counting. Introduction to probability and axioms of probability, emphasising to concepts, facts, interpretation and illustrating examples. Basic laws of probability. Conditional and marginal probabilities. Independence of events. Baye's theorem and its application.

Random Variable: (15%)

Discrete random variable. Probability function, probability distribution function. Mathematical expectation and its properties. Joint distribution of two discrete random variables. Marginal and conditional distributions. Mean, variance, moments, covariance and correlation of two discrete random variables. Moment generating function and its properties.

Continuous random variable. Probability distribution of a continuous random variable. Probability density function and probability distribution function. Joint distribution of two continuous random variables. Marginal and conditional distributions. Mathematical expectation and its properties. Moment generating function. Covariance and correlation of two random variables. Mean, Median, Mode, Geometric mean, Harmonic mean, Mean deviation, variance and moments of simple continuous functions.

Discrete Probability Distributions: (15%)

Uniform Bernoulli, Binomial, Multinomial, Hypergeometric, Poisson, Negative Binomial and Geometric distributions with their derivations, applications and fitting to statistical data. Poisson approximation to the binomial distribution.

Continuous Probability Distributions: (15%)

Uniform, Exponential and Normal distributions. Their properties, applications and fitting to statistical data. Normal approximation to the Binomial and Poisson distributions.

Bivariate Normal Distribution (10%):

Derivation, conditional density function, conditional expectation and moment generating function μ_{20}, μ_{02} and μ_{11}.

Method of Least Squares: (15%)

Scatter diagram, Principle of least square. Deduction and solution of normal equations of general linear model. Curve fitting. Equations of approximating curves by the method of least squares up to third degree polynomials. Fitting of exponential of the type (1) $y=ae^{bx}$ (2) $y = ab^x$ (3) $y = ax^b$. Graphic representation of the curves. Interpolation and Extrapolation graphically. Criteria for fitting a suitable curve.

Regression and Correlation Analysis: (10%)

Logic of regression and correlation, scatter diagram. Regression models. Simple linear regression, least square estimates and their properties. Properties of Least Square regression line, standard error of estimate, co-efficient of determination. Multiple linear regression with two regressors, co-efficient of multiple determination. Partial and multiple correlation up to three variables. Linear correlation . Correlation co-efficient and its properties. Correlation of bivariate frequency distribution. Partial and multiple correlation for three variables. Rank correlation. Tied ranks.

PAPER– B

Total Marks: 100

Sampling and Sampling Distributions: (15%)

Advantages of sampling. Probability and non-probability sampling. Sampling and non-sampling errors. Sampling designs of simple random, stratified, systematic, and cluster sampling. Judgment and quota sampling. Random numbers and their use in sampling. Calculation of sample mean, proportion and variance of simple and stratified random samples. Sampling distribution of a statistic and its standard error. Distributions of sample mean / proportion and difference between two sample means / proportions with properties. Central limit theorem with illustrations. Sampling distribution of sample variance and ratio of two sample variances. Concept of t, χ^2 and F – distributions.

Estimation: (10%)

Estimate and estimator. Point estimation by moments and maximum likelihood methods. Properties of point estimators: unbiasedness, consistency, efficiency and sufficiency.

Interval estimator and its interpretation. Interval estimation of the mean / proportion, difference between two means / proportions, of populations with known and unknown variances. Determination of sample size. Interval estimation of population variance and ratio of two population variances. Interval estimates of regression parameters, mean and individual prediction.

Hypothesis Testing: (15%)

Null and alternative hypotheses. Simple and composite hypotheses. Two types of errors, level of significance, p-value and power of the test. Acceptance and rejection regions, one sided and two sided tests. Testing of hypothesis for mean / proportion, difference between two means / proportions.

Testing of hypothesis (based on small samples and unknown population variance) for the mean, difference between two means for paired and independent observations. Testing of hypothesis about the variances and equality of two variances.

Testing of hypothesis about regression and simple correlation; partial and multiple correlation. Tests of hypothesis about regression parameters, mean and individual prediction. Pearson's test for goodness of fit. Contingency tables and tests for independence and homogeneity. Co-efficient of mean square contingency and its maximum value. Yates correction for continuity. Chi-Square test for the multinomial probabilities.

Non-Parametric Tests: (5%)

Sign test, Run test. Mann-Whitney U-test, Wilcoxon Signed Rand test, Wilcoxon Rank sum test and Kruskal-Wallies Test.

Analysis of Variance and Experimental Designs: (15%)

Definition, importance and assumptions of Analysis of Variance. Partitioning of sum of squares and degrees of freedom in one and two-way classification. Testing the equality of means for one and two-way classification. Multiple comparison tests: Least significant difference test, Duncan's and Newman-Keuls Multiple range tests.

Principles of experimental design. Completely randomised, randomised complete block and Latif square designs. Description, layout, statistical analysis, advantages, disadvantages, relative efficiency and applications of these designs.

Time Series: (10%)

Decomposition of Time Series. Measurement of Trend, Seasonal (Additive and multiplicative models), and Cyclical variations. Seasonal indices. Deseasonalisation of data.

Index Numbers: (10%)

Simple and composite indices. Problems in construction of index numbers. Laspayre, Paasche, Marshall-Edgworth, Fisher ideal, Walsh and Palgraves indices. Shifting of base. Quantity index numbers. Theoretical tests for index numbers. Consumer Price index. Construction and uses of index numbers in Pakistan. Sensitive Price Indicator.

Official Statistics: (10%)

Introduction, working of statistical organizations in Pakistan, main sources of Statistical Data in Pakistan, Documents produced by Statistical Organizations in Pakistan. Census, registration system of deaths and births in Pakistan.

Applications of statistics in social, economic and political problems. Public health crimes, Law, social innovations, economic development and socio-political inequality.

Vital Statistics: (10%)

Vital events. Uses and shortcomings of vital statistics. Sources of demographic data. Gender and child woman ratio. Vital Index, Crude, specific and standardised death / birth rates. General and specific fertility rate. Gross and net reproduction rates.

BOOKS RECOMMENDED:

1.   Clark, G.M. and Cooke, D. (1998), A Basic Course in Statistics, 4th ed, Arnold, London.
2.   Clark, G.M. and Kempson, R. E. (1997), Introduction to the Design & Analysis of Experiment, Arnold, London.
3.   Freedman, D; Pisani, R; Parues, R and Adhikari, A (1997). Statistics 3rd Edition. Norton, New York.
4.   Freund, J.E (1990). Modern elementary Statistics. Prentice Hall, Inc. New Jersy.
5.   Graybill, I and Burdick (1998). Applied Statistics: A first course in inference. Prentice Hall, New Jersy.
6.   Lipschutz, S and Schiller, J (1998). Introduction to Probability and Statistics, McGraw Hill, New York.
7.   Mittelhammer, R, C. (1996). Mathematical Statistics for Economics and Business, Springer Verlag, New York.
8.   Mood, A.M., Graybill, G.A.and Boes, D.c (1974). Introduction to the Theory of Statistics, McGraw Hill Book Company Inc. New York.
9.   Polland, A.H; Yousaf, F and Pollard, G.N. (1981). Demographic Techniques. Second Edition, Pergaman Press, Oxford.
10.   Speigal, M.R and Stephens. L.J. (1999). Statistics, 3rd Edition. McGraw Hill, New York.
11.   Speigal, M.R; Schiller, J.L; Srinivasan, R.L (2000). Probability and Statistics 2nd Edition. Schamus out line Series, McGraw Hill, New York.
12.   Walpole,R.E (1982). Introduction to Statistics. Macmillan Publishing Company, New York, London.
13.   Walpole, R.E., Myers, R.H., Myers, S. L. and Ye, K. (2004) Probability and Statistics for Engineers and Scientists, 7th Edition Prentice Hall, New York.
14.   Weiss, N.A. (1977), Introductory Statistics, 4th ed. Addison-Wesley Pub. Company, Inc.
15.   Wonnacott, T.H. and Wonnacott, R.J (1981). Introductory Statistics, John Wily & Sons. New York.