**PAPER– B**

**Total Marks: 100**

**Sampling and Sampling Distributions: (15%)**

Advantages of sampling. Probability and non-probability sampling. Sampling and nonsampling

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, χ2 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.*