FIFTH SEMESTER

6 hours of lecture + 6 hours of practical per week

(Theory: 4 credits + Practicals: 2 credits)

ST 501: SAMPLING THEORY AND STATISTICAL QUALITY CONTROL

(39 hours : 2 credits)

Unit 1

Introduction to sampling theory: Need for sampling. Complete enumeration Vs sample surveys. Probability and non-probability sampling. Methods of drawing random samples. Survey methods, principal steps in a sample survey, planning, execution, analysis, and reporting stages. Sampling and non-sampling errors. **5 hrs**

Unit 2

Simple random sampling (SRS): Sampling with and without replacement. Unbiased estimators of population mean and total. Derivation of sampling variances. SRS for proportions. Derivation of the sampling variances and standard errors. Confidence limits. Determination of sample size. Advantages and limitations of SRS. **8 hrs**

Unit 3

Stratified and systematic sampling: Stratified random sampling: Need for stratification, advantages, and limitations. Unbiased estimators of population mean and total. Derivation of the variance of the estimators and their estimation. Proportional, optimum and Neyman allocations. Comparison of variances with
SRSWOR. Estimation of gain in precision due to stratification.

Linear systematic sampling, its advantages and limitations. Estimation of mean, total and variance of the estimators. Comparison with SRSWOR .Circular systematic sampling. **10 hrs**

Unit 4

Process control: Introduction to statistical quality control (SQC), aims and objectives. Chance and assignable causes of variation. Process control and product control. Control charts and basis for their construction. Action and warning limits. Various tools of SQC. Rational subgroups. Derivation of control limits, basis, construction, and interpretation of mean, range, and standard deviation charts, np-chart, p-chart, stabilized p-chart, c-chart and u-chart. Criteria for detecting lack of control. Process capability study: Natural tolerance limits and specification limits, process capability, PCR and interpretation. **10 hrs**

Unit 5

Product control: Lot acceptance sampling- Sampling inspection, 100 percent inspection and rectifying inspection. AQL, LTPD, Producer's risk and consumer's risk. Acceptance sampling plans – single and double sampling plans by attributes- Derivation of OC, AOQ, ASN, and ATI, functions. **6 hrs**

ST 502: PRACTICAL – V List of Assignments

(30 hours : 1 credit)

1. Drawing of random sample under SRSWR and SRSWOR from a given population and estimation of the mean and total and the standard errors of the estimators. Construction of confidence intervals.
2. Estimation of the proportion, total, and the standard errors of the estimators based on a random sample under SRSWR and SRSWOR .
3. Stratified random sampling.
4. Systematic sampling.
5. $\overline{X}$ – R charts. (Standard values known and unknown).
6. $\overline{X}$ – s charts. (Standard values known and unknown).
7. np and p charts. (Standard values known and unknown).
8. c and u charts. (Standard values known and unknown).
9. Drawing OC, AOQ, ASN, and ATI curves for single sampling plan.
10. Drawing OC, AOQ, ASN, and ATI curves for double sampling plan.

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*,Vol.I, World Press, Calcutta.
2. Grant, E.L. and Leavenworth, R. S. (1996). *Statistical Quality Control*. 7th edition, McGrawHill, New York.
3. Mahajan, M. (2001).*Statistical Quality Control*, Dhanpat Rai & Co. (P) Ltd. New Delhi.
4. Montgomery, D.C. (2013). *Introduction to Statistical Quality Control*, (Wiley Int. Edn.)
5. Cochran,W. G. (2007). *Sampling Techniques*. 3/e, John Wiley and Sons, New York.
6. Alwan, L. C. (2000). *Statistical Process Analysis*, McGraw Hill, New York.

References

1. John, S.O. and Followell, R. F. (1990). Statistical Process Control. (East West Press, India.
2. Mukhopadhyay, P (1996). Applied Statistics. Calcutta Publishing House.
3. Des Raj and Chandok, P. (1998). *Sampling Theory*, Narosa, New Delhi.
4. Mukhopadhyay, P. (2015): *Mathematical Statistics,* Books and Allied (P) Ltd., Kolkata.
5. Murthy, M.N. (1977). Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
6. Sampath, S. (2006). *Sampling Theory and Methods*, 2/e, Narosa, New Delhi.

ST 503: DESIGN AND ANALYSIS OF EXPERIMENTS

(39 hours : 2 credits)

Unit 1

Analysis of variance: Meaning and assumptions. Fixed, random and mixed effect models. Analysis of variance of one-way and two-way classified data with and without interaction effects. Multiple comparison tests: Tukey's method, critical difference.

10 hrs

Unit2

Experimental designs: Principles of design of experiments. Completely randomized, randomized block, and Latin square designs (CRD, RBD, and LSD) -layout formation and the analysis using fixed effect models. **10 hrs**

Unit 3

Efficiency of a design and missing plot technique: Comparison of efficiencies of CRD, RBD, and LSD . Estimation of single missing observation in RBD and LSD and analysis. **5 hrs**

Unit 4

Factorial experiment: Factorial experiment: Basic concepts, main effects, interactions, and orthogonal contrasts in $2^2$and 2^3 factorial experiments. Yates' method of computing factorial effects total. Analysis and testing the significance of effects in $2^2$and 2^3 factorial experiments in RBD. **8 hrs**

Unit 5

Confounding: Need for confounding. Complete and partial confounding in a 2^3 factorial experiment in RBD - layout and its analysis. **6 hrs**

ST 504: PRACTICAL – V List of Assignments

(30 hours : 1 credit)

(Demonstration of practicals using MSExcel)

1. ANOVA for one way classified data.
2. ANOVA for two way classified data.
3. Analysis of CRD.
4. Analysis of RBD.
5. Analysis of LSD.
6. Missing plot techniques in RBD and LSD
7. Analysis of 2^2 factorial experiment using RBD layout.
8. Analysis of 2^3 factorial experiment using RBD layout.
9. Analysis of 2^3 factorial experiment using RBD layout. (Complete confounding)
10. Analysis of 2^3 factorial experiment using RBD layout. (Partial confounding)

Text Books

1. Goon A.M., Gupta, M.K., Das Gupta, B. (1991).*Fundamentals of Statistics*, Vol .I, World Press, Calcutta.
2. Montgomery, D.C. (2014). *Design and Analysis of Experiments*, Wiley. New York.
3. Joshi, D. D. (1987).*Linear Estimation and Design of Experiments*, New Age International (P) Limited, New Delhi.

References

1. Cochran, W.G. and Cox, G. M. (1992).*Experimental Designs*, John Wiley and Sons, New York.
2. Mukhopadhya, P.(2015): *Mathematical Statistics,* Books and Allied (P) Ltd., Kolkata.