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SOLUTIONS BOOK

CLASS 9

Mathematics · Ganita Manjari

CHAPTER 10

How Quantities Combine: Understanding Data

Complete Chapter Solutions

Examples & In-text Questions | Exercise Sets 10.1 – 10.5 | End-of-Chapter Exercises

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Every question, example and in-text prompt is followed by its answer. Question numbers above are clickable and the PDF bookmarks panel lets you jump to any exercise set or question.

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§10.1

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Combining Things

Examples & in-text questions · 10 items

Note: Worked solutions of the Examples and answers to the in-text questions and Think and Reflect prompts of Section 10.1, in the order in which they appear in the chapter.

EXAMPLE 1

In a badminton academy, there is a group of 11 trainees — 8 seniors and 3 juniors. Their heights and average heights (in cm) are given in the table below. Find the average height of the whole group.

	Heights (in cm)	Average Height (in cm)
Seniors	165, 169, 164, 167, 170, 159, 164, 166	165.5
Juniors	146, 149, 153	149.33

Two students calculate the average height of the whole group in two ways:

Method 1: (165.5 + 149.33) ÷ 2 = 314.83 ÷ 2 = 157.415

Method 2: (165 + 169 + 164 + 167 + 170 + 159 + 164 + 166 + 146 + 149 + 153) ÷ 11 = 1772 ÷ 11 = 161.09

Whose calculation gives the correct average height of the whole group?

ANSWER

1 Sum of the heights of each group

Seniors: 165 + 169 + 164 + 167 + 170 + 159 + 164 + 166 = 1324
Check: 1324 ÷ 8 = 165.5
Juniors: 146 + 149 + 153 = 448
Check: 448 ÷ 3 = 149.33

2 Average of the whole group

Sum of all 11 heights = 1324 + 448 = 1772
Average = 1772 ÷ 11 = 161.09 cm

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3 Which method is correct?

METHOD 2

The average of a group is (sum of all the values) ÷ (number of values). Method 2 does exactly this and gives 161.09 cm. Method 1 averages the two averages as if seniors and juniors counted equally; it gives 157.415 cm, which is not the average of the 11 heights. Shreyas's method, (165.5 × 8 + 149.33 × 3) ÷ (8 + 3) = (1324 + 448) ÷ 11 = 161.09, also gives the correct value.

Method 2 is correct: the average height of the whole group is 161.09 cm.

THINK AND REFLECT

Why did Method 1 not work?

ANSWER

Method 1 gives the average height of the seniors and the average height of the juniors the same importance, because each is simply divided by 2. But the group has 8 seniors and only 3 juniors, so the seniors' average should count for more. By treating two averages from groups of different sizes equally, Method 1 is pulled too far towards the juniors' average (157.415 instead of 161.09).

Method 1 ignores the different sizes of the two groups.

IN-TEXT QUESTION

Do you understand why Shreyas's method also works? Can you see why 165.5 × 8 gives the sum of the heights of all the seniors and 149.33 × 3 gives the sum of the heights of all the juniors?

ANSWER

1 Why average × number gives the sum

Average = (sum of the values) ÷ (number of values). Therefore sum of the values = average × number of values.

Seniors: sum = 165.5 × 8 = 1324
Juniors: sum = 149.33 × 3 ≈ 448

2 Why Shreyas's method works

Adding the two sums gives the sum of all 11 heights, and 8 + 3 = 11 is the number of heights. So (165.5 × 8 + 149.33 × 3) ÷ (8 + 3) is (sum of all heights) ÷ (number of heights), which is exactly Method 2. In general, for two collections with n and m values and averages a and b, the combined average is (an + bm) ÷ (n + m).

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Each average multiplied by the size of its group gives that group's sum, so the weighted calculation equals Method 2.

EXAMPLE 2

Jaspreet recently learnt cycling. She has explored different routes in her town. She tracked how much time she cycled on weekdays over the last 3 weeks. Find the mean time spent cycling per weekday over the last 3 weeks.

Table 10.1: Time spent cycling, in minutes, by Jaspreet

	Day 1	Day 2	Day 3	Day 4	Day 5	Weekly Average
Week 1	10	13	10	15	16	12.8
Week 2	14	10	20	17	18	15.8
Week 3	15	18	14	20	23	18

ANSWER

1 Weekly averages

Week 1: $(10 + 13 + 10 + 15 + 16) \div 5 = 64 \div 5 = 12.8$
Week 2: $(14 + 10 + 20 + 17 + 18) \div 5 = 79 \div 5 = 15.8$
Week 3: $(15 + 18 + 14 + 20 + 23) \div 5 = 90 \div 5 = 18$

2 Method 1: average of the weekly averages

$(12.8 + 15.8 + 18) \div 3 = 46.6 \div 3 \approx 15.53$

3 Method 2: weighted by the number of days

$(12.8 \times 5 + 15.8 \times 5 + 18 \times 5) \div (5 + 5 + 5)$
$= (64 + 79 + 90) \div 15 = 233 \div 15 \approx 15.53$

The mean time spent cycling per weekday is about 15.53 minutes (both methods agree).

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IN-TEXT QUESTION

Why does Method 1 give the correct answer in the cycling example (Example 2)? When does Method 1 work and when does it not work?

ANSWER

1 The general formula for three collections

Combined average = (a·p + b·q + c·r) ÷ (p + q + r)
a, b, c are the averages and p, q, r are the sizes of the three collections

2 Equal sizes: p = q = r

(a·p + b·p + c·p) ÷ (p + p + p) = (a + b + c)·p ÷ 3p = (a + b + c) ÷ 3

Jaspreet cycled on 5 days in each of the 3 weeks, so all three collections have the same size, 5. The sizes cancel, and the combined average equals the simple average of the three weekly averages. That is why Method 1 works here.

3 When does Method 1 work?

Method 1 (add the averages and divide by the number of collections) works when all the collections have the same size. When the sizes differ, as with 8 seniors and 3 juniors, it does not work in general and the weighted average must be used.

Method 1 works when the collections have equal sizes; otherwise use the weighted average.

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EXAMPLE 3

Two glasses of equal quantities of lemonade are prepared. One glass has 10% jaggery and the other has 20% jaggery. If we mix the lemonade from both glasses, what is the concentration of jaggery in the mixture?

ANSWER

1 Let y be the quantity of lemonade in each glass

Jaggery in glass 1 = 10% of y = 0.1y
Jaggery in glass 2 = 20% of y = 0.2y

2 **Concentration of the mixture**

$$(0.1y + 0.2y) \div (y + y) = 0.3y \div 2y = 0.15$$

The mixture has 15% jaggery, midway between 10% and 20%, because the quantities are equal.

EXAMPLE 4

A bowl of 500 mL lemonade has 10% jaggery. A glass of 200 mL lemonade has 20% jaggery. If we mix the lemonade from the bowl and the glass, what is the concentration of jaggery in the mixture?

Can you estimate what part of the mixture is jaggery? Is it 15%, or is it more or less? Why do you think so?

ANSWER

1 **Estimate first** **LESS THAN 15%**

The bowl holds more lemonade (500 mL) than the glass (200 mL), so the mixture will be closer to the bowl's 10% than to the glass's 20%. It will be less than 15%, which would be the midway value.

2 **Calculate**

Jaggery in the bowl = $500 \times 0.1 = 50$ mL
Jaggery in the glass = $200 \times 0.2 = 40$ mL
Concentration = $(50 + 40) \div (500 + 200) = 90 \div 700 \approx 0.1286 \approx 0.13$

The mixture is about 13% jaggery (less than 15%, as estimated).

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EXAMPLE 5

Brass is an alloy of copper and zinc. Batch A of brass weighs 200 kg of which 70% is copper. Batch B weighs 120 kg of which 50% is copper. Batch C is 45% copper. When all three batches are combined, we get an alloy that is 55% copper. What is the weight of Batch C?

ANSWER

1 Let y kg be the weight of Batch C

Copper in A = 200 × 0.7 = 140 kg
Copper in B = 120 × 0.5 = 60 kg
Copper in C = 0.45y kg

2 Form and solve the equation

$0.55 = (200 \times 0.7 + 120 \times 0.5 + 0.45y) \div (200 + 120 + y)$
$0.55(320 + y) = 200 + 0.45y$
$176 + 0.55y = 200 + 0.45y$
$0.10y = 24$, so $y = 240$

3 Check

Total weight = 200 + 120 + 240 = 560 kg
Copper = 140 + 60 + 0.45 × 240 = 140 + 60 + 108 = 308 kg
308 ÷ 560 = 0.55 = 55% ✓

Batch C weighs 240 kg.

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EXAMPLE 6

Rehmat's marks in Maths are as follows: 60% in internal tests, 64% in the project, 73% in the final exam. The annual percentage score is calculated by combining the internals, project, and final exam in the ratio 3 : 2 : 5. What is Rehmat's annual score in Maths?

ANSWER

1 **If all assessments had equal weightage**

$(60 + 64 + 73) \div 3 = 197 \div 3 \approx 65.7\%$

2 **With the ratio 3 : 2 : 5 as weights**

The data with these weights is equivalent to 60, 60, 60, 64, 64, 73, 73, 73, 73, 73, which is 10 values.

$(60 \times 3 + 64 \times 2 + 73 \times 5) \div (3 + 2 + 5)$
$= (180 + 128 + 365) \div 10 = 673 \div 10 = 67.3\%$

Rehmat's annual score in Maths is 67.3%.

EXAMPLE (HOTEL RATING)

Ratings of a hotel/eatery: one customer has given the rating shown in the picture. The weights assigned to food, service and ambience are 4 : 3 : 2 respectively. What is the customer's combined rating for the restaurant?



ANSWER

1 **Read the ratings**

Food = 5 stars, Service = 3 stars, Ambience = 4 stars
Weights: 4 : 3 : 2

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2 **Weighted mean**

$$(5 \times 4 + 3 \times 3 + 4 \times 2) \div (4 + 3 + 2) = (20 + 9 + 8) \div 9 = 37 \div 9 \approx 4.11$$

The customer’s rating for the restaurant is about 4.11.

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10.1

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Exercise Set 10.1

Solutions · 5 questions

QUESTION 1

The average score of students on a test in Section A is 72 and that of students in Section B is 76. What is the combined average of both the sections given that Section A has 30 students and Section B has 25 students?

ANSWER

1 **The sections have different sizes, so use the weighted average**

Combined average = (72 × 30 + 76 × 25) ÷ (30 + 25)
= (2160 + 1900) ÷ 55
= 4060 ÷ 55 ≈ 73.82

Section A has more students, so the combined average is closer to 72 than to 76. The simple average of 72 and 76, which is 74, would not be correct.

The combined average of both sections is about 73.82.

QUESTION 2

A farmer mixes three equal quantities of fertilisers. The first one contains 1/10 nitrogen, the second contains 9/50 nitrogen, and the third contains 3/60 nitrogen. What is the fraction of nitrogen in the mixture?

ANSWER

1 **Write the fractions with a common denominator**

3/60 = 1/20
1/10 = 10/100, 9/50 = 18/100, 1/20 = 5/100

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2 **Equal quantities, so take the simple average**

$$(10/100 + 18/100 + 5/100) \div 3 = (33/100) \div 3 = 11/100$$

The fraction of nitrogen in the mixture is 11/100 (that is, 11%).

QUESTION 3

(Śrīdharācārya, Pāṭīgaṇita, c. 750 CE) In ancient India, Varṇa was the measure of gold purity. A purity of 16 varṇa meant pure gold; in general, a purity of k varṇa meant that the gold-alloy was k/16 gold and the rest impurities. (Now the term used is karat; 16 Varna = 24 karat.)

Suppose a goldsmith melts together three pieces of gold: 9 units at 12 varṇa, 5 units at 10 varṇa, and 17 units at 11 varṇa. Find the purity in varṇa of the combined gold.

ANSWER

1 **Weighted average of the purities**

Total units = 9 + 5 + 17 = 31
Purity = (9 × 12 + 5 × 10 + 17 × 11) ÷ 31
= (108 + 50 + 187) ÷ 31 = 345 ÷ 31 ≈ 11.13 varṇa

In karat (16 varṇa = 24 karat): 11.13 × 24/16 ≈ 16.69 karat.

The purity of the combined gold is about 11.13 varṇa.

QUESTION 4

The average rainfall per day in the months of May, June, and July in a certain location are 3.5 mm, 10 mm and 8.7 mm respectively. Write an expression that gives their combined average.

ANSWER

1 **The months have different numbers of days**

May has 31 days, June has 30 days and July has 31 days. Each monthly average must be weighted by the number of days in that month.

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2 **Expression and value**

Combined average = (3.5 × 31 + 10 × 30 + 8.7 × 31) ÷ (31 + 30 + 31)
= (108.5 + 300 + 269.7) ÷ 92 = 678.2 ÷ 92 ≈ 7.37 mm per day

The combined average is (3.5 × 31 + 10 × 30 + 8.7 × 31) ÷ 92 ≈ 7.37 mm per day.

QUESTION 5

Calculate the concentration of spice mix in these two scenarios.

(i) A 100 mL kashayam/kadha with 5% spice mix, a 200 mL one with 10% spice mix, and a 300 mL one with 15% spice mix are combined.

(ii) A 300 mL kashayam/kadha with 5% spice mix, a 200 mL one with 10% spice mix, and a 100 mL one with 15% spice mix are mixed.

ANSWER

(i) **Combining 100 mL (5%), 200 mL (10%) and 300 mL (15%)**

Spice mix = 100 × 0.05 + 200 × 0.10 + 300 × 0.15 = 5 + 20 + 45 = 70 mL
Total volume = 100 + 200 + 300 = 600 mL
Concentration = 70 ÷ 600 ≈ 0.1167

(ii) **Combining 300 mL (5%), 200 mL (10%) and 100 mL (15%)**

Spice mix = 300 × 0.05 + 200 × 0.10 + 100 × 0.15 = 15 + 20 + 15 = 50 mL
Total volume = 300 + 200 + 100 = 600 mL
Concentration = 50 ÷ 600 ≈ 0.0833

(i) about 11.67% (ii) about 8.33%

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10.2

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

Exercise Set 10.2

Solutions · 1 questions

QUESTION 1

Savitri’s marks in Kashmiri are as follows: 35 out of 50 in internal tests, 44 out of 60 in the project, and 80 out of 100 in the final exam. The annual percentage score is calculated by combining the internals, project, and final exam in the ratio 3 : 4 : 5. Which of the following expression(s) gives her annual score (as a percentage) in Kashmiri?

(i) (35 × 3 + 44 × 4 + 80 × 5) ÷ (3 + 4 + 5)

(ii) ((35/100) × 3 + (44/100) × 4 + (80/100) × 5) ÷ (3 + 4 + 5)

(iii) [((35/50) × 3 + (44/60) × 4 + (80/100) × 5) ÷ (3 + 4 + 5)] × 100

(iv) ((35/50 × 100) × 3 + (44/60 × 100) × 4 + (80/100 × 100) × 5) ÷ (3 + 4 + 5)

ANSWER

1 Convert each mark to a percentage

Internals: 35 ÷ 50 × 100 = 70%
Project: 44 ÷ 60 × 100 ≈ 73.33%
Final exam: 80 ÷ 100 × 100 = 80%

2 Weighted mean with weights 3 : 4 : 5

(70 × 3 + 73.33 × 4 + 80 × 5) ÷ 12 = (210 + 293.33 + 400) ÷ 12 = 903.33 ÷ 12 ≈ 75.28%

3 Check each expression

(i) Uses the raw marks 35, 44, 80 — NOT CORRECT

The three marks are out of different totals (50, 60, 100), so they cannot be combined directly. Value: 681 ÷ 12 = 56.75, which is not her percentage.

(ii) Treats 35 and 44 as if they were out of 100 — NOT CORRECT

35 is out of 50 and 44 is out of 60, not out of 100. Value: 0.5675 (56.75%), which is incorrect.

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(iii) **Fractions of the full marks, weighted, then × 100** CORRECT

(35/50) × 3 = 2.1, (44/60) × 4 ≈ 2.9333, (80/100) × 5 = 4. Sum ≈ 9.0333; ÷ 12 ≈ 0.7528; × 100 ≈ 75.28%.

(iv) **Percentages (fraction × 100), weighted** CORRECT

(70 × 3 + 73.33 × 4 + 80 × 5) ÷ 12 ≈ 75.28%, the same value as in step 2.

Expressions (iii) and (iv) give her annual score, about 75.28%.

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10.3

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Exercise Set 10.3

Solutions · 8 questions

QUESTION 1

A stationery shop owner made ₹8000 selling books, of which 30% is the profit amount, and ₹1000 selling book covers, of which 50% is the profit amount. What is the percentage of profit on the total sales?

ANSWER

1 Profit from each item

Books: 30% of 8000 = ₹2400
Book covers: 50% of 1000 = ₹500

2 Overall percentage of profit

Total profit = 2400 + 500 = ₹2900
Total sales = 8000 + 1000 = ₹9000
Profit % = 2900 ÷ 9000 × 100 ≈ 32.22%

The percentage of profit on the total sales is about 32.22%.

QUESTION 2

A white stork’s migration is tracked. The average daily distance travelled, calculated over 20 days, is 44.5 km. On the 21st day, it flew 55 km. What is the average daily distance travelled over these 21 days? Make a guess before you calculate.

ANSWER

1 Guess JUST ABOVE 44.5 KM

The new day (55 km) is higher than the old average, so the average goes up. But it is only one day out of 21, so it should rise only slightly, to a little above 44.5 km.

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2 **Calculate**

Distance in 20 days = 44.5 × 20 = 890 km
Distance in 21 days = 890 + 55 = 945 km
Average = 945 ÷ 21 = 45 km

The average daily distance over the 21 days is 45 km, a small increase as guessed.

QUESTION 3

A 600 mL solution with 5% salt is mixed with a 300 mL solution with 8% sugar. What are the concentrations of salt and sugar in the mixture?

(i) Salt: 5%, Sugar: 8%

(ii) Salt: 13%, Sugar: 3%

(iii) Salt: 6%, Sugar: 6%

(iv) Salt: 5.55%, Sugar: 8.88%

(v) Salt: 3.33%, Sugar: 2.67%

(vi) Salt: 4.1%, Sugar: 7.08%

ANSWER

1 **Quantity of salt and sugar**

Salt = 5% of 600 mL = 30 mL (the sugar solution has no salt)
Sugar = 8% of 300 mL = 24 mL (the salt solution has no sugar)
Total volume of the mixture = 600 + 300 = 900 mL

2 **Concentrations in the mixture**

Salt = 30 ÷ 900 ≈ 0.0333 = 3.33%
Sugar = 24 ÷ 900 ≈ 0.0267 = 2.67%

Option (v) is correct: Salt 3.33%, Sugar 2.67%.

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QUESTION 4

At a panipuri (golgappa) stall, the concentration of spice in the pani (spiced water) was 8%. Many customers complained that it was too spicy. What quantity of regular water should be mixed into the 10 litres of pani so that the spice level is reduced to (3/4)th of the original concentration?

ANSWER

1 Target concentration and spice quantity

New concentration = 3/4 × 8% = 6%
Spice in 10 L of pani = 8% of 10 = 0.8 L

2 Let x litres of water be added (water has 0% spice)

0.8 ÷ (10 + x) = 0.06
10 + x = 0.8 ÷ 0.06 = 13.33...
x = 3.33... = 10/3 litres

3 Check

0.8 ÷ (10 + 10/3) = 0.8 ÷ (40/3) = 0.06 = 6% ✓

About 3.33 litres (10/3 L) of regular water should be mixed in.

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QUESTION 5

A physical fitness evaluation is being undertaken. The final marks are calculated by combining the marks for strength, flexibility, and agility in the ratio 4 : 5 : 6. Rashi has scored 60, 65, and 70. Keerthi has scored 55, 65, and 75 respectively.

(i) Find out whose total is more without calculating.

(ii) What are their final marks?

ANSWER

(i) Compare without calculating KEERTHI

Flexibility marks are equal (65 each). Rashi scores 5 more in strength (weight 4); Keerthi scores 5 more in agility (weight 6). Agility has the larger weight, so Keerthi's gain (5 × 6 = 30) is greater than Rashi's gain (5 × 4 = 20). Keerthi's weighted total is more.

(ii) **Final marks (weighted mean)**

Rashi = (60 × 4 + 65 × 5 + 70 × 6) ÷ 15 = (240 + 325 + 420) ÷ 15 = 985 ÷ 15 ≈ 65.67
Keerthi = (55 × 4 + 65 × 5 + 75 × 6) ÷ 15 = (220 + 325 + 450) ÷ 15 = 995 ÷ 15 ≈ 66.33

Rashi: about 65.67; Keerthi: about 66.33. Keerthi's total is more.

QUESTION 6

A restaurant collected ratings from 10 customers on a scale of 1 to 5. The resulting data is shown in the table below.

	5★	4★	3★	2★	1★
Food	5	3	2	0	0
Ambience	0	4	5	1	0
Service	1	2	2	4	1

What is the average rating if the metrics are combined with the weights food : ambience : service = 6 : 5 : 4?

ANSWER

1 **Average rating of each metric (10 customers each)**

Food = (5×5 + 4×3 + 3×2) ÷ 10 = (25 + 12 + 6) ÷ 10 = 4.3
Ambience = (4×4 + 3×5 + 2×1) ÷ 10 = (16 + 15 + 2) ÷ 10 = 3.3
Service = (5×1 + 4×2 + 3×2 + 2×4 + 1×1) ÷ 10 = (5 + 8 + 6 + 8 + 1) ÷ 10 = 2.8

2 **Combine with the weights 6 : 5 : 4**

(4.3 × 6 + 3.3 × 5 + 2.8 × 4) ÷ (6 + 5 + 4)
= (25.8 + 16.5 + 11.2) ÷ 15 = 53.5 ÷ 15 ≈ 3.57

The average rating is about 3.57 out of 5.

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QUESTION 7

The following table shows the weight data of langurs in an animal facility. Without doing any computations, can you tell whether there are more male langurs or more female langurs? Or are they equal in number?

	Male langurs	Female langurs	All langurs
Average weight	16.5 kg	13.8 kg	14.925 kg
Number of langurs			60

(i) Which of the following expression(s) describes the given scenario?

(a) (16.5x + 13.8y) ÷ (x + y) = 14.925

(b) (16.5x + 13.8y) ÷ 60 = – 14.925

(c) (16.5x + 13.8y) ÷ 2 = – 14.925

(d) (16.5x + 13.8y) ÷ (16.5 + 13.8) = – 14.925

(ii) Find out how many male langurs are present.

(iii) A female langur weighing 15.2 kg is admitted to the facility. What is the average weight of the female langurs after this?

(iv) Two male langurs weighing 16.9 kg and 16.1 kg are released from the facility. What is the average weight of the male langurs after this?

(v) Now, suppose one of the male langurs lost 1 kg of weight. What is the average weight of all the male langurs after this?

ANSWER

1 Without computing: more male or more female langurs? MORE FEMALES

The overall average (14.925 kg) is a weighted mean of 16.5 and 13.8. It lies closer to the female average (distance 14.925 − 13.8 = 1.125) than to the male average (distance 16.5 − 14.925 = 1.575). A weighted mean lies closer to the value with the larger weight, so there are more female langurs than male langurs.

(i) Which expression describes the scenario? (a)

Let x = number of male langurs and y = number of female langurs. Total weight = 16.5x + 13.8y and total number = x + y, so (16.5x + 13.8y) ÷ (x + y) = 14.925, which is (a). The right-hand sides of (b), (c) and (d) are printed as –14.925, a negative number, whereas the left-hand sides are positive; also (c) divides by 2 and (d) by 16.5 + 13.8, which are not the number of langurs. (Expression (b) divides by 60 = x + y, so it would agree with (a) if its right-hand side were +14.925.)

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(ii) Number of male langurs 25

$x + y = 60$, so $y = 60 - x$
$16.5x + 13.8(60 - x) = 14.925 \times 60$
$16.5x + 828 - 13.8x = 895.5$
$2.7x = 67.5$, so $x = 25$ (and $y = 35$)

Check: the distances $1.125 : 1.575 = 5 : 7$, so male : female $= 5 : 7 = 25 : 35$ ✓

(iii) Female langurs after a 15.2 kg female is admitted

Total weight of 35 females $= 13.8 \times 35 = 483$ kg
New average $= (483 + 15.2) \div 36 = 498.2 \div 36 \approx 13.84$ kg

(iv) Male langurs after two are released

Total weight of 25 males $= 16.5 \times 25 = 412.5$ kg
Weight released $= 16.9 + 16.1 = 33$ kg (their average is 16.5)
New average $= (412.5 - 33) \div 23 = 379.5 \div 23 = 16.5$ kg

The average does not change because the two langurs released have an average weight of exactly 16.5 kg.

(v) One of the male langurs loses 1 kg

Total weight of the 23 males $= 379.5 - 1 = 378.5$ kg
New average $= 378.5 \div 23 \approx 16.46$ kg

(Starting from the original 25 males the result is the same to two decimals: $411.5 \div 25 = 16.46$ kg.)

(ii) 25 male langurs; (iii) ≈ 13.84 kg; (iv) 16.5 kg; (v) ≈ 16.46 kg.

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QUESTION 8

Dorjee has collected 1 litre of water from the Dead Sea! Using the information in the table, answer the following questions. A calculator can be used if necessary.

Water Source	Salinity
Dead Sea	≈ 34%
Other seas and oceans	≈ 3.5%
Ground water	≈ 0.01%
Purified drinking water	≈ 0.001%

(i) What is the salinity of the mixture if he mixes 1 litre of water from the Dead Sea with 2 litres of purified drinking water?

(ii) Is it possible to mix water from the Dead Sea and purified drinking water to get a mixture with the salinity of groundwater? Why/Why not? What quantity of purified drinking water should Dorjee mix with 1 litre of water from the Dead Sea to get a mixture having the salinity of groundwater?

(iii) Is it possible to mix water from the Dead Sea and groundwater to get a mixture with the salinity of purified drinking water? Why/Why not? What quantity of groundwater should he mix with 1 litre of water from the Dead Sea to get a mixture having the salinity of purified drinking water?

ANSWER

(i) 1 L Dead Sea + 2 L purified drinking water

Salt = 34% of 1 L + 0.001% of 2 L = 0.34 + 0.00002 = 0.34002 L
Salinity = 0.34002 ÷ 3 ≈ 0.1133 = 11.33%
(equivalently, (34 × 1 + 0.001 × 2) ÷ 3 = 34.002 ÷ 3 ≈ 11.33%)

(ii) Dead Sea + purified water to get groundwater salinity POSSIBLE

Possible. The salinity of groundwater (0.01%) lies between that of purified drinking water (0.001%) and the Dead Sea (34%). A mixture's salinity always lies between the salinities of the things mixed, so a suitable amount of purified water gives 0.01%.

Let x litres of purified water be added to 1 litre of Dead Sea water.
(34 × 1 + 0.001 × x) ÷ (1 + x) = 0.01
34 + 0.001x = 0.01 + 0.01x
33.99 = 0.009x, so x ≈ 3776.67 litres

Check: (34 + 0.001 × 3776.67) ÷ 3777.67 ≈ 37.7767 ÷ 3777.67 = 0.01 ✓

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(iii) **Dead Sea + groundwater to get purified-water salinity** NOT POSSIBLE

Not possible. The salinity of purified drinking water (0.001%) is lower than that of both the Dead Sea (34%) and groundwater (0.01%). The salinity of a mixture lies between 0.01% and 34%, so it can never be as low as 0.001%. Solving $(34 \times 1 + 0.01 \times x) \div (1 + x) = 0.001$ gives $33.999 = -0.009x$, i.e. a negative quantity $x \approx -3777.67$ L, which is meaningless.

(i) ≈ 11.33%; (ii) possible, about 3776.67 L of purified water; (iii) not possible.

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§10.2.1

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

Stacking Columns

In-text questions on Table 10.2 · 2 items

Note: Answers to the in-text questions of Section 10.2.1, based on Table 10.2 (average weekly expenditure of three families, in ₹).

IN-TEXT QUESTIONS 1–8

Table 10.2 shows the average weekly expenditure, in rupees (₹), of three families across categories. Fig. 10.1 shows two cluster-column graphs: Choice 1 (clusters are categories) and Choice 2 (clusters are families). Answer each question by looking at Choice 1 first, and then Choice 2. Which was easier?

	Housing	Food	Education	Transportation	Healthcare	Recreation
Family A	1940	1700	1280	1200	1770	535
Family B	1750	1546	1500	1280	1210	0
Family C	950	1700	1540	1400	1300	150

1. **Which family spent the least on housing?**
2. **Which family spent the most on healthcare?**
3. **Approximately how much did Family A spend on education?**
4. **Which category did Family B spend most on?**
5. **Did Family A spend more on food or on healthcare?**
6. **Which family spent the least amount overall?**
7. **Approximately how much did Family C spend overall?**
8. **Approximately what percentage of Family C's expenses were on housing?**

ANSWER

1 Which family spent the least on housing? — FAMILY C

Housing: A = ₹1940, B = ₹1750, C = ₹950. Family C spent the least. (Choice 1, which puts the three families side by side for each category, makes this easy to see.)

2 Which family spent the most on healthcare? — FAMILY A

Healthcare: A = ₹1770, B = ₹1210, C = ₹1300. Family A spent the most (again easy from Choice 1).

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3 **Approximately how much did Family A spend on education?** ≈ ₹1300

Family A spent ₹1280, i.e. about ₹1300 per week. This is equally easy in both charts.

4 **Which category did Family B spend most on?** HOUSING

Family B: Housing 1750, Food 1546, Education 1500, Transportation 1280, Healthcare 1210, Recreation 0. The largest value is Housing (₹1750). Choice 2, which groups the bars by family, makes this easier.

5 **Did Family A spend more on food or on healthcare?** HEALTHCARE

Food = ₹1700 and healthcare = ₹1770, so Family A spent ₹70 more on healthcare than on food (easy from Choice 2).

6 **Which family spent the least amount overall?** FAMILY C

Family A: 1940 + 1700 + 1280 + 1200 + 1770 + 535 = ₹8425
Family B: 1750 + 1546 + 1500 + 1280 + 1210 + 0 = ₹7286
Family C: 950 + 1700 + 1540 + 1400 + 1300 + 150 = ₹7040

7 **Approximately how much did Family C spend overall?** ≈ ₹7000

From the total above, Family C spent ₹7040 per week, i.e. about ₹7000.

8 **What percentage of Family C's expenses were on housing?** ≈ 13.5%

950 ÷ 7040 × 100 ≈ 13.5%

Choice 1 is easier for Questions 1–2, Choice 2 for Questions 4–5, and Question 3 is similar in both. Questions 6–8 need totals, which neither cluster chart shows directly.

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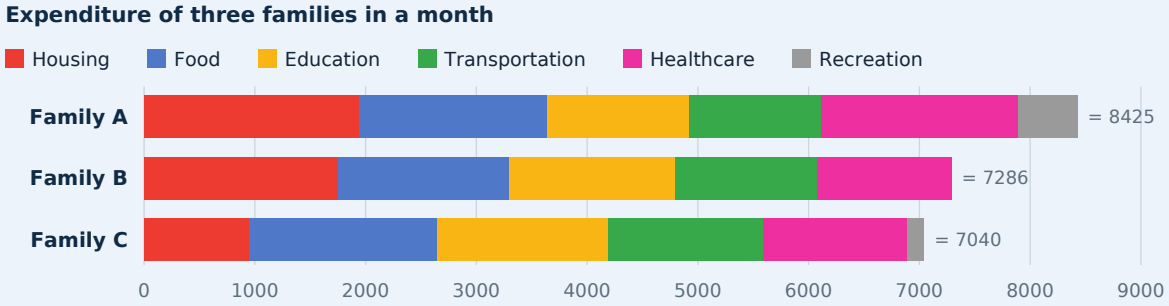
IN-TEXT QUESTIONS

Was it as straightforward to answer Questions 6–8 as the earlier questions? Is there a visualisation that makes it simpler to answer such questions? Look at the stacked bar chart (Fig. 10.2) of the same data, understand how it is organised and answer Questions 6–8. Then use it to answer Questions 1–5. Is it possible? Is it easy? If not, what made it harder than before?



ANSWER

1 Questions 6–8 from the stacked bar chart

The total length of each stacked bar is the family's total expenditure. The shortest bar is Family C's (it ends at about 7000), so Family C spent the least overall, about ₹7000 (exactly ₹7040). The housing segment of Family C runs from 0 to about 950, which is roughly 13–14% of its whole bar (950 ÷ 7040 ≈ 13.5%). So Questions 6–8 are much easier here.

2 Questions 1–5 from the stacked bar chart

It is possible, but harder. Except for the first (housing) segment, the other segments do not begin at 0, so a segment's value has to be found by subtracting its starting point from its end point. Also, the segments of different bars do not have a common base line, so comparing bars within a cluster and across clusters is harder.

> **A stacked bar chart shows the totals and the parts that make them up, but individual components are harder to compare.**

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10.4

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

Exercise Set 10.4

Solutions · 2 questions

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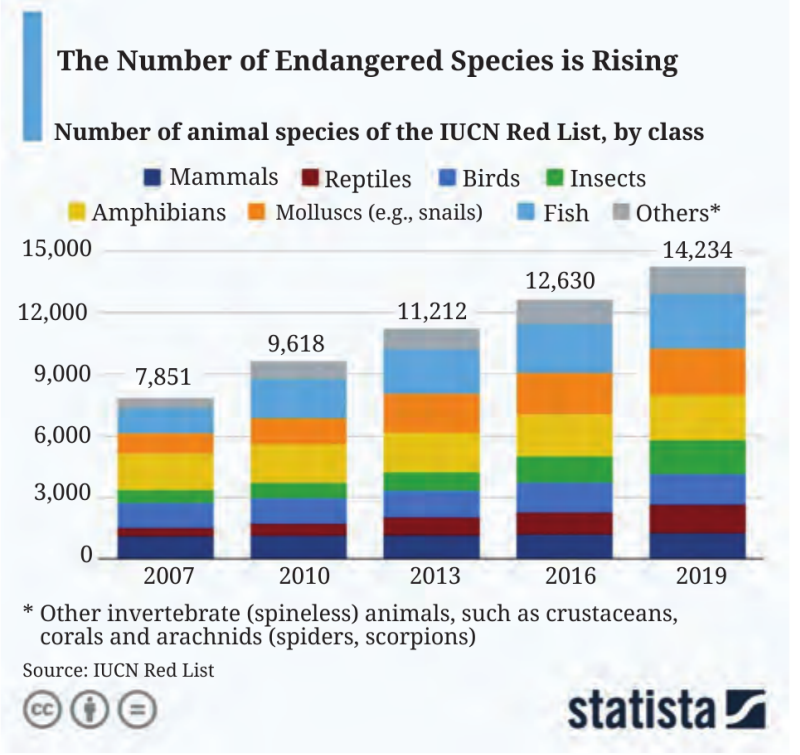
QUESTION 1

The following stacked column chart shows the number of animal species in the IUCN Red List, by class, over time.



The International Union for Conservation of Nature (IUCN) Red List is a large, regularly-updated database that tells us the extinction risk of species across the world. It classifies species into groups such as Least Concern, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild and Extinct, based on scientific data about their numbers, trends and habitats.

(i) What does the number 14,234 on the top of the column 2019 represent?

(ii) Approximately how many reptile species were in the list in 2016?

(iii) Which class(es) of species have seen a relatively small increase in count between 2007 and 2019?

ANSWER

(i) What does 14,234 represent?

The whole column for 2019 is a stack of all the classes, so 14,234 is the total number of animal species (mammals, reptiles, birds, insects, amphibians, molluscs, fish and others together) in the IUCN Red List in 2019.

(ii) Reptile species in 2016 ≈ 1000

In the 2016 column (total 12,630) the reptile band (dark red) is a little less than 8% of the column's height. So the number of reptile species was roughly 12,630 × 0.075 ≈ 950, i.e. approximately 1000 species. (A reading from a chart is approximate.)

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(iii) **Classes with a relatively small increase** MAMMALS AND BIRDS

Reading the bands approximately, mammals rose from about 1100 to about 1300 and birds from about 1200 to about 1500 between 2007 and 2019. Every other class grew much more (for example, reptiles from about 350 to about 1400, insects from about 600 to about 1600, fish from about 1200 to about 2600).

(i) total number of species on the Red List in 2019; (ii) approximately 1000; (iii) mammals and birds.

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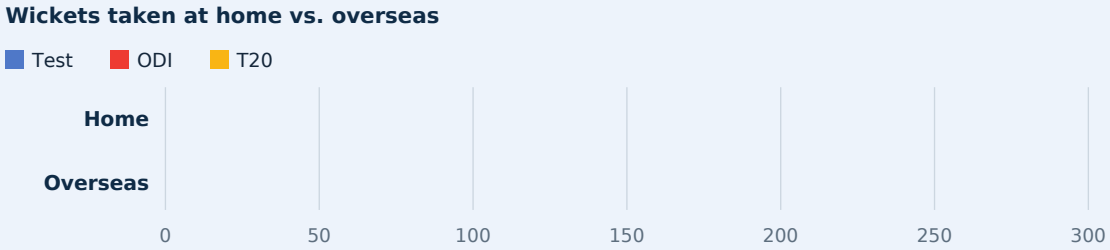
QUESTION 2

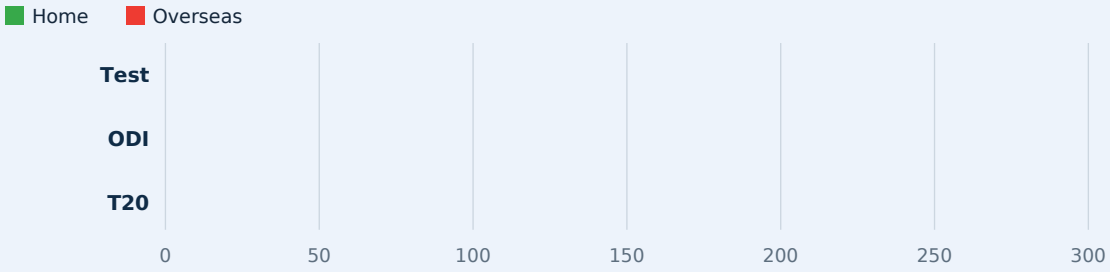
	Test	ODI	T20
Home	62	100	32
Overseas	172	49	71

The wickets taken by a bowler in International Cricket matches till 2025 are shown in the table. Complete the given stacked bar charts (the bar lengths can be approximate),

(i) comparing the total wickets taken at home vs. overseas:



(ii) The total wickets taken in each format:



ANSWER

1 Totals needed for the bars

Home = 62 + 100 + 32 = 194 wickets
Overseas = 172 + 49 + 71 = 292 wickets
Test = 62 + 172 = 234, ODI = 100 + 49 = 149, T20 = 32 + 71 = 103

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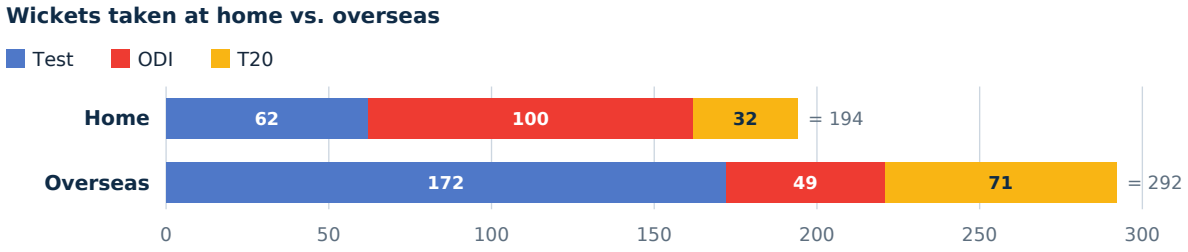
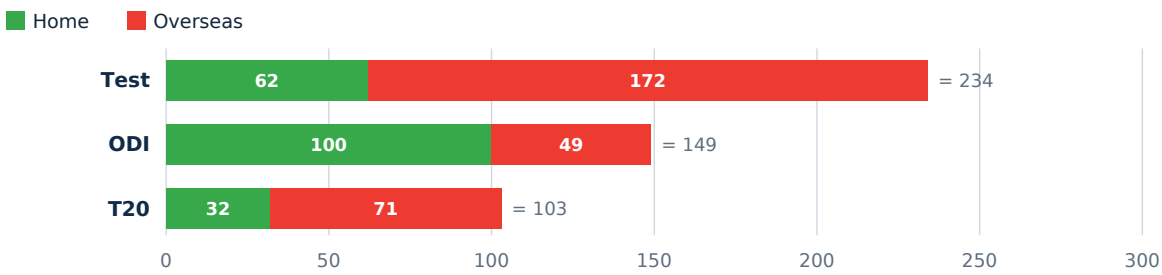
(i) Total wickets at home vs. overseas (each bar split by format)



Home bar: Test 0–62, ODI 62–162, T20 162–194. Overseas bar: Test 0–172, ODI 172–221, T20 221–292.

(ii) Total wickets in each format (each bar split into home and overseas)



Test bar: Home 0–62, Overseas 62–234. ODI bar: Home 0–100, Overseas 100–149. T20 bar: Home 0–32, Overseas 32–103.

Overseas wickets (292) exceed home wickets (194), and Test cricket has the most wickets (234) of the three formats.

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§10.2.2

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

Visualising and Interpreting Data

Examples, in-text questions & Think and Reflect · 8 items

Note: Solutions of Section 10.2.2 and the examples and Think and Reflect prompts that follow it (10.2.2 An Alternative to Pie Chart; Powering Up!; What Can We Infer?; A Typical Day).

IN-TEXT QUESTION

Try answering the following question based on the expenditure stacked bar chart you saw earlier: Which family has the smallest share of their total expenditure towards healthcare? Was it easy? If not, what visualisation can help answer such questions easily?

ANSWER

1 Share of healthcare in each family's total

Family A: 1770 ÷ 8425 ≈ 21.0%
Family B: 1210 ÷ 7286 ≈ 16.6%
Family C: 1300 ÷ 7040 ≈ 18.5%

2 Smallest share — FAMILY B

Family B has the smallest share of its expenditure on healthcare (about 16.6%); in rupees, too, Family B spends the least on healthcare (₹1210).

3 Was it easy? — NO

Not with the stacked bar chart: the three bars have different lengths and the healthcare segments start at different places, so the shares cannot be compared by eye. A pie chart for each family (Fig. 10.3) or a 100% stacked bar chart (Fig. 10.4), in which every family's total is scaled to the same length, shows the shares directly.

Family B (about 16.6%). Pie charts or 100% stacked bar charts are suited to comparing shares.

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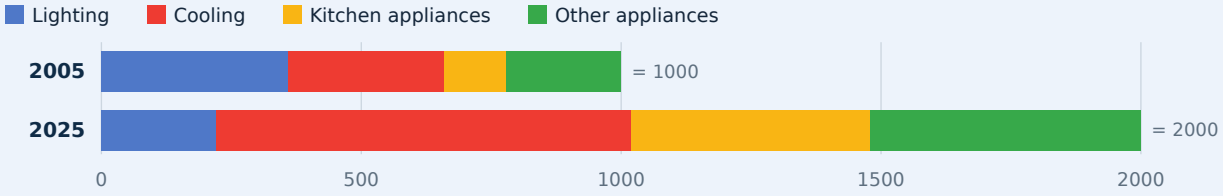
EXAMPLE 7

The average category-wise daily electricity consumption of a house, in kWh, in 2005 and 2025 is shown in the table below. The corresponding stacked bar chart is also shown. Make the corresponding 100% stacked bar chart. What do you observe? What do you find interesting in the data/graphs?

	Lighting	Cooling	Kitchen appliances	Other appliances
2005	360	300	120	220
2025	220	800	460	520



ANSWER

1 Total consumption

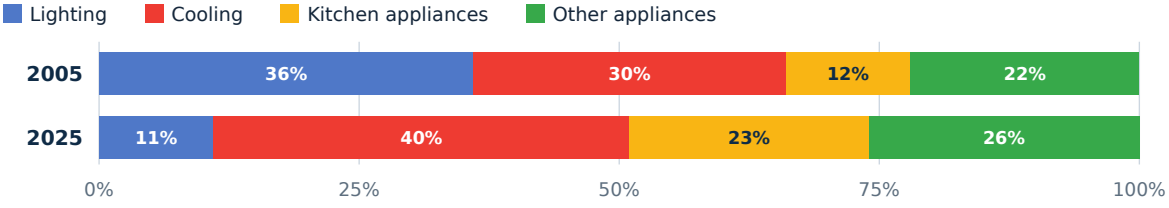
2005: 360 + 300 + 120 + 220 = 1000 units
2025: 220 + 800 + 460 + 520 = 2000 units

2 Percentage share of each category

2005: Lighting 360 ÷ 1000 × 100 = 36%, Cooling 30%, Kitchen 12%, Other 22%
2025: Lighting 220 ÷ 2000 × 100 = 11%, Cooling 800 ÷ 2000 × 100 = 40%,
Kitchen 460 ÷ 2000 × 100 = 23%, Other 520 ÷ 2000 × 100 = 26%

3 The 100% stacked bar chart

Daily electricity consumption: share of each category



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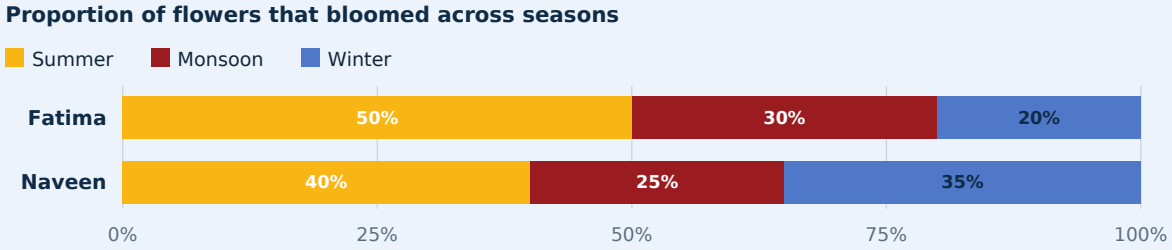
4 Observations

The total consumption has doubled (1000 to 2000 units). The share of lighting fell from 36% to 11%, and even its actual consumption fell (360 to 220 units), probably because of more efficient lighting. Cooling grew from 300 to 800 units and became the largest category (40% of the total). Kitchen appliances grew almost four times (120 to 460 units; 12% to 23%), and other appliances grew from 220 to 520 units (22% to 26%).

The 100% chart shows shares: lighting shrank in importance while cooling and appliances grew.

EXAMPLE 8

The 100% stacked bar below compares the proportion of flowers blooming in Fatima's garden and Naveen's garden across seasons.



Which of the following statements can be inferred from this chart?

(i) In Fatima's garden, there were more blooms in the summer than in the monsoon.

(ii) In summer, Fatima's garden had more blooms than Naveen's garden.

(iii) In winter, Fatima's garden had fewer blooms than Naveen's garden.

(iv) The total number of flowers, across seasons, is the same in both gardens but it varies in each season.

ANSWER

(i) Within one garden (Fatima's) — CAN BE INFERRED

The bar is Fatima's own total, split into shares: summer 50% and monsoon 30%. In the same garden the larger share means more flowers, so there were more blooms in summer than in the monsoon.

(ii) Summer: Fatima vs. Naveen — CANNOT BE INFERRED

50% of Fatima's total is compared with 40% of Naveen's total, but the two totals are not given. Example: Case 1 (totals 210 and 120): summer blooms 105 (Fatima) and 48 (Naveen). Case 2 (totals 180 and 240): 90 (Fatima) and 96 (Naveen). Both cases give the same 100% bars, but in Case 2 Fatima's garden has fewer summer blooms than Naveen's.

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(iii) Winter: Fatima vs. Naveen

CANNOT BE INFERRED

Fatima 20% and Naveen 35% of different totals. In Case 1 both gardens have 42 winter blooms (not fewer), while in Case 2 Fatima has 36 and Naveen 84. The same chart allows both, so (iii) is not certain.

(iv) Equal totals in both gardens

CANNOT BE INFERRED

A 100% stacked bar always shows each garden's total as 100%, whatever the actual total. The totals are 210 and 120 in Case 1 and 180 and 240 in Case 2; neither case has equal totals, yet the chart is identical.

Only statement (i) can be inferred. A 100% stacked bar compares shares inside each bar, not actual numbers.

THINK AND REFLECT

1. What does this say about the scope of the stacked bars and 100% stacked bars?

2. Given a stacked bar chart can we make a corresponding 100% stacked bar chart?

3. Given a 100% stacked bar chart can we make a corresponding stacked bar chart?

4. What kind of inferences or comparisons can be made from a stacked bar chart and in a 100% stacked bar chart?

ANSWER

1 Scope of the two charts

A stacked bar chart shows actual quantities, so totals as well as parts can be compared. A 100% stacked bar chart shows only proportions (every bar has the same length), so it says nothing about the actual numbers or totals.

2 Stacked bar chart to 100% stacked bar chart

YES

Yes. Add up each bar to get its total and express each part as a fraction (percentage) of that total, as was done in Example 7 for the electricity data.

3 100% stacked bar chart to stacked bar chart

NO

No. The totals are lost. Many different sets of actual numbers give the same 100% bar (Case 1 and Case 2 of Example 8), so the stacked chart cannot be recovered unless the totals are also known.

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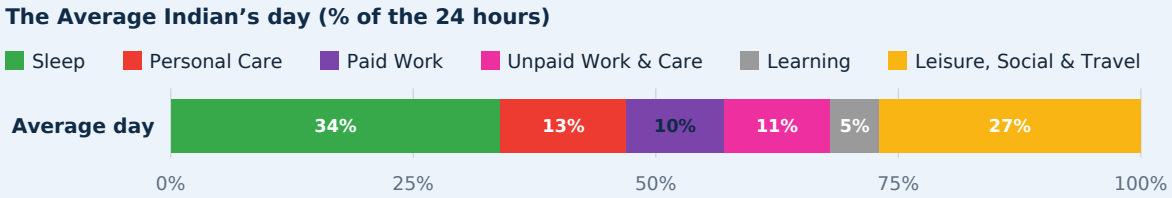
4 Inferences possible

Stacked bar: compare totals, compare parts and see how the parts add up to the total (part-to-part comparisons across bars are harder as bars don't start at the same base line). 100% stacked bar: compare the shares (fractions, percentages) of the parts within a bar and across bars; no comparison of actual amounts is possible.

Stacked bars keep the amounts; 100% stacked bars keep only the proportions.

EXAMPLE 9

The following chart shows the time spent on different activities in a day by the average Indian (Fig. 10.5, National Time Use Survey 2024; values rounded off). What do you notice? What do you wonder about?



ANSWER

1 Hours for each activity (percentage × 24 h)

Sleep 34% ≈ 8.2 h, Personal care 13% ≈ 3.1 h, Paid work 10% ≈ 2.4 h,
Unpaid work & care 11% ≈ 2.6 h, Learning 5% ≈ 1.2 h, Leisure, social & travel 27% ≈ 6.5 h
Total: 34 + 13 + 10 + 11 + 5 + 27 = 100%

2 What do you notice?

Sleep takes the largest share (about one-third of the day) followed by leisure, social and travel time (about 27%). Paid work takes only about 10% (2.4 hours) on average and learning only 5%, which is much less than the time given to unpaid work and care (11%). The strip is an average over all ages, genders and regions, so it hides the differences between individuals.

3 What do you wonder about?

How the time use differs by age, gender, rural and urban areas or income; what is included under personal care or travel; how the numbers have changed over time; and how people in other countries spend their time.

An average day is dominated by sleep and leisure; paid work (10%) and learning (5%) take small parts of the 24 hours.

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THINK AND REFLECT

Fig. 10.6 shows time use by age group (National Time Use Survey 2024, values rounded off), as a stacked column chart of Children (6–14), Youth (15–24), Adults (25–59) and Elderly (60+).

% of the day	Sleep	Personal care	Paid work	Unpaid work & care	Learning	Leisure, social & travel
Children (6–14)	38	13	0	1	22	26
Youth (15–24)	34	13	7	9	11	26
Adults (25–59)	32	13	14	15	0	26
Elderly (60+)	37	14	7	9	0	33

1. What do you find interesting in the chart above? What can you infer? Discuss.

2. Do you remember the sleep time over age trend that you studied last year? Does that trend align with this chart?

3. Can you explain why the learning time of people in the age group 15–24 has reduced significantly compared to that of the age group 6–14?

4. Do adults spend about an equal amount of time in paid and unpaid work? What do you think?

ANSWER

1 What is interesting?

Learning takes 22% of the day (about 5.3 hours) for children but 11% for youth and almost nothing for adults and the elderly. Paid work appears only from youth onwards and peaks in adults at 14% (about 3.4 hours). Leisure is the same, 26%, for the three younger groups but rises to 33% (about 7.9 hours) for the elderly. Personal care is about 13–14% for all groups.

2 Sleep trend and age

The sleep share is highest for children (38%), falls through youth (34%) to adults (32%), the lowest, and rises again for the elderly (37%). This agrees with the usual pattern that sleep time is highest in childhood, lowest in adulthood and rises a little again in old age.

3 Why learning falls from ages 6–14 to 15–24

Ages 6–14 are the school years, when going to school is part of the daily routine. After that many young people stop formal study and start working (paid work 7% and unpaid work 9% appear in the 15–24 group), and those who continue spend a smaller share of the day on classes and study.

4 Paid and unpaid work among adults

The averages are close: paid work 14% (about 3.4 hours) and unpaid work and care 15% (about 3.6 hours). But this is an average over all adults, which can hide differences; for example, how the work is divided among men and women would show up only if the data were split further by gender.

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Time use changes with age: learning falls after childhood, work peaks in adults, leisure is highest among the elderly.

IN-TEXT QUESTION

What type of chart is Fig. 10.6 — a stacked bar chart or a 100% stacked bar chart?

ANSWER

It is both. It is a stacked bar chart because each small bar represents the amount of time spent on a particular activity. It is also a 100% stacked bar chart because every stacked bar has the same total, 24 hours, and the lengths of the smaller bars within and across the stacks also represent the relative proportions of time spent. (If there is only one stacked bar, it can also be read as a 100% stacked bar.)

Fig. 10.6 is both a stacked bar chart and a 100% stacked bar chart, because all totals are equal (24 hours).

THINK AND REFLECT

Do you remember the 'What Can A Strip Say?' activity from last year? In each strip, if we club the tiny strips belonging to each activity together, will we get a 100% stacked bar chart like the one in Fig. 10.6?

ANSWER

Yes. Each strip covers the same 24 hours of the day. If the tiny strips of each activity in a strip are joined together (clubbed), the strip becomes one bar divided into parts, one for each activity, and its length is fixed (24 hours). The lengths of the parts show the share of the day spent on each activity, which is exactly how a 100% stacked bar chart such as Fig. 10.6 is built.

Yes: grouping the tiny strips by activity gives a bar of fixed total length split into shares, i.e. a 100% stacked bar.

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10.5

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

Exercise Set 10.5

Solutions · 2 items

QUESTION 1

The smart watch data of 5 people was tracked from Monday to Friday. The recorded data tells us how many hours each person spent lying down, sitting, and standing or moving around, etc., as shown in the following table.

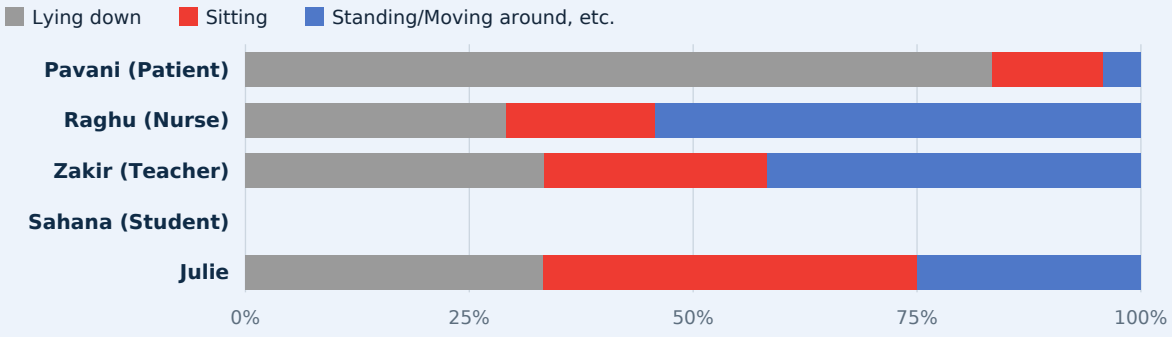
Table 10.3: Average number of hours spent per day (Monday–Friday) lying down, sitting, and standing or moving around, etc., of 5 people

	Lying down	Sitting	Standing or Moving around etc.
Pavani (Patient)	20	3	1
Raghu (Nurse)	7	4	13
Zakir (Teacher)	8	6	10
Sahana (Student)			
Julie (_____)	8	10	6

(i) How much time does Sahana spend per day in each of these body-states? Make a reasonable guess and fill her row in the table.

(ii) Guess what activity or work Julie could be engaged in based on the data. Find out what your classmates' guesses are.

(iii) Complete the chart below based on the tabular data.



ANSWER

(i) **Sahana's day (a reasonable guess)**

A student sleeps about 8 hours, sits for classes, homework and meals, and is on her feet or moving around for the rest of the day. A reasonable guess (24 hours in total):

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	Lying down	Sitting	Standing or Moving around etc.
Sahana (Student)	8	7	9

Check: 8 + 7 + 9 = 24 hours. Other reasonable answers are possible as long as the total is 24.

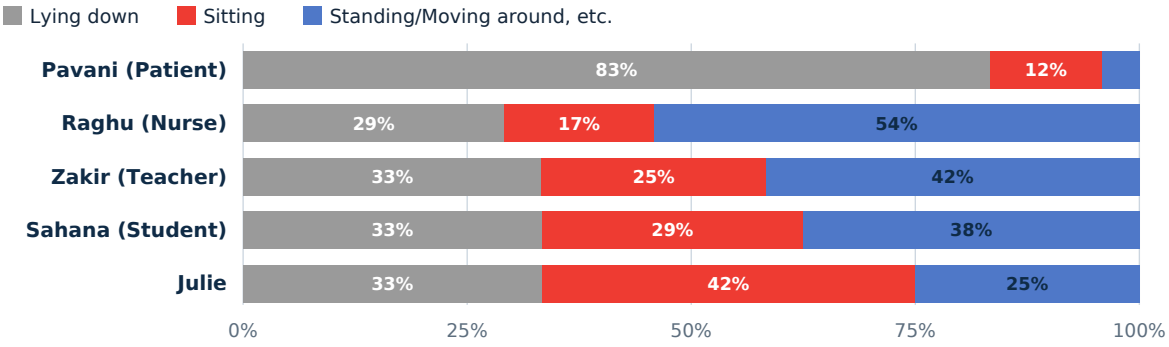
(ii) What could Julie be doing?

A DESK JOB

Julie sits for 10 hours and stands or moves around for only 6 hours, with 8 hours lying down (sleep). Work in which most of the day is spent sitting fits: for example an office or computer-based job (software developer, accountant, data-entry operator), or a driver. (Guesses may differ.)

(iii) The completed 100% stacked bar chart

Each person's total = 24 hours. Shares = hours ÷ 24 × 100:
Pavani: 83.3%, 12.5%, 4.2% Raghu: 29.2%, 16.7%, 54.2% Zakir: 33.3%, 25.0%, 41.7%
Sahana: 33.3%, 29.2%, 37.5% Julie: 33.3%, 41.7%, 25.0%



Sahana's row: 8 h, 7 h, 9 h (a guess); Julie probably has a sitting-based job.

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THINK AND REFLECT

1. Will the bars look similar if a different teacher's data is considered instead of Zakir's?

2. Will the bars look different if the data for all 7 days of the week is considered?

3. Some bars in the chart may also match people doing other kinds of work/activities. Can you think of any? Discuss.

ANSWER

1 A different teacher's data

The bars would look similar but not identical. Most teachers sleep 7–8 hours and spend the rest of the working day partly standing or moving (teaching, supervising) and partly sitting (correcting, planning). A physical-education teacher would have a much larger standing/moving part, and a teacher who works mostly at a computer would have a larger sitting part.

2 Data for all 7 days

Yes, they would probably look different. On Saturdays and Sundays a person does not follow the weekday work routine: a teacher or nurse would stand and move around less and might sit or lie down more, so the bars would change.

3 Other activities that match the bars

Raghu's bar (mostly standing/moving) also fits a shopkeeper, security guard, waiter, farmer or construction worker. Julie's bar (a lot of sitting) fits a software developer, accountant or driver. Pavani's bar (mostly lying down) fits a person who is bedridden or resting for a long time.

The bars depend on the kind of work and the day; different people with similar routines can have similar bars.

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EC

CLASS 9 MATHS · GANITA MANJARI · CHAPTER 10

End-of-Chapter Exercises

Solutions · 16 questions

QUESTION 1

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?

ANSWER

(i) **Run rate after two overs**

Total runs = 6 + 12 = 18 in 2 overs
Run rate = 18 ÷ 2 = 9 runs per over

(ii) **Run rate after 20 overs**

Run rate 6 after 19 overs means runs = 6 × 19 = 114
Runs after the 20th over = 114 + 12 = 126
Run rate = 126 ÷ 20 = 6.3 runs per over

(Weighted mean: (6 × 19 + 12 × 1) ÷ 20 = 6.3.)

(i) 9 runs per over; (ii) 6.3 runs per over.

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QUESTION 2

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: 40(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_s, a_k, a_p, a_g respectively. Write an expression that gives the combined average.

(ii) Suppose a_n, 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?

ANSWER

1 A way to work together

Each friend tells the others how many prices they collected and the average of those prices. Multiplying each average by its count gives that friend's total, and (sum of all totals) ÷ (total number of prices) is the overall average.

2 Number of prices collected

Yusuf 6, Srikanth 4, Kashvi 5, Prasanna 4, Gracy 4
Total = 6 + 4 + 5 + 4 + 4 = 23 prices

(i) Combined average from the five averages

Combined average = $(6 \cdot a_y + 4 \cdot a_s + 5 \cdot a_k + 4 \cdot a_p + 4 \cdot a_g) \div 23$
Sums: Yusuf 917, Srikanth 493, Kashvi 766, Prasanna 897, Gracy 990
Total of all prices = 4063, so the average = 4063 ÷ 23 ≈ ₹176.65

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(ii) Average from the nylon and feather averages

Nylon: 13 prices (40, 105, 108, 194, 85, 93, 121, 49, 105, 40, 124, 182, 183), sum = 1429, a_n = 1429 ÷ 13 ≈ 109.92
Feather: 10 prices (383, 165, 116, 297, 275, 333, 258, 220, 458, 129), sum = 2634, a_f = 2634 ÷ 10 = 263.4
Average = (13·a_n + 10·a_f) ÷ 23 = (1429 + 2634) ÷ 23 = 4063 ÷ 23 ≈ ₹176.65

Yes, the two answers are equal: both equal (sum of all 23 prices) ÷ 23 ≈ ₹176.65.

QUESTION 3

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?

ANSWER

(i) Shreyas's average price after buying 10 shares

Cost of the old shares = 25 × 150 = ₹3750
Cost of the new shares = 10 × 30 = ₹300
Average price = (3750 + 300) ÷ (25 + 10) = 4050 ÷ 35 ≈ ₹115.71

(ii) Number of shares Vaishnavi bought 10

Cost of her old shares = 5 × 150 = ₹750
Let x be the number of new shares; cost = 30x
(750 + 30x) ÷ (5 + x) = 70
750 + 30x = 350 + 70x
400 = 40x, so x = 10

Check: (750 + 300) ÷ 15 = 1050 ÷ 15 = 70 ✓

(i) about ₹115.71 per share; (ii) she bought 10 shares.

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QUESTION 4

(Pṛthūdakasvāmī, 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.

ANSWER

1 **Weighted mean of the depths (weights = section lengths)**

Total length = 4 + 5 + 6 + 7 + 8 = 30 hastas ✓
Mean depth = (4 × 9 + 5 × 7 + 6 × 7 + 7 × 3 + 8 × 2) ÷ 30
= (36 + 35 + 42 + 21 + 16) ÷ 30 = 150 ÷ 30 = 5

The mean depth of the pool is 5 hastas.

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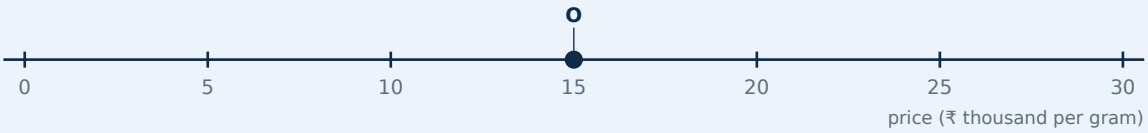
QUESTION 5

Suvarna had purchased 1g gold at ₹15k (short for ₹15,000). This is shown by point O denoting 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

ANSWER

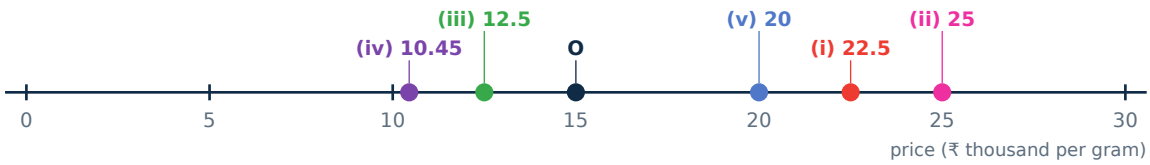
1 Method

The new average price is the weighted mean of ₹15k (weight 1 g, the gold she has) and the new price (weight = grams bought). It lies between the two prices and is closer to the price with more grams.

2 Estimate and calculate each scenario

(i) 1 g at 30k: equal weights, midway: (15 × 1 + 30 × 1) ÷ 2 = 22.5k
(ii) 2 g at 30k: (15 + 60) ÷ 3 = 25k (closer to 30k, as 2 g > 1 g)
(iii) 1 g at 10k: (15 + 10) ÷ 2 = 12.5k
(iv) 10 g at 10k: (15 + 100) ÷ 11 ≈ 10.45k (very close to 10k)
(v) 0.5 g at 30k: (15 + 15) ÷ 1.5 = 20k (closer to 15k)
(vi) 0.5 g at 15k: (15 + 7.5) ÷ 1.5 = 15k (unchanged)

3 Marked on the number line



Point (vi) coincides with O at 15, because buying gold at the same price does not change the average.

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(i) 22.5k (ii) 25k (iii) 12.5k (iv) ≈ 10.45k (v) 20k (vi) 15k

QUESTION 6

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.

ANSWER

1 Experiment

Data 10, 20, 40 with weights 1, 2, 3: (10 + 40 + 120) ÷ 6 = 170 ÷ 6 ≈ 28.33
Weights doubled (2, 4, 6): (20 + 80 + 240) ÷ 12 = 340 ÷ 12 ≈ 28.33

The weighted average did not change.

2 Algebra

Original: $x = (w_1x_1 + w_2x_2 + \ldots + w_nx_n) \div (w_1 + w_2 + \ldots + w_n)$
Doubled: $(2w_1x_1 + \ldots + 2w_nx_n) \div (2w_1 + \ldots + 2w_n)$
$= 2(w_1x_1 + \ldots + w_nx_n) \div 2(w_1 + \ldots + w_n) = x$

The weighted average stays the same when all the weights are doubled (only the relative weights matter; the same holds for multiplying all weights by any non-zero number).

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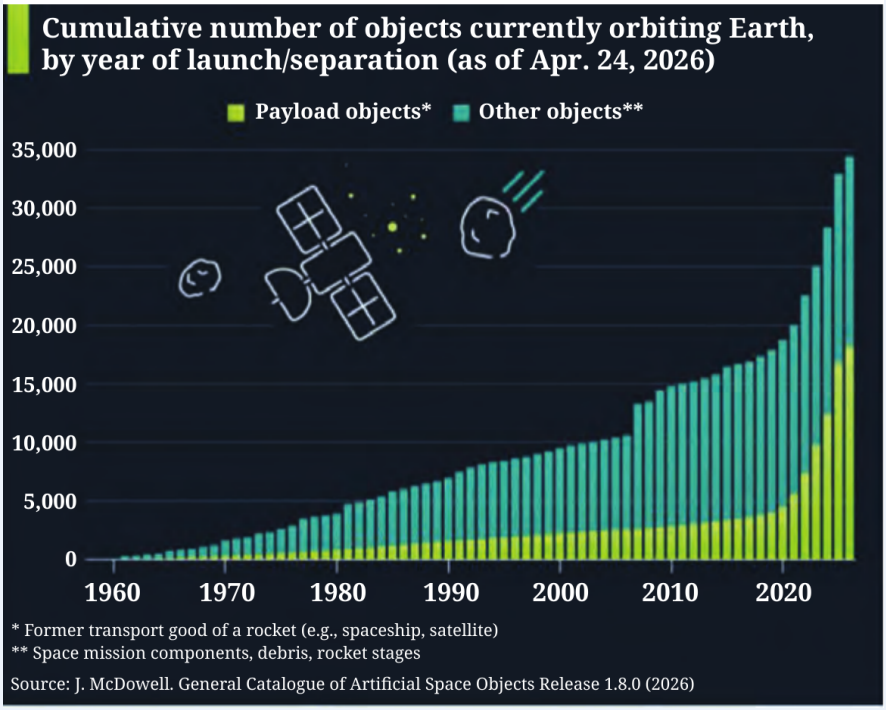
QUESTION 7

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?

ANSWER

(i) Total objects in 2003 and when it doubled ≈ 10,000; 2021

Reading the height of the whole bar for 2003 gives about 10,000 objects in total. Double of that is about 20,000, which the bars reach in about 2021.

(ii) Objects in 2025

Total ≈ 33,000 objects
Payload objects ≈ 16,500, share ≈ 16,500 ÷ 33,000 = 50%
Other objects ≈ 16,500, share ≈ 50%

(These are approximate readings from the graph.)

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(iii) **Trends over time**

Number: both payload objects and other objects have increased over time. Other objects grew steadily (with a big jump around 2007), and payload objects grew slowly till about 2020 and then very quickly; both rise steeply in the most recent years.

Share: from 1960 to about 2020 payload objects were roughly 20–25% of all objects (about 24% in 2003, for example) and other objects roughly 75–80%. In the last few years the share of payload objects has risen sharply, to about 50% in 2025, so the share of other objects has fallen to about 50%.

(i) ≈ 10,000 in 2003, doubled by ≈ 2021; (ii) ≈ 16,500 payload (50%) and ≈ 16,500 other (50%) in 2025; (iii) both counts rise, and the payload share has risen sharply recently.

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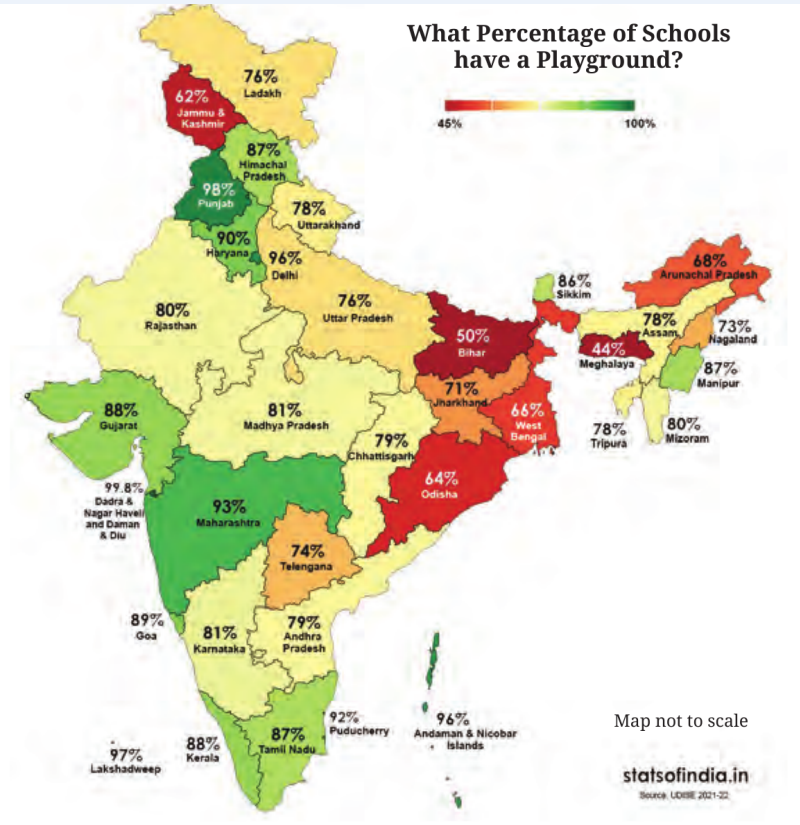
QUESTION 8

Observe the following 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.

(ii) Using the information given, can we find the nation-wide percentage of schools with a playground? If not, what additional information is needed?

ANSWER

(i)(a) Haryana (90%) vs. Uttarakhand (78%) — CANNOT BE INFERRED

The map gives percentages, not numbers of schools. A higher percentage of a smaller number of schools can be fewer schools than a lower percentage of a larger number of schools.

(i)(b) Arunachal Pradesh (68%) — CORRECT

68% is close to 2/3 ≈ 66.7%, so approximately 2 out of every 3 schools in Arunachal Pradesh have a playground.

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(i)(c) Punjab (98%) — NOT CORRECT

The map shows the percentage, not the number, of schools. Also 98% is not even the highest percentage (Dadra & Nagar Haveli and Daman & Diu show 99.8%).

(i)(d) Maharashtra (93%) vs. Telangana (74%) — CORRECT

If Maharashtra has more schools and also a higher percentage with a playground, then 93% of a larger number is more than 74% of a smaller number. So Maharashtra has more schools with a playground.

(ii) Nation-wide percentage — NOT POSSIBLE FROM THE MAP

The nation-wide percentage is a weighted mean of the state percentages, with the number of schools in each state/UT as weights: (Σ percentage × number of schools) ÷ (total number of schools). A plain average of the percentages would be wrong because the states have very different numbers of schools. So we need the number of schools in each state/UT.

> **(i) (b) and (d) are correct; (ii) no — the number of schools in each state/UT is also needed.**

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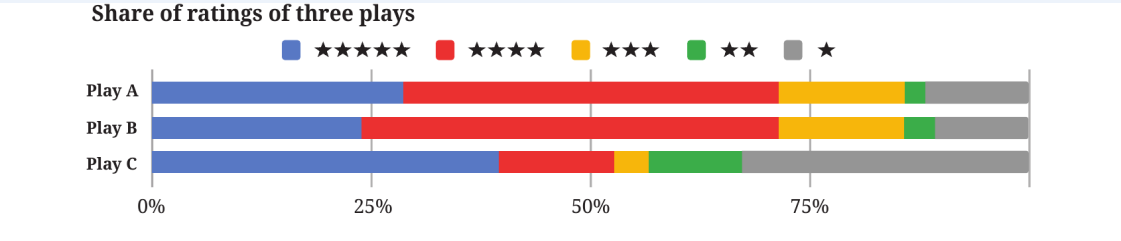
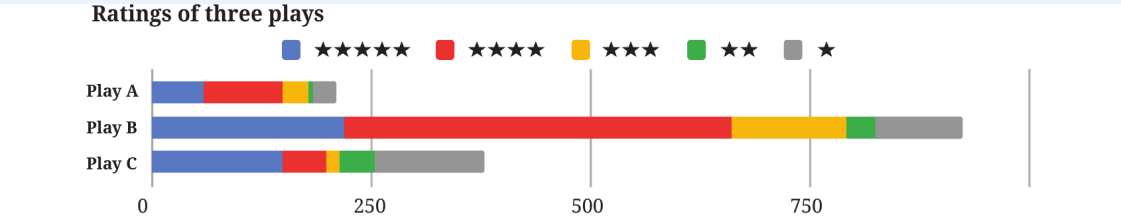
QUESTION 9

Decision Dilemma:

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



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



ANSWER

(i) Using the shares of ratings (100% chart)

Reading the bars (approximate shares of customers):
Play A: 5★ 29%, 4★ 43%, 3★ 15%, 2★ 2%, 1★ 11%
Play B: 5★ 24%, 4★ 47%, 3★ 15%, 2★ 3%, 1★ 11%
Play C: 5★ 39%, 4★ 13%, 3★ 4%, 2★ 11%, 1★ 33%

Plays A and B have about the same share of 4★ and 5★ ratings (about 71%) and only about 14% low ratings (1★ or 2★). A has slightly more 5★ ratings. Play C is polarising: many 5★ (39%) but also about 43% of customers gave 1★ or 2★. So, from this chart, Play A (or B, almost equally good) looks best.

(ii) Using the stacked bar chart (actual numbers) DISCUSSION

The stacked chart shows how many people rated: Play A about 210 ratings, Play B about 920 and Play C about 380. Play B's good ratings come from more than four times as many people as Play A's. A rating share based on few people (Play A) is less reliable than one based on many people (Play B), so I would now choose Play B, or at least treat A and B as equally good with B better supported. Play C remains the least preferable.

Reason: the 100% chart hides the number of ratings; the stacked chart shows it. (Answers to a decision question can differ if the reasoning is given.)

Based on shares alone, A (about equal to B); after seeing the number of ratings, B is the safer choice.

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QUESTION 10

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.

Table 10.4: Finish time of three athletes in each segment of a triathlon race (values in hh:mm)

	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?

ANSWER

(i) **Suitable representation** — STACKED BAR CHART

The race result depends on the total time, and we also want to see how that time is made up by swimming, cycling and running. A stacked bar chart shows both: the bar length is the total time and the parts show the segments. A 100% stacked bar chart would give every athlete the same length and hide the total time.

Total times (in minutes): Athlete 1 = 68 + 300 + 195 = 563 (9 h 23 min)
Athlete 2 = 65 + 310 + 215 = 590 (9 h 50 min)
Athlete 3 = 82 + 355 + 230 = 667 (11 h 7 min)

(ii) **What a 100% stacked bar chart can answer**

(a) **Who finished the race first?** — NO

Every bar has the same length (100%), so total times cannot be compared.

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(b) Fraction of Athlete 1's time spent cycling — YES

The cycling part of Athlete 1's bar is a fraction of the whole bar: 300 ÷ 563 ≈ 0.53, a little more than half.

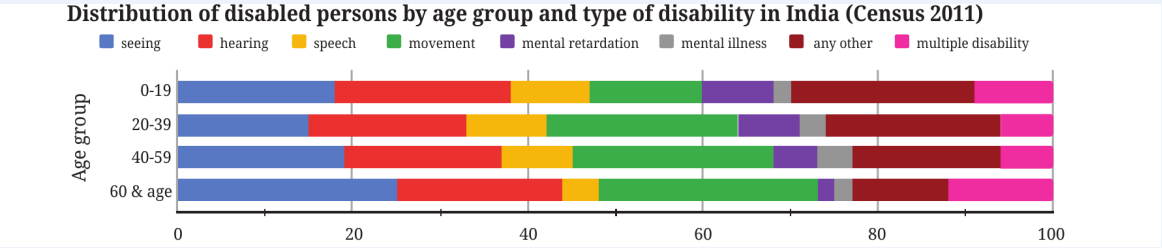
(c) Who took the longest for running? — NO

The lengths of the parts are shares of each athlete's own total, not actual times; a bigger share does not mean more time when the totals differ.

(i) stacked bar chart; (ii) only (b) can be answered from a 100% stacked bar chart (≈ 53% for Athlete 1). Athlete 1 finished first.

QUESTION 11

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



ANSWER

1 Approximate shares (%) read from the chart

Age group	Seeing	Hearing	Speech	Movement	Mental retard.	Mental illness	Any other	Multiple
0–19	18	20	9	13	8	2	21	9
20–39	15	18	9	22	7	3	20	6
40–59	19	18	8	23	5	4	17	6
60 & above	25	19	4	25	2	2	11	12

Each row adds up to 100%.

2 What do you notice?

The chart shows shares, so each bar is a 100% bar for its age group. Movement disability has a larger share with age (about 13% for 0–19 and about 25% for 60 and above). The share of seeing disability is also highest (about 25%) for 60 and above. Speech and mental retardation have smaller shares with age (about 9% to 4% and 8% to 2%). Hearing is about 18–20% in every group. "Any other" is the largest group for ages 0–19 (about 21%) and the smallest, about 11%, for 60 and above, where "multiple disability" is highest (about 12%).

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3 What do you wonder?

Because this is a 100% chart, it does not tell us how many disabled persons there are in each age group, so we cannot say which age group has more persons with a given disability. We may wonder what the actual numbers are, whether disability becomes more common with age, what causes the movement and seeing shares to rise with age, and how the picture differs between men and women or rural and urban areas.

The chart shows the mix of disability types in each age group, not their actual numbers; movement and seeing disabilities take larger shares with age.

QUESTION 12

Individual project: 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 any one of the weekdays, 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.

ANSWER

This is a project based on your own family's data. A model solution with illustrative (sample) numbers is given; replace them with your own.

(i) Body-states: sample data and stacked bar chart

Steps: write down the previous day hour by hour (sleep time, school/work, meals, travel, study, TV) and put each hour into lying down, sitting or standing/moving; the three numbers must add up to 24 hours. Do the same for 2 family members.

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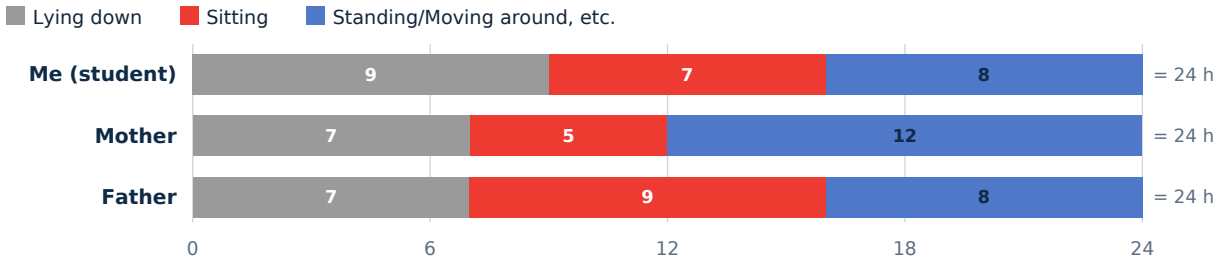
Hours per day in each body-state (sample)



Sample reasoning: a student's day: sleep 9 h; school, homework and meals sitting 7 h; walking, play and chores 8 h. A mother who works at home and looks after the family: sleep 7 h, sitting 5 h and standing or moving around 12 h. A father with an office job: sleep 7 h, sitting 9 h, standing or moving 8 h. Observation: the father's bar has the largest sitting part and the mother's the largest standing/moving part.

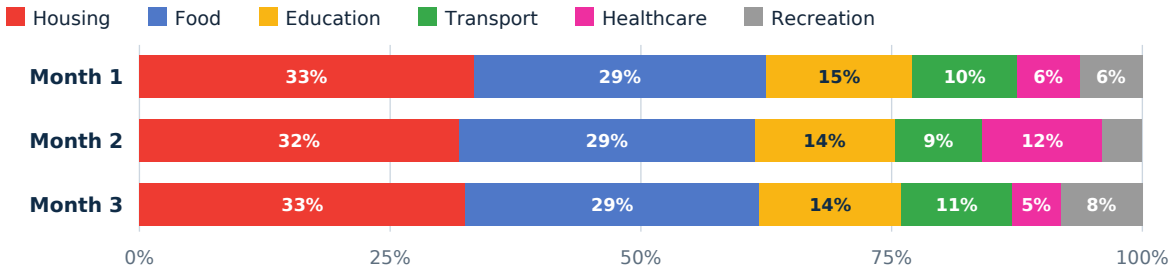
(ii) Family expenditure: sample data (₹) for 3 months

₹	Housing	Food	Education	Transport	Healthcare	Recreation	Total
Month 1	8000	7000	3500	2500	1500	1500	24000
Month 2	8000	7400	3500	2200	3000	1000	25100
Month 3	8000	7200	3500	2700	1200	2000	24600

(a) Categories: housing, food, education, transport, healthcare and recreation. (b) Use a notebook or phone note for every expense, add up each category at the month end. (c) Collect for 3 months. (d) Percentage share of each category = amount ÷ month's total × 100:

Share	Housing	Food	Education	Transport	Healthcare	Recreation
Month 1	33.3%	29.2%	14.6%	10.4%	6.2%	6.2%
Month 2	31.9%	29.5%	13.9%	8.8%	12.0%	4.0%
Month 3	32.5%	29.3%	14.2%	11.0%	4.9%	8.1%

Family expenditure: 100% stacked bar chart (sample)



(e) Observations (sample data): housing is the largest share each month (33.3%, 31.9%, 32.5%), followed by food (29.2%, 29.5%, 29.3%); healthcare changed the most (6.2%, 12.0% and 4.9%), mainly because of one month with extra medical expenses; education stays at the same amount, so its share changes only because the totals change. The chart shows shares; to compare actual rupees the totals (₹24000, ₹25100, ₹24600) must also be seen.

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Model solution: sample data for (i) and (ii) with charts and observations; replace the numbers with your family's data.

QUESTION 13

Small-group project: 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 (5 being very good).

(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.

ANSWER

A model solution for scenario (b), travel experience in a bus, with imagined ratings. A group should choose its own scenario, aspects and weights.

(i) Aspects to rate and why they matter

Aspect	Why it matters
Safety	Passengers must reach their destination without risk (driving, brakes, lighting, safety at night).
Punctuality	Delays affect school, work and connections.
Cleanliness	Affects health and comfort on the journey.
Seat comfort	Matters most on long journeys, less for short trips.
Staff behaviour	Polite driver and conductor, correct change and help for senior citizens.

(ii) Relative weights

Safety : Punctuality : Cleanliness : Seat comfort : Staff behaviour = 5 : 4 : 3 : 2 : 2 (total 16). Safety has the greatest weight because it concerns passengers' lives; punctuality comes next as it affects plans; comfort and staff behaviour are important but less critical.

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(iii) Ratings from 10 people (imagined), scale 1–5

Person	Safety	Punctuality	Cleanliness	Seat comfort	Staff behaviour	Weighted rating
P1	4	3	3	4	5	3.69
P2	5	4	3	3	4	4.00
P3	3	2	2	3	3	2.56
P4	4	4	4	3	4	3.88
P5	5	3	2	2	3	3.31
P6	4	5	3	4	4	4.06
P7	3	3	3	2	2	2.75
P8	5	4	4	4	5	4.44
P9	4	2	3	3	4	3.19
P10	4	4	2	3	3	3.38

(iv) Individual ratings and the overall average

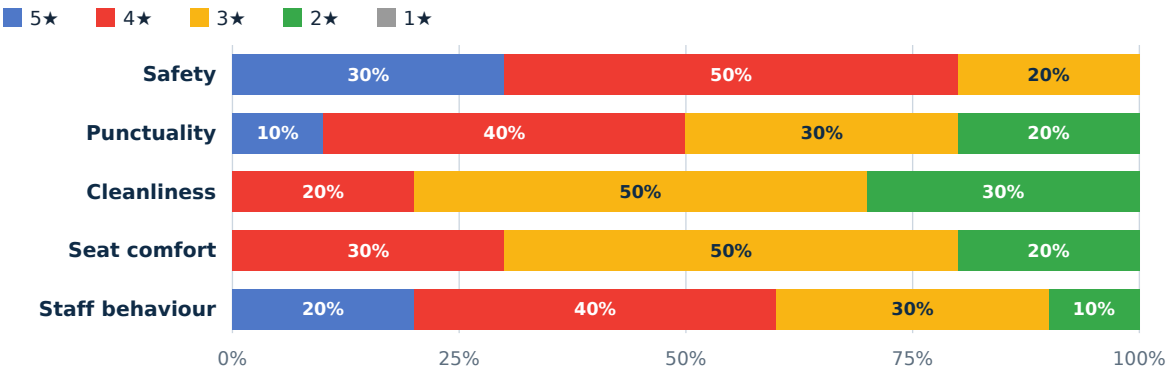
Weighted rating of a person = (5·Safety + 4·Punctuality + 3·Cleanliness + 2·Comfort + 2·Staff) ÷ 16

Person 1: (5×4 + 4×3 + 3×3 + 2×4 + 2×5) ÷ 16 = (20 + 12 + 9 + 8 + 10) ÷ 16 = 59 ÷ 16 ≈ 3.69

Other individual ratings are in the last column of the table above.

Overall average = (sum of the 10 individual ratings) ÷ 10 ≈ 3.52 out of 5

(v) 100% stacked bar chart of the ratings (share of 5★ … 1★ for each aspect)



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(vi) Observations and inferences

Average rating by aspect (unweighted): Safety 4.1, Punctuality 3.4, Cleanliness 2.9, Seat comfort 3.1, Staff behaviour 3.7. The highest-rated aspect is Safety (4.1) and the lowest is Cleanliness (2.9). Safety, with the largest weight, rates well, so it lifts the overall score to about 3.52. The weighted score gives more importance to the aspects that matter more; a plain average of the five aspects would give a different value. What the scheme misses: it does not capture cost, reliability on a particular route, accessibility for the disabled or the experience of different groups (the average hides disagreement), and it depends on only 10 imagined people.

Model solution for the bus scenario with imagined data; the weighted rating is (5·S + 4·P + 3·C + 2·K + 2·B) ÷ 16.

QUESTION 14

Whole class project: 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.

ANSWER

1 The method

The average age of a family multiplied by its number of members gives the sum of the ages of that family. Adding these sums for all the families gives the sum of the ages of all the people in the class's families. Dividing by the total number of family members gives the average age of everyone.

$$\text{Average age} = (\Sigma \text{ average age of family} \times \text{number of members}) \div (\Sigma \text{ number of members})$$
$$= (a_1n_1 + a_2n_2 + \ldots + a_kn_k) \div (n_1 + n_2 + \ldots + n_k)$$

Simply averaging the family averages would be wrong because the families have different sizes: a family of 8 should count for more than a family of 3.

2 Example with four families (sample numbers)

(average age, members) = (30, 4), (25, 3), (36, 5), (28, 4)
Sum of ages = 30×4 + 25×3 + 36×5 + 28×4 = 120 + 75 + 180 + 112 = 487
Number of members = 4 + 3 + 5 + 4 = 16
Average age = 487 ÷ 16 ≈ 30.44 years

Use the weighted mean with the family sizes as weights.

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QUESTION 15*

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.

ANSWER

1 Experiment

Data 10 and 20 with weights 1 and 3: $(10 \times 1 + 20 \times 3) \div 4 = 70 \div 4 = 17.5$
Weights increased by 1 (2 and 4): $(10 \times 2 + 20 \times 4) \div 6 = 100 \div 6 \approx 16.67$
The simple (unweighted) mean of 10 and 20 is 15

The weighted average changes (17.5 to 16.67), and it moves towards the simple mean, 15.

2 Algebra

Let $S = w_1x_1 + \ldots + w_nx_n$, $W = w_1 + \ldots + w_n$, $T = x_1 + \ldots + x_n$
Old weighted mean = $S \div W$. Simple mean = $T \div n$.
New mean = $((w_1 + 1)x_1 + \ldots + (w_n + 1)x_n) \div ((w_1 + 1) + \ldots + (w_n + 1)) = (S + T) \div (W + n)$
$= (W \cdot (S \div W) + n \cdot (T \div n)) \div (W + n)$

So the new mean is the weighted average of the old weighted mean (weight W) and the simple mean (weight n): it lies between them, closer to the old mean when W is large. It stays unchanged only when the old weighted mean already equals the simple mean (for example, when all the values are equal).

Increasing every weight by 1 changes the weighted average in general; it moves it towards the simple mean of the values. (Doubling the weights, as in Question 6, leaves it unchanged.)

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QUESTION 16*

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.

ANSWER

The three shares always add up to 100%. Test each option with numbers (last year: 60 cows, 25 sheep, 15 chickens), where every population must be smaller this year.

(i) All three shares decrease — NOT POSSIBLE

The shares would add up to less than 100%.

(ii) All three shares increase — NOT POSSIBLE

The shares would add up to more than 100%.

(iii) All three shares stay the same — POSSIBLE

For example, every population falls by 10%: 54 cows, 22.5 sheep, 13.5 chickens, still 60%, 25%, 15%.

(iv) Cows decrease, sheep increase, chickens the same — POSSIBLE

Example: 52.5 cows, 24 sheep and 13.5 chickens (total 90). Chickens: 13.5 ÷ 90 = 15% (same); sheep 24 ÷ 90 ≈ 26.7% (increased); cows 52.5 ÷ 90 ≈ 58.3% (decreased). Each number is less than last year's (60, 25, 15).

(v) Cows increase, sheep increase, chickens decrease — POSSIBLE

Example: 50 cows, 21 sheep and 9 chickens (total 80). Cows 62.5% (increased), sheep 26.25% (increased), chickens 11.25% (decreased), and each number is less than last year's.

Options (iii), (iv) and (v) are possible; (i) and (ii) are not.

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