# Chapter 11 - Biostatistics and Data Handling

**All Lectures Uploaded on YouTube:**
https://tinyurl.com/fkm10-biology


## 11.1. Biostatistics and Its Uses

### 11.1.1. Biostatistics

**Biostatistics** is the application of statistical methods to analyze, interpret, and present data related to **biology, medicine, health sciences, agriculture, and other life sciences**.

It involves:

- **Collection** of biological data
- **Analysis** of data
- **Interpretation** of results
- **Presentation** of findings to derive solutions, policies, or scientific conclusions

Biostatistics helps understand:

- Disease patterns
- Health trends
- Effectiveness of treatments
- Productivity in agriculture, poultry, and dairy sectors

**Components of Biostatistics Studies**

1. **Identification of the problem**
    - The first step in studying any biological issue, especially those related to humans or living organisms.
2. **Designing experiments**
    - Planning procedures to investigate the biological problem.
3. **Collecting and analyzing data**

- Systematic data collection followed by thorough statistical analysis.

4. **Interpreting results**
    - Determining causes, outcomes, and future implications based on the analyzed data.

5. **Developing new tools**
    - Using interpretations to create new methods, tools, or plans (e.g., healthcare solutions).

Biologists are encouraged to have basic knowledge of biostatistics.

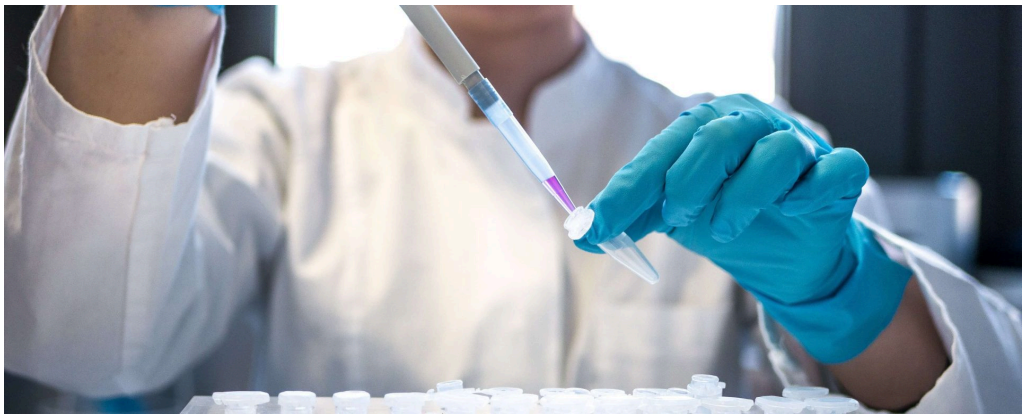
## 11.1.2. Uses of Biostatistics

**1. Agriculture and Cattle Farming**

- Helps estimate food, dairy, and livestock demands of a growing population.
- Guides governments about import/export needs of food items.

**2. Medical and Pharmacological Research**

- Designs clinical trials and controlled studies.
- Assesses safety, effectiveness, and optimal dosage of drugs.
- Compares treatment benefits vs. side effects.



**3. Epidemiology and Policy Development**

- Monitors spread and rate of epidemic diseases.
- Identifies risk factors and disease patterns.
- Helps prevent future outbreaks (Polio, COVID-19, Hepatitis).
- Provides statistical evidence for public health policies.

**4. Public Health Management**

- Studies population data: birth rate, death rate, disease prevalence.
- Assists in planning health strategies and resources.
- Helps improve hospital performance (patients, doctors, medicines).


**5. Genetic Diseases**

- Analyzes inheritance patterns of disorders (thalassemia, muscular dystrophy).
- Estimates risk factors and predicts genetic disease behavior.

**6. Environmental Protection**

- Measures pollution levels and related health risks.

- Helps plan solutions (e.g., smog control, identifying affected areas).
- Supports environmental policies (plantation drives in Lahore).

**7. Survival Analysis**

- Predicts survival rates after treatments.
- Estimates life expectancy and treatment success (e.g., 5-year survival in cancer).

## 11.2. Definition and Calculation of Mean, Median and Mode

Average-type statements (e.g., heart rate = 72 BPM, rainfall = 1500 mm/year) represent **central tendency**, not exact values.

**Average:**
A single value representing an entire dataset.

**Types of averages:**

1. **Arithmetic Mean (Mean)**
2. **Median**
3. **Mode**
4. Geometric Mean
5. Harmonic Mean

### 11.2.1. Arithmetic Mean (Mean)

**Definition**

$$Mean = \frac{Sum\ of\ values}{Total\ number\ of\ values}$$

Symbol: $\bar{x}$ **(x-bar)**

**Example 1 (Un-grouped Data)**

Monthly polio cases in Pakistan for 2022 & 2023.

**2022 Total:** 192
**2023 Total:** 144

Mean number of Polio patients per month in 2022:

$$\frac{Sum\ of\ Polio\ Cases\ in\ complete\ year}{Total\ number\ of\ months} = \frac{192}{12} = 16$$

Mean number of Polio patients per month in 2023:

$$\frac{Sum\ of\ Polio\ Cases\ in\ complete\ year}{Total\ number\ of\ months} = \frac{144}{12} = 12$$

**Difference:** 4 fewer cases/month in 2023 → **Prevalence decreased**.

**Example 2 (Grouped Data)**

Mean mass of 100 students.

Using:

$$Mean = \frac{\Sigma fx}{\Sigma f} = \frac{4950}{100} = 49.5\ Lbs$$

Final answer:

Mean mass = 49.5 Lbs

## 11.2.2. Median

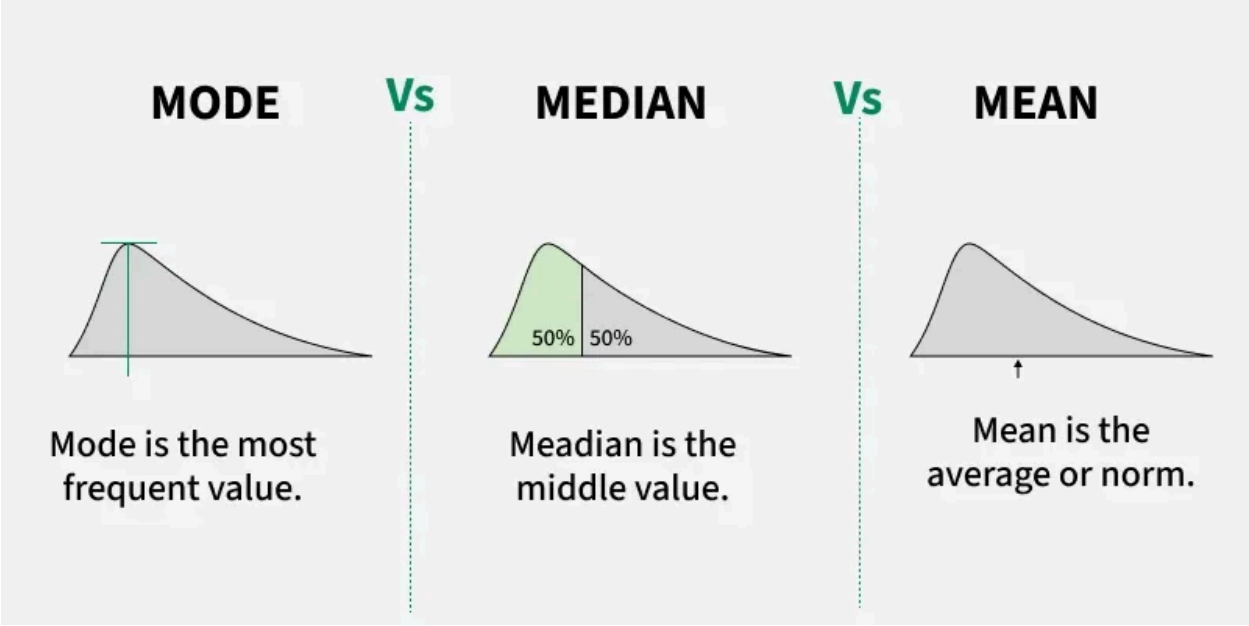
**Definition**

Median is the **middle value** of a dataset arranged in ascending or descending order.

Symbol: $\tilde{x}$ **(x-tilde)**

- **Odd number of values:**
  $Median = \frac{n+1}{2}$

- **Even number of values:**
  Median = Mean of the two middle values.




**Example (Odd number of values)**

Plant heights (13 values): 46,49, 55, 58, 62, 63, 64, 65, 66, 67, 68, 70,72

Median = $\frac{13+1}{2} = 7$ (7th value)

Median = 64

**Example (Even number of values)**

Fruit count in 16 plants: 3,5,18,21,15,10,8,12,13,7, 11, 14,9, 16, 20, 24

Median = $\frac{16+1}{2} = 8.5$ (Average of 8th and 9th values)

Median = $\frac{12+13}{2} = 12.5$

Median = **12.5 fruits per plant**

**Advantages of Median**

1. Easy to calculate.
2. Not affected by very large or very small values.
3. Useful for quantitative data.

**Disadvantages**

1. Cannot combine medians of multiple datasets.
2. May not represent the actual central value.
3. Not useful where exact values matter (age, weight).

## 11.2.3. Mode

**Definition**

Mode is the value that occurs **most frequently** in a dataset.

Symbol: $\hat{x}$ **(x-hat)**

A dataset may be:

- **Unimodal** – one mode
- **Bimodal** – two modes
- **Multimodal** – many modes
- **Amodal** – no mode

**Examples**

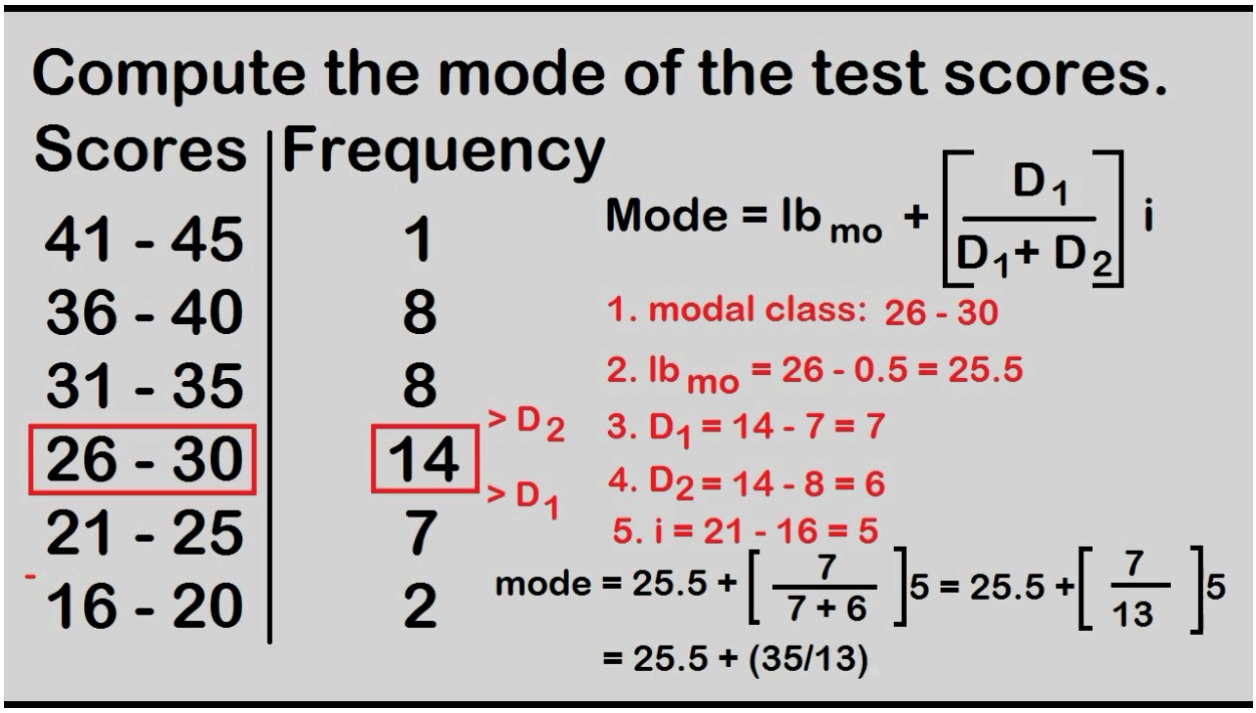
1. Word **BIOLOGY** → Mode = **O**
2. Values: 3, 5, 6, 6, 9, 10, 9, 6, 6 → Mode = **6**
3. Values: 3, 5, 5, 6, 9, 9, 10 → Mode = **5 & 9** (bimodal)

**Mode for Grouped Data**

$$Mode\ (X):\ l\ +\ \frac{(fm-f1)\times h}{(fm-f1)+(fm-f2)}$$

Where:

- **l** = lower boundary of modal class
- **fm** = maximum frequency
- **f1** = frequency before modal class
- **f2** = frequency after modal class
- **h** = class interval




## 11.3. Sketching a Bar Chart for a Given Set of Biological Data

### 11.3.1. Graphic Presentation: Need and Importance

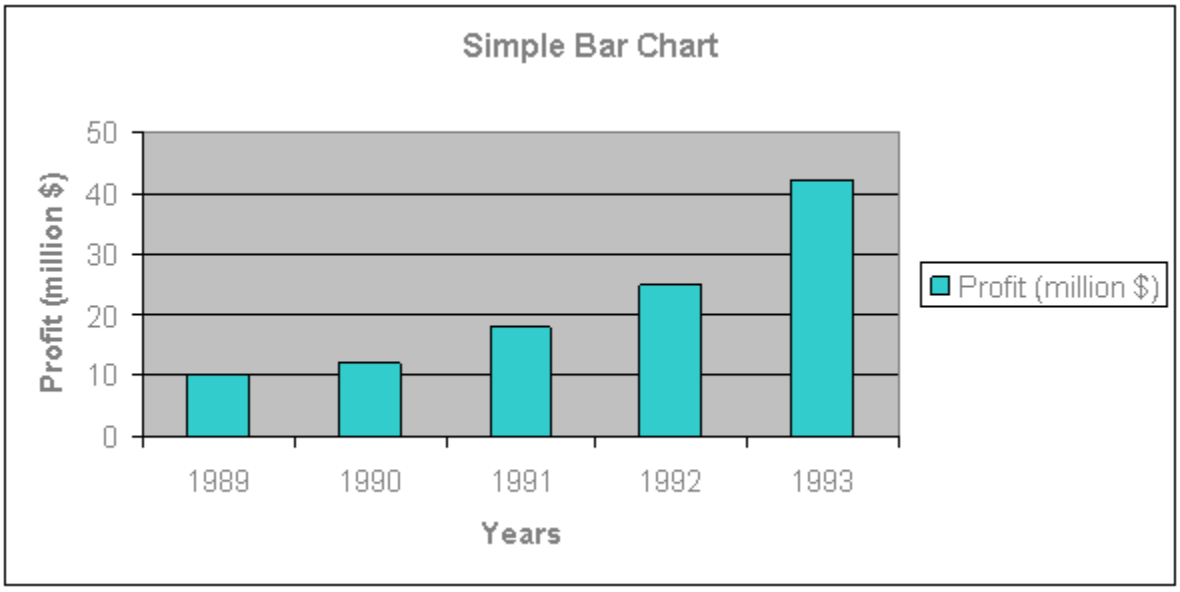
- Numerical tables are difficult to understand quickly.
- Diagrams and graphs provide:
    - Clear representation
    - Better understanding

    - Stronger visual impact

- Types include: bar charts, rectangles, pie charts.

### 11.3.2. Simple Bar Chart

- Represents **one characteristic** of data only.




- Bars have:
    - **Equal width**
    - **Variable length** (representing magnitude)

- One bar = one value

- Bars may be vertical or horizontal (usually vertical).

### 11.3.3. Steps for Constructing a Bar Graph

1. Choose a suitable graph paper.
2. Draw two perpendicular axes meeting at zero.

3. Label horizontal axis (X-axis) and vertical axis (Y-axis).
4. Choose equal widths for bars and equal spacing.
5. Label X-axis with categories.
6. Select a scale for Y-axis based on data range.
7. Mark Y-axis units.
8. Plot heights of bars.
9. Draw bars neatly and check all values.


**PAKISTAN'S ONE OF THE BEST EDUCATIONAL PLATFORM FOR FEDERAL BOARD PREPARATION - FEDERAL KA MANJAN**

**FEDERAL KA MANJAN**

Online Batch For Class (9,10,11 & 12)

SUBJECTS:

1. BIOLOGY
2. CHEMISTRY
3. PHYSICS
4. MATH
5. COMPUTER SCIENCE
6. ENGLISH

**INCLUDES:**

1. CHAPTER TESTS
2. Live Class Recordings
3. MONTHLY TESTS
4. HOME WORK
5. Topper Notes
6. Full Book Notes
7. TARGET / GUESS PAPERS
8. QUESTION AND ANSWERS
9. 24/7 TEACHER SUPPORT
10. DOUBT CLASSES & Support
11. Get 95+% in Board Exams
12. LIVE GRAND TESTS
13. MOST IMPORTANT EXAM WRITING METHOD SESSIONS

**CONTACT US ON WHATSAPP +92 336 8079808**
**For Registration: REGISTER NOW**

**ONLY Rs. 2,999 /= For One YEAR (1 SUBJECT)**

**ONLY Rs. 250 / Month**

**GET 95+% IN FEDERAL BOARD EXAMS**

# GET 95+%

## IN FEDERAL BOARD EXAMS

# FEDERAL KA MANJAN

BATCH 1.0 | Grade 9 & 10 FBISE

### SUBJECTS OFFERED:

- Biology / Computer Science
- Chemistry
- Physics
- Math
- English

### PROGRAM INCLUDES:

- ✓ Chapter Tests
- ✓ Monthly Tests
- ✓ Assignments
- ✓ MCQs Sheets
- ✓ Notes and Short Tricks
- ✓ Target / Guess Papers
- ✓ 24/7 Teacher Support
- ✓ Doubt Classes
- ✓ WhatsApp Group
- ✓ Mock Tests
- ✓ Live Grand Tests
- ✓ Most Important Exam Writing Method Sessions

## AMAZING OFFER!

1 SUBJECT For Full One YEAR (12 Months)

~~Rs 12,000~~ **NOW ONLY Rs 3,000!**

(Per Subject for the Entire Year)

## READY TO ACE YOUR EXAMS?

REGISTER ON WHATSAPP

0336-8079808