UNIT 1 INTRODUCTION TO SAMPLE SURVEYS

Structure

1.1 INTRODUCTION

The use of sampling in making inferences about a population is possible and has been in operation right from beginning. When one has to make an inference about a lot of large size and it is not practicable to examine each individual unit, then few units of the lot are examined and on the basis of the information of those units, one makes decisions about whole lot. For example, a person would like to purchase a bag of rice may examine a handful of rice from the bag and on the basis of that he/she makes his/her decision about the purchase of full bag.

A brief introduction to population, sample and sampling is given in Section 1.2. Census and sample survey are explored in Sections 1.3 and 1.4. The basic principles of sample survey are explained in Section 1.5 whereas the principle steps in sample survey are described in Section 1.6. The basic concepts of sampling and non-sampling error are provided in Section 1.7 and advantages of sampling over census are explained in Section 1.8. Various types of sampling methods are explored in Section 1.9 whereas the objectives of sampling are described in Section 1.10. Problems in sample surveys are dicussed in Section 1.11.

Objectives

After studying this unit, you would be able to

- define a population and explain the different kinds of population;
- describe the census and sample survey;
- describe the conditions and principles of sample survey;
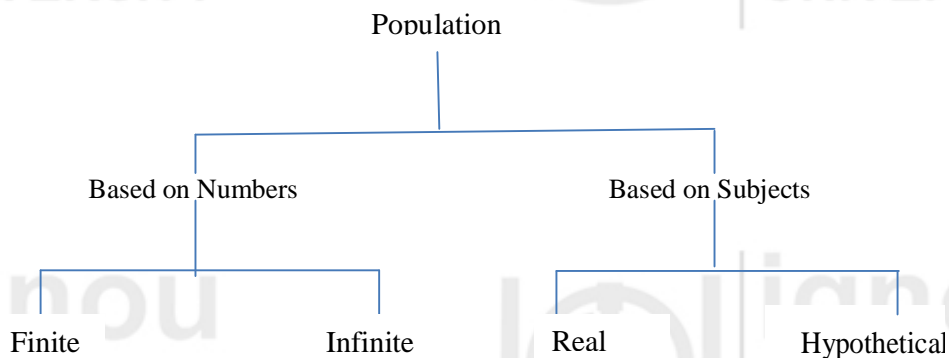- explain the principle steps in sample survey;

- describe the sampling and non-sampling error;
- explain the different kinds of sampling procedures; and
- explain the objectives, problems and importance of sampling.

1.2 INTRODUCTION TO POPULATION

A group of individuals having same characteristics in same surrounding is known as population. According to A. C. Rosander "A population is the totality of objects under consideration". In short, group of all objects which are coming under the definition of investigation unit. For example, the group of employees of a institute shall be the population for every investigation related to the employees. Individuals of the population are known as a unit or a element in population.

1.2.1 Types of Population

There are two types of a population as discussed below:

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                          Population
                              |
            ┌─────────────────┴─────────────────┐
      Based on Numbers                    Based on Subjects
            |                                    |
      ┌─────┴─────┐                        ┌─────┴─────┐
   Finite      Infinite                  Real      Hypothetical
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Finite or Infinite Population
In a finite population the number of units is finite i.e. number of students in a class, number of employees in a college. In a infinite population, the number of units are infinite, for example the number of hair in head etc. and also if the units of a population are unable to count and the limits cannot be made then the population is known as Infinite population, for example stars in sky, leaves in tree, number of viewers of a T.V. serial, etc.

Real or Hypothetical Population
Population of a concrete subject is called real population. For example, students in a university, employees of an institution. In a hypothetical population the subjects are not concrete, whether they are hypothetical. For example, the population made by the number of Heads or Tails based on the trial of a coin.

1.2.2 Information about Population

The need for adequate and reliable data is ever increasing for taking wise decisions in different fields of human activity and business. There are two ways in which the required information may be obtained:
1. Complete Enumeration or Census
2. Sample Survey

E 1) Define a population and describe the different types of populations.

1.3 CENSUS

In census, we study about each and every unit of the population. Population means total units of investigation area. In census, whole group related to investigation is investigated and the informations are collected, i.e. Census of population of a country, Census of import and export, etc.

Census investigation is useful in following situations:

1. When a deep study to be performed;
2. When study area is limited;
3. When an adequate accuracy and reliability is desired;
4. When investigator have resources; and
5. When use of sampling method is tough and prohibited.

1.3.1 Merits and Demerits of Census

Merits

1. **Useful in Heterogeneity**
   This method is very appropriate when the units are heterogeneous from each other and hard to be succeeded for sampling method.

2. **Deep Study is Possible**
   Through census, deep study of the subject is possible so that the investigator can get the total information of the variable of interest. He also knows the things or subjects which otherwise overlooked.

3. **High Level of Accuracy**
   High level of accuracy is expected by following this method. Because of that the personnel investigation is to be performed in investigation area therefore the results are accurate at higher degree.

4. **Necessary in Some Situation**
   If the nature of investigation is like that the involvement of all units is necessary than census is necessary i.e. census of population of a country.

Demerits

1. **Useless in Case of Destructive Units**
   If the units are destructive type and been destroyed by examining, this method is useless. For example, to study about the hardness of a chawk or quality of crackers or life of bulbs or tube lights.

2. **More Time and Energy**
   This method is very time consuming and large number of persons required to complete the process. This method consumes much of energy and hard work to perform the study.

3. **More Expensive**
   Much of time and organization of big size is needed for a census investigation. A large number of field investigators to be involved in this

work and arrangement of their training is also needed. In all, in this process large scale expenditure is needed.

4. **Investigation Remains Incomplete**
   In this method time, money, organization and large number of field investigators are required. Population is also large. Therefore, the investigation may remain incomplete due to weakness of investigating team or time or lack of availability of resources. In that situation, the effort or expenses which have already done that become useless.

5. **Inconvenient**
   This method is very inconvenient because this needs a whole department to be established separately. Problems related to management arise.

6. **Not Possible for all**
   This method is not comfortable for all because this method can be used solely by powerful person or organizations.

7. **Not Possible in Every Situation**
   Census is not possible from many reasons in various situations, where the investigation area is large and wide. In such cases contact to each and every unit is not possible.

8. **Statistical Error**
   In this method we cannot have the knowledge of statistical error.

E 2) Describe the census and situations where it is essential.

1.4 SAMPLE SURVEY

A finite subset of statistical individuals in a population is called a sample and the number of individuals in a sample is called the sample size.

Sample is often used in our day to day practical life. For example, in a shop we assess the quality of rice, wheat or any other commodity by taking a handful of it from the bag and then decide to purchase it or not. A house wife normally tests the cooked food to find if they are properly cooked and contain the proper quantity of salt.

If the population is infinite, census is not possible. Also, if the units are destroyed in the course of inspection, 100% inspection though is not possible at all desirable. But even if the population is finite or the inspection is not destructive, 100% inspection is not taken recourse too, because of the administrative, financial and time factor related problems. So we take the help of sampling.

1.4.1 Merits and Demerits of Sample Survey

Merits

1. **Detailed Inspection**
   As selected information is large so their detailed inspection can be done.

2. **Statistical Error**
   The investigator can analyse the statistical error from only the size of the sample in their investigation.

3. **Good Representative**
   If the proper selection is done than the result will be as same as after a census.

4. **Easy and Less Expensive**
   This method is easy and less expensive. It saves time, money and energy.

5. **Appropriate for Social and Economic Problem**
   As this method takes less time, therefore, this method is very appropriate for fast changing social and economic problems.

6. **Scientific**
   This method is more scientific because study may be done by other samples for available information.

Demerits

1. **Possibility of Inaccurate Result**
   If an investigator is biased at the time of selection of sample units then the result would be inaccurate.

2. **Inappropriate in Lack of Homogeneity**
   Where the lack of homogeneity exists or every unit being different type and nature this method cannot be adopted.

3. **Inappropriate in High Level Accuracy**
   This method is not appropriate in case where high level of accuracy is needed.

4. **Confused Result**
   If a suitable sampling method is not adopted or the sample size is not sufficient then the results would be incorrect.

1.4.2 Conditions for Sample Survey

The investigations through sample survey are appropriate in the following conditions:

1. **Broad Area**
   When the investigation area is broad, for example, testing of the effect of a drug for disease by a drug company, then they have to adopt the sample survey method.

2. **Implication of Rules**
   When implications of rules are to be done in a broad way, use of this method is advisable because conformation of rules can be done by various samples.

3. **When the Population is Infinite**
   When the number of elements in the population is infinite then this method is suitable i.e. counting of leaves in a tree is a tough job.

4. **Insufficient Resources**
   Where the money, time and employee/workers are in insufficient numbers, then this method can be adopted.

5. **No Need of High Level of Accuracy**
   Where a very high level of accuracy is not necessary, then this method can be used.

6. **When Units are of Destructive Nature**
   In some situations, if the units of the population are of destructive nature and if the census method is used then all the population would be destroyed. In this situation, the sample survey is advisable, for example, testing of sound of crackers.

7. **Use of Census is not Advisable as well as not Possible**
   Some investigation situations, where census is not only inappropriate but impossible also the sample survey is appropriate. For example if it has to know that in India's coal mine, how much and which type of coal existed so for that the sample survey is appropriate.

8. **Homogeneity**
   If the elements of a population are homogeneous than sample units would be of same characteristics as of the population. In short a sample should be a true representative of population.

E 3) Define a sample and describe the conditions for sample survey briefly.

1.5 PRINCIPLES OF SAMPLE SURVEY

Three basic principles for the design of a sample survey are:

1. **Principle of Optimization**
   The principle of optimization takes into account the factors of
   (a) Efficiency and (b) cost.

   (a) **Efficiency**
       Efficiency is measured by the inverse of sampling variance of the estimator. The principle of optimization ensures that a given level of efficiency will be reached with the minimum possible resources and minimum cost.

   (b) **Cost**
       Cost is measured by expenditure incurred in terms of money or man powers. So, the term optimization means that, it is based on developing methods of sample selection and of estimation; these provide a given value of cost with the maximum possible efficiency.

2. **Principle of Validity**
   By validity of a sample design, we mean that the sample should be so selected that the results could be interpreted objectively in terms of probability. According to this, sampling provides valid estimates about population parameters. This principle ensures that there is some definite

and preassigned probability for each individual of the aggregate (population) to be included in the sample.

3. **Principle of Statistical Regularity**
   According to the principle of statistical regularity we mean that a moderately large number of items chosen at random from a large group are almost sure on the average to possess the characteristics of the large group. This principle has also its origin in the law of large numbers of the theory of probability.

1.5.1 Essentials of Sampling

For obtaining the unbiased and real result by a sampling method, a sample should have the following factors (characteristics):

1. **Homogeneity**
   The nature of each and every unit of the population should not contain much difference. If two or more samples are selected then they should be similar in nature not in their response/output.

2. **Representativeness**
   The sample should represent all the characteristics of the population that can be possible only when the selection of items or units has been done unbiased and each and every unit have an equal probability of chance to be selected in the sample.

3. **Independency**
   Each and every unit of the population should be independent. In other words, the selection of a unit in the sample should not be dependent on the selection of other units.

4. **Adequacy**
   The number of units or elements which are to be selected in the sample should be sufficient. If the sample size is not sufficient then results cannot be reliable. The more the sample units in the sample, more reliable results would occur.

E 4) What do you mean by the principle of optimization?

1.6   PRINCIPLE STEPS IN SAMPLE SURVEY

The main steps involved in the planning and execution of a sample survey are under the following heads:

1. **Objectives**
   The objective of the survey must be defined in clear and concrete terms. Generally, in survey a investigation team is not quite clear in mind as to what they want and how they are going to use the results. Some of the objectives may be immediate and some far-reaching. The investigator should take care of these objectives with the available resources in terms of money, manpower and the time limit required for the availability of the survey.

2. **Defining the Population**
The population from which sample is chosen should be defined in clear and unambiguous terms. The geographical, demographic and other boundaries of the population must be specified so that no ambiguity arises regarding the coverage of the survey.

3. **Sampling Frame and Sampling Units**

The sampling unit is the ultimate unit to be sampled for the purpose of the survey. The sampling units must cover the entire population and they must be distinct, unambiguous and non-overlapping in the sense that every element of the population belongs to one and only one sampling unit. In a Socio economic survey, whether a family or a member of a family is to be the ultimate sampling unit.

Once the sampling units are defined, one must see whether a sampling frame which is a list of all the units in the population, is available. The construction of the frame is often one of the major practical problem since it is the frame which determines the structure of the sample survey. The list of units have to be carefully scrutinized and examined to ensures that it is free from duplicity or incompleteness and are up-to-date. A good frame is hard to come by and only good experience helps to construct a good frame.

4. **Selection of Proper Sampling Design**
This is the most important step in planning a sample survey. There is a group of sampling designs (to be discussed later) and selection of the proper one is an important task. The design should take into account the available resources and the time-limit, if any, besides the degree of accuracy desired. The cost and precision should also be considered before the final selection of sampling design.

5. **Method of Collecton of Data**
For collection of data, either the interview method or the mail questionnaire method is to be adopted. Although the later method is less costly but there is a large scope of non-response in it. In the cases, where the information is to be collected by observation they must decide upon the method of measurement.

6. **Data to be Collected**
Collection of data must be done in conformity with the objectives of the survey and the nature of the data. After it is decided upon, one must prepare a questionnaire or a schedule of enquiry. A schedule or a questionnaire contains a list of items of which information is sought, but the exact form of the questions to be asked is not standardized but left to the judgment of the investigators. A questionnaire should be in a specified order. The questions should be clear, brief, collaborative, non offending and unambiguous and to the point so that not much scope of speculation is left on the part of the respondent or interviewer.

7. **Field Work Organization**
Field work, itself has several stages and so it is to be well organized. The different stages includetraining the field workers, supervising the field workers, etc. It is absolutely essential that the personnel should be

thoroughly trained in locating the sample units, the methods of collection of required data before starting the field word. The success of a survey to a great extent depends upon the reliable field work. Inspection after field work by the adequate supervisors should also be performed.

8. **Summary and Analysis of Data**
   This is the last step wherein inference is to be made on the basis of collected data. This step again consists of the following steps:

   a) The filled in questionnaires should be carefully scrutinized to find out whether the data furnished are plausible and consistent;

   b) Depending upon the quantity of data, a hand-tabulation or machine tabulation is to be drawn;

   c) After the data has been properly scrutinized, edited and tabulated, a very careful statistical analysis is to be made; and

   d) Finally a report incorporating detailed statement of the different stages of the survey should be prepared. In the presentation of the result, it is advisable to report technical aspects of the design.

Let us answer the given exercise.

E 5) List the principles steps of sample surveys.

1.7 SAMPLING AND NON-SAMPLING ERROR

The errors involved in the collection, processing and analysis of data may be broadly classified under the following two heads:

1. Sampling Error
2. Non-sampling Error

1.7.1 Sampling Error

The error which arises only in sample survey is termed as sampling error. This error arises because in sample survey a part of the population is only studied. This is the reason why sampling error is absent in census. The main factors of sampling error are:

1. Some of the bias is introduced by the use of defective sampling techniques for the selection of a sample;

2. Substitution of a non-selected a convenient unit of the population in place of a selected unit to which the investigation is difficult leads to some biases in the sample survey;

3. Bias due to defective demarcation of sampling units, particularly in area/filed survey; and

4. Constant errors due to improper choice of the statistics for estimating the population parameters.

1.7.2 Non-Sampling Error

The non-sampling error arises at the stages of observation, ascertainment and processing of the data. This is the reason why the non-sampling error presents

in both the census and the sample survey. Non-sampling error can occur at every stage of the planning or execution of census or sample survey. Non-sampling errors arise due to the following factors:

1. Data specification being inadequate and inconsistent with respect to the objective of the study;

2. Error due to location of the units and actual measurement of the characteristics;

3. Error due to ill designed questionnaire;

4. Lack of trained and qualified investigators and lack of adequate supervisory staff;

5. Errors due to lack of correct responses furnished by the respondents;

6. Non-response biases occur if full information is not obtained on all the sampling units;

7. If the objectives of the survey are not stated clearly, it may result in inclusion of the units which are not to be included and exclusion of the units which are to be included in the sample;

8. Due to error in various operations of data processing such as editing and coding of the responses, punching of cards, tabulation and summarizing the observation made in the survey; and

9. The errors may be committed during presentation and printing the results of the survey.

Let us answer the given exercise.

E 6) Distinguish between the sampling and non-sampling Error.

1.8 ADVANTAGES OF SAMPLING OVER CENSUS

The advantages of sampling over complete census may be outlined as follows:

1. Sampling requires less time and labor than census because only a part of the population has to be examined. The sampling results also can be analysed much faster;

2. Sampling usually results in reduction in cost in terms of money and man powers. The total cost of the sample survey is expected to be much smaller than a complete census;

3. There is generally a greater scope in a sample survey than in census. Some inquiries may require highly trained personnel or specialized equipment for collection of data, then the census may be inconceivable;

4. In some cases a complete census is ruled out by the nature of the population. If there is a population which is infinite and/or hypothetical, then sampling is the only option;

5. A sample survey gives data of better quality than a complete census, because in a sample survey it may be possible to use better resources than complete census;

6. If the population is too large, as for example, trees in a jungle, leaves in a tree i.e. we are left with no option but to resort to sampling; and

7. If testing is destructive, then complete enumeration is impracticable and sampling design is the only method to be used in such cases. For example, testing the breaking strength of a chalk, testing of lifetime of an electrical bulb, etc.

Let us answer the given exercise.

E 7) Describe the advantages of sampling over census.

1.9 TYPES OF SAMPLING

According to the method of selection of sample, the sampling schemes can be categorised as follows:
1. Non-probability sampling;
2. Probability or random sampling; and
3. Mixed sampling.

1.9.1 Non-Probability Sampling

In this method, the sample is selected with a definite purpose in view and the choice of the sampling units depends entirely on the discretion and judgment of the investigator. While selecting a sample, investigator tries to include each and every characteristics of population in sample.

Non-Probability Sampling scheme can be classified as:

1. **Purposive Sampling**
    In this sampling the sample is selected with definite purpose in view and the choice of sampling units depends entirely on the discretion of the surveyor. This sampling suffers from drawback of favoritism and nepotism of the surveyor.

2. **Judgment Sampling**
    In judgment sampling respondents are selected on the judgment of the surveyor with the hope that they will meet requirements of the study. The underling assumptions are that the respondent truly represents the entire population. To find out the potential guide for the food and catering technology a researcher go to the teachers of Hotel Management Department may be the example of judgment sampling.

3. **Deliberate Sampling**
    In deliberate sampling, deliberate selection of sample is made so that any important unit could not be leftout.

4. **Convenience Sampling**
    In convenience sampling method, a surveyor selects the sample at his/her own convenience, often as the study is being conducted. Convenience

sampling is based on assumption that the target population is homogeneous and the individuals selected and interviewed yields similar information with regard to the characteristics under study. If persons selected from restaurants to collect the information about quality of the food, service, etc. are supposed to represent the population of food takers. Such a sampling is known as convenience sampling.

5. **Quota Sampling**

If the cost of selected random samples in each stratum is very high in stratified sampling then the sampling units are assigned in a quota (fixed number of units) in each stratum and the actual selection of units is left at the decision of the surveyor.

Merits of Non-Probability Sampling

1. This method of sampling is very simple;
2. After sample size determination with the help of planning, a suitable sample may possibly be obtained; and
3. Important units or members may be included in the sample.

Demerits of Non-Probability Sampling

1. Predetermined view of selector effects the selection of sample which impure the result. This effect does directly or indirectly on the process;
2. There is no place for probability in selection of units therefore sampling error cannot be obtained;
3. There is no guaranty of validity of the results from the sample selected by this method; and
4. The attitude and biasedness of the investigator also affect the selection of sample that's why the results obtained by this method are not reliable scientifically.

Significance of Non-Probability Sampling

1. When the number of units in population is less and there is possibility that the important units may be left;
2. When sample size is to be kept small;
3. When the deep study of the important unit (purposive unit) is to be done;
4. When the investigator has the experience of obtaining a correct sample; and
5. This method can be used in pilot survey.

1.9.2   Random or Probability Sampling

The technique of random sampling is of fundamental importance in the application of Statistics. The estimation theory is based on the assumption of random sampling. Probability sampling is the scientific method of selecting samples accordingly to some laws of chance in which each unit in the population has some definite pre-assigned probability of being selected in the sample. The following are the different types of probability sampling:

1. Where each unit has an equal chance of being selected;
2. Sampling units have different probabilities of being selected; and

3. Probability of selection of a unit is proportional to the sample size.

Merits of Random or Probability Sampling

1. **No Plan for Selection**
   There is no need to make any detailed plan for the selection of units.

2. **Less Expensive**
   In this method, money, time and hard work are very less.

3. **Unbiased**
   In this method there is no space for any biasedness. Every unit has same chance of selection.

4. **Inspection of Purity**
   Inspection of purity of one sample can be done by other sample. In this method measure of statistical error can also be done.

5. **Random Selection**
   Selector has not to use his mind. He selects units at random.

6. **True Representation of Population**
   In this method real characteristics can be represented through sample because it is based on the law of statistical regularity and law of inertia. In real, it becomes a small part of population.

Demerits of Random or Probability Sampling

1. **Inappropriate**
   This method is not appropriate where some units are so important to be included necessarily in the sample.

2. **Less Representative**
   It may be possible that sample could not represent the population if sample is not sufficiently large.

3. **Less Independency**
   This method is useless if the units of the population are dependent.

Limitations of Random Sampling

1. If investigation area is small then results may not be reliable;

2. If all the units are heterogeneous then sample cannot be true representative;

3. The elements of the population should be independent; and

4. The results would not be reliable if the investigator is biased.

1.9.3 Difference between Probability and Non-probability Sampling

1. In non-probability sampling the selection of units are pre-decided whether in probability sampling is based on chances.

2. Non-probability sampling is biased but probability sampling is unbiased.

3. In non-probability sampling, the errors are of cumulative in nature whereas in probability sampling errors are less.

4. If a sample, from a population with homogeneous and important units, is to be selected then non-probability sampling is appropriate where as probability sampling is used in various kinds of population.

1.9.4 Mixed Sampling

If the samples are selected partly according to some laws of chance and partly according to a fixed rule, they are called mixed samples and the method of selecting such samples is known as mixed sampling. The merits of this sampling are the mixture of the merits of both sampling. Selection of units is more reliable in this method because that is the representation of various stages of population. In mixed sample no important characteristics is left which is to be selected in the sample.

E 8) Describe the types of sampling briefly.

1.10 OBJECTIVES OF SAMPLING

Sampling investigation can be performed to fill the following objectives:

1. **Checking of Validity of Census**
   Validity of results obtained from census investigation is to be checked by sampling. To check the validity of the census results the sample survey are to be organized after census.

2. **Checking of Difference between the Measurements of a Sample and Population**
   There is always a difference between the measurements of population and its sample whether the sample is suitable enough. Even, there is always difference between the measures of two samples of the same population. Inspection of authenticity of these differences is the main objective of sampling.

3. **Checking of Characteristics of Population**
   This is the main objective of a sampling study that all the characteristics of the population can be found in less time, through less effort and with least cost. More information can be obtained about the whole population through sampling.

4. **Find Estimate of Parameters of Population**
   The measure of the population is to be obtained on the basis of statistical measures of sample mean; sample standard deviation, sample correlation, etc. In this way the objective of the sampling is to find out the most probable values of the parameters. The measures of the population are called parameters and the measures of sample are called statistic.

5. **Fulfillment of Special Objective and for Continuous Information**
   Sampling methods are applied to fulfill the specific objective. Social, economic and behavioral surveys come under this. Continuous information about the behavior of the unit is needed for some population. Through sampling, corrections are to be done regularly in the results of the previous sample survey as in Medical Sciences and Quality Control.

1.11 PROBLEMS OF SAMPLING METHODS

Some problems arise regarding the sampling on which pre discussion is necessary:

1. Determination of Base of Sampling

Sample should neither be too small nor too big. This is to be noted that a sample is surely would not be a representative only by size. Sample size depends on the following points:

1. Homogeneity or heterogeneity of population;
2. Nature of investigation;
3. Practical things like money, time, hard work by trained supervisors, etc.;
4. Level of purity; and
5. Sampling method.

2. Discussion on Effect of Biasedness in Sampling
Partiality, predecided and unknowingly happenings make impure the sample. So it is necessary to beware of that.

3. Reliability in Sampling
This can be done in following ways:
1. Comparison of sample after dividing in two equal parts;
2. Selection of another sample of same size from the same population and comparison; and
3. Comparison of the result of a sub-sample to the result of the sample itself.

1.12 SUMMARY

In this unit, we have discussed:

1. A population and the different kinds of populations;
2. The census method and sampling method and comparison of both;
3. The conditions and principles of sample surveys;
4. The principle steps in sample survey;
5. The sampling and non-sampling error;
6. The different kinds of sampling procedure; and
7. The objectives, problems and importance of sampling.

1.13 SOLUTIONS /ANSWERS

E1) Same as the Section 1.2 and Sub-section 1.2.1

E2) In census we study about each and every unit of the population, that means whole group related to investigation is investigated and the information are to be collected. Population means total units of

investigation area i.e. census of population, census of import and exports, etc.

Census investigation is useful in following situation

1. When a deep study to be performed;
2. When study area is limited;
3. When an adequate accuracy and reliability is desired;
4. When investigator have resources; and
5. When use of sampling method is tough and prohibited.

E3) A finite subset of statistical individuals in a population is called a sample and the number of individuals in a sample is called the sample size. Sample is oftenly used in our day to day practical life. For example, in a shop we assess the quality of rice, wheat or any other commodity by taking a handful of it from the bag and then decide to purchase it or not. Rest part of the answer is as same as Sub-section 1.4.2.

E4) The principle of optimization takes into account the factors of

(a) Efficiency and (b) Cost.

Efficiency is measured by the inverse of sampling variance of the estimator. The principle of optimization ensures that a given level of efficiency will be reached with the minimum possible resources and will be attained with available resources and cost.

Cost is measured by expenditure incurred in terms of money or manpower's. The term optimization means that, it is based on developing methods of sample selection and of estimation; these provide a given value of cost with the maximum possible efficiency.

E5) The main steps involved in the planning and execution of a sample survey are as follows:

1. Defining the population
2. Defining the objectives of the sample survey
3. Method of data collection
4. Selection of proper sampling design
5. The frame and the sampling unit
6. Data collection
7. Field work organization
8. Analysis of data and summary

E6) The error which arises only in sample survey is termed as sampling error. This error arises because a part of the population is only studied. This is the reason why sampling error is absent in census. The main factors of sampling error are:

1. Some of the bias is introduced by the use of defective sampling techniques for the selection of a sample;
2. Substitution of a non-selected convenient unit of the population, in place of a selected unit to which investigation is difficult, leads to some biases in the sample survey;

3. Bias due to defective demarcation of sampling units is particularly in area survey; and

4. Constant errors due to improper choice of the statistics for estimating the population parameters.

The non-sampling errors arise at the stages of observation, ascertainment and processing of the data. This is the reason why the non-sampling error presents in both the census and the sample survey. Non Sampling error can occur at every stage of the planning or execution of census or sample survey. Non-Sampling errors arise from the following factors:

1. Data specification being inadequate and inconsistent with respect to the objective of the study;
2. Error due to location of the units and actual measurement of the characteristics, error due to ill designed questionnaire, etc.;
3. Lack of trained and qualified investigators and adequate supervisory staff;
4. Errors due to lack of correct responses furnished by the respondents;
5. Non-response biases occur if full information is not obtained on all the sampling units;
6. If the objectives of the survey are not stated clearly that may result in inclusion of the units which are not to be included and execution of the units which are to be included in the sample;
7. Due to error in various operations of data processing such as editing and coding of the responses, punching of cards, tabulation and summarizing the observation made in the survey; and
8. The errors may be committed during presentation and printing the results of the survey.

E7) Same as Section 1.8

E8) According to the method of selection of sample, the sampling schemes can be categories as follows:

1. Non-Probability Sampling;
2. Probability or Random Sampling; and
3. Mixed Sampling.

1. **Non-Probability Sampling**

In this method, the sample is selected with definite purpose in view and the choice of the sampling units depends entirely on the discretion and judgment of the investigator. While selecting a sample investigator tries to include each and every characteristics of population in sample.

Non-Probability Sampling scheme can be classified as:
1. Purposive Sampling
2. Judgment Sampling
3. Deliberate Sampling
4. Convenience sampling
5. Quota Sampling

2. **Random or Probability Sampling**

The technique of random sampling is of fundamental importance in the application of Statistics. The estimation theory is based on the assumption of random sampling. Probability sampling is the scientific method of selecting samples according to some laws of chance in which each unit in the population has some definite pre assigned probability of being selected in the sample. The following are the different types of probability sampling:

1. Where each unit has an equal chance of being selected;
2. Sampling units have different probabilities of being selected; and
3. Probability of selection of a unit is proportional to the sample size.

Some of the Probability Sampling schemes are:

1. Simple Random sampling;
2. Stratified Random sampling;
3. Systematic Random sampling; and
4. Cluster sampling, etc.

3. **Mixed Sampling**

If the samples are selected partly according to some laws of chance and partly according to a fixed rule, they are called mixed samples and the method of selection of such samples is known as mixed sampling. The merits of this sampling are the mixture of the merits of both sampling. Selection of units is more reliable in this method because that is the representation of various stages of population. In mixed sample no important characteristics is left which is to be selected in the sample.