Syllabus of Ph. D. Entrance Examination in Statistics, 2021-22

The Ph. D. Course offered in Statistics shall be based on the admission test conducted by the University for this purpose. Ph. D. entrance test examination will be of two hrs. duration. The test shall consist of 100 marks. There will be 30 multiple choice questions with two marks each and 8 short answer type questions with 5 marks each. Atmost 50 words will be set for each short answer type question. The medium of entrance examination will be English. No revaluation will be permitted in any circumstances.

The questions in the Ph. D. entrance examination will be asked on the following topics:

(1) Statistical Methods
(2) Statistical Inference
(3) Sampling Theory
(4) Design of Experiments

1. Statistical Methods

Frequency distribution, measures of location, dispersion and skewness, Moments and cumulates moment generating function.
Simple correlation coefficient, Multiple and Partial Correlation. Linear and Multiple Regression, fit of polynomials.

Definition of probability, Bays theorem, Basic distribution function probability mass function, probability density function, joint, marginal and conditional p.m.f. . Random Variable and its mathematical expectation, conditional Expectation, Expectation of sum and multiplication of random variables.

Standard Discrete Distributions- Bernoulli, Binomial, Poisson, Geometric, Hyper geometric and Multinomial distribution.

Limiting form of Binomial and Poisson distributions. Standard continuous distributions- Uniform, Exponential, Normal, Cauchy. Order statistics-their distributions and properties. Joint & Marginal distributions of Order-Statistics.

Sampling distributions. Central and Non-central chi-square, t- and F- distributions, their properties and related tests.Sampling distributions of mean and variance of a sample from a normal population, sampling distribution of simple correlation coefficient in null case.

2. Statistical Inference

Unbiasedness , Consistency, efficiency and sufficiency of point estimator ,. Fisher –Neymann factorization theorem, Cramer Rao inequality, Bhattacharya bounds, Minimum Variance unbiased estimators, Minimal sufficient statistics,

Liklihood function, examples from standard discrete and continuous distributions. such as Bernoulli, Binomial, Possion, normal, exponential gamma etc) Methods of estimation – Method of maximum likelihood estimators, properties of maximum likelihood estimators. Method of scoring, method of moments, method of minimum chi-square, method of minimum variance, B.A.N. estimators.

Rao Blackwell theorem. Completeness of sufficient statistics. Completeness and Bounded Completeness, Koopman's theorem (Distributions admitting sufficient statistics),.,invariant estimators, Confidence interval and confidence coefficients, Confidence interval for large samples.

Concepts of critical regions, Test functions, two kinds of errors. Size function, power function, level, M. P. and U,M.P. Test, Neymann Pearson Lemma, M. P. test for simple null against simple alternative hypothesis ,UMP test for simple null hypothesis against one sided alternatives in one parameter exponential family .Unbiased test, UNIFORMELY most powerful unbiased test ,Type "A" critical region or locally most powerful unbiased test. Generalized form of Neyman pearson lemma, Composite Hypothesis and similar regions, similar regions and complete sufficient statistics, Construction of most powerful similar regions, Unbiased critical regions, optimum regions and Sufficient Statistics

Liklihood ratio test, properties of likelihood ratio test, Likelihood ratio test for the mean of normal population, LR test for equality of means and variances of two and several normal populations.

sequential analysis: Wald's sequential probability ratio test (SPRT) with prescribed errors of two types, OC and ASN function of SPRT

Non parametric test, Rank test, Wilcoxon test, Median test, Sign test, Mann-Whitney U test, Wald-Wolfowitz run test, Kolomogorov-Smirnov test, One sample location problem, chi square test of goodness of fit.

3. Sampling Theory

Sample Surveys : concept of population sample and properties of estimator for finite populations need for sampling, census and sample survey ,sample selection and sample size, Basic finite population sampling techniques ,simple random sampling with and without replacement, Estimation of population proportion, Non-sampling errors.

Stratified sampling, systematic sampling and related results on estimation of population mean/total. Allocation problem in stratified sampling. Optimum allocation, Neyman allocation and Proportion allocation, Comparison of stratified, systematic and simple random sampling, estimation of gain in precision due to stratification, Post Stratification, Systematic sampling under a linear model. Circular systematic sampling.

Ratio and regression estimators based on srswor and stratified methods of sampling. Bias of ratio estimate, optimum property of ratio estimate, Ratio estimate in stratified sampling, Regression estimate with pre-assigned and with estimated regression coefficient, comparison of ratio and regression estimate with sample mean. Unequal probability sampling: pps wr/wor methods [including Lahiri's scheme] and related estimators of a finite population mean.

Cluster sampling. One stage cluster sampling, variance and cost functions ,sampling with probability proportional to cluster size, Hurwitz-Thompson estimation , two stage cluster sampling ,Allocation of sample to two stages :equal first stage units, comparison of two stage with one stage sampling. Double sampling ratio and regression estimate with and without cost aspect .

4. Design of Experiments

Fixed, mixed and random effect models, Analysis of Variance of one way and Two-way classified data, Introduction to design of experiments, Principle of design of experiments, Completely ranomized design, Randomized block design, Latin square design. Missing plot technique - general theory and applications, efficiency of design.

Graeco Latin Square design, Cross-over designs, Analysis of covariance: Applications to standard designs with one concomitant variable, Testing the homogeneity of a group of regression coefficients. Split plot and split block experiments, efficiency of whole plot and sub plot treatments, merits and demerits of split plot experiments in comparison to factorial experiments.

General factorial experiments, factorial effects; testing the significance of factorial effects ; study of 2 and 3 factorial experiments in randomized blocks ; Complete and partial confounding.