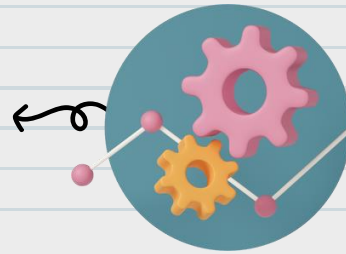
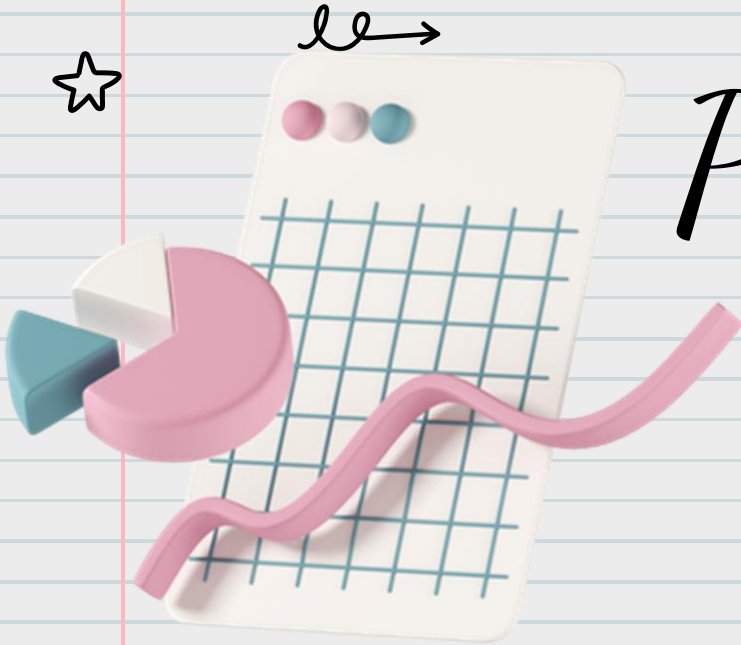


Probability and Statistics

2024-2025





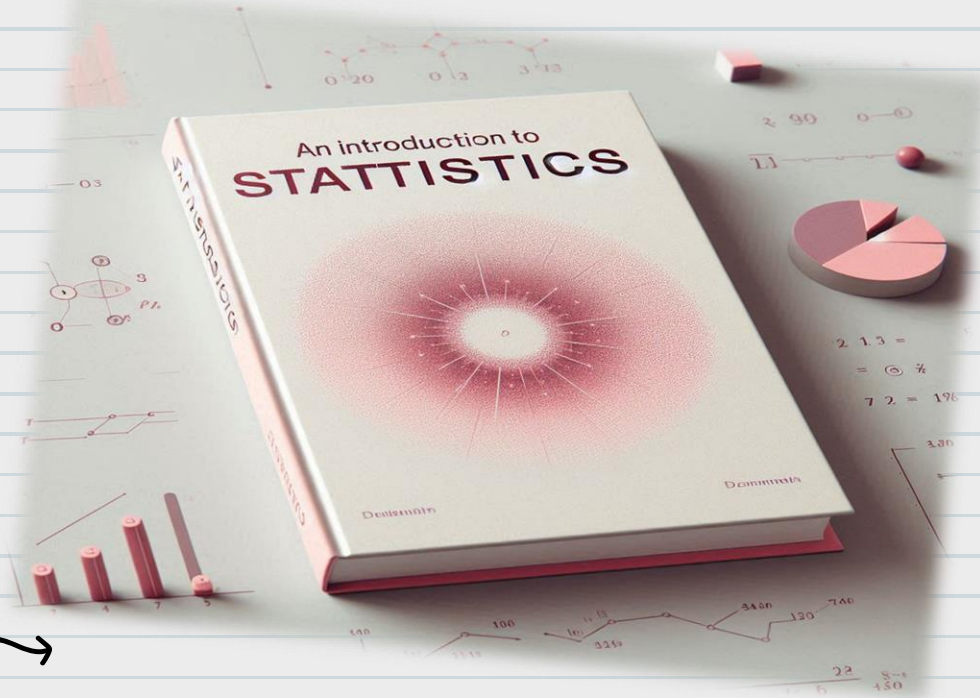
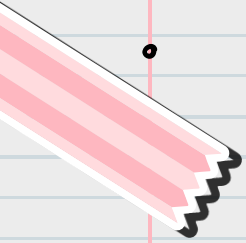
Part A : Statistics

Chapter 1: Basic Definitions



01

Introduction to Statistics

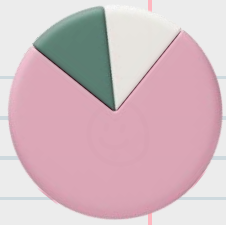


Statistics



As defined by the American Statistical Association (ASA)
"is the science of learning from data, and of measuring,
controlling and communicating uncertainty".





Statistics



Method



DATA

Collect

Order

Treat

Analyze

Interpret

Represent graphically



Descriptive Statistics



Descriptive statistics is a basic area of study in statistics. It is used to summarize data in an organized manner by describing the relationship between variables in a sample or population. It uses parameters, such as graphs, tables and data analysis methods.

Descriptive statistics involves methods of organizing, picturing and summarizing information from data.

Mathematical statistics or inductive (Inferential)



Inferential statistics involves methods of using information from a sample to draw conclusions about the population.

The aim of statistical induction is to bring out properties of a set of variables. It draws on the results of mathematical statistics, which applies rigorous mathematical calculations using probability theory.

Probability



Probability is the branch of mathematics that calculates the probability of an event, that is, the frequency of an event compared to all possible cases. This branch of mathematics originated from games of chance, more specifically from the desire to predict the unpredictable or quantify the uncertain.

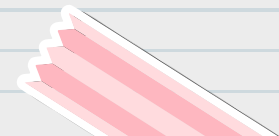
➤ Study a large amount of data ----- Statistics

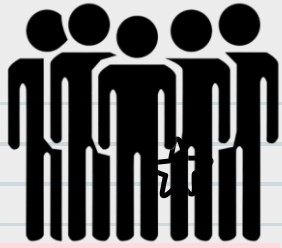
➤ Random aspect of results ----- Probability



02

Basic concepts of statistics





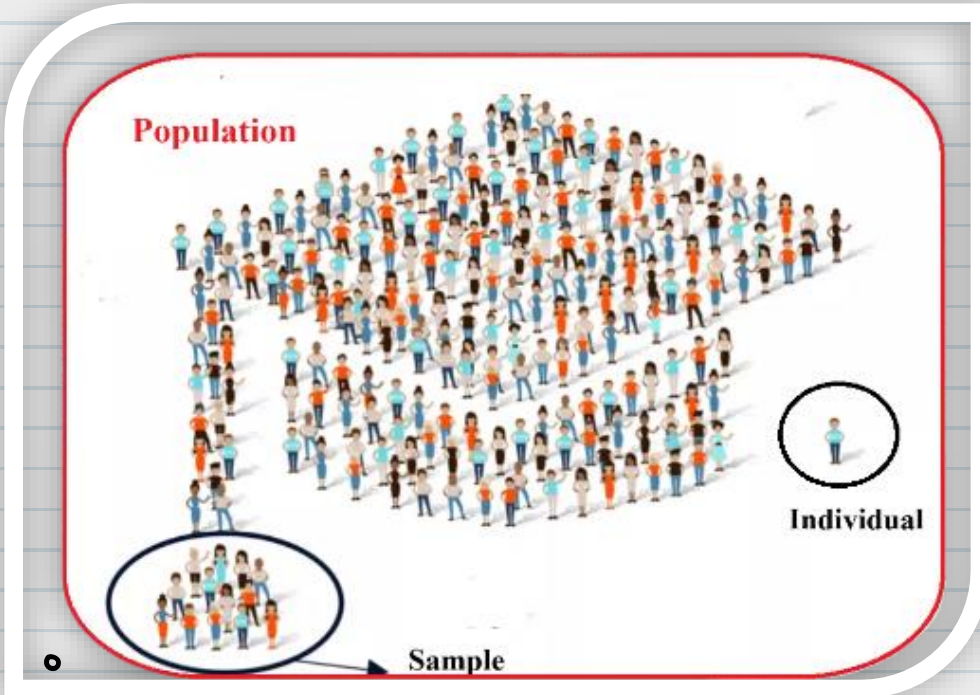
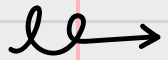
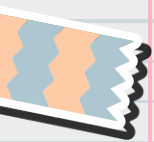
Population



Individu



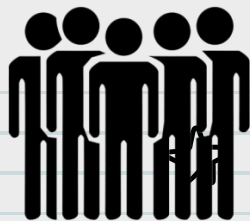
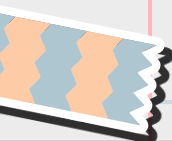
Echantillon



Don't forget

- ❖ Character or variable
- ❖ Modalities





Population

In statistics the notion of population represented the whole subject of the study, it is about what we want to study (individuals, objects, companies, institutions, etc.). It always brings together all individuals relating to this study. The population is generally rated: Φ

Example 1

- We consider all teachers at Algiers University. We are interested in number of children of each teacher. In this case:

Φ = set of teachers





Example 2

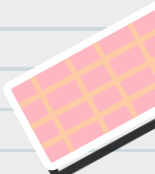
We take the Example 1, the individual represents a teacher at the University of Algiers.

\mathcal{P} = set of teachers
 i : one teacher at the University of Algiers.



Individual

The population is the set of individuals, each person^o in this population represents a statistical unit (individuals), It is indivisible and can be a human, an animal, an object or a plant. The individual is rated: i





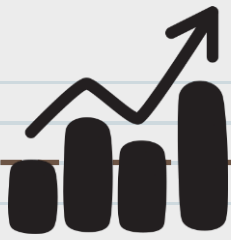
Sample

Sometimes in statistics, we find ourselves with a very large population that we cannot study at that time, we will select someone from this population, what we call a **sample**.

Example 3

- We consider all Algerian students. We are interested of the eyes color of each student. In this case we are in front of a large population, we select just 500 students for the study.

500 is a sample of population.



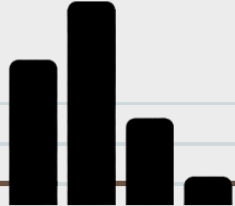
Character or Statistical Variable



Variables are properties or characteristics of some event, object, or person that can take on different values or amounts.

- **A single character** studied represents a one-dimensional statistical series or variable
- **Two characters** studied represent a statistical series in two dimensions or two variables.
- The characteristics studied can be: age, weight, marital status, number of children in a family, height, professional categories, eyes color, level of education, mass, list of manufacturing defects, temperature, price, professional categories of employees, year of study, nationality, etc.





Modalities



A modality is the value taken by a character or a statistical variable. The modalities therefore correspond to the set of possible values.

- A character can take different modalities or values.
- Each individual must present one and only one modality. (Ex: red, blond, brown).
- A statistical variable is denoted by a capital letter X, Y , and the values it takes by lowercase letters $x_1, x_2, \dots, y_1, y_2, \dots$
- A variable must present at least two categories or values.

Example:

- ❖ For the variable "family situation", modalities are "single, married, divorced".
- ❖ For the variable "number of children", modalities are "1, 2, 3, 4".



Different types of statistical variables

Statistical Variables may be classified into two main categories:

Quantitative (numerical) or Qualitative (categorical).

Example 6:

- ❖ Variable "Number of rooms in an apartment", their modalities are: 1, 2, 3. It is a Quantitative Variable.
- ❖ Variable "family situation", their modalities are: single, married, divorced. It is a Qualitative Variable.



Character or statistical variable

Qualitative
Ex: Marital status, Eye color

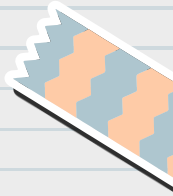
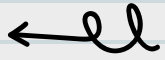
Quantitative
Ex: Age, Height

Ordinal
Ex: weak, normal, strong, very strong

Nominal
Ex: Marital status, Eye color

Discrete
Ex: Number of children,

Continuous
Ex: a finite or infinite interval



Different types of statistical variables

Quantitative Variable

- These variables represent numbers values. It can be categorized into two types: Discrete or Continuous

a. **Discrete Variables:** These variables can only take on a countable and finite numbers.

Example 7:

- The number of books in the library, The number of patients in a hospital.

Different types of statistical variables

b. **Continuous Variables:** Continuous if it takes all the values of a finite or infinite interval (real numbers \mathbb{R}).

Example 8:

- The weight of the students the values are: 40.8kg, 42.5kg, 45.6kg.
- Time to respond to a question.

Different types of statistical variables

Qualitative Variable

It represents categories that cannot be measured numerically. It can be categorized into two types:

a. **Nominal Variables**: Their modalities cannot be ordered or ranked.

Example 9:

- The variable "family situation", their modalities are: Single, Married, Divorced.
- The variable "eyes color", their modalities are: Blue, Green, Black, Brown.

Different types of statistical variables

b. **Ordinal Variables:** Their modalities can be ordered in a specific order or ranking.

Example 10:

- The variable "The condition of a car", their modalities are: New, Ancient, Degraded.
- The variable "strength", their modalities are: Weak, Normal, Strong, Very strong.