Indira Gandhi National Open University
School of Sciences

MST-005
Statistical Techniques

Block

1

SAMPLING DESIGNS

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STATISTICAL TECHNIQUES

In MST-004, you have studied some of the sampling distributions, methods of estimation and various kinds of parametric and non parametric tests. In Block 1 of this course, we have discussed some frequently used methods of sampling with their characteristics and applications.

In Block 3 of MST-004, we have restricted ourselves to the test of equality of means of two populations only. If the number of populations are more than two and some one is interested to test the hypothesis of equality of means then the ANOVA test serves the purpose. In Block 2, we have discussed the mythology and applications of One-way and Two-way analysis of variance.

In various field of experimentation, we have to plan an experiment and design the execution without loss of time and energy. In Block 3, we have elaborated different kind of designs with, their layout and the statistical analysis.

In case, where the experiment results are different in nature and not good enough to reach on any decision, the need of simulation technique arises. Generation of the random numbers is an important part of simulation technique. In Block 4, we have discussed various kind of systems and methods of generation of the random numbers for discrete and continuous variables. The simulation techniques and their applications in different fields are also discussed in this block.

Notations and Symbols

N	:	Population size / Number of units or elements in the population
n	:	Sample size / Number of units in sample
X_i	:	i^{th} unit or member in population
$\bar{X}$ or μ	:	Population mean
$\bar{x}$	:	Sample mean
S^2	:	Population mean square
s^2	:	Sample mean square
σ^2	:	Population variance
${}^{N}C_{n}$	:	Number of combinations of n units out of N units.
$E(\bar{x})$	:	Expected value of $\bar{x}$
$Var(\bar{x})$	:	Variance of $\bar{x}$
$Var(\bar{x}_{st})_{PROP}$	:	Variance of stratified sample mean under proportional allocation
$Var(\bar{x}_{st})_{NEY}$	:	Variance of stratified sample mean under Neyman's allocation
$Var(\bar{x}_{sys})$	:	Variance of systematic sample mean
S^2_{sys}	:	Population mean square of systematic sampling
SRSWR	:	Simple random sampling with replacement
SRSWOR	:	Simple random sampling without replacement
A	:	Number of population units possessing attribute A
A'	:	Number of population units not possessing attribute A
π	:	Population proportion
a	:	Number of sample units possessing attribute A
a'	:	Number of sample units not possessing attribute A
p	:	Sample proportion
SE (x)	:	Standard error of x
α	:	Level of significance
d	:	Difference between population mean and its estimate
t_α	:	Significant value of t at α level of significance

SAMPLING DESIGN

A sample survey has now become to be considered an organized fact finding instrument. Its importance to modern civilization lies in fact that it can be used to summarize the facts which would otherwise be in accessible owing to the remoteness and obscurity of the persons or to her unit concerned. Sample survey allows to make decisions to be made which take into account the significant factors of the problems they are meant to solve.

The information on a population may be collected in two ways. Either every unit in the population is enumerated which is called census or enumerated limited to only a part or a sample selected from the population called sample survey. A sample survey will usually be less costly and less time consuming than a complete census.

The main objective of this block is to present the theory and techniques of sample surveys with their applications. Sample surveys are to be widely used as a means of collecting information on to meet a definite need in government, industry and trade, physical and life sciences and technology, social, educational and economical problems, etc. All the walks of life are covered by sample surveys.

In Unit 1, a general introduction of the sample survey has been elaborated. In that unit, the basic principles, principle steps and types of sampling have been described. In Unit 2, we shall discuss the simple random sampling and its methodology. The properties of the simple random sampling are also described. In Unit 3, the stratified random sampling and its basic properties are discussed and in Unit 4 some other random sampling i.e. systematic random sampling, cluster sampling and two stage sampling with their basic properties are discussed.

Suggested Readings:

1. Goon, A. M., Gupta, M. K. and Das Gupta, B.; Fundamentals of Statistics, Vol II, World Press, Calcutta.
2. Gupta, S. C. and Kapoor, V. K.; Fundamentals of Applied Statistics, Sultan Chand & Sons.
3. Cochran, W. G.; Sampling Techniques (Chs. 13, 5-8, 10-13), John Wiley, 1963 and Wiley Eastern.
4. Deming, W. E.; Some Theory of Sampling (Chs. 1, 2, 4-6.), John Wiley, 1950.
5. Raj, D.; Sampling Theory, McGraw-Hill, 1968 and Tata McGraw-Hill.
6. Murthy, M. N.; Sampling Theory and Methods (Chs. 1-3, 5, 7, 9-11, 13-15), Statistical Publishing Society.
7. Sukhatme, P. V. and Sukhatme, B. V.; Sampling Theory of Surveys with Applications, FAO (United Nations) and Asia Publishing House, 1970.
8. Yates, F.; Sampling Methods in Censes and Surveys (Chs. 1-3, 6-8), Charles Griffin, 1960.

Notations and Symbols

N_i	:	Number of units in i^{th} stratum
n_i	:	Number of sample units selected from i^{th} stratum
X_{ij}	:	Value of the character under study for the j^{th} unit in i^{th} stratum
x_{ij}	:	Value of j^{th} sample unit taken from i^{th} stratum
$\overline{X}_i$	:	Mean of i^{th} stratum in population
$\overline{X}$	:	Population mean
W_i	:	Weight of i^{th} stratum
S_i^2	:	Population mean square of i^{th} stratum
$\overline{x}_i$	:	Sample mean of i^{th} stratum
s_i^2	:	Sample mean square of units selected from i^{th} stratum
$\overline{x}_{st}$	:	Stratified sample mean
π_i	:	Proportion of population units belonging to attribute A in i^{th} stratum
p_i	:	Proportion of sample units belonging to attribute A from i^{th} stratum
$Var(\overline{x}_{st})$	:	Variance of stratified sample mean
c_i	:	Cost per unit of i^{th} stratum
c_0	:	Over head fixed cost
C	:	Total cost
λ	:	Lagrange's multiplier
ρ	:	Intra-cluster correlation coefficient