### **SAMPLING TECHNIQUES**

STAT 331 Chapter 1

## INTRODUCTION

This course covers sampling design and analysis methods useful for research and management in many fields.

يغطي هذا المقرر الدراسي أساليب تصميم وتحليل العينات المفيدة للبحث والإدارة في العديد من المجالات.

A well designed sampling procedure ensures that we can summarize and analyze the data with a minimum of assumptions or complications.

يضمن إجراء أخذ العينات المصمم جيدًا أنه يمكننا تلخيص البيانات وتحليلها بأقل قدر من الافتراضات أو المضاعفات. In this course, we'll cover the basic methods of sampling and estimation and then explore selected topics and recent developments including:

في هذا المقرر، سنغطى الطرق الأساسية لأخذ العينات والتقدير ثم نستكشف الموضوعات المختارة والتطورات الأخيرة بما في ذلك:

- Simple random sampling
- Systematic sampling
- Stratified sampling
- The estimation of the mean, total and proportion.
- Confidence interval methods
- Selecting sample sizes

## Types Of Data

- The statistical data are of two types:
- Primary Data, and
- Secondary Data.

### **Definition 1.1**

The data collected by the investigator from the original source are called Primary Data.

#### **Definition 1.2**

If the required data had already been collected by some agencies or individuals and are now available in the published or unpublished records, these are known as Secondary Data.

## **Methods Of Collecting Primary Data**

The methods usually adopted for collecting primary data are: (1) Direct Personal Interview

The investigator contacts the respondents personally and interviews them. The interviewer asks the questions and the obtained information is recorded on a schedule (a questionnaire form).

#### (2) Questionnaires Sent Through Mail

The investigator prepares a questionnaire and sends it by mail to the respondents.

#### (3) Interview by Enumerators

#### مقابلة بواسطة العدادين

This method involves the appointment of enumerators by the surveying agency. Enumerators go to the respondents, ask them the questions contained in the schedule, and then fill up the responses in the schedule themselves.

#### (4) Telephone Interview

The responses to various questions, included in the schedule, can be obtained over phone.

## Framing Of Questionnaire /schedule

The questionnaire is a channel through which the needed information is elicited. The success of eliciting information, to a considerable extent, depends on the tactful drafting of the questionnaire (or the schedule).

صياغة الاستبيان / الجدول الزمني

Following points should be kept in mind:

- 1. The person conducting the survey must introduce himself and state the objective of the survey. Also, the enclosing of a self-addressed stamped envelope for the respondent's convenience in returning the questionnaire, will help in improving the response rate.
- 2. The questions forming the questionnaire schedule should be clear and to the point.

- 3. Questions affecting prestige and sentiments of the people and those involving calculations should be avoided.
- 3. Precise and definite instructions for filling the questionnaire and about units of measurement should also be given.
- 3. The questionnaire should not be lengthy, otherwise, the respondents begin to lose interest in answering them.
- 3. The outlook of questionnaire should be attractive. The printing and the paper used should be of good quality.

# **Some Technical Terms**

## **Definition 1.3**

An element is a unit for which information is sought

## **Definition 1.4**



The population or universe is an aggregate of elements, about which the inference is to be made.

## • <u>NOTE:</u>

Populations are called **finite** or **infinite**, depending on the number of units constituting it.

### **Definition 1.5**

Sampling units are nonoverlapping collections of elements of the population.

### **Definition 1.6**

A list of all the units in the population to be sampled is termed frame or

sampling frame.

• <u>Note:</u>

If individual voter is taken as the sampling unit then a list of all registered voters will constitute the frame.

#### **Definition 1.7**

A subset of population selected from a frame to draw inferences about a population characteristic is called a sample.

## **Definition 1.8**

The collection of information on every unit in the population for the characteristics of interest is known as complete enumeration or census.

يُعرف جمع المعلومات عن كل وحدة في المجتمع للخصائص ذات الأهمية باسم التعداد الكامل أو التعداد

- The number of units (not necessarily distinct) included in the sample is known as the **sample size** and is usually denoted by *n*.
- The number of units in the population is called **population size** and is denoted by *N*.

## The Advantages Of A Sample Survey

There are certain advantages of a sample survey over complete enumeration.

### **Greater Speed**

The time taken for collecting and analyzing the data for a sample is much less than that for a complete enumeration

#### **Greater Accuracy**

A census usually involves a huge and unwieldy organization and, therefore, many types of errors may creep in.

### **More Detailed Information**

As the number of units in a sample are much less than those in the census, it is, therefore, possible to observe/interview each and every sample unit intensively.

#### **Reduced Cost**

Because of less number of units in the sample in comparison to the population, considerable time, money, and energy are saved in observing the sample units in relation to the situation where all units in the population are to be covered.

# **Sampling Design/Procedures**

## **Probability Sampling**

If the units in the sample are selected using some probability mechanism, such a procedure.

#### **Example:**

Simple Random Sample, Systematic Sample, Stratified Sampling (Our focus in this term)

### **Nonprobability Sampling**

The procedure of selecting a sample without using any probability mechanism

#### Example:

The convenience sampling and the purposive sampling (also termed judgement sampling), quota sampling.

## With And Without Replacement Sampling

### **Definition 1.9**

In with replacement (WR) sampling, the units are drawn one by one from the population, replacing the unit selected at any particular draw before executing the next draw. This procedure gives rise to  $N^n$  possible samples

#### **Definition 1.10**

In without replacement (WOR) sampling, the units are selected one by one from the population, and the unit selected at any particular draw is not replaced back to the population before selecting a unit at the next draw. Then there are  ${}^{N}C_{n}$  possible samples for this selection procedure.

#### Example 1.1

Given below are the weights (in pounds) of 4 children at the time of birth in a hospital: Child : A B C D Weight : 5.5 8.0 6.5 7.0

Enumerate all possible WR samples of size 2. Also, write values of the study variable (weight) for the sample units.

#### Solution

Here, N=4 and n=2. There will, therefore, be  $4^2=16$  possible samples. These are enumerated below along with the weight values for the units included in the sample.

Table 1.1 Possible samples along with their variable values

Sample	Children in the sample	Weight for the sampled children	Sample	Children in the sample	Weight for the sampled children
1	A, A	5.5, 5.5	9	C, A	6.5, 5.5
2	A, B	5.5, 8.0	10	С, В	6.5, 8.0
3	A, C	5.5, 6.5	11	C, C	6.5, 6.5
4	A, D	5.5, 7.0	12	C, D	6.5, 7.0
5	<b>B</b> , A	8.0, 5.5	13	D, A	7.0, 5.5
6	<b>B</b> , <b>B</b>	8.0, 8.0	14	D, B	7.0, 8.0
7	B, C	8.0, 6.5	15	D, C	7.0, 6.5
8	B, D	8.0, 7.0	16	D, D	7.0, 7.0

#### Example 1.2.

Using data of example 1.1, enumerate all possible WOR samples of size 2, and also list the weight values for the respective sample units.

Solution In this case, number of possible samples will be  $\binom{4}{2} = 6$ . These are enumerated below. Note

that no samples like AA or BB appear in the list of possible samples, and also the ordered samples like AB and BA are treated as the same sample.

Sample	Children in the sample	Weight for the sample children	Sample	Children in the sample	Weight for the sample children
1	A, B	5.5, 8.0	4	B, C	8.0, 6.5
2	A, C	5.5, 6.5	5	B, D	8.0, 7.0
3	A, D	5.5, 7.0	6	C, D	6.5, 7.0

## **Planning And Execution Of Sample Surveys**

### **Objectives**

The first task is to lay down, in concrete terms, the objectives of the survey. The investigator should ensure that these objectives are commensurate with available resources in terms of money, manpower, and the time limit specified for the survey.

نخطيط وتنفيذ المسوحات النموذجية

## **Population to be Studied**

The population to be covered by the survey should be clearly defined.

#### Sampling Unit

The population should be capable of being divided into sampling units, and these should be properly defined.

#### **The Sampling Frame**

It's always desired that the sampled and the target population should be coincide. It should be ensured that all the sampling units of the population under the study are included in the frame.

#### **Sample Selection**

The size of the sample and manner of selecting the sample should receive careful attention. The aim is achieving either a given degree of precision with a minimum cost, or the maximum precision with a fixed cost.

يجب أن يحظى حجم العينة وطريقة اختيار ها باهتمام بالغ. الهدف هو تحقيق إما درجة معينة من الدقة بأقل تكلفة أو أقصى دقة بتكلفة ثابتة.

### **Methods of Collecting Information**

Decide about the type of data to be used whether to collect **primary data** or to use **secondary data**.

#### **Handling of Nonresponse**

التعامل مع عدم الاستجابة

Procedures should be devised to deal with the respondents, who do not give information by choice, or are not found at home.

## مسح تجريبى Pilot Survey



It is desirable to design and carry out a pilot survey when some prior information about the nature of population and the operational and cost aspects of data collection and analysis is not available from the past.

#### تنظيم العمل الميداني Organization of Field Work

Different aspects of field work such as recruitment and training of investigators, and inspection and supervision of field

### **Analysis of Data and Preparation of Report**

The stage of analysis of collected data and drawing inferences from a sample is a vital issue, as the results of survey are the backbone of the policies to be framed. Last, but not the least, comes the report writing.



#### **The Elements of Survey Sampling book**

#### Page 11 questions 1.2, 1.16, 1.17, 1.18.