MATHS WITHOUT GUESSWORK

Statistics

Understand the Data.
Choose the Method.
Solve Independently.

A guided problem-solving workbook

CBSE Class 10 Mathematics · Syllabus session 2026–27

12 35 27 8
41 19 23 30
16 44 28 33
5 21 38 25
…
raw data

→

Marks	Students f_i	Cumulative frequency (cf)
0 – 10	5	5
10 – 20	8	13
20 – 30	15	28
30 – 40	12	40
40 – 50	6	46
50 – 60	4	50
Total	**$\Sigma f_i = 50$**	

→ **mean** 28.6 **median** 28 **mode** 27

Recognise the method first. The calculation comes second.

Core topics: mean (direct, assumed mean, step-deviation) · median · mode of grouped data

Original explanations, examples and questions. Not a substitute for the NCERT textbook or your teacher.

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From raw data to a frequency table

PREREQUISITE

Learning objective: Turn a list of observations into a grouped frequency distribution, and read it correctly.

◆ UNDERSTAND

Statistics is about collecting, organising and interpreting data. **Raw data** is the list exactly as collected. A **frequency distribution** organises it: how many observations (the **frequency**) fall in each group (the **class interval**).

Raw data: marks of 30 students (out of 50).

12, 35, 27, 8, 41, 19, 23, 30, 16, 44, 28, 33, 5, 21, 38, 25, 14, 47, 29, 36, 22, 18, 31, 26, 9, 42, 24, 34, 17, 27

Marks	Tally	Frequency
0 − 10	|||	3
10 − 20	||||/ |	6
20 − 30	||||/ ||||/	10
30 − 40	||||/ ||	7
40 − 50	||||	4
Total		**30**

★ SPOT THE CLUE

Which class does 30 go in? In NCERT tables such as 20 − 30, 30 − 40, a value equal to an upper limit belongs to the **next** class. So 30 is counted in 30 − 40, not 20 − 30.

? WHY THIS STEP?

Why group the data? 30 separate marks are hard to read. Five classes show the shape at once: most students scored between 20 and 40. The price is that we no longer know each exact mark, so grouped-data methods *assume* the values in a class are centred at its middle (its class mark).

✓ CHECK BEFORE YOU CALCULATE

Check the total. The frequencies must add up to the number of observations: 3 + 6 + 10 + 7 + 4 = 30 ✓. If they do not, a value was missed or counted twice.

✓ CHECK YOURSELF

C1. Using the raw data above, regroup the marks into classes 0 − 25 and 25 − 50. Write the two frequencies and check that they add up to 30.

Concept 1: the direct method, step by step

CORE

Learning objective: Build the table, substitute, and check that the mean is sensible.

WORKED EXAMPLE **Find the mean marks of 40 students (table on page 12).**

1	Class marks: (0 + 10) ÷ 2 = 5, (10 + 20) ÷ 2 = 15, (20 + 30) ÷ 2 = 25, (30 + 40) ÷ 2 = 35, (40 + 50) ÷ 2 = 45	Represent each class by its centre.
2	Products: 3 × 5 = 15, 7 × 15 = 105, 12 × 25 = 300, 10 × 35 = 350, 8 × 45 = 360	Estimated total marks of each class.
3	$\Sigma f_i = 40$; $\Sigma f_i x_i = 15 + 105 + 300 + 350 + 360 = 1130$	Total observations; total marks.
4	$\bar{x} = \Sigma f_i x_i \div \Sigma f_i = 1130 \div 40 =$ **28.25**	Share the total equally.

≈ ESTIMATE AND CHECK

Is 28.25 sensible? It must lie between the smallest and largest class marks (5 and 45), and near the tallest classes (20 − 40 hold 22 of 40 students). ✓

✓ CHECK BEFORE YOU CALCULATE

Before dividing: (1) Σf_i equals the number of observations in the question. (2) Each class mark is exactly halfway. (3) Each product uses the frequency **from the same row**.

→ PREDICT THE NEXT STEP

You have finished the x_i column. What comes next, and what will you add up at the end? (The $f_i x_i$ column; then Σf_i and $\Sigma f_i x_i$.)

Daily wage (₹ in tens)	Workers f_i
10 − 20	4
20 − 30	6
30 − 40	10
40 − 50	12
50 − 60	8
Total	**$\Sigma f_i = 40$**

✎ YOUR TURN

T1. The table shows the daily wages (in tens of rupees) of 40 workers. Find the mean daily wage by the direct method. Show the x_i and $f_i x_i$ columns.

Concept 4: the median of grouped data

CORE

Learning objective: Locate the median class with cumulative frequency, and understand every symbol of the median formula.

Hold this question: *The median is the middle observation. In a grouped table, how do I know which class it is in?*

◆ UNDERSTAND

The median is the value with **half the observations below it**: the (n/2)-th observation. Cumulative frequency counts how many observations lie below each upper limit, so the first class whose cf passes n/2 must contain the median. This is the **median class**. NCERT: the class whose cumulative frequency is **greater than (and nearest to) n/2**.

Marks	Students f_i	Cumulative frequency (cf)	
0 – 10	4	4	
10 – 20	6	10	
20 – 30	10	20	◀ cf
30 – 40	**16**	**36**	◀ median class
40 – 50	8	44	
50 – 60	4	48	
60 – 70	2	50	
Total	**$\Sigma f_i = 50$**		

▶ WHICH CLASS SHOULD I CHOOSE?

n = 50, n/2 = 25. Running down the cf column: 4, 10, 20, 36. The first cf greater than 25 is **36**, so the median class is **30 – 40**. The class above it has cf = 20: that many observations come *before* the median class.

➤ THE MEDIAN FORMULA

$$\text{Median} = l + ((n/2 - cf) \div f) \times h$$

Symbol	Meaning	Where to find it	Here
l	lower limit of the median class	the orange row	**30**
n	total frequency	total of f column	**50**
cf	cumulative frequency of the class **before** the median class	the pale orange row	**20**
f	frequency of the median class	the orange row	**16**
h	class size	upper − lower limit	**10**

? WHY THIS STEP?

Why "n/2 − cf"? 20 observations are below the median class. We need 25 below the median, so we must go a further 5 observations into the class. The class holds f = 16 observations spread over h = 10 marks, so we move (5 ÷ 16) of the way across it.

Doubts 1 and 2: which measure? frequency or cf?

DOUBT 1 — *"How do I know whether to find the mean, the median or the mode?"*

✗ WHY THIS CONFUSION HAPPENS

All three are "averages" in everyday speech, and questions sometimes just say "find the average value".

◆ UNDERSTAND

Mean = the total shared equally. Median = the middle observation. Mode = the most common value. Decide from what the answer will be *used* for.

★ SPOT THE CLUE

"average, mean, per day" → mean · "middle, half, 50% below" → median · "most, most popular, modal, typical size sold" → mode.

➤ CHOOSE THE METHOD

Mean: $\Sigma f_i x_i \div \Sigma f_i$ (or a shortcut). Median: cf + formula. Mode: modal class + formula.

✎ SOLVED EXAMPLE

"A shop wants to stock the quantity it sells **most often**." → mode. Modal class 100 − 150: Mode = 100 + (22 − 14) ÷ (2 × 22 − 14 − 10) × 50 = 100 + 8/20 × 50 = **120**.

Units sold	Days f_i
0 − 50	8
50 − 100	14
100 − 150	22
150 − 200	10
200 − 250	6
Total	**$\Sigma f_i = 60$**

? WHY THIS STEP?

The shop does not care about total sales here, only about the most common day, so the mode answers its question.

⚠ COMMON TRAP

Finding the mean (118.33) because it is the "real average". It answers a different question.

✎ YOUR TURN DB1

Members' ages: classes 20 − 30, …, 60 − 70 with frequencies 6, 9, 15, 12, 8. (a) Which measure tells you "half the members are younger than ___"? (b) Find it.

✓ CHECK YOURSELF

Half below → median. Your answer must lie in the class where cf first passes n/2.

DOUBT 2 — *"What is the difference between frequency and cumulative frequency?"*

✗ WHY THIS CONFUSION HAPPENS

Both are counts in columns next to each other, and both are called "frequency".

◆ UNDERSTAND

Frequency counts the observations **in** one class. Cumulative frequency counts all observations **up to the end of** that class.

★ SPOT THE CLUE

"How many in 10 − 15?" → frequency. "How many less than 15?" → cumulative frequency.

➤ CHOOSE THE METHOD

Build cf by adding each frequency to the previous cf. The last cf must equal n.

✎ SOLVED EXAMPLE

Hours online: classes 0 − 5, …, 20 − 25 with frequencies 7, 11, 15, 9, 8. cf: 7, 18, 33, 42, 50. Students online less than 15 hours = **33**; in 10 − 15 alone = **15**.

? WHY THIS STEP?

The running total answers every "less than" question at once, which is exactly what the median needs.

⚠ COMMON TRAP

Writing the frequency again in the cf column, or forgetting the first row (cf of the first class = its own frequency).

✎ YOUR TURN DB2

Weights: classes 30 − 40, …, 70 − 80 with frequencies 5, 12, 18, 9, 6. Write the cf column. How many people weigh less than 60 kg? How many weigh 50 kg or more?

✓ CHECK YOURSELF

The last cf must be 50. "50 kg or more" = n − (cf less than 50).

Question clue → measure → table → formula → first step

Learning objective: Translate the words of a question into a measure, the columns to build, and a first step.

Question clue	Required measure	Table preparation	Formula	First step
"Find the mean / average ..."	**mean**	x_i, f_ix_i	$\Sigma f_i x_i \div \Sigma f_i$	class marks
"... by the assumed mean method"	**mean**	x_i, d_i, f_id_i	$a + \Sigma f_i d_i \div \Sigma f_i$	choose a central x_i
"... by the step-deviation method"	**mean**	x_i, u_i, f_iu_i	$a + h \times \Sigma f_i u_i \div \Sigma f_i$	check h divides every d_i
"The mean is 54; find the missing frequency"	**mean (reversed)**	x_i, f_ix_i with p	**equation in p**	write Σf and Σfx with p
"Find the median / middle value"	**median**	cf	$l + ((n/2 - cf) \div f) \times h$	n/2
"Half the ... are below what value?"	**median**	cf	**median formula**	n/2
"Less than 10: 3, less than 20: 11, ..."	**median (usually)**	recover f, then cf	**median formula**	subtract consecutive cf
"The median is 28 and n = 60; find x and y"	**median (reversed)**	cf with x, y	**median formula + Σf = n**	locate median class
"Find the mode / modal ..."	**mode**	none extra	$l + ((f_1 - f_0) \div (2f_1 - f_0 - f_2)) \times h$	find the highest f
"Most popular / most common ..."	**mode**	none extra	**mode formula**	find the highest f
"Classes 10 − 19, 20 − 29, ..."	**any**	class boundaries	**same formulas, l from boundaries**	subtract/add 0.5
"Find the mean, median and mode and compare"	**all three**	x_i, f_ix_i and cf	**three formulas**	n, then build all columns once

➤ WHY THIS FORMULA?

Read the table from left to right, never right to left. The formula is the result of the first three columns. Two rows can share a formula (median) and still need different first steps, because the table arrives in a different form.

✓ CHECK BEFORE YOU CALCULATE

Before calculating anything, write one line: "Measure: ___ · Columns: ___ · Method: ___ because ___." It takes 15 seconds and prevents most wrong-method answers.

Mistake clinic (1 of 3): reading the table

MISTAKE 1 · Class mark taken as the upper limit

✗ STUDENT'S WORK	*Mean of classes 10 − 20, ..., 40 − 50; frequencies 3, 5, 8, 4.* "x_i = 20, 30, 40, 50; $\bar{x}$ = 36.5"
⚠ WHY IT IS WRONG	The class mark is the midpoint. Upper limits push every value up by half a class.
✓ CORRECTED	x_i = 15, 25, 35, 45; $\bar{x}$ = 630 ÷ 20 = 31.5.
➤ QUICK RULE	x_i = (lower + upper) ÷ 2. Check: it is exactly halfway.
✎ FIX IT E1	Find the mean of classes 20 − 40, ..., 80 − 100; frequencies 4, 6, 7, 3.

MISTAKE 2 · Frequency used as the class mark

✗ STUDENT'S WORK	*Mean of a table.* "$\bar{x} = \Sigma f_i \times f_i \div \Sigma f_i$"
⚠ WHY IT IS WRONG	Frequencies say how many; class marks say how big. Multiplying frequency by itself has no meaning.
✓ CORRECTED	Build a separate x_i column from the class limits; then use $f_i x_i$.
➤ QUICK RULE	Headings: "how many" column (f) and "how big" column (x).
✎ FIX IT E2	Write the class marks of 0 − 8, 8 − 16, 16 − 24. What is the class width?

MISTAKE 3 · Dividing by the number of classes

✗ STUDENT'S WORK	*Mean of classes 0 − 10, ..., 40 − 50; frequencies 6, 9, 14, 8, 3.* "$\Sigma f_i x_i$ = 930; $\bar{x}$ = 930 ÷ 5 = 186"
⚠ WHY IT IS WRONG	The total must be shared among n = 40 observations, not 5 classes. 186 is outside the data.
✓ CORRECTED	$\bar{x}$ = 930 ÷ 40 = 23.25.
➤ QUICK RULE	Divide by Σf_i. Check the mean lies within the class marks.
✎ FIX IT E3	Find the mean of classes 0 − 5, ..., 20 − 25; frequencies 3, 7, 11, 6, 3.

MISTAKE 4 · Median class taken as the tallest class

✗ STUDENT'S WORK	*Median of classes 0 − 10, ..., 50 − 60; frequencies 14, 6, 9, 11, 7, 3.* "Median class = 0 − 10 (highest f)... median = 17.86"
⚠ WHY IT IS WRONG	n/2 = 25; cf: 14, 20, 29, 40, 47, 50. The first cf above 25 is in 20 − 30.
✓ CORRECTED	n = 50, n/2 = 25; median class 20 − 30; l = 20 cf = 20 f = 9 h = 10 Median = 20 + (25 − 20) ÷ 9 × 10 = 20 + 5.5556 = **25.56**
➤ QUICK RULE	Median class: first cf greater than n/2. Never by height.
✎ FIX IT E4	Find the median of classes 10 − 20, ..., 50 − 60; frequencies 14, 9, 7, 6, 4.

Practice 1: recognise

Learning objective: Read tables, recognise the measure and locate the right classes before calculating.

1 Recognise | 2 Apply | 3 Connect | 4 Board-style — *Little or no calculation. Answers: Section H.*

P1 The class mark of the class $15 - 25$ is:

(a) 15 (b) 20 (c) 25 (d) 10

Purpose: Class marks. **easy ★☆☆**

P2 A cumulative frequency column is needed to find the:

(a) mean (b) median (c) mode (d) class width

Purpose: Columns follow the measure. **easy ★☆☆**

P3 For the table, find (a) the total frequency (b) the class width (c) all class marks.

Purpose: Read a table. **easy ★☆☆**

Class interval	Frequency f_i
$0 - 10$	7
$10 - 20$	12
$20 - 30$	18
$30 - 40$	9
$40 - 50$	4
Total	**$\Sigma f_i = 50$**

Working space (use separate paper if needed)

P4 Complete the cumulative frequency column for this table. What must the last cf equal?

Purpose: Build cf. **easy ★☆☆**

Marks	Frequency f_i
$10 - 20$	5
$20 - 30$	8
$30 - 40$	12
$40 - 50$	9
$50 - 60$	6
Total	**$\Sigma f_i = 40$**

Working space (use separate paper if needed)

Revision sheet

Learning objective: Recall every prescribed method, its symbols and its first step, on one page.

Term	Meaning	Term	Meaning
class mark x_i	(lower + upper limit) ÷ 2	class size h	upper − lower limit
$n = \Sigma f_i$	total frequency	cumulative frequency	running total; last cf = n
median class	first class with cf > n/2	modal class	class with the highest frequency

Measure / method	Formula	Columns	First step
Mean, direct	$\bar{x} = \Sigma f_i x_i \div \Sigma f_i$	x_i, $f_i x_i$	class marks
Mean, assumed mean	$\bar{x} = a + \Sigma f_i d_i \div \Sigma f_i,\ d_i = x_i - a$	x_i, d_i, $f_i d_i$	choose a central x_i as a
Mean, step-deviation	$\bar{x} = a + h \times \Sigma f_i u_i \div \Sigma f_i,\ u_i = d_i \div h$	x_i, u_i, $f_i u_i$	check h divides every d_i
Median	$l + ((n/2 - cf) \div f) \times h$	cf	n/2, then the median class
Mode	$l + ((f_1 - f_0) \div (2f_1 - f_0 - f_2)) \times h$	none	highest f, then f_0 above, f_2 below

◆ RECOGNISE THE METHOD

Rushing says: "Use the formula I remember best."

1 · WHAT IS ASKED?	Average · middle · most common?
2 · WHICH MEASURE?	Mean · median · mode.
3 · WHICH COLUMNS?	x_i (and d_i/u_i) · cf · nothing extra.
4 · WHICH METHOD, WHY?	Direct if numbers are small; shortcut if class marks are large; median/mode by their formulas.

SO USE **Only then: build columns, list values, substitute.**

◆ CONVENTIONS

Table conventions. A value equal to an upper limit belongs to the next class. Inclusive classes (10 − 19, 20 − 29): use boundaries (9.5 − 19.5, ...) for l and h in median and mode. Cumulative tables: recover f by subtracting. Bimodal tables are avoided in the syllabus. 3 Median ≈ Mode + 2 Mean is an NCERT remark (empirical), not a required formula.

⚠ COMMON TRAP

Top mistakes: upper limit as class mark · dividing by number of classes · median class = tallest class · cf of the median class itself · l = upper limit · f_0/f_2 swapped · forgetting × h · lost minus signs · skipped cf row · early rounding · inclusive classes not converted.

✓ CHECK BEFORE YOU CALCULATE

Before every final answer: $\Sigma f_i = n$? last cf = n? mean between the smallest and largest class marks? median inside the median class? mode inside the modal class? two mean methods agree?

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