Class 9 Maths

How Quantities Combine: Understanding Data

Chapter 10

Ganita Manjari

Weighted Average

The **weighted average** of a set of values is the sum of the products of each value and its weight, divided by the sum of the weights.

Formula

$$\bar{x} = \frac{w_1x_1 + w_2x_2 + \cdots + w_nx_n}{w_1 + w_2 + \cdots + w_n}$$

where $x_1, x_2, \ldots, x_n$ are the values
$w_1, w_2, \ldots, w_n$ are the corresponding weights (positive numbers)

Key Points

1. Weights show the relative importance of each value.
2. The sum of the weights is taken in the denominator.
3. If all weights are equal, the weighted average is the same as the simple average.
4. Weighted average is useful when different items have different importance (e.g., marks, prices, etc.).

Example

A student has the following marks in three tests:

Test	Marks (x)	Weight (w)
Test 1	80	2
Test 2	70	3
Test 3	90	5

Find the weighted average of the marks.

Solution:

$$\bar{x} = \frac{2 \times 80 + 3 \times 70 + 5 \times 90}{2 + 3 + 5}$$

$$= \frac{160 + 210 + 450}{10} = \frac{820}{10} = 82$$

Therefore, the weighted average = 82.

Real-Life Uses

- Calculating final marks (with different test weights)
- Finding average price (with different quantities)
- Average age of a group (with different group sizes)
- Analysing data in surveys and statistics

Different weights, a fairer average!

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Combined Average

When two or more groups have different numbers of observations, their average is found using the combined average formula.

Formula

If a group of n_1 items has an average of $\bar{x}_1$, and another group of n_2 items has an average of $\bar{x}_2$, then the combined average ($\bar{x}$) is

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

For more than two groups:

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2 + n_3\bar{x}_3 + \cdots + n_k\bar{x}_k}{n_1 + n_2 + n_3 + \cdots + n_k}$$

Key Points

1. Used when different groups have different numbers of items (observations).
2. Multiply each group's average by the number of items in that group.
3. Add these products and divide by the total number of items.
4. It is a special case of the weighted average, where the weights are the number of items in each group.

Example

In a school, Class A has 25 students with an average score of 70 in a test, and Class B has 35 students with an average score of 80. Find the average score of all the students.

Solution:

Let $n_1 = 25,\ \bar{x}_1 = 70,\ n_2 = 35,\ \bar{x}_2 = 80$

$$\bar{x} = \frac{n_1\bar{x}_1 + n_2\bar{x}_2}{n_1 + n_2}$$

$$= \frac{25 \times 70 + 35 \times 80}{25 + 35} = \frac{1750 + 2800}{60}$$

$$= \frac{4550}{60} = 75.83$$

Therefore, the average score of all the students is 75.83.

Real-Life Uses

- Average marks of students from different classes
- Average age of people in different groups
- Average price when buying different quantities
- Combining data from different surveys or groups

Combine data, get the bigger picture!

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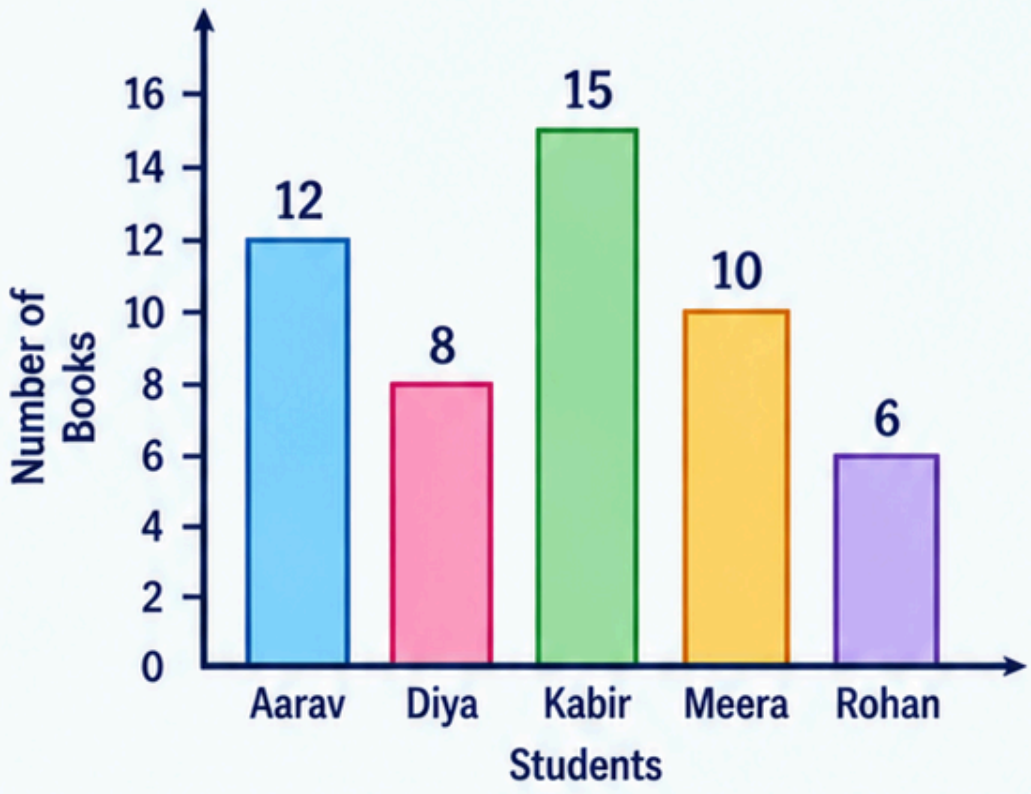
Simple Bar Chart

A bar chart (or bar graph) uses rectangular bars to represent data. The height (or length) of each bar shows the value of the quantity.

Example

The following bar chart shows the number of books read by five students in a month.



Key Points

1. Bars are of equal width and are equally spaced.
2. The height (or length) of each bar is proportional to the value it represents.
3. Gaps are left between the bars.
4. Both axes should be clearly labelled.
5. A suitable scale is chosen based on the data.
6. Bar charts help in comparing different categories easily.

Read and Interpret

1. Which student read the most books?
2. Which student read the least books?
3. How many more books did Kabir read than Meera?
4. Find the total number of books read by all the students.

Real-Life Uses

- Comparing marks of students
- Showing sales of different products
- Comparing population of cities
- Representing data from surveys

Data in bars, insights in seconds!

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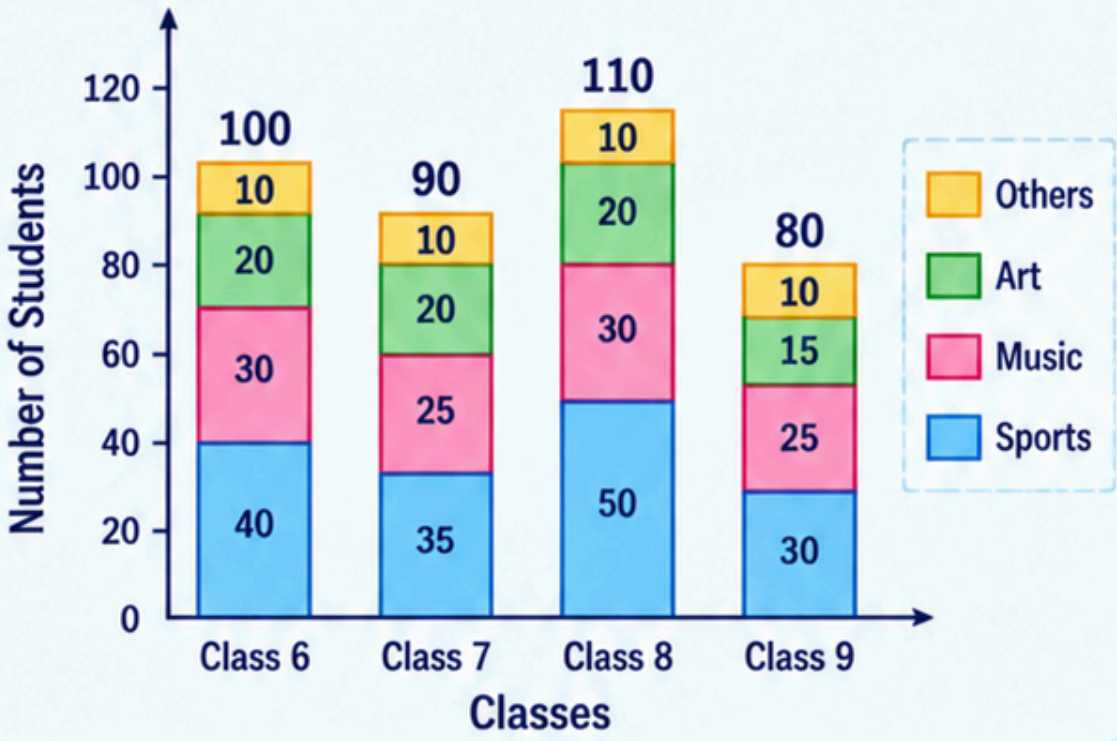
Stacked Bar Chart

A **stacked bar chart** shows the total quantity as a single bar, which is divided into parts to represent different categories.

Example

The following stacked bar chart shows the number of students in each activity in four classes of a school.



Key Points

1. Each bar represents the total for a category (e.g., a class).
2. Different coloured sections show different categories.
3. The height of each section shows the value for that category.
4. The total value is the sum of all the sections in a bar.
5. Stacked bar charts help us compare the composition of different groups.

Read and Interpret

1. Which class has the highest total number of students?
2. How many students in Class 8 are in Sports?
3. Which activity has the same number of students in all classes?
4. Find the total number of students in Class 7.
5. In which class is the difference between Sports and Music the greatest?

Real-Life Uses

- Comparing different categories in a school (e.g., activities, houses)
- Showing sales of different products
- Comparing the population composition of different places
- Analysing survey data

Different parts, a complete picture!

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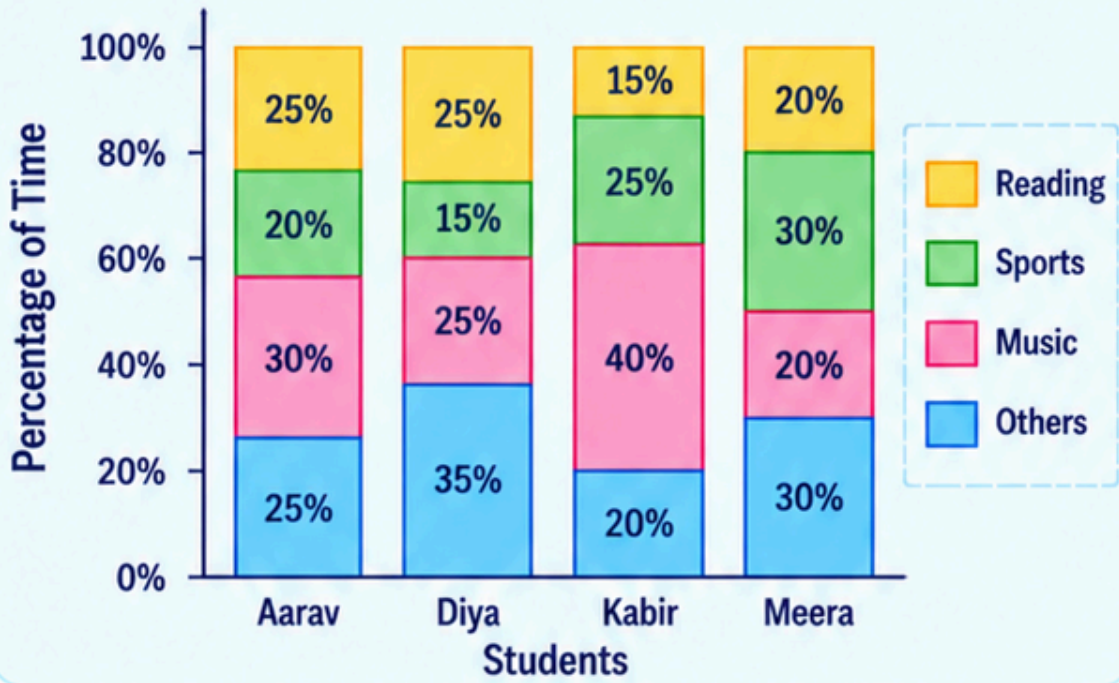
100% Stacked Bar Chart

A **100% stacked bar chart** shows the **composition or percentage** of each category. Each bar represents 100%, and is divided into parts to show how the whole is shared among different categories.

Example

The following 100% stacked bar chart shows the percentage of time spent on different activities by four students.



Key Points

1. Each bar represents 100%.
2. Shows the proportion or percentage of each category.
3. Useful for comparing composition across different groups.
4. The total height of each bar is the same.
5. Helps us see how a whole is divided into parts.

Read and Interpret

1. Which student spends the highest percentage of time on Music?
2. Which student spends the same percentage of time on Reading and Others?
3. What percentage of time does Kabir spend on Sports?
4. Which activity takes the smallest share of time for Diya?
5. How does Meera's time on Sports compare with Aarav's?

Real-Life Uses

- Comparing how people spend their time (e.g., study, play, rest)
- Showing the composition of populations (e.g., age groups)
- Comparing the percentage of sales in different product categories
- Understanding the composition of resources (e.g., land use, energy sources)

Same total, different parts!
Compare the bigger picture!

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Stacked vs 100% Stacked Bar Chart

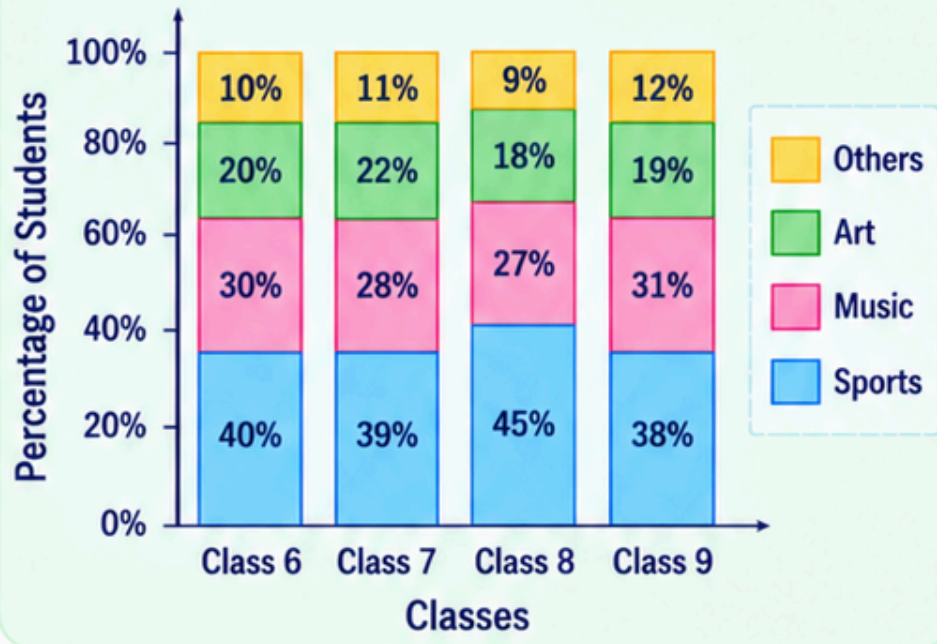
Both charts show the same data, but in different ways.
A stacked bar chart shows the **actual values**, while a 100% stacked bar chart shows the **percentage (composition)** of each category.

Stacked Bar Chart (Shows Actual Values)

The following stacked bar chart shows the number of students in each activity in four classes.

100% Stacked Bar Chart (Shows Percentage)

The following 100% stacked bar chart shows the percentage of students in each activity in four classes. Each bar represents 100%.



Key Differences

Feature	Stacked Bar Chart	100% Stacked Bar Chart
What it shows	Actual numbers (frequencies)	Percentage (composition) of each category
Total height of each bar	Different (depends on total value)	Same (always 100%)
Use	Compare total amounts and category values	Compare the proportion of categories
Best suited for	When total values are important	When we want to see the share/percentage of each category

When to Use Which?

Use a Stacked Bar Chict when:

- You want to compare actual numbers.
- Total amounts are important.
- Useful for comparing quantities across different groups (e.g., sales, population).

Use a 100% Stacked Bar Chart when:

- You want to compare the composition or percentage.
- All bars represent 100%.
- Useful for comparing the share of categories (e.g., time use, survey results).

Same data, different perspective!

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