CHAPTER 12: STATISTICS

YOUR ULTIMATE GUIDE TO MASTERING THE FOUNDATIONS OF MATHEMATICS

1. BASIC TERMINOLOGY

1.1 Class Interval

Range between two consecutive numbers in grouped data.

Types:

- **Inclusive: 20-29, 30-39 (29 & 30 in different classes)**
- **Exclusive: 20-30, 30-40 (30 in first class)**

Convert Inclusive to Exclusive: Subtract 0.5 from upper limit

Example: 20-29 → 19.5-28.5

1.2 Lower Limit

True Lower Limit: Actual smallest value in class

Example: 30-40 → True Lower Limit = 30

Apparent Lower Limit: Written value (for inclusive series)

1.3 Upper Limit

True Upper Limit: Actual largest value in class

Example: 30-40 → True Upper Limit = 40

1.4 Class Size (Width)

$$\text{Class Size} = \text{Upper Limit} - \text{Lower Limit}$$

Example: 30-40 → Class Size = 10

1.5 Class Mark (Mid-Point)

$$\text{Class Mark} = \frac{\text{Lower Limit + Upper Limit}}{2}$$

Detailed Table:

Class	Lower	Upper	Class Size	Class Mark
10-20	10	20	10	15
20-30	20	30	10	25
30-40	30	40	10	35
40-50	40	50	10	45

Memory Trick: Class Mark = Average of boundaries

1.6 Frequency

Number of observations falling in a class interval.

Example: Marks 30-40: 12 students → Frequency = 12

1.7 Adjusted Frequency

Used ONLY for histograms with unequal class widths

$$\text{Adjusted Frequency} = \frac{\text{Frequency} \times \text{Minimum Class Width}}{\text{Class Width of this interval}}$$

Why? Area of rectangle ∝ Frequency (Histogram Rule)

Height × Width = Frequency → Height = Adjusted Frequency

2. BAR GRAPHS

2.1 Definition

Rectangular bars for categorical/discrete data with gaps between bars.

2.2 When to Use

- **Different categories (fruits, cities, subjects)**
- **NOT for continuous grouped data**

2.3 Step-by-Step Construction

1. Draw x-axis → Categories (Apples, Bananas...)

2. Draw y-axis → Frequency (Scale from 0)

3. Mark categories equally spaced

4. Draw bars: SAME WIDTH, SAME GAPS

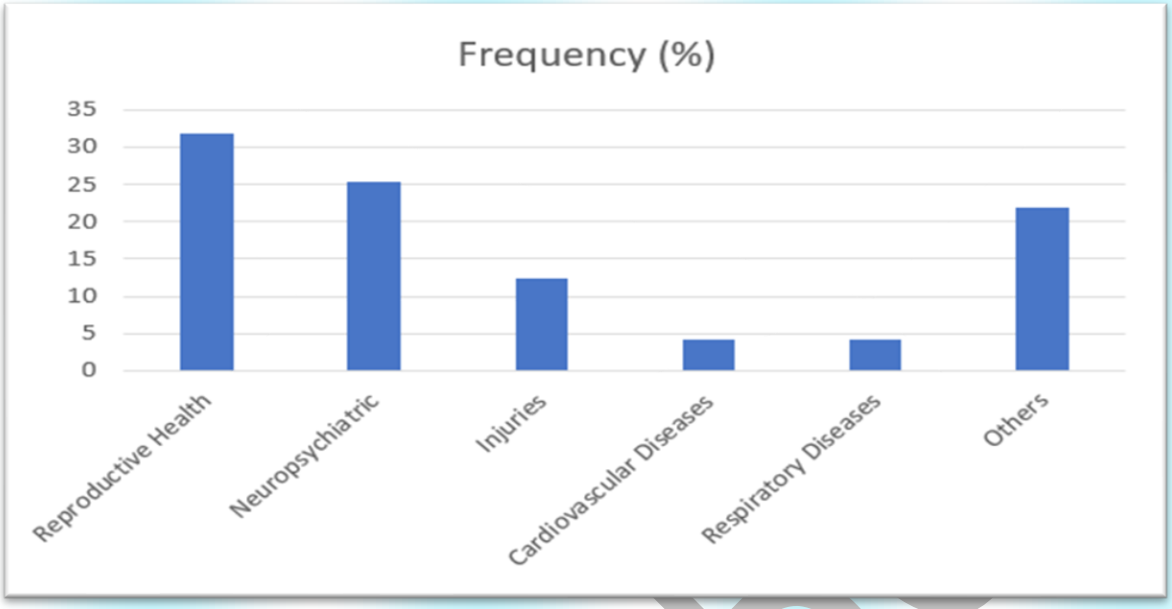
5. Label + Title

Example

Data:

Cause	Frequency (%)
Reproductive Health	31.8
Neuropsychiatric	25.4
Injuries	12.4
Cardiovascular Diseases	4.3
Respiratory Diseases	4.1
Others	22.0

Graph:



3. HISTOGRAMS

3.1 Definition

Adjacent bars (NO GAPS) for continuous grouped data.

Golden Rule: Area of each bar ∝ Frequency

3.2 Types of Histograms

A. Equal Class Width

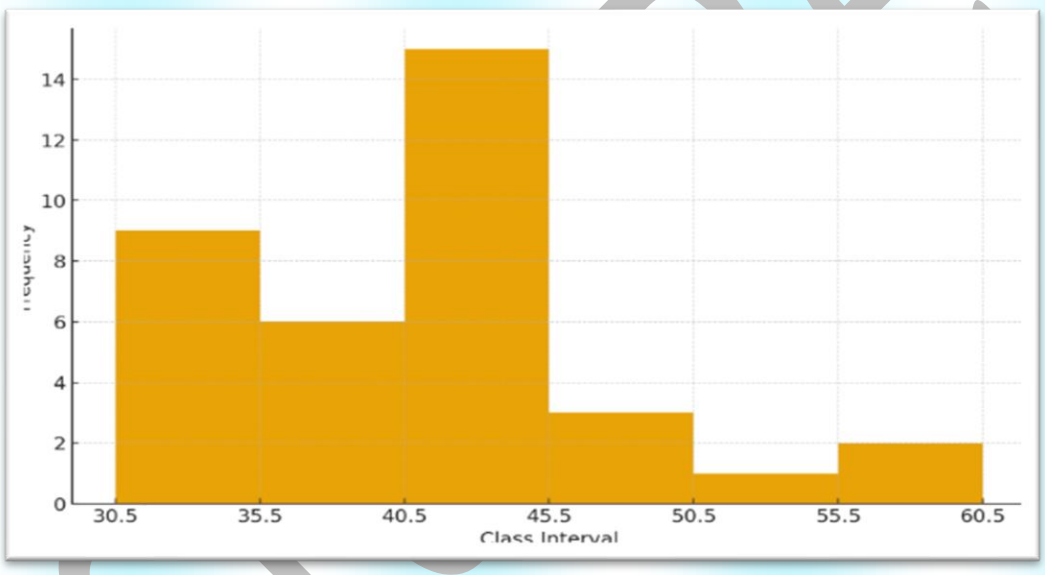
Height = Frequency directly

Example:

Data: Weights of 36 students.

Class Interval	Frequency (f)	Class Width	Class Mark
30.5 - 35.5	9	5	33
35.5 - 40.5	6	5	38
40.5 - 45.5	15	5	43
45.5 - 50.5	3	5	48
50.5 - 55.5	1	5	53
55.5 - 60.5	2	5	58

Graph:



B. Unequal Class Width

Height = Adjusted Frequency

Complete Formula Application:

Step 1: Find Minimum Class Width (h_min)

Step 2: For each class: Adjusted Freq = (f × h_min) / h_i

Example:

Data:

Marks	Freq (f)	Width (h)	Adjusted Freq = (f × 10)/h
0-20	7	20	(7×10)/20 = **3.5**
20-30	10	10	(10×10)/10 = **10**
30-40	12	10	(12×10)/10 = **12**
40-50	15	10	(15×10)/10 = **15**
50-60	10	10	(10×10)/10 = **10**
60-70	8	10	(8×10)/10 = **8**
70-100	30	30	(30×10)/30 = **10**

Now, follow the same steps for plotting of the graph as we have followed for plotting equal class width histogram. But remember that we have to plot the graph according to adjusted frequency, not given frequency.

4. FREQUENCY POLYGONS

4.1 Two Methods

Method 1: From Histogram

Join mid-points of rectangle tops → Extend to x-axis

Method 2: Direct (Recommended)

1. Add classes (freq=0) at both ends

2. Calculate all class marks

3. Plot (Class Mark, Frequency)

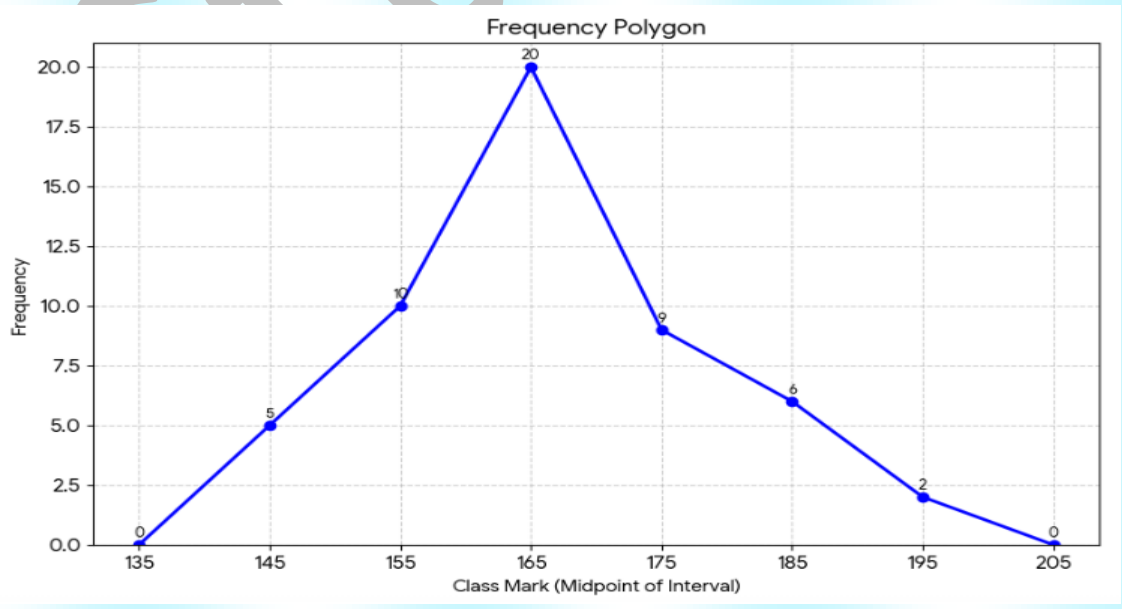
4. Join with straight lines

Example:

Data:

Interval	Class Mark	Frequency
130-140*	135	0
140-150	145	5
150-160	155	10
160-170	165	20
170-180	175	9
180-190	185	6
190-200	195	2
200-210*	205	0

Graph:



5. COMMON ERRORS & PRO TIPS

1. Histogram with gaps → Looks like bar graph
2. Wrong Adjusted Frequency → Use: $(f \times h_{min})/h_i$
3. Class marks wrong → (L+U)/2 exactly
4. No imaginary classes → Polygon incomplete
5. Y-axis not from 0 → Proportions wrong
6. Inclusive intervals → Convert to exclusive
7. Unequal scales → Misleading graph
8. Missing labels/title → 1 mark lost
9. Wrong continuous intervals → 30-35 → 29.5-35.5
10. Frequency vs Density confusion

6. PRACTICE DRILLS

1. Write any five numbers of your choice and show how they would be represented using tally marks.

2. Convert the raw data 6, 11, 15, 19, 24, 28, 30 into two suitable class intervals and make a grouped frequency table.

3. The class intervals are 0–5, 5–10, 10–15. Find the class size and the class boundaries of the interval 5–10.

4. A student tries to draw a histogram using class intervals 3–7, 8–12, 13–17. Explain why the histogram cannot be made correctly using these intervals.

5. A frequency polygon is drawn using midpoints of four classes. What extra points must be added to close the polygon properly?