

5

TALES BY DOTS AND LINES

This chapter helps us understand how the mean behaves with data. We use dot plots to visualise and explore important ideas.

In this chapter

- Mean as the 'centre'
- Effect of including / removing values
- Unchanging Mean
- Relatively Unchanged Mean



Scan to learn more!

1. THE BALANCING ACT

Key Idea

The mean (average) is the 'centre' of a collection of data. It balances the data so that the total distance of values on the left equals the total distance of values on the right.

For 2 Numbers

Mean is exactly halfway between the two numbers.

Example:

$$(3, 7) \rightarrow \text{Mean} = \frac{3+7}{2} = 5$$

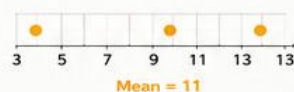
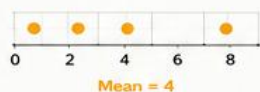
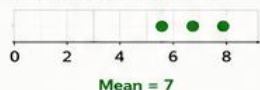


$$(8, 9) \rightarrow \text{Mean} = \frac{8+9}{2} = 8.5$$



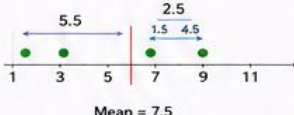
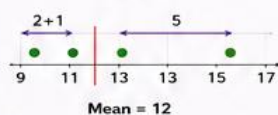
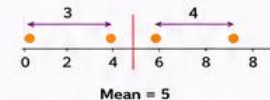
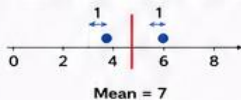
For 3 Numbers

Calculate and mark the mean.



Mean as Balance (Examples)

Sum of distances on LHS = Sum of distances on RHS



Unique Centre

If we move the centre away from the mean, the two sides are no longer balanced.

Collection: 10, 10, 11, 17 (Mean = 12)



Hence, the mean is the **only** centre.

3. UNCHANGING MEAN

- It is possible to include or remove values without changing the mean.
- Some possibilities:

Add one value = mean
(10 added to data with mean 10)

Remove one value = mean
(any one 10 removed)

Add two below & one above
(e.g., 8, 8 and 12)



Similarly: add two above & one below.
There are many such combinations!

2. EFFECT OF INCLUDING / REMOVING VALUES

Including a New Value

- If a new value greater than the mean is added, the mean increases.

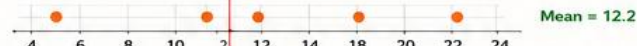


- If a new value smaller than the mean is added, the mean decreases.



Removing a Value

- Removing a value greater than the mean → mean decreases.

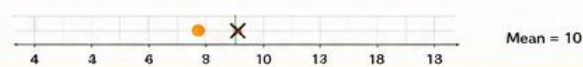
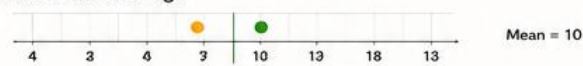


- Removing a value smaller than the mean → mean increases.



Adding / Removing a Value Equal to the Mean

- Mean does not change.



Fair-Share Interpretation

- Think of sharing equally (fairly) among all values.
- If one value is larger than the mean, others must share more to keep it fair.
- If one value is smaller, others share less.



IMPORTANT FORMULAS

- Mean: $\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}$
- When each value changes:
Add $k \rightarrow \text{Mean} = \bar{x} + k$
Subtract $k \rightarrow \text{Mean} = \bar{x} - k$
Multiply by $k \rightarrow \text{Mean} = k\bar{x}$

KEY TAKEAWAYS

- ✓ Mean is the centre that balances data.
- ✓ Adding values greater than the mean increases it; smaller values decrease it.
- ✓ Removing works in the opposite way.
- ✓ Adding/removing a value equal to the mean does not change it.
- ✓ Mean changes predictably when all values change together.



KEY DEFINITIONS

- **Mean (Average):** Sum of all values divided by the number of values.
- **Centre (Balance Point):** A value where the sum of distances of data on the left equals the sum on the right.
- **Dot Plot:** A way to display data using dots on a number line.



TALES BY DOTS AND LINES

WORKSHEET-1

Section A: MCQs (Part-1) ($10 \times 1 = 10$ marks)

1. Which of the following is a statistical question?

- (a) What is your roll number? (b) Who is the class monitor?
(c) How many hours do Grade VII students study daily? (d) What is the date today?

2. The formula for Arithmetic Mean is:

- (a) $\text{Sum} \div \text{Largest value}$ (b) $\text{Sum of all values} \div \text{Number of values}$
(c) $\text{Largest value} \div \text{Smallest value}$ (d) $\text{Middle value} \times 2$

3. The average of 18, 22, 20, 25 and 15 is:

- (a) 18 (b) 19 (c) 20 (d) 21

4. Mean and Median are called measures of:

- (a) Central tendency (b) Dispersion (c) Variation (d) Probability

5. In a Grade 5 class, boys' average height is 142.94 cm and girls' is 146.9 cm. This means:

- (a) Every girl is taller than every boy (b) Girls are taller than boys on average in this class
(c) Boys will never be taller (d) The data is incorrect

6. What does a dot plot help us observe?

- (a) Only the mean (b) Variability and patterns in data
(c) Only outliers (d) Only the maximum value

7. The median of the data 3, 5, 7, 8, 10, 12, 15 is:

- (a) 7 (b) 8 (c) 10 (d) 12

8. Which measure of central tendency is least affected by outliers?

- (a) Mean (b) Total (c) Median (d) Range

9. In a dot plot, repeated values are shown by:

- (a) Different colours (b) Dots stacked above the same value
(c) Bars (d) Lines

10. In a dot plot, repeated values are shown by:

- (a) Different colours (b) Dots stacked above the same value
(c) Bars (d) Lines

Section A- Part 2: MCQs (10 × 1 = 10 marks)

11. What does the mean represent in a dot plot visualization?

- a) The midpoint between the highest and lowest values
- b) The value with the highest frequency
- c) The middle-most value when sorted
- d) The "balance point" where the sum of distances on the left and right is equal

12. If a new value greater than the current mean is added to a dataset, the mean will:

- a) Decrease
- b) Increase
- c) Stay the same
- d) Become zero

13. Which change will not affect the mean of a data set?

- a) Adding a value greater than mean
- b) Adding a value equal to mean
- c) Removing a value smaller than mean
- d) Removing the largest value

14. A frequency table has total frequency 40. The median lies between:

- a) 20th and 21st values
- b) 19th and 20th values
- c) 20th value
- d) 21st value

15. Which graph is best to show change over time?

- a) Bar graph
- b) Pie chart
- c) Dot plot
- d) Line graph

16. In a spreadsheet, which cell reference would indicate the intersection of column D and row

5?

- a) 5D
- b) D5
- c) Cell-D
- d) D + 5

17. Which formula correctly calculates the average of values in cells B2 to B10?

- a) =SUM(B2:B10)
- b) =TOTAL(B2:B10)
- c) =AVERAGE(B2:B10)
- d) =MEAN(B2,B10)

18. If the mean of 10 values is 39.2, what is the sum of these values?

- a) 392
- b) 3.92
- c) 3920
- d) 39.20

19. A clustered-column graph is best suited for:

- a) Showing a single trend line
- b) Comparing two or more sets of data side-by-side
- c) Finding the balance point of a dataset
- d) Representing a 3D solid

20. In a line graph, which axis is typically used to represent time or independent categories?

- a) X-axis
- b) Y-axis
- c) Z-axis
- d) Origin

Section B: Short Answer ($10 \times 2 = 20$ marks)

1. Define a 'Dot Plot' visualization and write its one primary advantage.

2. A dataset contains the numbers 4, 7, 7, 8, 10, 12. Find the mean.

3. In Excel/Spreadsheets, what is the purpose of using a colon (:) in a range like A1:A50?

4. If a dataset has a mean of 15 and 5 is subtracted from each data point, what will be the new mean?

5. What type of dataset is best visualized using a dual line graph?

6. Find the median of the following observation points: 22, 11, 15, 19, 32, 25, 27.

7. How can you identify outliers quickly using a dot plot visualization?

8. Write down the spreadsheet formula to find the maximum value from cell C1 to C20.

9. If the total frequency of a data distribution is 25, which term represents the median position?

10. Explain what a trend line in a line graph signifies.

Section C: Short Answer ($6 \times 3 = 18$ marks)

11. The mean of 5 observations is 20. If one observation is excluded, their mean becomes 18. Find the value of the excluded observation.

12. Draw a sample dot plot representing the number of books read by 10 students in a month:
2, 2, 3, 3, 3, 4, 5, 5, 6, 8.

13. Describe how columns and rows are indexed in modern digital spreadsheet tools like Microsoft Excel or LibreOffice Calc.

14. A line graph shows temperature variations over 6 hours: (1 PM: 30°C, 2 PM: 32°C, 3 PM: 35°C, 4 PM: 33°C, 5 PM: 31°C, 6 PM: 28°C). Identify the peak hour and explain the trend.

15. Prove with an example that adding a constant value 'k' to all observations increases the mean by exactly 'k'.

16. Explain how a spreadsheet's automatic formula calculation saves time compared to manual multi-step statistical tracking.

Section D: Long Answer ($4 \times 5 = 20$ marks)

17. The daily pocket expenses of 8 students are: Rs 45, Rs 50, Rs 40, Rs 60, Rs 55, Rs 45, Rs 70, Rs 80. Calculate the mean and median, then construct a dot plot for this data.

18. Create a spreadsheet plan to track monthly electricity consumption. Explain the cell layout from columns A to D, formulas for total, average, and how you will generate a trend line graph.

19. Discuss the structural differences, benefits, and typical applications between a standard single Bar Graph, a Clustered Column Graph, and a Line Graph.

20. A data operator inputs a dataset of 50 items into a spreadsheet. The original mean was 100. Later, it was discovered that two entries were wrongly entered as 80 and 90 instead of 50 and 60. Find the correct mean up to two decimal places.

Case Study Based Questions ($2 \times 4 = 8$ marks)

21: (Dot Plot Analysis)

Context: A researcher is studying the test scores of a small remedial batch of students. They plot the scores out of 10 points on a dot plot to find the balance point. The dataset plotted consists of: 4, 5, 5, 6, 6, 6, 7, 7, 8, 10.

Questions:

1. Calculate the exact mathematical mean ("balance point") of the test scores.
2. Identify the value that has the highest frequency from this dataset.
3. If an extreme score of 0 is added to this batch, how will it change the balance point (mean)? Explain.

22: (Spreadsheet Modeling)

Context: An electronics retail shop tracks the daily sales of smartphones from Monday to Sunday in a spreadsheet. The cells from B2 to B8 contain the values:

12, 15, 14, 20, 22, 25, 32.

Questions:

Write down the exact cell reference text that represents Friday's sales data if Monday starts at cell B2.

1. Write the exact spreadsheet formula required to compute the total smartphone sales for the entire week.
2. Determine the median sales value among the seven days recorded.

Self Assessment:

I understood all the concepts:

☐ Yes

☐ No

I need more practice:

☐ Yes

☐ No

Name of Concepts having doubts/Not Cleared: _____

Parent's Assessment:

My ward understood all the concepts:

☐ Yes

☐ No

He/She need more practice:

☐ Yes

☐ No

Name of Concepts having doubts/Not Cleared: _____

Signature of Parent:

Teacher's Assessment

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Answers of Worksheet-1

Q.No.	1	2	3	4	5	6	7	8	9	10
Ans.	c	b	c	a	b	b	b	c	b	b
Q.No.	11	12	13	14	15	16	17	18	19	20
Ans.	d	b	b	a	d	b	c	a	b	a

Answers of Worksheet-2

Q.No.	1	2	3	4	5	6
Ans.	Graphic data using dots over values	8	Denotes continuous cell grid blocks	10	Comparing tracking parameters simult.	22
Q.No.	7	8	9	10	11	12
Ans.	Points far removed from the primary cluster	=MAX(C1:C20)	13th observation value	Indicates overall directional drift of numbers over time	28	Plot dots vertically above ticks 2,3,4,5,6,8.
Q.No.	13	14	15	16	17	18
Ans.	Columns via alphabets (A,B,C..), Rows via integers (1,2,3..)	Peak: 3 PM (35°C). Trend rises till 3 PM then cools down.	Mean is additive under linear translations	Instantly updates totals upon modifying raw inputs without manual re-calculation	53.125, 52.50	Column A: Month, B: Units, C: Cost. Cell D2: =B2*C2. Total: =SUM(D2:D13)
Q.No.	19	20	21	22		
Ans.	Bar for discrete counts, Column Clustered for side group variables, Line for chronological changes.	Correct Mean = 98.80	Mean = 6.4 Mode = 6 3. Decreases the balance point significantly	B6 =SUM(B2:B8) 3. Median = 20		

6

ALGEBRA PLAY

We use algebra to understand number tricks, create new tricks, and explore patterns in number pyramids.

In this chapter

- Algebra tricks & puzzles
- Thinking/about 'Think of a Number' tricks
- Number pyramids



Scan to learn more!

1. THE BALANCING ACT

Key Idea

The mean (average) is the 'centre' of the data. It balances the total distance of values on the left and right.

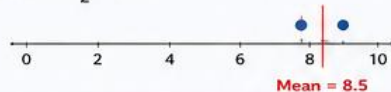
For 2 Numbers

Mean is exactly halfway between the two numbers.

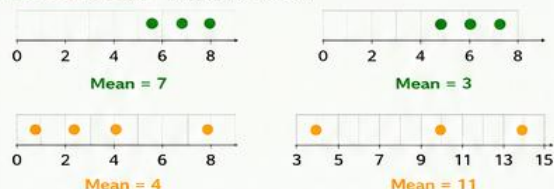
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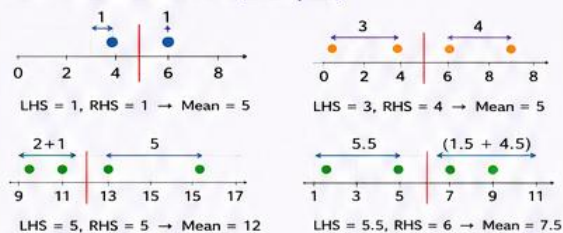
$$(8, 9) \rightarrow \text{Mean} = \frac{8+9}{2} = 8.5$$



For 3 Numbers – Mark the mean.

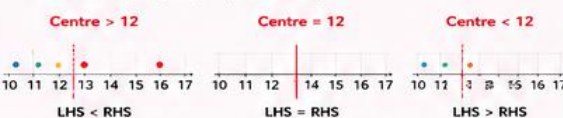


How Mean is the Centre (Examples)



Unique Centre

For the data 10, 10, 11, 17 (mean = 12)



Hence, the mean is the **only** centre.

4. HOW MEAN CHANGES

Add a value > mean	Mean increases.	
Add a value < mean	Mean decreases.	
Remove a value > mean	Mean decreases.	
Remove a value < mean	Mean increases.	
Add or remove value = mean	Mean does not change.	

Relatively Unchanged Mean

- If every value changes by the same amount:
- Add k to every value $\rightarrow$ Mean increases by k .
 - Subtract k from every value $\rightarrow$ Mean decreases by k .
 - Multiply every value by $k \rightarrow$ Mean becomes k times.
 - Divide every value by $k \rightarrow$ Mean becomes $\frac{1}{k}$ times.

Math Talk

2. THINKING ABOUT 'THINK OF A NUMBER' TRICKS

(A) Always 2 Trick

- Think of a number.
- Double it.
- Add four.
- Divide by two.
- Subtract the original number.

Algebraic Explanation

- x
- $2x$
- $2x + 4$
- $x + 2$
- $x + 2 - x = 2$

No matter what the starting number is, the result is always 2.

(B) Date Trick

- Think of a date (DD/MM).
- Multiply the month by 5.
- Add 6.
- Multiply by 4.
- Add 9.
- Multiply by 5.
- Add the day.

Algebraic Explanation

Let month = M , day = D

- $5M$
- $5M + 6$
- $20M + 24$
- $20M + 33$
- $100M + 165$
- $100M + 165 + D$

Final answer = $100M + 165 + D$

- Subtract 165 from final answer $\rightarrow 100M + D$
- Last two digits $\rightarrow D$ (day)
- Remaining digits $\rightarrow M$ (month)
- Example: $291 - 165 = 126 \rightarrow M = 1, D = 26 \rightarrow 26^{\text{th}}$ January

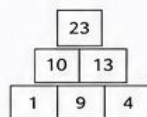
Explore & Create

- Try other dates and find the pattern.
- Change the steps (add, subtract, multiply etc.) to make new tricks.
- You can also aim for a fixed final answer like 3, 5, 10 and so on.

3. NUMBER PYRAMIDS

Rule: Each number is the sum of the two numbers directly below it.

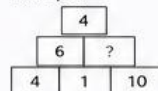
Example



How to Fill?

- To find a missing number, subtract the known number from the number above it.

Example:



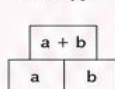
$$6 - 4 = 2$$

$$4 - 1 = 3$$

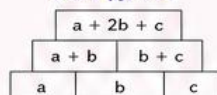
$\rightarrow$ Missing number = 3

General Pattern

2-row pyramid



3-row pyramid



Observation

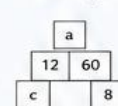
The top number = a weighted sum of the bottom row. (Middle numbers act as coefficients 1, 2, 1.)

Figure it Out

1. Fill the pyramids.



2. Given pyramid:



Equations:

$$a + 12 = 60$$

$$12 + c = a$$

$$c + 8 = 60$$

$\Rightarrow c = 52, a = 48$

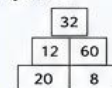
3. Without building, find top number for given bottom row.

Bottom row: 4, 13, 8, 7, 11 $\rightarrow$ Top = $4 + 3 \times 13 + 3 \times 8 + 3 \times 7 + 11 = 84$

Bottom row: 8, 19, 21, 13, 7, 18 $\rightarrow$ Top = $8 + 2 \times 19 + 2 \times 21 + 2 \times 13 + 2 \times 7 + 18 = 146$

(Coefficients: 1, 2, 2, ..., 2, 1)

Pyramid:



KEY DEFINITIONS

- Mean (Average):** Sum of all values divided by the number of values.
- Centre (Balance Point):** Value where the sum of distances on the left equals the sum on the right.
- Dot Plot:** Data shown as dots on a number line.
- Number Pyramid:** Each number is the sum of the two numbers below it.

IMPORTANT FORMULAS

- Mean: $\bar{x} = \frac{x_1 + x_2 + \dots + x_n}{n}$
- After adding k : New mean = $\bar{x} + k$
- After subtracting k : New mean = $\bar{x} - k$
- After multiplying by k : New mean = $k\bar{x}$
- After dividing by k : New mean = $\frac{\bar{x}}{k}$

KEY TAKEAWAYS

- ✓ The mean balances data.
- ✓ Including/removing values changes the mean predictably.
- ✓ Algebra helps us understand tricks and invent new ones.
- ✓ In number pyramids, the top number is a weighted sum of the bottom row.
- ✓ Patterns in numbers can be explored and explained systematically.