PUNJAB PUBLIC SERVICE COMMISSION
COMBINED COMPETITIVE EXAMINATION (CCE) SYLLABUS

STATISTICS

Total Marks: 100

Topics

Section- A

1. **Descriptive Statistics:**
   Meaning of Statistics, its characteristics, uses and misuses of statistics, observations and variables, types of variables, data and its types according to nature (qualitative and quantitative), w.r.t. source (primary and secondary), measurement scales (nominal, ordinal, interval and ratio), population and sample, descriptive and inferential statistics, description of qualitative and quantitative data using frequency tables and graphs (simple bar chart, histogram, pie chart, stem and leaf plot), measures of central tendency and their types.
   Ungrouped and Grouped Data: arithmetic mean, median and mode, empirical relationship among mean, median and mode, properties of arithmetic mean (proof not required), weighted mean and its application.
   Ungrouped Data: Geometric mean and harmonic mean, Quantiles (quartiles, deciles and percentiles), relative merits and demerits of all above averages, measure of dispersion, absolute and relative measure of dispersion: Range, semi-interquartile range, variance and standard deviation, properties of variance and standard deviation (proof not required), coefficient of quartile deviation, coefficient of variation, Box and whisker plot, standardized variables.
2. **Concept of probability and Random variables:**
   Random experiment, sample space and events, counting principles, including the multiplication principle, combinations, and permutations, introduction to probability and axioms of probability, basic laws of probability, addition and multiplication laws of probability for two events, conditional probabilities, Bayes' theorem (proof not required) and its application, discrete random variable, probability mass function and cumulative distribution function, joint distribution of two discrete random variables, marginal and conditional distribution, continuous random variable, probability density function and cumulative distribution function, joint distribution of two continuous random variables, marginal and conditional distribution, mathematical expectations and its properties, mean, variance, covariance and correlation of two discrete and continuous random variables.
3. **Probability Distributions:**
   Discrete Binomial, hypergeometric, Poisson distribution, application and fitting to real life data, concept of negative binomial and geometric distribution, continuous exponential and normal distributions, applications and fitting to real-life data, properties of normal distribution.

4. Regression and Correlation Analysis:

Concept of regression and correlation analysis, scatter diagram and its uses, estimation of simple linear regression, properties of the least-squares regression line, standard error of estimate, coefficient of determination, linear correlation, coefficient of correlation and its properties. Spearman's rank correlation (with and without tied observations), partial and multiple correlations up to three variables.

5. Index Numbers and Basics of Time series:

Construction and application of wholesale price index numbers, fixed and chain base methods, weighted index numbers (Laspeyres', 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, components of a time series, analysis of time series, measurement of secular trend and seasonal variations by various methods, deseasonalization of data.

Topics

Section-B

6 Sampling and Sampling Distribution:

Concept of sampling, advantages and scope of sampling, probability and non probability sampling, sampling and non sampling error, sampling design and sampling frame, sampling design of simple random sampling, stratified, systematic and cluster sampling, judgment and quota sampling, sampling distributions of sample means, proportions and variances under simple random sampling, sampling distributions of mean of stratified random sampling, sampling distributions of difference between two sample means and the sample proportions, and their properties, concept of central limit theorem, concepts of t-, χ^2-, F-distributions.

7 Estimation and Testing of Hypothesis:

Estimates and estimators, point estimator and its properties: Unbiasedness, consistency, efficiency and sufficiency, interval estimation and its interpretations, interval estimation of the single population mean or proportion with known and unknown variances, differences between two mean/proportions with known and unknown variances, determination of sample size, interval estimation of population variance and ratio of two population variances, null and alternative hypothesis, simple and composite hypothesis, concept of Type-I and Type-II error, level of significance, concept of p-value, acceptance and rejection regions, one sided and two sided test, testing of hypothesis for single mean/proportion, difference between two means/proportions, testing of hypothesis (based on small sample and unknown population variance) for single mean, difference between two means, paired and independent observations, testing of hypothesis about the variances and equality of two variances, concept of association, contingency tables, chi-square test for independence of attributes.

8 Analysis of variance and Experimental Design:

Definition, importance and assumptions of analysis of variance, partitioning of sums 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 multiple range test, principles of experimental design, completely randomized, randomized complete block and Latin square design, description of the layout,

and statistical analysis, advantages and disadvantages of each design.

9 **Non-Parametric Tests:**
Parametric vs Non-parametric tests, when to use non-parametric procedures, testing procedures and applications one-sample tests: Wilcoxon Signed Rank Test, Run test, testing procedures and applications two related-sample tests: Wilcoxon Signed Rank Test, testing procedures and applications for two independent samples: Mann-Whitney U test, run test, testing procedures and application two or more independent samples: Kruskal Wallis H test.

10 **Vital Statistics and Official Statistics:**
Vital events, uses and shortcomings of vital statistics, sources of demographic; data gender and child woman ratio, vital index, crude, specific and standardised death and birth rates, general fertility rate, gross and net reproduction rate, introduction to official statistics, sources of official statistics, use of official statistics in administration and planning, concepts and evaluation of GDP, GNP, NNP, registration systems of births and deaths in Pakistan.

Suggested readings:

1) Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., Cochran, J. J., Fry, M. J., et al. (2014). Statistics for Business and Economics.

2) Beg, M. A., & Mirza, M. D. (2006). Statistics: Theory and Methods, Vol. I. Carvan Book House, Lahore.

3) Beg, M. A., & Mirza, M. D. (2006). Statistics: Theory and Methods, Vol. II. Carvan Book House, Lahore.

4) Bluman, A. G. (2011). Elementary Statistics, 8th ed. McGraw-Hill, New York.

5) Chatfield, C. (2003). The Analysis of Time Series: An Introduction, 6th ed. Chapman & Hall, London.

6) Chaudhry, S. M., & Kamal, S. (2009). Introduction to Statistical Theory, Part II. Ilmi Kitab Khana, Lahore.

7) Chaudhry, S. M., & Kamal, S. (2012). Introduction to Statistical Theory, Part I. Ilmi Kitab Khana, Lahore.

8) Cochran, W. G. (1977). Sampling Techniques, 3rd ed. John Wiley & Sons, New York.

9) Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand & Sons.

10) Hirai, A. S. (2012). A Course in Mathematical Statistics. Ilmi Kitab Khana, Lahore.

11) Hirai, A. S. (2012). Estimation of Statistical Parameters. Ilmi Kitab Khana, Lahore.

12) Montgomery, D. C. (2012). Design and Analysis of Experiments. John Wiley & Sons, New York.

13) Mood, A. M., Graybill, F. A., & Boes, D. C. (2007). Introduction to the Theory of Statistics. McGraw-Hill, New York.

14) Raj, D. (1971). Sampling Theory. McGraw-Hill Book Company, New York.

15) Sharma, J. K. (2010). Fundamentals of Business Statistics. Vikas Publishing House.

16) Steel, R. G. D., Torrie, J. H., & Dickey, D. A. (2008). Principles and Procedures of Statistics: A Biometrical Approach. McGraw-Hill.

17) Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (1993). Probability and Statistics for Engineers and Scientists. New York.

Note: **The above list is only suggestive and not exhaustive. Candidates may consult other standard books and relevant material covering the prescribed syllabus.**

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