STATISTICS

A   STATISTICAL INVESTIGATION

Turn on the TV or flip through a newspaper, and you'll often spot statistics in action. For example:

- Su averages 14.6 points per basketball game.

- Last year was the hottest on record since 1897.

Statistics is the science of gathering, organizing, analyzing, interpreting, and presenting data. It helps us make smart decisions in all kinds of areas. Check out these real-world examples:

- **Scientific Research**: Testing if a new medicine works by studying trial results.

- **Industrial Production**: Improving products by tracking defects and fixing processes.

- **Social Issues**: Figuring out what people think about new laws through surveys.

A statistical investigation follows these five steps:

- **Step 1: State the Problem**: Decide what you want to learn.
  Example: How has the average temperature changed over the last 100 years?

- **Step 2: Collect Data**: Gather the info you need.
  Example: Get temperature records from weather stations.

- **Step 3: Calculate Descriptive Statistics**: Summarize the data with tools like mean, median, or mode.
  Example: Find the average temperature for each decade.

- **Step 4: Organize and Display Data**: Put the data in order and show it with charts or graphs.
  Example: Make a graph of temperature changes over time.

- **Step 5: Interpret the Statistics**: Figure out what the data tells you.
  Example: Does the data show temperatures are rising significantly?

By following these steps, you can dig into data and use it to make solid decisions!

> Definition **Statistics**
>
> **Statistics** is all about collecting information, sorting it out, summarizing it, and figuring out what it means.

B   STATING THE PROBLEM

When you start a statistical investigation, the first step is to ask a clear question. This keeps you focused on what you're trying to find out and who or what you're studying.

We call the group we're studying the **population**. It could be all the people in a country, every student in a school, all the animals of a species, or even every item made by a machine. The information we collect from this group is called **data**, and it can come in many forms—like numbers, words, or measurements.

> Definition **Problem**
>
> A **problem** in statistics is a question that guides us to the information we need to find.

Ex: Do girls like math more than boys?

> Definition **Population**
>
> A **population** is the whole group of people or things with something in common that we want to study.

Ex: The population is all the students in a college.

> Definition **Data**
>
> **Data** is the information we collect, like numbers, words, measurements, or observations.

Ex: For our math study, we collect:

- **Gender**: Is the student a boy or a girl?

- **Favorite Subject**: What subject do they like best (e.g., Math, Science, English)?

- **Math test score**: What was their grade on the last assessment??

Definition Types of Variables

- **Qualitative Variable (Categorical)**: Describes categories or groups that cannot be measured numerically.

- **Quantitative Variable (Numerical)**: Represents measurable quantities with numerical values.

Ex: For our math study:

- **Qualitative Variables**: Gender and favorite subject.

- **Quantitative Variable**: Math test score.

C COLLECTING DATA

Method Making Survey

To do the survey, follow these steps:

1. Ask each student your question, like "What is your favorite pet?"

2. Write down what each student says. You can:
   - Write their name next to their answer (e.g., "Emma: Dog").
   - Or use tally bars to count the answers (e.g., draw a tally mark for each "Dog").

D DESCRIPTIVE STATISTICS

Descriptive statistics are numbers that help us summarize and understand data—like finding the average or the most common answer.

Definition A statistics

A **statistics** is a single value that sums up or describes a set of data.

Ex: The average score in a class is 85% is a statistics number because it tells us something about the whole group in one simple figure.

E DESCRIPTIVE STATISTICS: RELATIVE FREQUENCY

In statistics, it's important to understand the frequency of a category. This concept helps us analyze patterns and make predictions. It applies to everyday scenarios, such as gauging the popularity of a favorite food among friends or calculating how often a basketball player scores a shot. By studying relative frequencies, we gain valuable insights into data trends.

Definition Frequency and Relative Frequency

Frequency is how many times each value or category appears.
Relative Frequency is the frequency divided by the total, often shown as a percentage.

Ex: The data for favorite subject is: Maths: 15 students, Sciences: 12 students, English: 3 students.
Fill in the table:

Subject	Frequency	Relative frequency (%)
Maths		
Sciences		
English		
Total		100%

Answer:

Subject	Frequency	Relative frequency (%)
Maths	15	$\frac{15}{30} \times 100\% = 50\%$
Sciences	12	$\frac{12}{30} \times 100\% = 40\%$
English	3	$\frac{3}{30} \times 100\% = 10\%$
Total	30	100%

F DESCRIPTIVE STATISTICS: CENTRAL TENDENCY

In statistics, central tendency refers to a measure that identifies a single value as representative of the center or typical point of a dataset. Three key measures are commonly used to assess central tendency: the mode, the mean, and the median.

> **Definition Mode**
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> The **mode** is the value that shows up most often in your data.

Ex: A group of students reported their last mark (out of 5) on a math exam as follows:

$$1, 4, 2, 3, 5, 4, 5, 4, 3$$

What is the mode of this dataset?

Answer: From the frequency table:

Mark	Frequency
1	1
2	1
3	2
4	4
5	2

The mode is 4 because it appears most frequently (4 times).

> **Definition Mean**
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> The **mean** is the average. Add up all the values and divide by how many there are:
>
> $$\bar{x} = \frac{\text{sum of all values}}{\text{number of values}}$$
> $$= \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$$

Ex: Ratings: 1, 4, 2, 3, 5, 4, 5, 4, 4. What's the mean?

Answer:

$$\text{Mean} = \frac{1 + 4 + 2 + 3 + 5 + 4 + 5 + 4 + 4}{9}$$
$$= \frac{32}{9}$$
$$\approx 3.56$$

G ORGANIZING AND DISPLAYING DATA
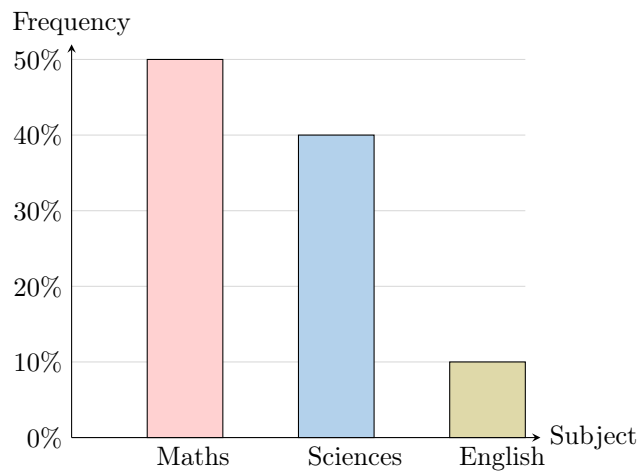
> **Definition Bar Chart/Histogram**
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> A **bar chart/histogram** shows data with bars:
>
> - Categories or values go on x-axis.
> - Frequencies go on y-axis.

Ex: Draw a bar chart for:

Subject	Relative frequency (%)
Maths	50%
Sciences	40%
English	10%

Answer:

Definition Pie Chart
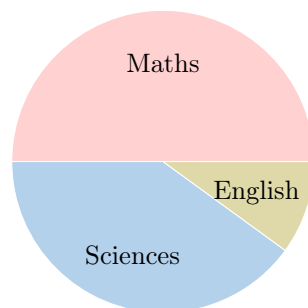
A **pie chart** is a circle split into slices to show how data compares.

Ex: Draw the pie chart of the following data:

Subject	Frequency
Maths	15
Sciences	12
English	3
Total	30

Answer: Angles are :

- Maths : $\frac{15}{30} \times 360° = 180°$

- Sciences : $\frac{12}{30} \times 360° = 144°$

- English : $\frac{3}{30} \times 360° = 36°$

H INTERPRETING THE STATISTICS

Interpreting statistics means looking at the data to find out what it really tells us. We spot patterns, compare groups, and think about what the results mean in real life. The goal? Turn numbers into useful ideas for decisions or advice.

Ex: The girls' average score in math is 87 (B+), while the boys' average is 75 (C). Are girls better at math?

Answer: Yes, since $87 > 75$, on average, girls perform better than boys in math.