

SAMPLING THEORY -UNIT II

INTRODUCTION

- There are situations when we would like to know about a vast, infinite universe or population.
- But some important factors like time, cost, efficiency, vastness of the population make it almost impossible to go for a complete enumeration of all the units constituting the population.
- Instead, we take recourse to selecting a representative part of the population and infer about the unknown universe on the basis of our knowledge from the known sample

Sampling Definition:

- Sampling refers to the process of selecting a subset of individuals, items, or data points from a larger population
- to analyze and make inferences about the whole group.
- It is commonly used in statistics, research, and quality control to gather insights without examining every single element in the population.

BASIC PRINCIPLES OF SAMPLE SURVEY

Law of Statistical regularity	According to the law of statistical regularity, if a sample of fairly large size is drawn from the population under discussion at random, then on an average the sample would possess the characteristics of that population.
Principle of Inertia	according to the principle of inertia of large numbers, are likely to be more reliable, accurate and precise as the sample size increases , provided other factors are kept constant. This is a direct consequence of the first principle.

Principle of Optimization	The principle of optimization ensures that an optimum level of efficiency at a minimum cost or the maximum efficiency at a given level of cost can be achieved with the selection of an appropriate sampling design.
Principle of Validity	The principle of validity states that a sampling design is valid only if it is possible to obtain valid estimates and valid tests about population parameters. Only a probability sampling ensures this validity.

COMPARISON BETWEEN SAMPLE SURVEY AND COMPLETE ENUMERATION

BASIS	SAMPLE SURVEY	COMPLETE ENUMERATION
Speed	Higer	Slow
Cost	sample survey is likely to be less expensive	More expensive
Reliability	Less	More
Accuracy	Less	More
Necessity:	sampling becomes necessity. When it comes to destructive sampling where the items get exhausted like testing the length of life of electrical bulbs or sampling from a hypothetical population like coin tossing, there is no alternative to sample survey.	it is necessary to get detailed information about each and every item constituting the population, we go for complete enumeration. If the population size is not large, there is hardly any merit to take recourse to sampling. If the occurrence of just one defect may lead to a complete destruction of the process as in an aircraft, we must go for complete enumeration.

ERRORS IN SAMPLE SURVEY:

Errors or biases in a survey may be defined as the deviation between the value of population parameter as obtained from a sample and its observed value. Errors are of two types.

Sampling Errors	Since only a part of the population is investigated in a sampling, every sampling design is subjected to this type of errors. The factors contributing to sampling errors are listed below: ▪ Errors arising out due to defective sampling design: ▪ Errors arising out due to substitution: ▪ Errors owing to faulty demarcation of units: ▪ Errors owing to wrong choice of statistic:
Non-sampling Errors	As discussed earlier, this type of errors happen both in sampling and complete enumeration. Some factors responsible for this particular kind of biases are lapse of memory, preference for certain digits, ignorance, psychological factors like vanity, non- responses on the part of the interviewee's wrong measurements of the sampling units, communication gap between the interviewers and the interviewees, incomplete coverage etc. on the part of the enumerators also lead to non-sampling errors.

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SOME IMPORTANT TERMS ASSOCIATED WITH SAMPLING

Population Or Universe	▪ It may be defined as the aggregate of all the units under consideration. ▪ All the lamps produced by "General Electricals" in our first example in the past, present and future constitute the population. In the second example, ▪ all the people living in the town of Miss Manju form the population. ▪ The number of units belonging to a population is
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	known as population size ▪ then the population size, to be denoted by N, ▪ A population may be finite or infinite infinite or uncountable number of units, then it is known as an infinite population. The population of electrical lamps of General Electricals is infinite. Similarly, the population of
Sample	▪ A sample may be defined as a part of a population so selected with a view to representing the population in all its characteristics selection of a proper representative ▪ sample is pretty important because statistical inferences about the population are drawn only on the basis of the sample observations. ▪ If a sample contains n units, then n is known as sample size. If a sample of 500 electrical lamps is taken from the production process of General Electricals, then $n = 500$. The units forming the sample are known as "Sampling Units".

TYPES OF SAMPLING

Probability Sampling	When each member of the population has an equal chance to belong to the sample
• Simple Random Sampling (SRS): Every individual has an equal chance of being chosen. Example: Picking names from a hat. • • Stratified Sampling: Population is divided into subgroups (strata) based on characteristics, and random samples are taken from each. Example: Selecting students from different grades. • Systematic Sampling: Selecting every nth member from a list after choosing a random starting point. Example: Surveying every 10th customer in a store. • Cluster Sampling: Population is divided into clusters (groups), and entire clusters are randomly selected. Example: Selecting whole schools instead of individual students. • Multistage Sampling: A combination of different sampling methods applied in multiple stages. Example: Selecting random schools, then random classes within those schools.	

Non-Probability Sampling

Selection is based on subjective methods, and not all members have a known chance of being selected.)

- **Convenience Sampling:** Choosing individuals who are easiest to reach. Example: Surveying people at a nearby mall.
- **Judgmental (Purposive) Sampling:** Selecting individuals based on the researcher's judgment. Example: Selecting experts for an interview.
- **Quota Sampling:** Ensuring that certain characteristics are represented, but selecting participants non-randomly. Example: Surveying 50 men and 50 women but not randomly choosing them.
- **Snowball Sampling:** Existing participants recruit new participants, useful for hard-to-reach populations. Example: Interviewing drug users, who refer others.

Mixed Sampling: Mixed sampling is based partly on some probabilistic law and partly on some pre decided rule. Systematic sampling belongs to this category

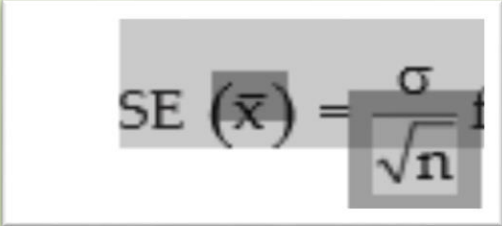
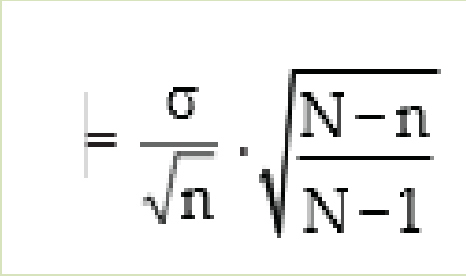


PRACTICAL CONCEPT

BASIC TERM USED IN SAMPLING (Parameter of sampling)

POUPULATION (N)	SAMPLE (n)
Population means (μ)	Sample means ($\bar{X}$)
Population (SD)= σ	Sample SD=S
Population Variance = σ^2	Sample Variance = S^2
Population Proportion =P	Sample Proportion=p

STANDARD ERROR

Standard Error of Sample mean	Standard error of Proportion
Standard Error of sample Mean	
With Replacement	Without Replacement
SE (x) = s for SRS WR 	

STANDARD ERROR OF PROPORTION	
With Replacement	Without Replacement
$SE(p) = \sqrt{\frac{Pq}{n}}$	$\sqrt{\frac{Pq}{n}} \sqrt{\frac{N-n}{N-1}}$
SRSWR and SRSWOR stand for simple random sampling with replacement and simple random sampling without replacement. The factor $\sqrt{\frac{N-n}{N-1}}$ is known as finite population correction (fpc) or finite population multiplier and may be ignored as it tends to 1 if the sample size (n) is very large or the population under consideration is infinite when the parameters are unknown, they may be replaced by the corresponding statistic.	

QUESTION:

Example 1: A population comprises the following units: a, b, c, d, e.
Draw all possible samples of size three without replacement.

Solution: Since in this case, sample size (n) = 3 and population size (N) = 5. the total number of possible samples without replacement = ${}^5C_3 = 10$

These are abc, abd, abe, acd, ace, ade, bcd, bce, bde, cde.

Example 2: A population comprises 3 member 1, 5, 3. Draw all possible samples of size two

- with replacement
- without replacement

Find the sampling distribution of sample mean in both cases.

THEORY QUESTION

Answer the following questions. Each question carries one mark.

1. Sampling can be described as a statistical procedure
 - (a) To infer about the unknown universe from a knowledge of any sample
 - (b) To infer about the known universe from a knowledge of a sample drawn from it
 - (c) To infer about the unknown universe from a knowledge of a random sample drawn from it
 - (d) Both (a) and (b).
2. The Law of Statistical Regularity says that
 - (a) Sample drawn from the population under discussion possesses the characteristics of the population
 - (b) A large sample drawn at random from the population would possess the characteristics of the population
 - (c) A large sample drawn at random from the population would possess the characteristics of the population on an average
 - (d) An optimum level of efficiency can be attained at a minimum cost.
3. A sample survey is prone to
 - (a) Sampling errors
 - (b) Non-sampling errors
 - (c) Either a and b
 - (d) Both (a) and (b)
4. The population of roses in Salt Lake City is an example of
 - (a) A finite population
 - (b) An infinite population
 - (c) A hypothetical population
 - (d) An imaginary population.
5. Statistical decision about an unknown universe is taken on the basis of
 - (a) Sample observations
 - (b) A sampling frame
 - (c) Sample survey
 - (d) Complete enumeration
6. Random sampling implies
 - (a) Haphazard sampling
 - (b) Probability sampling
 - (c) Systematic sampling
 - (d) Sampling with the same probability for each unit.
7. A parameter is a characteristic of
 - (a) Population
 - (b) Sample

(c) Both (a) and (b) (d) (a) or (b)

8. A statistic is

- (a) A function of sample observations (b) A function of population units
(c) A characteristic of a population (d) A part of a population.

9. Sampling Fluctuations may be described as

- (a) The variation in the values of a statistic
(b) The variation in the values of a sample
(c) The differences in the values of a parameter
(d) The variation in the values of observations.

10. The sampling distribution is

- (a) The distribution of sample observations
(b) The distribution of random samples
(c) The distribution of a parameter
(d) The probability distribution of a statistic.

11. Standard error can be described as

- (a) The error committed in sampling
(b) The error committed in sample survey
(c) The error committed in estimating a parameter
(d) Standard deviation of a statistic.

12. A measure of precision obtained by sampling is given by

- (a) Standard error (b) Sampling fluctuation
(c) Sampling distribution (d) Expectation.

13. As the sample size increases, standard error

- (a) Increases (b) Decreases
(c) Remains constant (d) Decreases proportionately.

14. If from a population with 25 members, a random sample without replacement of 2 members is taken, the number of all such samples is

- (a) 300 (b) 625
(c) 50 (d) 600

15. A population comprises 5 members. The number of all

possible samples of size 2 that can be drawn from it with replacement is

- (a) 100
 - (b) 15
 - (c) 125
 - (d) 25
16. Simple random sampling is very effective if
- (a) The population is not very large
 - (b) The population is not much heterogeneous
 - (c) The population is partitioned into several sections.
 - (d) Both (a) and (b)
17. Simple random sampling is
- (a) A probabilistic sampling
 - (b) A non- probabilistic sampling
 - (c) A mixed sampling
 - (d) Both (b) and (c).
18. According to Neyman's allocation, in stratified sampling
- (a) Sample size is proportional to the population size
 - (b) Sample size is proportional to the sample SD
 - (c) Sample size is proportional to the sample variance
 - (d) Population size is proportional to the sample variance.
19. Which sampling provides separate estimates for population means for different segments and also an over all estimate?
- (a) Multistage sampling
 - (b) Stratified sampling
 - (c) Simple random sampling
 - (d) Systematic sampling
20. Which sampling adds flexibility to the sampling process?
- (a) Simple random sampling
 - (b) Multistage sampling
 - (c) Stratified sampling
 - (d) Systematic sampling
21. Which sampling is affected most if the sampling frame contains an undetected periodicity?
- (a) Simple random sampling
 - (b) Stratified sampling
 - (c) Multistage sampling
 - (d) Systematic sampling
22. Which sampling is subjected to the discretion of the sampler?
- (a) Systematic sampling
 - (b) Simple random sampling
 - (c) Purposive sampling
 - (d) Quota sampling.
23. If a random sample of size 2 with replacement is taken from the population containing the units 3, 6 and 1, then the samples would be
- (a) (3,6), (3,1), (6,1)

(b) (3,3),(6,6),(1,1)

(c) (3,3),(3,6),(3,1),(6,6),(6,3),(6,1),(1,1),(1,3),(1,6)

(d) (1,1),(1,3),(1,6),(6,1),(6,2),(6,3),(6,6),(1,6),(1,1)

24. If a random sample of size two is taken without replacement from a population containing the units a,b,c and d then the possible samples are

(a) (a, b),(a, c),(a, d)

(b) (a, b),(b, c), (c, d)

(c) (a, b), (b, a), (a, c),(c,a), (a, d), (d, a)
(b, d), (c, d)

(d) (a, b), (a, c), (a, d), (b, c),

ANSWERS

1.	(c)	2.	(c)	3.	(d)	4.	(b)	5.	(a)	6.	(d)
7.	(a)	8.	(a)	9.	(a)	10.	(d)	11.	(d)	12.	(a)
13.	(b)	14.	(a)	15.	(d)	16.	(b)	17.	(a)	18.	(a)
19.	(b)	20.	(d)	21.	(d)	22.	(c)	23.	(c)	24.	(d)

PAST YEARS QUESTION

JAN 2025

1. Standard Error (SE) and square root of sample size are:

(A) Equal

(B) Directly proportional

(C) Inversely proportional

(D) Not equal

2. Non-probability Sampling is also known as:

(A) Simple Random Sampling

(B) Stratified Sampling

(C) Purposive or Judgment Sampling

(D) Cluster Sampling

3. Which sampling technique is most appropriate when a person wants to ensure that subgroups are proportionally represented?

(A) Simple Random Sampling

(B) Stratified Sampling

(C) Multistage Sampling

(D) Systematic Sampling

4. Population comprise 7 members. The number of All possible Sample of Size 3 can be drawn from it with Replacement it

(a) 343 (b) 216 (c) 21 (d) 125

5. A sample of 100 people is taken from a population of 1000. The sample mean height is 170 Cm with standard Deviation of 10 Cm . what is the standard Error of Mean ?

(a) 1 Cm (b) 0.5 Cm (c) 1.58 Cm (d) 10 Cm

SEP 2024

1. Exit polls are an example of which method of collecting data?

(a) Investigation

(b) Random sampling

(c) Census

(d) Quota sampling om

2. What is the purpose of stratified random sampling?

A. To divide the population into subgroups and then randomly sample from each subgroup

B. To ensure that every individual in the population has an equal chance of being selected

C. To select individuals based on their availability and convenience.

D. To select a fixed percentage of the population without any specific criteria.

June 2024

1. Which sampling is based on the discretion of the sampler?

a. Systematic

b. Multi-stage

c. Stratified

d. Purposive

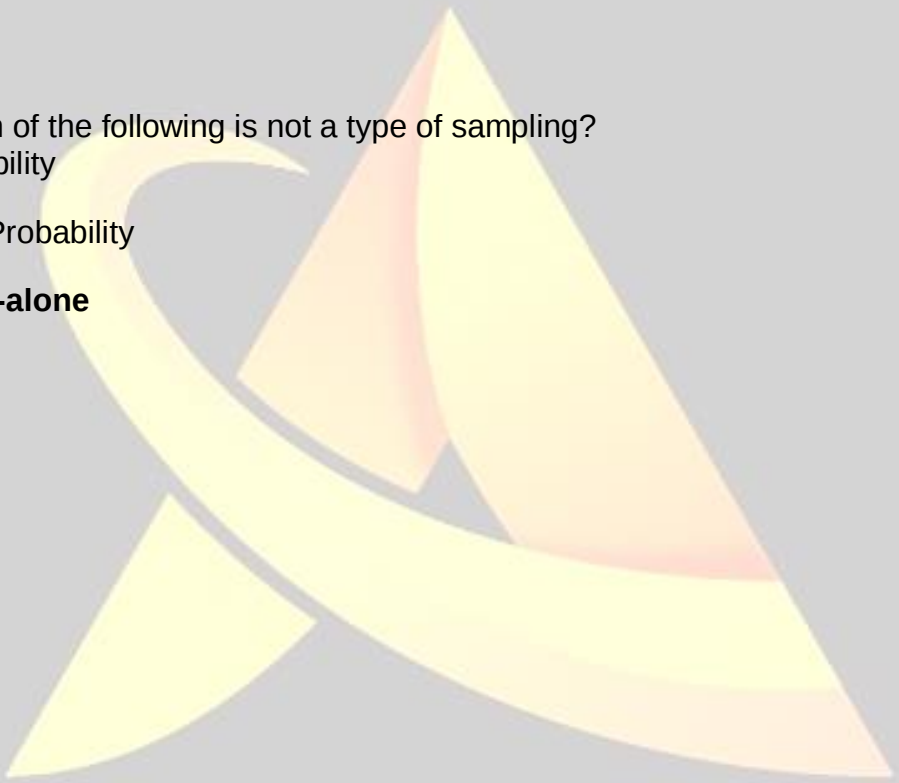
2. Which of the following is not a type of sampling?

a. Probability

b. Non- Probability

c. Stand-alone

d. Mixed



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