

**Department of Statistics**  
**Kumaun University, Nainital**  
**M.Sc.(Statistics)**

**Syllabus 2020-21**  
**CBCS PATTERN**

**M.Sc. Statistics Second semester course under CBCS pattern  
COURSE STRUCTURE (CBCS Pattern)**

**SEMESTER II**

**(Each paper of 04 credits. Total Credits = 4x5=20)**

**PAPER I: SAMPLING THEORY**

**[MM- 100 (Theory: 75 marks;  
Internal Assessment: 25 marks)]**

Fundamentals of survey sampling, Probability sampling, purposive sampling.  
Advantages of sample survey over complete survey.

Simple random sampling, with and without replacement.

Stratified sampling, proportional and optimum allocation.

Cluster Sampling: Estimates of mean and Variance for equal and unequal clusters,  
Efficiency in terms of Intra class correlation, Optimum unit of sampling.

Systematic sampling, comparison with simple random sampling, linear trend,  
periodicity, circular systematic sampling.

Ratio and regression method of estimation. sampling with replacement and unequal  
probabilities, Estimation of mean and it's variance,

Double sampling,

Multistage sampling with special reference to two stage design,

Non Sampling errors, problems of Non Response, errors of measurement

Interpenetrating sub-sampling,

Sampling with varying probabilities with and without replacement, PPS sampling,

Cumulative method and Lahiri's method of selection, Horvitz-Thompson  
estimator, Ordered and unordered estimators, Sampling strategies due to

Midzuno-Sen, Sampford and Rao-Hartley-Cochran, inclusion probability  
proportional to size sampling, PPS systematic sampling,

Multistage sampling with unequal probabilities.

**BOOKS RECOMMENDED:**

**Cochran WG. 1977.** Sampling Techniques. John Wiley.

**Murthy MN. 1977.** Sampling Theory And Methods. 2<sup>nd</sup> Ed. Statistical Publ. Soc., Calcutta.

**Mukhopadhyay P. 1998.** Theory and Methods of Survey Sampling. Prentice Hall of India Pvt.  
Ltd., New Delhi.

**Des Raj & Chandhok P. 1988.** Sample Survey Theory. Narosa Publ. House.

**Sukhatme PV, Sukhatme BV, Sukhatme S & Asok C. 1984.** Sampling Theory of Surveys  
with Applications. Sampling Theory of Surveys with Applications. Iowa State University  
Press and Indian Society of Agricultural Statistics, New Delhi.

**Thompson SK. 2000.** Sampling. John Wiley.

## **PAPER II: DESIGN OF EXPERIMENT**

**[MM- 100 (Theory: 75 marks;  
Internal Assessment: 25 marks)]**

### **Design of Experiment:**

Fundamentals of experimental designs, zero-way; one way and two way, heterogeneity settings, connectedness, balance, orthogonal structures, contrasts, balanced incomplete block design and Lattice design, Recovery of intra-block information, Latin square, mutually orthogonal latin squares, Youden squares, Factorial Experiments-  $2^n$  and  $3^2$  designs, confounding in factorial experiments, Missing Plot technique. Plot sampling, Uniformity Trials. Split Plot and Strip plot Design.

### **BOOKS RECOMMENDED**

**Joshi DD. 1990.** Linear Estimation and Design of Experiment. First reprint. Wiley Eastern Ltd. **Cochran WG & Cox GM. 1957.** Experimental Designs. 2<sup>nd</sup> Ed. John Wiley.

**Federer WT. 1985.** Experimental Designs. MacMillan

**Nigam AK & Gupta VK. 1979.** Handbook on Analysis of Experiments. IASRI Publ.

**Dean AM & Voss D. 1999.** Design and Analysis of Experiments. Springer.

**Fisher RA. 1953.** Design and Analysis of Experiments. Oliver & Boyd.

## **PAPER III: STATISTICAL INFERENCE - I**

**[MM- 100 (Theory: 75 marks;  
Internal Assessment: 25 marks)]**

**Elements of Decision Theory:** Admissibility, Properties of good estimators, Unbiasedness, Efficiency, Sufficiency and completeness, Cramer —Rao inequality and its generalization, Bhattacharya's Bounds, Characteristics of distribution admitting sufficient statistic, Rao-Blackwell Theorem and Lehmann - Scheffe theorem. Method of Estimation, Method of Maximum Likelihood, Method of Moments, Method of Chi-Square, Properties of M.L.E, existence of best asymptotic normal estimate under regularity conditions,.

**Interval Estimation** Confidence Regions, Best Confidence Intervals, Interval Relationship with the Testing of Hypothesis.

**Testing of Hypothesis-** Neyman Pearson Lemma and its generalization, UMP Tests, Unbiased Tests, UMPU Tests, Tests with Neyman structure and UMP similar tests, Likelihood Ratio tests and their large sample properties along with simple applications.

### **BOOKS RECOMMENDED:**

**Rohatgi VK. 1984.** Statistical Inference. John Wiley

**Rohatgi VK & Sala AK. Md. E. 2005.** An Introduction to Probability and Statistics. 2<sup>1st</sup> Ed. John Wiley

**Joshi DD. 1990.** Linear Estimation and Design of Experiment. First reprint. Wiley Eastern

**Rao CR. 1973.** Linear Statistical Inference And Its Applications. 2<sup>nd</sup> Ed. Wiley

Eastern

**E. L Lehman. 1990.** Testing of Hypothesis. John Wiley

## PAPER IV: STATISTICAL INFERENCE -II

[MM- 100 (Theory: 75 marks;  
Internal Assessment: 25 marks)]

### Linear Estimation:

Theory of Linear Estimation; Linear Model, Gauss Markoff set up, Aitken's transformation, Gauss Markoff Theorem, Test of linear hypothesis and related confidence interval, Restricted parameter estimation, General two way classification, without and with interactions, nested classification, Polynomial regression models and orthogonal polynomials.

**Sequential Analysis-** Need of Sequential Probability Ratio tests and its properties, Wald's fundamental identity, OC and ASN function, Optimality of SPRT, Applications to Normal, Binomial and Poisson Distributions, Sequential estimation- Basic idea, Stein's two stage procedure.

**Bayesian Inference-** General structure of a Bayesian Decision problem, role of loss function, Risk function, Prior information, Application of Bayes theorem in computing posterior distributions, Bayes estimators of the posterior mean under squared error loss, Bayesian notion of sufficiency, construction of conjugate priors, improper and diffuse priors.

### BOOKS RECOMMENDED:

**Rohatgi VK. 1984.** Statistical Inference. John Wiley

**Rohatgi VK & Sala AK. Md. E. 2005.** An Introduction to Probability and Statistics. 2<sup>nd</sup> Ed. John Wiley

**Joshi DD. 1990.** Linear Estimation and Design of Experiment. First reprint. Wiley Eastern

**Wald A. 2004.** Sequential Analysis. Dover Publ.

**Sinha Sk 1998.** Bayesian Estimation. New Age International.

**Winkler.** Introduction To Bayesian Inference

## PAPER V: PRACTICAL EXAMINATION

(MM-100)

A Practical examination based on above papers