

 **STATISTICS**

Chapter 13 - CBSE Class 10 Mathematics

Complete Study Material 2025-26

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## Fascinating Facts About Statistics

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### Did You Know?

-  The word "Statistics" comes from the Latin word "status" meaning "state" - originally used by governments to collect data about their nations
-  Florence Nightingale was a pioneer in using statistical graphs to convince the British government to improve sanitary conditions in hospitals
-  Cricket teams use batting averages (mean) to evaluate players' performances
-  The median salary is often more useful than mean salary because it's not affected by extremely high salaries of CEOs
-  Fashion designers use mode to determine the most popular sizes to manufacture
-  The United Nations uses statistical data to measure country development through HDI (Human Development Index)
-  Stock market analysts use moving averages to predict future price trends
-  Hospitals use median waiting time instead of mean because extreme cases can distort the average
-  Social media platforms use statistics to show "trending" topics based on frequency (mode)
-  Sports leagues use statistics extensively - batting averages, strike rates, and player ratings all involve measures of central tendency

## Chapter Overview

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### **Weightage**

#### **10 Marks**

1-2 questions in Board Exam

Very High Importance

### **Study Time**

#### **10-12 Hours**

Theory: 4 hours

Practice: 6-8 hours

### **Difficulty Level**

#### **Moderate**

Formula-based chapter

Score easily with practice

### **Key Topics**

Mean (3 methods)

Mode

Median

## 13.1 Introduction to Statistics

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Statistics is the science of collecting, organizing, analyzing, and interpreting numerical data. In this chapter, we extend our understanding of measures of central tendency from ungrouped data to **grouped data**.

### Three Measures of Central Tendency

- **Mean (Average):** Sum of all observations divided by total number of observations
- **Median:** The middle value when data is arranged in order
- **Mode:** The value that appears most frequently

## 13.2 Mean of Grouped Data

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For grouped data, we have **THREE METHODS** to calculate mean. All give the same result!

### Method 1: Direct Method

$$\text{Mean } (\bar{x}) = \frac{\sum f_i x_i}{\sum f_i}$$

Where:

- $x_i$  = Class mark (mid-point of class) = (Upper limit + Lower limit) / 2
- $f_i$  = Frequency of class
- $\sum f_i x_i$  = Sum of (frequency × class mark)
- $\sum f_i$  = Total frequency (N)

**When to use:** When  $x_i$  and  $f_i$  values are small

### Method 2: Assumed Mean Method

$$\text{Mean } (\bar{x}) = a + \frac{\sum f_i d_i}{\sum f_i}$$

Where:

- $a$  = Assumed mean (any class mark, preferably middle one)
- $d_i = x_i - a$  (deviation from assumed mean)
- $f_i d_i$  = frequency × deviation

**When to use:** When  $x_i$  values are large

### Method 3: Step Deviation Method

$$\text{Mean } (\bar{x}) = a + h \times (\Sigma f_i u_i / \Sigma f_i)$$

Where:

- $a$  = Assumed mean
- $h$  = Class size (class width)
- $u_i = (x_i - a) / h$
- This method simplifies calculations when  $d_i$  values have a common factor

**When to use:** When class intervals have equal width and  $d_i$  values have common factor

#### NCERT Example: Finding Mean

**Question:** Find the mean of the following distribution using step-deviation method:

Class Interval	10-25	25-40	40-55	55-70	70-85	85-100
Frequency	2	3	7	6	6	6

**Solution:**

**Step 1:** Find class marks ( $x_i$ ): 17.5, 32.5, 47.5, 62.5, 77.5, 92.5

**Step 2:** Choose  $a = 47.5$  (middle class mark),  $h = 15$

**Step 3:** Calculate  $u_i = (x_i - 47.5) / 15$

$u_i$  values: -2, -1, 0, 1, 2, 3

**Step 4:** Calculate  $f_i u_i$  and  $\Sigma f_i u_i$

$$\Sigma f_i u_i = -4 + (-3) + 0 + 6 + 12 + 18 = 29$$

$$\Sigma f_i = 30$$

**Step 5:** Apply formula:

$$\text{Mean} = 47.5 + 15 \times (29/30) = 47.5 + 14.5 = \mathbf{62}$$

## 13.3 Mode of Grouped Data

**Mode** is the value that occurs most frequently in the data. For grouped data, we find the **modal class** (class with highest frequency) and use a formula.

### Mode Formula

$$\text{Mode} = l + \left[ \frac{(f_1 - f_0)}{(2f_1 - f_0 - f_2)} \right] \times h$$

Where:

- **l** = Lower limit of modal class
- **f<sub>1</sub>** = Frequency of modal class
- **f<sub>0</sub>** = Frequency of class preceding modal class
- **f<sub>2</sub>** = Frequency of class succeeding modal class
- **h** = Class size (width of class interval)

### Steps to Find Mode

1. Identify the modal class (class with maximum frequency)
2. Note down  $l$ ,  $f_1$ ,  $f_0$ ,  $f_2$ , and  $h$
3. Substitute in formula
4. Calculate the result

### NCERT Example: Finding Mode

**Question:** Find the mode of the following frequency distribution:

Class Interval	0-10	10-20	20-30	30-40	40-50
Frequency	5	8	15	20	12

**Solution:**

**Step 1:** Modal class = 30-40 (highest frequency = 20)

**Step 2:** Note values:

- $l = 30$
- $f_1 = 20$
- $f_0 = 15$
- $f_2 = 12$
- $h = 10$

**Step 3:** Apply formula:

$$\begin{aligned}\text{Mode} &= 30 + [(20-15) / (2 \times 20 - 15 - 12)] \times 10 \\ &= 30 + [5 / 13] \times 10 \\ &= 30 + 3.85 \\ &= \mathbf{33.85}\end{aligned}$$

## 13.4 Median of Grouped Data

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**Median** is the middle value of the data when arranged in order. It divides the data into two equal halves. For grouped data, we use cumulative frequency.

### Median Formula

$$\text{Median} = l + \left[ \frac{(n/2 - cf)}{f} \right] \times h$$

Where:

- **l** = Lower limit of median class
- **n** = Total frequency ( $\Sigma f_i$ )
- **cf** = Cumulative frequency of class before median class
- **f** = Frequency of median class
- **h** = Class size

### Steps to Find Median

1. Prepare cumulative frequency table
2. Calculate  $n/2$
3. Locate median class (class whose cf is just greater than  $n/2$ )
4. Note down  $l$ ,  $n$ ,  $cf$ ,  $f$ , and  $h$
5. Apply formula

### Cumulative Frequency

**Cumulative Frequency (cf)** = Sum of all frequencies up to that class

**Two types:**

- **Less than type:** Upper limits on x-axis
- **More than type:** Lower limits on x-axis

### NCERT Example: Finding Median

**Question:** Find the median of the following distribution:

<b>Class Interval</b>	<b>0-10</b>	<b>10-20</b>	<b>20-30</b>	<b>30-40</b>	<b>40-50</b>	<b>50-60</b>
Frequency	5	3	4	3	3	4
Cumulative Frequency	5	8	12	15	18	22

**Solution:**

**Step 1:**  $n = 22$ , so  $n/2 = 11$

**Step 2:** Median class = 20-30 (cf = 12 is just greater than 11)

**Step 3:** Note values:

- $l = 20$
- $n/2 = 11$
- $cf = 8$
- $f = 4$
- $h = 10$

**Step 4:** Apply formula:

$$\begin{aligned}\text{Median} &= 20 + \left[ \frac{(11-8)}{4} \right] \times 10 \\ &= 20 + \left( \frac{3}{4} \right) \times 10 \\ &= 20 + 7.5 \\ &= \mathbf{27.5}\end{aligned}$$

## Common Mistakes to Avoid

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### Major Errors Students Make

1. **Class Mark Calculation:** Remember, Class mark = (Upper limit + Lower limit) / 2, NOT (Upper limit - Lower limit) / 2
2. **Modal Class Confusion:** Modal class is the one with HIGHEST frequency, not highest class interval
3. **Cumulative Frequency Error:** Don't forget to add previous frequencies. cf is CUMULATIVE (running total)
4. **Median Class Mistake:** Median class is where cf is JUST GREATER THAN  $n/2$ , not equal to  $n/2$
5. **Formula Confusion:** In mode formula, it's  $2f_1 - f_0 - f_2$  in denominator, not  $2f_1 + f_0 + f_2$
6. **Class Size (h):** Always calculate correctly.  $h = \text{Upper limit} - \text{Lower limit}$  of a class
7. **Assumed Mean Choice:** While 'a' can be any class mark, choosing the middle one simplifies calculations
8. **Sign Errors:** Be careful with negative signs when calculating deviations ( $d_i$ )
9. **Division Error:** In step-deviation method, don't forget to multiply by  $h$  after finding  $\Sigma f_i u_i / \Sigma f_i$
10. **Continuous Classes:** Ensure class intervals are continuous before finding mode/median

## Smart Tips & Tricks

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### Scoring Strategies

1. **Method Selection:** For mean, use Step-Deviation method in exams - it's fastest!
2. **Cross-Check:** Verify your answer using empirical relation:  $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$
3. **Table Format:** Always make a proper table with columns for  $x_i$ ,  $f_i$ ,  $d_i$ ,  $u_i$ , cf etc. Examiners love organized work!
4. **Formula Memory:** Mode and Median formulas look similar - remember Mode has THREE frequencies, Median has  $n/2$
5. **Practice Trick:** For mean, if  $\sum f_i d_i = 0$ , then mean = assumed mean (a)
6. **Median Shortcut:** If median class is obvious, directly start calculation without writing full cf table
7. **Class Mark Speed:** Add upper and lower limits mentally, then divide by 2 - saves time!
8. **Common Factor Check:** Before starting, check if  $d_i$  values have a common factor. If yes, use step-deviation!
9. **Interpretation:** Always write what the answer means in context (e.g., "Average marks obtained is 62")
10. **Unit Check:** Never forget to write units in your final answer

## Which Measure to Use When?

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### Use **MEAN** when:

- You want overall average
- All observations are important
- Comparing two distributions
- Example: Average exam scores

### Use **MEDIAN** when:

- Data has extreme values
- You want typical observation
- Finding middle value
- Example: Median salary in company

### Use **MODE** when:

- Finding most common value
- Determining popularity
- Most frequent observation
- Example: Most sold shoe size

### **Empirical Relationship (Important for Board Exams!)**

$$3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$$



This relationship helps verify your calculations! If your calculated values don't approximately satisfy this, recheck your work.

 **NCERT Exercise Questions**

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**Exercise 13.1 (Mean) - 9 Questions**

1. Plants in houses - Find mean number of plants (Direct method recommended)
2. Daily wages of 50 workers - Find mean daily wages
3. Daily pocket allowance - Find missing frequency when mean is given
4. Heartbeats per minute - Find mean heartbeats
5. Mangoes in packing boxes - Find mean number (Step-deviation method)
6. Daily expenditure on food - Find mean expenditure
7. Concentration of  $\text{SO}_2$  in air - Find mean concentration
8. Student absentee record - Find mean number of days absent
9. Literacy rate of cities - Find mean literacy rate

**Exercise 13.2 (Mode) - 6 Questions**

1. Ages of hospital patients - Find mode and mean, compare them
2. Lifetime of electrical components - Find modal lifetime
3. Monthly household expenditure - Find modal expenditure
4. Teacher-student ratio - Find mode and mean
5. Cricket runs scored by batsmen - Find mode
6. Cars passing through spot - Find mode

**Exercise 13.3 (Median) - 7 Questions**

1. Monthly electricity consumption - Find median, mean, mode and compare
2. Find missing frequencies when median is given
3. Life insurance policy holders - Calculate median age
4. Lengths of plant leaves - Find median length (continuous classes)
5. Lifetime of neon lamps - Find median lifetime
6. Number of letters in surnames - Find median, mean and modal size

7. Weights of students - Find median weight

## ⚡ Last Minute Revision Checklist

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### ✅ Must Remember Before Exam

1. ✓ **Three methods for Mean:** Direct, Assumed Mean, Step-Deviation
2. ✓ **Class Mark Formula:**  $(\text{Upper limit} + \text{Lower limit}) / 2$
3. ✓ **Mode Formula:**  $l + [(f_1 - f_0) / (2f_1 - f_0 - f_2)] \times h$
4. ✓ **Median Formula:**  $l + [(n/2 - cf) / f] \times h$
5. ✓ **Cumulative Frequency:** Running total of frequencies
6. ✓ **Modal Class:** Class with highest frequency
7. ✓ **Median Class:** Where cf just exceeds  $n/2$
8. ✓ **Empirical Relation:**  $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$
9. ✓ **Step-Deviation:**  $u_i = (x_i - a) / h$
10. ✓ **Table Making:** Always organize data in table format
11. ✓ **Units:** Write units in final answer
12. ✓ **Interpretation:** Explain what the answer means



## Expert Tips for Scoring Full Marks

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### Board Exam Strategy

1. **Step-by-Step:** Write all steps clearly. Even if answer is wrong, you get method marks
2. **Table Format:** Make neat tables with proper headings. Presentation matters!
3. **Formula First:** Always write the formula before substituting values
4. **Value Identification:** Clearly mention which values are  $l$ ,  $f$ ,  $cf$ ,  $h$  etc.
5. **Show Calculations:** Don't just write final answer. Show intermediate steps
6. **Use Brackets:** When substituting in formula, use brackets properly
7. **Box Final Answer:** Highlight your final answer in a box
8. **Write Conclusion:** "Therefore, the mean marks is 62" - write complete sentence
9. **Check Your Work:** Use empirical relation to verify:  $3 \text{ Median} \approx \text{Mode} + 2 \text{ Mean}$
10. **Time Management:** Statistics questions are formula-based. Practice to solve in 8-10 minutes
11. **Missing Frequency:** For such questions, set up equation carefully and solve step by step
12. **Continuous Classes:** If classes are discontinuous (10-20, 20-30), they're already continuous!
13. **Decimal Places:** Keep 2 decimal places in answer unless otherwise specified
14. **Common Errors:** Double-check signs, especially in assumed mean method

15. **Practice Variety:** Solve questions with all three methods to build confidence

## Complete Formula Sheet

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### MEAN ( $\bar{x}$ )

$$1. \text{ Direct Method: } \bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

$$2. \text{ Assumed Mean Method: } \bar{x} = a + \frac{\sum f_i d_i}{\sum f_i}$$

$$3. \text{ Step-Deviation Method: } \bar{x} = a + h \times \left( \frac{\sum f_i u_i}{\sum f_i} \right)$$

### MODE

$$\text{Mode} = l + \left[ \frac{(f_1 - f_0)}{(2f_1 - f_0 - f_2)} \right] \times h$$

### MEDIAN

$$\text{Median} = l + \left[ \frac{(n/2 - cf)}{f} \right] \times h$$

### OTHER IMPORTANT

$$\text{Class Mark } (x_i) = \frac{(\text{Upper limit} + \text{Lower limit})}{2}$$

$$\text{Class Size } (h) = \text{Upper limit} - \text{Lower limit}$$

$$\text{Deviation } (d_i) = x_i - a$$

Step Deviation ( $u_i$ ) =  $(x_i - a) / h$

Empirical Relation:  $3 \text{ Median} = \text{Mode} + 2$   
Mean

# Board Exam Marking Scheme

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## 1 Mark Question

### MCQ or Very Short

- Direct formula application
- Finding class mark
- Identifying modal class

## 2 Marks Question

### Short Answer

- Calculate mean (direct method)
- Find missing frequency
- Calculate mode/median

## 3 Marks Question

### Long Answer-I

- Mean (any method) with table
- Mode calculation
- Median calculation

## 4 Marks Question

### Long Answer-II

- Find all three measures
- Compare and interpret
- Verify using empirical relation

- **1 Mark:** Correct table formation / Identification of modal or median class
- **1 Mark:** Correct formula writing
- **1.5 Marks:** Correct substitution and calculation
- **0.5 Mark:** Final answer with unit and interpretation

## Chapter Summary

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### Key Takeaways

- **Statistics** deals with measures of central tendency for grouped data
- **Three Measures:** Mean (average), Mode (most frequent), Median (middle value)
- **Mean Methods:** Choose based on data - Direct, Assumed Mean, or Step-Deviation
- **Mode:** Found using modal class (highest frequency class)
- **Median:** Found using cumulative frequency and median class (where  $cf > n/2$ )
- **Cumulative Frequency:** Running total of all frequencies up to that class
- **Class Mark:** Mid-point of class =  $(\text{Upper} + \text{Lower limit}) / 2$
- **Applications:** Mean for overall average, Mode for most popular, Median for typical value
- **Verification:** Use  $3 \text{ Median} = \text{Mode} + 2 \text{ Mean}$  to check your work
- **Presentation:** Always make tables, show steps, and write units

## Final Words of Encouragement

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### You Can Score Full Marks!

Statistics is one of the **EASIEST chapters to score full marks** in CBSE Class 10 Maths! It's purely formula-based with no complex concepts. With proper practice of 15-20 questions, you can confidently solve any Statistics problem in the board exam within 8-10 minutes.

**Remember:** Even if you make a calculation error, you'll get method marks for correct approach. So, always write formulas, make tables, and show all steps clearly. Practice daily, and this chapter will become your scoring powerhouse! 

*"Statistics is not just about numbers; it's about making informed decisions. Master this chapter, and you'll use these concepts throughout your life!" *

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