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*Do not use tables for this question.*

#### Question Five

Records show that 60% of students pass their examinations at first attempt. Using the normal approximation to the binomial, calculate the probability that at least 65% of a group of 200 students will pass at the first attempt.

#### Question Six

A batch of 5000 electric lamps has a mean life of 1000 hours and a standard deviation of 75 hours. Assume a normal distribution.

- a) How many lamps will fail before 900 hours?
- b) How many lamps will fail between 950 and 1000 hours?
- c) What proportion of lamps will fail before 925 hours?
- d) Given the same mean life, what would the standard deviation have to be to ensure that no more than 20% of lamps fail before 916 hours?

## CHAPTER SEVEN

### SAMPLING

#### SPECIFIC OBJECTIVE

At the end of the topic the trainee should be able to:

- Discuss the reasons for sampling;
- Differentiate between sampling and census;
- Discuss the various types of sampling.

#### Introduction

Census method and sampling method can be used in sampling. Sampling is the only tool which helps to know the characteristics of the universe or population by examining only a small part of it.

#### Advantages of sampling method

- i) It is cheaper to collect data as only a small part of the whole population is studied.

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- ii) The data are collected and analyzed more quickly. Thus sampling saves a lot of time.
  - iii) A good quality of labor with better supervision can be provided since only a part of the whole population is to be studied.
  - iv) An investigation of small part of the population gives us more detailed information.

#### Disadvantages of sampling

- Non accurate
- Reliability is low.

#### Size of the sample

An important decision that has to be taken while adopting a sampling technique is about the size of the sample. However the following two considerations may be kept in mind in determining the appropriate size of the sample;

- a) The size of the sample should increase as the variation in the individual item increases.
- b) The greater the degree of accuracy desired the larger should be the sample size.

#### Sampling and non- sampling errors

A sample being only a part of a population cannot represent the population no matter how carefully the sample is selected. This gives rise to the difference between the value of sample statistics and the true value of the corresponding population parameters. Such difference is called sampling error for that sample. These errors can be avoided through proper selection of questionnaires, following up the non-response, proper training of the investigator, and correct manipulation of the collected information.

Sampling errors are of two types.

- I. Biased errors
- II. Unbiased errors

#### Biased errors

These errors arise from any bias in selecting estimation.

#### Unbiased errors

These errors arise due to chance difference between the member of population included in the sample and those not included. Thus the total sampling errors is made up of errors due to bias and the random sampling.

#### Causes of bias

- I. Faulty process of selection
- II. Faulty work during the collection of information

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### Faulty methods of analysis.

Sampling bias means a systematic component of error which deprives statistical results of its representatives. Bias is introduced by the following methods of selection.

i) Deliberate selection

Bias originates from deliberate selection which is biased on personal judgment of what is representative.

ii) substitution

Sometime sit becomes difficult to make contact with certain member or information is not obtained from certain units then we substitute members or units that are conveniently available such substitution introduce bias.

iii) incomplete coverage

Bias also enters when we fail to cover the whole of he selected sample.

iv) haphazard selection

Haphazard human selection can also introduce bias as every human being has a tendency away from randomness in his choice.

v) Inadequate interviewing

Bias also enters when the interviewing is hasty, incomplete and misleading.

### Sampling distribution

A sampling distribution is defined as a probability distribution of the values of a statistics such as mean, standard deviation, proportion computed from all possible samples of the same size. Sampling distribution constitutes the theoretical basis of statistical inference and are considerable important in business decision making.

### Methods of Sampling

a). Random or probability sampling methods

They include:

- i. Simple random sampling
- ii. Stratified sampling
- iii. Systematic sampling
- iv. Multi stage sampling

b). Non random probability sampling methods

These consist of:

- i. Judgment sampling

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- ii. Quota sampling
  - iii. Cluster sampling

### Simple Random Sampling

This refers to the sampling technique in which each and every item of the population is given an equal chance of being included in the sample. Since selection of items in the sample depends entirely on chance, this method is also called chance selection or representative sampling.

It is assumed that if the sample is chosen at random and if the size of the sample is sufficiently large, it will represent all groups in the population. Random sampling is of 2 types; sampling with replacement and sampling without replacement.

Sampling is said to be with replacement when from a finite population a sampling unit is drawn, observed, and then returned to the population before another unit is drawn. The population in this case remains the same and a sampling unit might be selected more than once.

If on the other hand a sampling unit is chosen and not returned to the population after it has been observed, the sampling is said to be without replacement.

Random samples may be selected by the help of lottery method or table of random numbers (such as tippet's table of random numbers, Fischer and Yates numbers or Kendall and Babington Smith numbers.)

### Stratified sampling

In this case the population is divided into groups in such a way that units within each group are as similar as possible in a process called stratification. The groups are called strata. Simple random samples from each of the strata are collected and combined into a simple. This technique of collecting a sample from a population is called stratified sampling.

Stratification may be by age, occupation, income group, etc.

### Systematic Sampling

This sampling is a part of simple random sampling in ascending or descending orders. In systematic sampling a sample is drawn according to some predetermined object. Suppose a population consists of 1000 units, then every tenth, 20<sup>th</sup> or 50<sup>th</sup> item are selected. This method is very easy and economical. It also saves a lot of time.

### Multistage sampling

This is similar to stratified sampling except division is done on geographical/location basis, e.g. a country can be divided into provinces and then survey is done in 4 towns in each province. This helps to cut traveling costs for a surveyor.

### Cluster Sampling

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This is where a few geographical regions e.g. a location, town or village are selected at random and say every single household or shop in that area is interviewed. This again cuts on costs.

### Judgment Sampling

Here the interviewer selects whom to interview believing that their view is more fundamental since they might be directly affected e.g. to find out effects of public transport one may chose to interview only people who don't own cars and travel frequently to work.

### Merits of random or probability sampling

- i) Since the sample is objective and unbiased, it is defensive before the supervisor.
- ii) The size of the sample does not depend upon the expediency or mere tradition but on demonstrable statistical method.
- iii) Te degree of deviation from the parameter i.e. the statistical measure based on population can be estimated.
- iv) It provides a more accurate method of drawing conclusion.

The sample may be combined and evaluated even though accomplished by different individual.

## PRACTICE QUESTIONS

### Question One

A firm purchases a very large quantity of metal off-cuts and wishes to know the average weight of an off-cut. A random sample of 625 off-cuts is weighed and it is found that the mean sample weight is 150 grams with a sample standard deviation of 30 grams. What is the estimate of the population mean and what is the standard error of the mean? What would be the standard error if the sample size was 1225?

### Question Two

A sample of 80 is drawn at random from a population of 800. The sample standard deviation was found to be 6 grams.

- What is the finite population correction factor?
- What is the approximation of the correction factor?
- What is the standard error of the mean?