📘 Class 9 Maths – Ganita Manjari

📊 Chapter 10: How Quantities Combine: Understanding Data

📝 End-of-Chapter Exercises – Questions & Solutions

---

1. 🏏 Run Rate in Cricket

Question:

In cricket, the run rate is the average number of runs scored per over. In a T20 match, a team scored 6 runs in the first over making the run rate 6.

(i) In the second over they scored 12 runs. What is the run rate now?

(ii) After Over 19, their run rate was 6. What is the run rate after 20 overs given the team made 12 runs in the last over?

Solution:

(i)

Total runs after 2 overs:

= 6 + 12

= 18 runs

Number of overs = 2

Run rate:

= 18 ÷ 2

= **9 runs per over**

✅ **Answer: 9 runs per over**

(ii)

After 19 overs, run rate = 6 runs per over.

Total runs after 19 overs:

= 6 × 19

= **114 runs**

Runs in the 20th over = 12

Total runs after 20 overs:

= 114 + 12

= **126 runs**

Run rate:

= 126 ÷ 20

= **6.3 runs per over**

✅ **Answer: 6.3 runs per over**

---

2. 🏸 Average Price of Shuttlecocks

Question:

Five friends who play badminton surveyed the city and collected the price of shuttlecocks across brands and types (Nylon and Feather). The following is the list of the prices, in rupees (₹), that each one compiled.

Yusuf: 400(N), 105(N), 383(F), 108(N), 165(F), 116(F)

Srikanth: 194(N), 85(N), 93(N), 121(N)

Kashvi: 49(N), 297(F), 105(N), 275(F), 40(N)

Prasanna: 124(N), 333(F), 182(N), 258(F)

Gracy: 220(F), 458(F), 129(F), 183(N)

Can you describe a way they can work together to find the average price of a shuttlecock across types?

(i) Each one calculated the average of the prices they had gathered. Suppose these are a_y, a□, a□, a□, a_g respectively. Write an expression that gives the combined average.

(ii) Suppose a□, a_f are the average prices of the nylon shuttlecocks and the feather shuttlecocks, respectively. Write an expression that gives the average price of a shuttlecock. Will this be equal to the answer we got using the method in the previous part?

Solution:

(i) Average of the five averages

Number of prices collected:

- Yusuf = 6
- Srikanth = 4
- Kashvi = 5
- Prasanna = 4
- Gracy = 4

Individual averages are:

Yusuf:

= (400 + 105 + 383 + 108 + 165 + 116) ÷ 6

= 1277 ÷ 6

= **212.83**

Srikanth:

= 493 ÷ 4

= **123.25**

Kashvi:

= 766 ÷ 5

= **153.20**

Prasanna:

= 897 ÷ 4

= **224.25**

Gracy:

= 990 ÷ 4

= **247.50**

Therefore, if these averages are a_{y}, $a_{\square}$, $a_{\square}$, $a_{\square}$ and a_{g}, the simple average of the five averages is:

$(a_{y} + a_{\square} + a_{\square} + a_{\square} + a_{g}) / 5$

However, this is **not the combined average of all the prices**, because the five friends collected different numbers of prices.

The actual combined average is:

= Total of all prices ÷ Total number of prices

= 4423 ÷ 23

≈ ₹192.30

✅ **Answer:**

Combined average = $(6a_{y} + 4a_{\square} + 5a_{\square} + 4a_{\square} + 4a_{g}) / 23$

(ii) Nylon and Feather Averages

Total nylon prices = 3 + 4 + 3 + 2 + 1 = **13**

Total feather prices = 3 + 0 + 2 + 2 + 3 = **10**

So the average price is:

$(13a_{\square} + 10a_{f}) / 23$

This is a **weighted average**, because there are 13 nylon prices and 10 feather prices.

It will **not generally be equal** to the simple average:

$(a_{\square} + a_{f}) / 2$

because the numbers of nylon and feather shuttlecocks are different.

---

3. 💰 Shares and Average Price

Question:

Shreyas holds 25 shares of a company at an average price of ₹150 and Vaishnavi holds 5 shares of the same company at an average price of ₹150.

(i) Shreyas buys 10 shares of this company at a price of ₹30 each. What is the average price per share for him after the purchase?

(ii) Vaishnavi buys some shares of this company at a price of ₹30 each and the average price per share for her after the purchase is ₹70. How many shares did she buy?

Solution:

(i) Shreyas

Initial value:

= 25 × ₹150

= ₹3750

Value of new shares:

= 10 × ₹30

= ₹300

Total value:

= ₹3750 + ₹300

= ₹4050

Total shares:

= 25 + 10

= 35

Average price:

= 4050 ÷ 35

= **₹115.71 approximately**

✅ **Answer: ₹115.71 per share approximately**

(ii) Vaishnavi

Let the number of new shares be **x**.

Initial value:

= 5 × 150

= ₹750

Value of new shares:

= 30x

Total shares:

= 5 + x

Given average = ₹70.

So,

(750 + 30x) / (5 + x) = 70

750 + 30x = 350 + 70x

400 = 40x

x = **10**

✅ **Answer: 10 shares**

---

4. 🏊 Mean Depth of a Pool

Question:

(Pr̥thūdaksvāmī, commentary on Brahmagupta's Brāhmasphuṭasiddhānta, c. 864 CE) A “hasta” (meaning “forearm”) refers to a unit of length measuring around 18 inches.

A pool 30 hastas long is dug to different depths along its length. It is divided into 5 sections having lengths 4, 5, 6, 7, and 8 hastas, and is dug to depths of 9, 7, 7, 3, and 2 hastas, respectively.

Find the mean depth of the pool.

Solution:

Since the sections have different lengths, we use a **weighted average**.

Mean depth:

= (4×9 + 5×7 + 6×7 + 7×3 + 8×2) / (4+5+6+7+8)

= (36 + 35 + 42 + 21 + 16) / 30

= 150 / 30

= **5 hastas**

✅ **Answer: 5 hastas**

---

5. 🪙 Gold Price

Question:

Suvarna had purchased 1g gold at ₹15k (short for ₹15,000). This is shown by point O to indicate the average price of gold that she possesses. Six different scenarios are given below for her next transaction. For each scenario estimate and mark the average price of gold she will have after the transaction.

(i) Purchase 1g gold at ₹30k
(ii) Purchase 2g gold at ₹30k
(iii) Purchase 1g gold at ₹10k
(iv) Purchase 10g gold at ₹10k
(v) Purchase 0.5g gold at ₹30k
(vi) Purchase 0.5g gold at ₹15k

Solution:

Initial holding:

- Quantity = 1 g

- Average price = ₹15,000/g

(i) Purchase 1g at ₹30,000

New average:

= (15,000 + 30,000) / 2

= **₹22,500/g**

(ii) Purchase 2g at ₹30,000

Total value:

= 15,000 + 60,000

= ₹75,000

Total quantity = 3g

Average:

= 75,000 ÷ 3

= **₹25,000/g**

(iii) Purchase 1g at ₹10,000

Average:

= (15,000 + 10,000) / 2

= **₹12,500/g**

(iv) Purchase 10g at ₹10,000

Total value:

= 15,000 + 100,000

= ₹115,000

Total quantity = 11g

Average:

= 115,000 ÷ 11

≈ ₹10,455/g

(v) Purchase 0.5g at ₹30,000

Value of new gold:

= 0.5 × 30,000

= ₹15,000

Total value = ₹30,000

Total quantity = 1.5g

Average:

= 30,000 ÷ 1.5

= **₹20,000/g**

(vi) Purchase 0.5g at ₹15,000

New gold value:

= 0.5 × 15,000

= ₹7,500

Total value:

= 15,000 + 7,500

= ₹22,500

Total quantity = 1.5g

Average:

= 22,500 ÷ 1.5

= **₹15,000/g**

Answer Summary

Scenario	New Average Price

(i)	₹22,500/g
(ii)	₹25,000/g
(iii)	₹12,500/g
(iv)	₹10,455/g approx.
(v)	₹20,000/g
(vi)	₹15,000/g

---

6. ⚖️ Doubling the Weights

Question:

Given some data with corresponding weights, how would the weighted average change if all the weights are doubled? If required, experiment with some data. What do you observe? Justify your answer using algebra.

Solution:

Let the data values be:

$x_1, x_2, x_3, \ldots, x_n$

and their weights be:

$w_1, w_2, w_3, \ldots, w_n$.

The weighted average is:

Weighted average = $(w_1x_1 + w_2x_2 + \ldots + w_nx_n) / (w_1 + w_2 + \ldots + w_n)$

If all weights are doubled:

Weighted average = $(2w_1x_1 + 2w_2x_2 + \ldots + 2w_nx_n) / (2w_1 + 2w_2 + \ldots + 2w_n)$

Taking 2 common from numerator and denominator:

$= 2(w_1x_1 + \ldots + w_nx_n) / 2(w_1 + \ldots + w_n)$

$= (w_1x_1 + \ldots + w_nx_n) / (w_1 + \ldots + w_n)$

Therefore, the weighted average **does not change**.

✅ **Answer: Doubling all the weights does not change the weighted average.**

---

7. 🛰️ Objects Orbiting Earth

Question:

Answer the following questions based on the graph.

(i) In 2003, approximately how many total objects were found orbiting Earth in space? In what year did this number double?

(ii) Find the approximate number and share of payload objects and other objects in the year 2025.

(iii) What can you say about the number of payload objects over time, and the number of other objects over time? What can you say about the share of payload objects over time, and the share of other objects over time?

Solution:

(i)

From the graph, the total number of objects orbiting Earth in **2003 was approximately 1,000**.

The number approximately doubled to around **2,000 in the mid-2000s, around 2006**.

✅ **Answer: Approximately 1,000 objects; it doubled around 2006.**

(ii)

From the 2025 bar, approximately:

- **Payload objects:** about **20,000**
- **Other objects:** about **10,000**
- **Total:** about **30,000**

Thus, approximately:

Payload share:

= 20,000 / 30,000 × 100

≈ 67%

Other objects share:

= 10,000 / 30,000 × 100

≈ 33%

✅ **Answer:** Approximately **20,000 payload objects (about 67%)** and **10,000 other objects (about 33%)**.

(iii)

From the graph:

- The number of **payload objects increases considerably over time**.
- The number of **other objects also increases over time**, especially in recent years.
- The **share of payload objects generally increases** over time.
- The **share of other objects generally decreases** as a proportion, although their actual number increases.

---

8. 🗺️ Schools Having a Playground

Question:

Observe the given infographic.

(i) Identify the correct inference(s) from the statements given.

(a) More schools have a playground in Haryana compared to Uttarakhand.

(b) Approximately every 2 out of 3 schools in Arunachal Pradesh have a playground.

(c) Punjab has the highest number of schools with a playground.

(d) Suppose it is given that Maharashtra has more schools than Telangana. Then the number of schools having a playground is more in Maharashtra.

Solution:

(a) ❌

The map gives **percentages**, not the total number of schools.

Therefore, we cannot conclude that Haryana has more schools with playgrounds than Uttarakhand.

(b) ✅

Arunachal Pradesh has approximately **67%** schools with playgrounds.

67% is approximately:

= 2/3

Therefore, this inference is reasonable.

(c) ❌

The map gives percentages, not the total number of schools.

Therefore, we cannot conclude that Punjab has the highest **number** of schools with playgrounds.

(d) ❌

Even if Maharashtra has more schools than Telangana, their percentages are different.

Therefore, simply knowing that Maharashtra has more schools is **not sufficient** to conclude that it has more schools with playgrounds.

✅ **Answer: Only statement (b) is a correct inference.**

(ii)

Can we find the nation-wide percentage of schools with a playground?

No, not from the given information alone.

We would need additional information such as:

- Total number of schools in each state, and
- Number of schools having playgrounds in each state.

Then we could calculate the national percentage.

---

9. 🎭 Decision Dilemma

Question:

(i) Which of the plays would you choose to watch based on the following chart?

The chart shows the **share of ratings of three plays**.

(ii) The corresponding stacked bar chart is shown below. Would you change your decision after looking at this chart? Why/Why not? Discuss.

Solution:

(i)

The first chart is a **100% stacked bar chart**.

It compares the **proportion of different ratings** for each play.

There is no single mathematically determined choice because the decision depends on what the viewer considers important—for example, the proportion of 5-star ratings or the combined proportion of high ratings.

The chart should therefore be used to **compare the rating distributions** of Plays A, B and C.

(ii)

Yes, the second chart provides additional information.

The first chart shows **proportions**, while the second stacked bar chart shows **actual numbers of ratings**.

Therefore, a play may have a high percentage of favourable ratings but fewer total ratings.

This illustrates an important point:

100% stacked bar charts show proportions but hide the actual totals.

The ordinary stacked bar chart shows both the **components and their totals**.

---

10. 🏊🚴🏃 Triathlon

Question:

A triathlon is an endurance race consisting of swimming 3.8 km, cycling 180 km, and running 42.2 km. Athletes compete for the fastest overall time, completing each segment in that order. The following table shows the finish time of 3 athletes in each segment.

	Swimming	Cycling	Running
Athlete 1	01:08	05:00	03:15
Athlete 2	01:05	05:10	03:35
Athlete 3	01:22	05:55	03:50

(i) What is a suitable representation of this data – a stacked bar chart or a 100% stacked bar chart? Why do you think so?

(ii) Suppose a 100% stacked bar chart is drawn. Which of the following question(s) can be answered by looking at just that chart?

(a) Who finished the race first?

(b) Approximately what fraction of their race time did Athlete 1 spend cycling?

(c) Which athlete took the longest for running?

Solution:

(i)

A **stacked bar chart** is more suitable.

The athletes are competing for the **fastest overall time**, so the actual total time is important.

A 100% stacked bar chart would show only the **proportion** of time spent in each segment and would hide the actual total time.

✅ **Answer: A stacked bar chart.**

(ii)(a) ❌

A 100% stacked bar chart does not show the actual total times.

Therefore, it cannot tell us who finished first.

Actual total times are:

Athlete 1:

1:08 + 5:00 + 3:15

= **9:23**

Athlete 2:

1:05 + 5:10 + 3:35

= **9:50**

Athlete 3:

1:22 + 5:55 + 3:50

= **11:07**

So Athlete 1 finished first, but this cannot be determined from the 100% stacked chart alone.

(ii)(b) ✅

Yes.

Athlete 1's cycling time = 5 hours = 300 minutes.

Total time = 9 hours 23 minutes = 563 minutes.

Fraction:

= 300/563

≈ **0.53**

So Athlete 1 spent approximately **53%** of the total race time cycling.

(ii)(c) ❌

A 100% stacked bar chart does not give the actual running times.

Therefore, it cannot determine which athlete took the longest for running.

From the table, Athlete 3 actually took the longest:

= **3 hours 50 minutes**

---

11. 📊 Distribution of Disabled Persons

Question:

Look at the following graph. What do you notice? What do you wonder? Write your inferences.

Solution:

This is an open-ended question based on the graph.

Possible observations:

- The distribution of different types of disabilities varies across age groups.
- The graph compares the shares of disabilities for different age groups.
- Each horizontal bar represents **100%**.
- Different types of disabilities occupy different proportions of each bar.
- The pattern of disability types is not identical across all age groups.

Possible questions:

- Why do the proportions differ between age groups?
- Which disability category has the largest share in each age group?
- How does the distribution change with age?

Possible inference:

The graph allows us to compare the **proportions** of different disability categories across age groups, but it does not show the actual number of persons in each group.

---

12. 👨‍👩‍👧 Individual Project

Question:

Do at least one of the following.

(i) Recall the previous day and fill in the approximate time spent lying down, sitting, and standing/moving around, etc. Ask at least 2 of your family members about their day and fill it in. Alternatively, you can choose to track just your own body-state for one of the weekdays and Saturday and Sunday. Visualise it using a stacked bar chart. Discuss with your class how you arrived at the estimated time spent in each state.

(ii) Visualise your family's monthly expenditure using a 100% stacked bar chart.

(a) First, identify the expense categories in your family budget.

(b) Discuss with your family members to decide how you will collect and organise the data.

(c) Collect expense data for at least 3 months.

(d) Represent the data in a 100% stacked bar chart, with each bar showing how the total monthly expenditure is divided across the different categories.

(e) Finally, write your observations and inferences based on the chart.

Solution:

This is an **individual project**, so there is no single fixed answer.

Students should collect their own data, prepare the appropriate chart and write observations based on their data.

---

13. ⭐ Small-Group Project

Question:

Make a group of 3–4 students. Choose one scenario to design a custom rating scheme by assigning appropriate weights:

(a) shopping experience at a cloth store,
(b) travel experience in a bus,
(c) tourism experience of a nearby tourist spot,
(d) clinic/hospital experience.

(i) Discuss and arrive at 4–6 aspects to rate. For each aspect chosen, justify why it matters for an overall experience.

(ii) Discuss and decide the relative weights and justify.

(iii) Collect or imagine ratings from at least 10 people on a scale of 1–5.

(iv) Compute each individual rating. Compute the overall average across individuals.

(v) Make a 100% stacked bar chart using your data.

(vi) Write a short note on the observations and inferences, what your rating system captures well and what it misses.

Solution:

This is a **small-group project**, so answers will depend on the scenario, aspects, weights and data selected by the group.

A possible structure is:

Aspect	Weight
Quality	3
Service	2
Cleanliness	2
Value for money	2
Overall experience	1

Then calculate the weighted average using:

Weighted Average = Σ(weight × rating) / Σweights

The group can then represent the ratings using a **100% stacked bar chart**.

---

14. 👨‍👩‍👧‍👦 Whole-Class Project

Question:

Each student shares the average age of their family and the number of family members. Discuss among the class and come up with a way to find out the average age of all the families of the class.

Solution:

The simple average of the students' family averages would not generally give the correct answer because families have different numbers of members.

Suppose family *i* has:

- average age = $\mathbf{a_i}$
- number of members = $\mathbf{n_i}$

Then the combined average age is:

Combined average = $(n_1a_1 + n_2a_2 + \ldots + n_na_n) / (n_1 + n_2 + \ldots + n_n)$

Therefore, the family averages must be combined using their **family sizes as weights**.

---

15. ⚖️ Increasing All Weights by a Constant

Question:

Given some data with corresponding weights, what would happen to the weighted average if all the weights are increased by a constant value, say 1? If required, experiment with some data. What do you observe? Justify your answer using algebra.

Solution:

Let the data values be:

$x_1, x_2, \ldots, x_n$

and their weights be:

$w_1, w_2, \ldots, w_n$.

Original weighted average:

$A = (\Sigma wx) / \Sigma w$

If every weight is increased by 1, the new weighted average becomes:

$A' = [\Sigma(w+1)x] / \Sigma(w+1)$

$= \mathbf{(\Sigma wx + \Sigma x) / (\Sigma w + n)}$

This is generally **not equal** to the original weighted average.

Therefore, unlike multiplying all weights by the same number, **adding the same constant to every weight can change the weighted average**.

✅ **Answer: The weighted average generally changes when 1 is added to every weight.**

---

16. 🐄🐑🐔 Changes in Animal Population Shares

Question:

A farm has some cows, sheep, and chickens. Last year the cows made up 60%, the sheep 25%, and the chickens 15%. There was a decrease in the number of all three animals' population over the year. Choose the possibilities for the change in their respective shares of the population—

(i) % of cows decreased, % of sheep decreased, % of chickens decreased

(ii) % of cows increased, % of sheep increased, % of chickens increased

(iii) % of cows remained the same, % of sheep remained the same, % of chickens remained the same

(iv) % of cows decreased, % of sheep increased, % of chickens remained the same

(v) % of cows increased, % of sheep increased, % of chickens decreased

Solution:

Remember that the three shares always add up to **100%**.

(i) ❌ Not possible

If all three shares decreased, their total would become less than 100%.

So this is not possible.

(ii) ❌ Not possible

If all three shares increased, their total would become more than 100%.

So this is not possible.

(iii) ✅ Possible

If all three populations decrease by the **same percentage**, their relative shares can remain unchanged.

For example, if all three populations decrease by 10%, their percentages remain:

- Cows = 60%
- Sheep = 25%
- Chickens = 15%

(iv) ✅ Possible

The cows' share can decrease, sheep's share can increase, and chickens' share can remain the same if the populations decrease by different percentages.

(v) ✅ Possible

The cows' and sheep's shares can increase while the chickens' share decreases if the chicken population decreases proportionally more than the other two.

✅ Answer

The possible choices are:

(iii), (iv) and (v).