

VCE VM Numeracy Units 3 & 4

Chapter 11 — Unit 4 numeracy in context

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Theory

Personal numeracy at Unit 4 level. Section 6A built this numeracy from the everyday jobs — shopping, cooking, a BBQ, a garden bed. Unit 4 keeps the same numeracy and raises the stakes: longer jobs, more steps, and numbers that arrive embedded in media, maps, apps and timetables. The study design (Unit 4, Outcome 1) describes the scope this way: personal numeracy is the maths you need to organise your own life, working with money, time, travel, numbers and data.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

The five situation areas. For Unit 4 the study design's examples (Outcome 1) cover everyday situations like these:

- statistics that matter to you personally, in print and online — step counts, sleep logs, sales claims on a blog
- travel for you and your family — getting to school or work, holidays, driving and road safety
- making schedules and timetables, and rearranging your own work and travel plans when the day changes
- maps and other materials that show direction and location — printed and online maps, building diagrams and GPS screens — and following directions
- planning a family event or a cultural event: a reunion, a birthday, a family day out

Every one of these runs on mathematics from earlier chapters: percentages (§2F), time and durations (§4D), rates and fuel economy (§5B), compass points and bearings (§7B, §7C), measures of centre and spread (§8C, §8D), and planner inputs and outputs (§10A, §10E). This section joins them up and points them at your own life.

What Unit 4 asks of you. The Unit 4 outcome verbs are *apply, critically analyse, evaluate and justify*. So here it is not enough to compute a mean: you decide **which** measure of centre tells the truth about a data set and say why; you do not just find two route costs, you choose a route and justify the choice against both money and time; and every answer closes with a Stage 3 evaluation and a Stage 4 report that states the decision, not only the number.

The problem-solving cycle, personal edition.

Personal jobs never arrive labelled “use division”. You run each one through the four-stage cycle from §1A. Here it is on a small commuting decision.

Stage	Working
1 Identify	A commuter buys single tickets at \$4.60 each, or a 10-trip ticket at \$38. Compare the cost of 10 singles with the ticket.
2 Act	10 singles: $10 \times \$4.60 = \$46.00$. Saving: $\$46.00 - \$38.00 = \$8.00$.
3 Evaluate	Estimate: $\$4.60 \approx \$4.50$, so 10 singles $\approx \$45.00$ and the saving $\approx \$7.00$; the exact \$8.00 sits close ✓. Add-back: $\$38.00 + \$8.00 = \$46.00$ ✓.
4 Report	“The 10-trip ticket saves \$8.00 over ten singles — buy the ticket.”

From here on, every example and question in this section is worked the same way.

Personal statistics in the media (AoS6). Mean, median, mode, range and outliers (§8C, §8D) are the tools for reading personal data in print and on screens. Worked model: five daily maximum temperatures of 21, 23, 20, 24 and 22 °C sum to 110, so the mean is $110 \div 5 = 22$ °C exactly. When a mean does not come out exactly, round only as far as the question states — and say how far. Critically analyse what you read: a single outlier pulls the mean towards itself while the median holds (§8D), and a graph whose axis does not start at zero can make a tiny change look enormous (§8B). Both traps appear in the practice questions.

“Up to” claims. Worked model: a catalogue promises “up to 30% off”, and your \$100 item gets 10% off. Discount: $0.10 \times \$100 = \$10$. Price paid: $\$100 - \$10 = \$90$. The claim is technically true — $10\% \leq 30\%$ — yet the shopper saved exactly a third of the headline. Justify your reading of such claims: “up to” states a limit, not a promise.

Travel: time, fuel and road-safety breaks. Time = distance $\div$ speed: a 240 km trip at an average 80 km/h takes $240 \div 80 = 3$ h. Fuel: a car using 6.5 L per 100 km on a 450 km trip uses $4.5 \times 6.5 = 29.25$ L, and at \$1.92 per litre that fuel costs $29.25 \times \$1.92 = \$56.16$. Road-safety rule used throughout this section: **take a 15-min break after every 2 h of driving, counting a break only if it falls before you arrive**. Five hours of driving then means breaks at the 2 h and 4 h marks — $2 \times 15 = 30$ min — so the door-to-door time is 5 h 30 min.

Scheduling and timetabling (§4D). Read durations across a timetable row, and work backwards from an arrive-by time. Worked models: a ride from 15:48 to 17:23 takes 95 min, that is 1 h 35 min; and if you must be somewhere at 09:00 with a 40-min walk, you leave by 08:20.

Maps, compass points and GPS (AoS5, §7B, §7C). A scale of 1:25 000 means 1 cm on the map is 25 000 cm on the ground, that is 250 m; so 6 cm on the map is $6 \times 250 = 1500$ m = 1.5 km. Compass points name directions (N, NE, E and so on); the bearing form writes the same direction as an angle from north, so NE is N 45° E (§7B). A GPS display is a rate problem: 12 km to go at an average 40 km/h is $12 \div 40$ h = 18 min, so at 14:05 the arrival time is 14:23 — and a GPS fuel range is a number to check against the distance left, not just to read.

Planners: inputs and outputs (AoS8, §10A, §10E). A planner — a party-costing card, an online calculator — takes **inputs** (headcount, price per head, fixed costs) and returns **outputs** (totals, per-head costs). Change an input and the output changes; choosing inputs so the output fits a constraint is what §10E calls adjusting parameters. Worked model: a \$300 budget with catering at \$8.50 per head and no fixed costs gives $\$300 \div \$8.50 = 35.2941\dots$, that is 35.29 to 2 decimal places. Guests are whole and the budget is a limit, so round **down**: 35 guests cost $35 \times \$8.50 = \$297.50$ (under budget) while 36 would cost \$306.00 (over).

Tools (D11). A GPS, a trip-planner app, a spreadsheet or an online planner can demonstrate and check any of this (§10C, §10D). Every question in this section can still be done with pen, paper and a basic calculator: technology is demonstrated here, never required.

Precision. Carry full precision through your working and round only where the question tells you to — and the question always says how far (“to 1 decimal place”, “correct to the nearest cent”, “to the nearest whole number”). Money rounds to the nearest cent (§2C); clock times are written in 24-hour time.

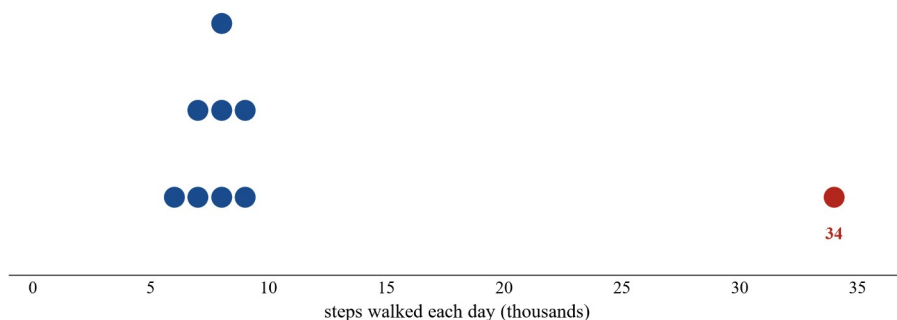
About the data in this section. The step counts, sleep logs, timetables, fuel prices, maps, app screens and planner cards here are **made up** (not real): pretend apps, pretend towns and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Worked examples

Example 1 — scaffolded

Maree’s phone app counts her steps each day. The dot plot shows nine days of data, in thousands of steps. A fitness blog posts: “Maree averages over 10 000 steps a day!” Find the mean (to 1 decimal place), the median and the range of the data, in thousands of steps, then critically analyse the blog’s claim.

Maree's walking app — 9 days of step counts



Made-up data: every step count in the dot plot is made up for this section.

Working

Comment

Stage 1 — Identify: read the nine values off the dot plot; mean = $\text{sum} \div 9$ (round to 1 dp), median = the middle value once sorted, range = largest – smallest. Then test the claim against both measures of centre.

A dot plot shows every value, so the shape is visible: one dot sits far to the right.

Stage 2 — Act: sorted (thousands): 6, 7, 7, 8, 8, 8, 9, 9, 34. Sum = 96, so mean = $96 \div 9 = 10.6666\dots = 10.7$ to 1 dp.

Nine values: the median is the 5th of the sorted list.

Median = 8 (the 5th value). Range = $34 - 6 = 28$.

The 34 is the far-out dot — an outlier (§8D).

Stage 3 — Evaluate: only 1 of the 9 days reached 10 thousand steps, so “a typical day over 10 000” is false even though the mean is 10.7. Drop the outlier: the other 8 days sum to 62, mean $62 \div 8 = 7.75$ — the single 34-day drags the mean from 7.75 up to 10.7.

The median (8) barely moves when the outlier goes; the mean jumps. That is the tell.

Stage 4 — Report: “Mean 10.7 thousand steps (to 1 dp), median 8 thousand, range 28 thousand. The blog’s claim is true only for the mean, and that mean rides on one outlier day; the median of 8 thousand is the honest picture of Maree’s typical day.”

Justify: name the measure you trust and say why — that is the Unit 4 verb.

Example 2 — scaffolded

Jordan starts work at Central at 09:00, and the workplace rule is to be at the desk 10 minutes early, so Jordan must arrive by 08:50. The Lakeside line timetable is shown below.

LAKESIDE LINE	
weekday departures — Lakeside to Central	
Departs Lakeside	Arrives Central
06:52	07:39
07:22	08:09
07:52	08:44
08:22	09:09
all times are 24-hour time	

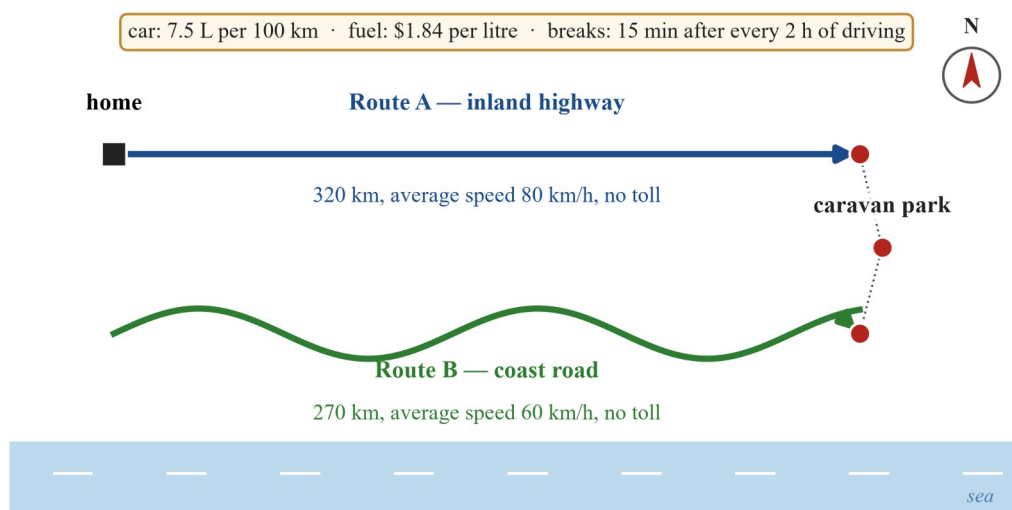
Made-up data: the service numbers and every time in this timetable are made up for this section.

- How long is the journey on the 07:22 service?
- Which is the latest service that gets Jordan in by 08:50, and when does it arrive?
- One morning Jordan reaches the platform 3 minutes after the service from (b) departs. Which service does Jordan catch instead, and how late for work is Jordan?

Working	Comment
Stage 1 — Identify: duration of each service = arrival – departure; then pick the latest departure whose arrival is 08:50 or earlier; then compare the new arrival with 09:00.	A timetable row is one service: read across, not down.
Stage 2 — Act: (a) 07:22 → 08:09 is 47 min. All four durations: 47, 47, 52 and 47 min.	Three of the four services agree at 47 min, so 47 is the line's normal run.
(b) Arrivals against 08:50: 07:39 ✓, 08:09 ✓, 08:44 ✓, 09:09 ✗. Latest usable departure: 07:52, arriving 08:44.	08:44 leaves 6 min of spare — tight, but inside the rule.
(c) On the platform at 07:55; the next service is the 08:22, arriving 09:09. Late by 09:09 – 09:00 = 9 min.	Services run every 30 min, so missing one by 3 min costs half an hour of waiting.
Stage 3 — Evaluate: 08:44 + 6 min = 08:50 ✓ the rule is met exactly; 09:09 is 9 min past 09:00 ✓; and the 08:22 departs 30 min after the 07:52 ✓, which is why the 3-min miss hurts.	The cross-checks tie all three parts to the one timetable.
Stage 4 — Report: “(a) 47 min. (b) The 07:52, arriving 08:44. (c) Jordan catches the 08:22 and arrives 09:09 — 9 min late for work.”	Reorganising a plan when it breaks is exactly what this situation area is about.

Example 3 — unscaffolded

A family is driving to the coast for a holiday. The map shows two routes from home to the caravan park. Their car uses 7.5 L of fuel per 100 km, fuel costs \$1.84 per litre, and the driver takes a 15-min break after every 2 h of driving. They leave at 08:30.



- For each route, find the driving time and the fuel cost.
- For each route, find the door-to-door time including breaks, and the arrival time.
- Choose a route and justify your choice using both cost and time.

Stage 1 — Identify. Driving time = distance ÷ average speed; fuel = (km ÷ 100) × 7.5 L, then × \$1.84; breaks come from the 2-hour rule; door-to-door = driving + breaks; arrival = 08:30 + door-to-door. Part (c) needs the money and the clock together, so compute both for both routes.

Stage 2 — Act. Route A: $320 \div 80 = 4$ h driving. Fuel: $3.2 \times 7.5 = 24$ L; cost $24 \times \$1.84 = \$44.16$. Breaks: one, at the 2 h mark (the 4 h mark is arrival, so no break falls before it) → 15 min. Door-to-door 4 h 15 min; arrive 12:45.

Route B: $270 \div 60 = 4.5 \text{ h} = 4 \text{ h } 30 \text{ min}$ driving. Fuel: $2.7 \times 7.5 = 20.25 \text{ L}$; cost $20.25 \times \$1.84 = \$37.26$. Breaks at the 2 h and 4 h marks $\rightarrow 2 \times 15 = 30 \text{ min}$. Door-to-door 5 h; arrive 13:30.

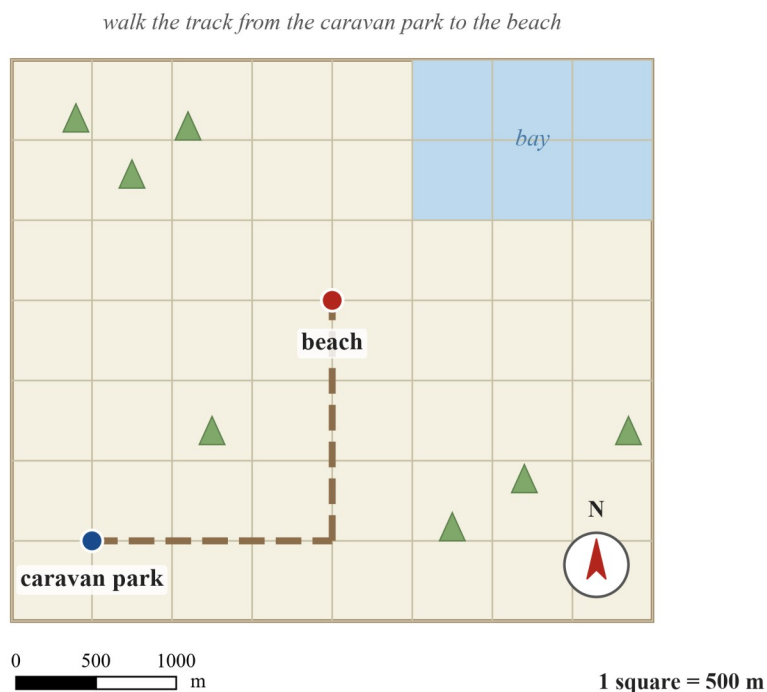
Stage 3 — Evaluate. Fuel cross-check: B is 50 km shorter, which is $0.5 \times 7.5 = 3.75 \text{ L}$ less, and $3.75 \times \$1.84 = \$6.90$ — exactly the gap $\$44.16 - \$37.26 = \$6.90$ ✓. Time cross-check: 4 h 15 min against 5 h is a 45-min gap, consistent with B's slower speed and its extra break ✓. Both arrival times sit inside the day ✓.

Stage 4 — Report.

$\therefore$ Route A costs \$44.16 in fuel and takes 4 h 15 min door-to-door (arrive 12:45); Route B costs \$37.26 and takes 5 h (arrive 13:30). Choosing Route A is justified: the extra \$6.90 of fuel buys 45 min — about \$0.15 per minute of time saved, to the nearest cent — and puts the family at the caravan park 45 min earlier; Route B would be the choice only if the budget matters more than the clock, since it is \$6.90 cheaper.

Example 4 — unscaffolded

The grid map below shows a holiday park in which 1 square represents 500 m. A walking track runs from the caravan park 3 squares east, then 3 squares north, to the beach. The family walks at an average 4 km/h and leaves the caravan park at 09:20.



- Find the length of the track walk, in km.
- State the direction of the beach from the caravan park as a compass point and as a bearing.
- Find the time the walk takes and the arrival time at the beach.
- State the compass point for the return walk.

Stage 1 — Identify. The track follows grid lines, so its length is the number of squares along the legs $\times 500 \text{ m}$. The overall direction comes from combining the east and north legs, and the bearing form (§7B) writes it as an angle from north. Time = distance $\div$ speed, and the return direction reverses the outward one.

Stage 2 — Act. Squares: $3 + 3 = 6$. Distance: $6 \times 500 = 3000 \text{ m} = 3 \text{ km}$. Equal east and north legs put the beach exactly between north and east: compass point NE, bearing $N 45^\circ E$. Time: $3 \div 4 \text{ h} = 0.75 \text{ h} = 45 \text{ min}$; $09:20 + 45 \text{ min} = 10:05$. Return: reversing NE flips both halves, giving SW.

Stage 3 — Evaluate. At 4 km/h the family covers 1 km every 15 min, so 3 km should take $3 \times 15 = 45 \text{ min}$ ✓ — the same as the division. Reversing NE turns north to south and east to west, giving SW ✓; and a 45-min walk from 09:20 lands well inside the morning ✓.

Stage 4 — Report.

∴ the track walk is 3 km long; the beach lies NE of the caravan park, bearing $N 45^{\circ} E$; the walk takes 45 min, so the family arrives at 10:05; and the return walk heads SW.

Practice questions

Scaffolded

Q1. A sleep app records hours of sleep per night for one week: 8, 7, 9, 7, 8, 10, 7. *Made-up data: every value in this list is made up for this section.* (a) Find the mean hours of sleep per night. (b) Find the median. (c) Find the range.

Q2. A morning-peak bus timetable is shown.

Service	Departs Wattle Park	Arrives CBD
1	07:10	07:52
2	07:40	08:25
3	08:10	08:55

Made-up data: the service numbers and every time in this table are made up for this section. (a) How long is the journey on the 07:10 service? (b) Mia must be in the CBD by 08:30. Which is the latest service she can catch, and when does it arrive? (c) If Mia catches the 08:10 service, how early or late is she for a 09:00 start?

Q3. A walking map uses a scale of 1:25 000. (a) How many metres on the ground does 1 cm on the map represent? (b) A track measures 7 cm on the map. Find its real length in metres, and in km. (c) A 3 km walk is drawn on the same map. How many cm long is it on the map?

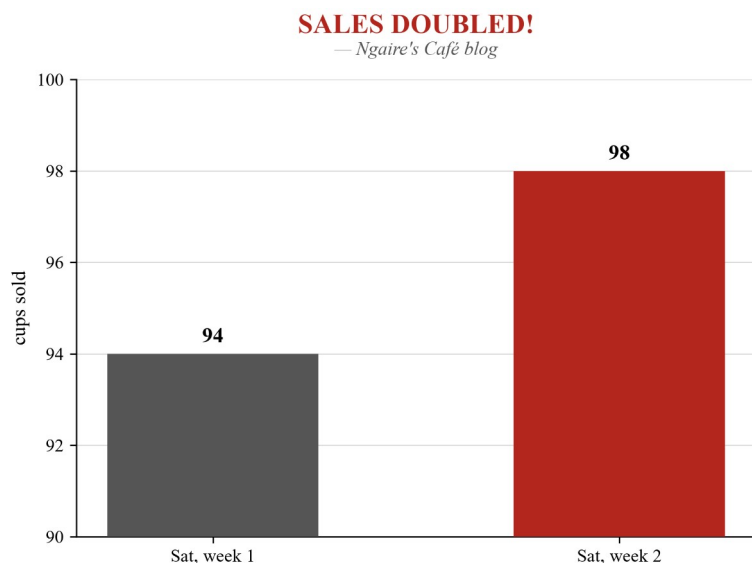
Q4. A camp grid map labels a lookout as lying exactly between north and east of the camp. (a) Name that compass point. (b) Name the compass point for the return walk from the lookout to the camp. (c) Write the outward direction as a bearing in the form used in §7B.

Q5. Three workmates car-pool. The car uses 8 L of fuel per 100 km and their shared trip is 180 km. Fuel costs \$1.90 per litre. (a) How many litres of fuel does the trip use? (b) Find the fuel cost for the trip. (c) The three workmates split the fuel cost equally. How much does each pay?

Q6. A party planner takes these inputs: catering \$12.40 per head, room hire \$45 (fixed), guests 25. (a) Find the planner's catering output. (b) Find the planner's total output. (c) Adjust the guest input to 30. Find the new catering output and the new total output.

Unscaffolded

Q7. A café blog posts the graph below about its Saturday coffee sales.



Made-up data: the cup counts in the graph are made up for this section. (a) How many more cups were sold in week 2 than in week 1? (b) Find the percentage increase from week 1 to week 2, to 1 decimal place. (c) Critically analyse the blog's "SALES DOUBLED!" claim. Justify your answer with a calculation.

Q8. A waiter records his tips (\$) over ten shifts: 12, 15, 14, 13, 95, 16, 14, 12, 15, 14. *Made-up data: every value in this list is made up for this section.* (a) Find the mean tip. (b) Find the median tip. (c) Find the range. (d) Which measure of centre better represents a typical shift? Justify your choice.

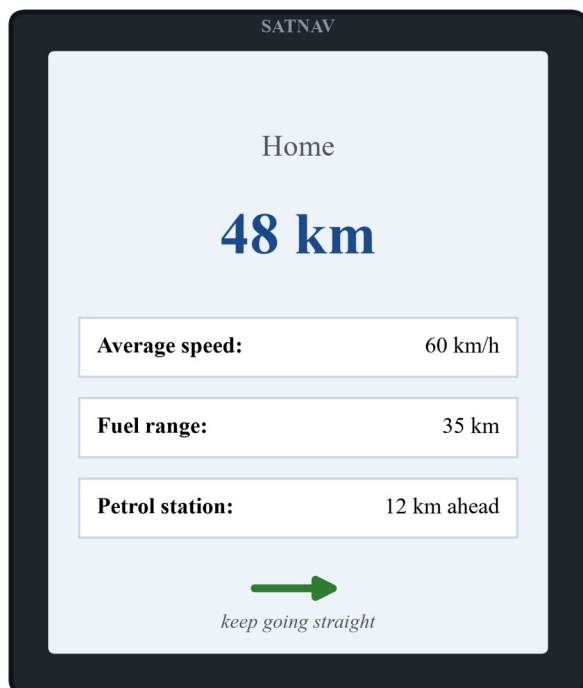
Q9. A family plans a 480 km drive at an average 80 km/h, with a 15-min break after every 2 h of driving. (a) Find the driving time. (b) How many breaks are taken, and what is the door-to-door time? (c) They leave at 08:15. What time do they arrive?

Q10. The map below shows Rivertown, in which 1 square represents 250 m and walking tracks follow the grid lines.



- State the compass point of the hospital from the station.
- Find the walking distance from the station to the hospital along the grid lines, in km.
- State the direction and the walking distance from the station to the market.
- Describe the walk from the market to the hospital along the grid lines (directions and number of squares), and find its length in km.

Q11. The GPS screen below is from a car heading home.



- At the average speed shown, how many minutes does the car take to reach home?
- If the time now is 17:35, what is the arrival time?
- Evaluate whether the car can reach home on the fuel left, and justify your answer using the display. How many km of the trip remain after the petrol station?

Q12. Ana commutes 18 km each way, five days a week. Her car uses 7 L per 100 km, fuel costs \$1.85 per litre, and parking costs \$9 per day. The train alternative costs \$5.40 per trip and takes 38 min per ride plus a 6-min walk at each end; driving takes 30 min door-to-door each way. (a) Find the fuel Ana uses per day in L, and its cost correct to the nearest cent. (b) Find the daily cost of driving (fuel plus parking) correct to the nearest cent, and the weekly cost over 5 days. (c) Find the weekly train cost (two trips a day) and the weekly saving compared with driving. (d) Find the train's door-to-door time each way and the extra time per week compared with driving. Use your numbers from (c) and (d) to justify one option for Ana.

Q13. The reunion planner card below shows the inputs a family has typed in.

REUNION PARTY PLANNER	
type in your inputs — the planner works out the cost	
INPUTS	
Guests	45
Catering (per head)	\$14.50
Hall hire (fixed)	\$120
Entertainment (fixed)	\$85
budget for the day: \$800	

- Find the planner's catering output.
- Find the planner's total output for the day.
- Find the total cost per head, correct to the nearest cent.
- The family's budget is the \$800 shown on the card. Keeping the hall and entertainment inputs, adjust the guest input to the largest whole number of guests the budget allows. Show your rounding and check your answer.

Q14. Saturday plan: chores at home finish at 13:30; the netball match starts at 15:00 at a centre 25 min drive away; the family wants to arrive 30 min before the start. (a) Find the arrive-by time and the leave-by time, and how much spare time that leaves at home after chores. (b) The match runs for 90 min. What time does it finish? (c) The drive home takes 25 min. What time is the family home, and how long is the gap until dinner at 18:30? (d) Reorganise: the chores run 30 min over and finish at 14:00, and the family leaves straight away. What time do they arrive, and do they still make the arrive-by time? By how much?

Q15. A cycling app logs kilometres per day over a fortnight: 12, 15, 0, 18, 14, 22, 16, 0, 13, 17, 15, 20, 14, 16 (a 0 is a rest day). The rider's goal was to average at least 15 km per day across the fortnight. *Made-up data: every value in this list is made up for this section.* (a) Find the total kilometres ridden. (b) Find the mean (to 1 decimal place), the median and the range of the 14 daily values. (c) Was the goal met? Justify your answer with a statistic. (d) Find the mean over the 12 riding days only, and explain in one sentence why it differs from the mean in (b).

Q16. A trip-planner app offers two routes from home to the airport, shown below, with the car's fuel figure and today's fuel price.

TRIP PLANNER — Home to Airport

Route 1 — city then freeway

38 km

45 min

toll \$8.60

Route 2 — main road

52 km

58 min

no toll

your car: 6.5 L per 100 km fuel price: \$1.90 per litre

tap a route to start navigation

- (a) Find Route 1's fuel use in L and its fuel cost, correct to the nearest cent.
- (b) Find the total cost of each route (fuel plus any toll), correct to the nearest cent.
- (c) Evaluate the choice: how much time does Route 1 save, and what extra cost does it add? Justify which route you would take.

Q17. Two coastal towns advertise their holiday weather. Daily maximum temperatures (°C) over one week: Town A: 24, 26, 23, 27, 25, 26, 24. Town B: 21, 22, 28, 30, 23, 20, 22. *Made-up data: every value in these lists is made up for this section.* (a) Find the mean daily maximum for each town, to 1 decimal place. (b) Find the range for each town. (c) The family wants a warm, steady beach week. Which town do you choose? Justify your choice with both statistics.

Q18. A family of 2 adults and 3 children plans a day at the city aquarium. Entry tickets are \$32.50 per adult and \$21.00 per child; lunch costs \$15 per person; parking is \$27.50 for the day. The train ride to the city takes 52 min, and the walk from the station is 500 m to the corner then 300 m to the aquarium entrance, at an average 4 km/h. Trains back home depart at 56 minutes past each hour. (a) Find the total cost of the entry tickets. (b) Find the total cost of the day and the cost per person. The family budgets \$250: does the day fit, and what is left over? (c) They leave home at 10:12. What time do they reach the aquarium entrance? (d) They leave the aquarium at 15:30 and walk back at the same pace. Which train do they catch, and what time are they home?

Answers

Q1. (a) 8 h. (b) 8 h. (c) 3 h. **Q2.** (a) 42 min. (b) The 07:40, arriving 08:25. (c) 5 min early. **Q3.** (a) 250 m. (b) 1750 m = 1.75 km. (c) 12 cm. **Q4.** (a) NE. (b) SW. (c) N 45° E. **Q5.** (a) 14.4 L. (b) \$27.36. (c) \$9.12 each. **Q6.** (a) \$310.00. (b) \$355.00. (c) catering \$372.00; total \$417.00. **Q7.** (a) 4 cups. (b) 4.3% (to 1 dp). (c) false — doubling 94 would need 188 cups. **Q8.** (a) \$22. (b) \$14. (c) \$83. (d) the median — the \$95 outlier pulls the mean up. **Q9.** (a) 6 h. (b) 2 breaks (30 min); door-to-door 6 h 30 min. (c) 14:45. **Q10.** (a) NE. (b) 1.5 km. (c) due west (W); 1 km. (d) 7 squares E then 3 squares N; 2.5 km. **Q11.** (a) 48 min. (b) 18:23. (c) no — 35 km of range against 48 km to go, 13 km short; 36 km remain after the petrol station. **Q12.** (a) 2.52 L; \$4.66 (nearest cent). (b) \$13.66 per day; \$68.31 per week. (c) \$54.00; saving \$14.31. (d) 50 min each way; 3 h 20 min extra per week; either option can be justified. **Q13.** (a) \$652.50. (b) \$857.50. (c) \$19.06 (nearest cent). (d) 41 guests (\$799.50; 42 would cost \$814.00). **Q14.** (a) arrive by 14:30; leave by 14:05; 35 min spare. (b) 16:30. (c) 16:55; gap 1 h 35 min. (d) arrive 14:25; yes, 5 min to spare. **Q15.** (a) 192 km. (b) mean 13.7 km (to 1 dp); median 15 km; range 22 km. (c) no — 13.7 km is below the 15 km goal. (d) 16 km; the two rest days drag the fortnight mean down. **Q16.** (a) 2.47 L; \$4.69 (nearest cent). (b) Route 1 \$13.29; Route 2 \$6.42 (nearest cent). (c) 13 min saved; \$6.87 extra; either route can be justified. **Q17.** (a) A 25.0 °C; B 23.7 °C (to 1 dp). (b) A 4 °C; B 10 °C. (c) Town A — warmer mean and a much smaller range. **Q18.** (a) \$128.00. (b) \$230.50; \$46.10 per person; fits, with \$19.50 left. (c) 11:16. (d) the 15:56; home at 16:48.

Fully-worked solutions

Q1. (a) Sum = $8 + 7 + 9 + 7 + 8 + 10 + 7 = 56$; mean = $56 \div 7 = 8$ h exactly. (b) Sorted: 7, 7, 7, 8, 8, 9, 10; the median is the 4th value = 8 h. (c) Range = $10 - 7 = 3$ h. Evaluate: mean = median = 8 with a small range — a steady week with no outlier ✓.

Q2. (a) 07:10 → 07:52 is 42 min. (b) Arrivals against 08:30: 07:52 ✓, 08:25 ✓, 08:55 ✗ — so the latest service is the 07:40, arriving 08:25. (c) 08:55 is 5 min before 09:00, so Mia is 5 min early. Evaluate: the durations 42, 45 and 45 min are consistent for one route in building traffic ✓.

Q3. (a) $1:25\ 000 \rightarrow 1\ \text{cm} = 25\ 000\ \text{cm} = 250\ \text{m}$. (b) $7 \times 250 = 1750\ \text{m} = 1.75\ \text{km}$. (c) $3\ \text{km} = 3000\ \text{m}$; $3000 \div 250 = 12\ \text{cm}$. Evaluate: 12 cm at 250 m per cm rebuilds 3000 m ✓.

Q4. (a) Exactly between north and east is NE. (b) The return reverses both halves: SW. (c) NE as a bearing: N 45° E (§7B). Evaluate: 45° is half of the 90° from N to E, which is what “exactly between” means ✓.

Q5. (a) 180 km is 1.8 lots of 100 km: $1.8 \times 8 = 14.4\ \text{L}$. (b) $14.4 \times \$1.90 = \$27.36$. (c) $\$27.36 \div 3 = \$9.12$ each. Evaluate: $3 \times \$9.12 = \$27.36$ ✓ — the shares rebuild the bill.

Q6. (a) $25 \times \$12.40 = \$310.00$. (b) $\$310.00 + \$45 = \$355.00$. (c) $30 \times \$12.40 = \$372.00$; total $\$372.00 + \$45 = \$417.00$. Evaluate: 5 extra guests add $5 \times \$12.40 = \$62.00$, and $\$355.00 + \$62.00 = \$417.00$ ✓ — the fixed room hire does not change.

Q7. (a) $98 - 94 = 4$ cups. (b) $\frac{4}{94} \times 100 = 4.2553\dots = 4.3\%$ to 1 decimal place. (c) Doubled would mean $2 \times 94 = 188$ cups; 98 is nowhere near 188, so the claim is false. The graph makes the claim look plausible because its axis starts at 90 instead of 0 (§8B): the week-2 bar looks about twice as tall while sales rose only 4.3%. Evaluate: a 4-cup rise on 94 is a small percentage, which matches two bars of nearly equal height on a zero-based axis ✓.

Q8. (a) Sum = 220; mean = $220 \div 10 = \$22$. (b) Sorted: 12, 12, 13, 14, 14, 14, 15, 15, 16, 95; median = $(14 + 14) \div 2 = \$14$. (c) Range = $95 - 12 = \$83$. (d) The median. Nine of the ten shifts sit between \$12 and \$16, so \$14 is a typical night; the single \$95 shift pulls the mean up to \$22, above every shift but one (§8D). Evaluate: mean $\$22 >$ median $\$14$ with a range of \$83 — the signature of one high outlier ✓.

Q9. (a) $480 \div 80 = 6$ h. (b) Breaks fall at the 2 h and 4 h marks (the 6 h mark is arrival, so no break there): 2 breaks = 30 min. Door-to-door 6 h 30 min. (c) $08:15 + 6\ \text{h}\ 30\ \text{min} = 14:45$. Evaluate: 6 h at 80 km/h rebuilds 480 km ✓, and two breaks in six hours matches the every-2-h rule ✓.

Q10. (a) The hospital is 3 squares E and 3 squares N of the station — equal legs, so NE. (b) $3 + 3 = 6$ squares; $6 \times 250 = 1500 \text{ m} = 1.5 \text{ km}$. (c) Due west (W); 4 squares = $4 \times 250 = 1000 \text{ m} = 1 \text{ km}$. (d) 7 squares E then 3 squares N (or 3 N then 7 E); $7 + 3 = 10$ squares, $10 \times 250 = 2500 \text{ m} = 2.5 \text{ km}$. Evaluate: every leg follows a grid line, so the squares add; 10 squares at 250 m rebuilds 2.5 km ✓.

Q11. (a) $48 \div 60 \text{ h} = 0.8 \text{ h} = 48 \text{ min}$. (b) $17:35 + 48 \text{ min} = 18:23$. (c) No. The fuel range (35 km) is less than the distance to go (48 km) — the car is 13 km short — so it cannot reach home on the fuel left. The petrol station is 12 km ahead, and after it $48 - 12 = 36 \text{ km}$ of the trip remain, so filling in there covers the rest. Evaluate: 48 min at 60 km/h is 48 km ✓, matching the display; and $35 + 13 = 48$ ✓ — the shortfall adds back to the trip.

Q12. (a) 36 km per day is $36 \div 100 = 0.36$ lots of 100 km; fuel = $0.36 \times 7 = 2.52 \text{ L}$. Cost = $2.52 \times \$1.85 = \$4.662 = \$4.66$ to the nearest cent. (b) Daily: $\$4.662 + \$9 = \$13.662 = \$13.66$ to the nearest cent. Weekly: $\$13.662 \times 5 = \$68.31$ exactly. (c) Train: $5 \times 2 \times \$5.40 = \$54.00$ a week. Saving = $\$68.31 - \$54.00 = \$14.31$. (d) Train door-to-door: $38 + 6 + 6 = 50 \text{ min}$ each way against 30 min driving — 20 min extra each way, 40 min per day, $5 \times 40 = 200 \text{ min} = 3 \text{ h } 20 \text{ min}$ per week. Justify (one defensible line): the train saves \$14.31 a week but costs 3 h 20 min of Ana's time; if that time can be used (reading, calls, study) the train is the better buy, and if Ana's hours are tight then \$14.31 is a cheap price for 3 h 20 min back. Evaluate: $\$54.00 + \$14.31 = \$68.31$ ✓, and 200 min = 3 h 20 min ✓.

Q13. (a) $45 \times \$14.50 = \$652.50$. (b) Fixed inputs: $\$120 + \$85 = \$205$. Total: $\$652.50 + \$205 = \$857.50$. (c) $\$857.50 \div 45 = 19.0555... = \$19.06$ to the nearest cent. (d) Available for catering: $\$800 - \$205 = \$595$. Then $\$595 \div \$14.50 = 41.0344...;$ guests are whole and the budget is a limit, so round **down** to 41. Check: $41 \times \$14.50 + \$205 = \$799.50 \leq \$800$ ✓, while 42 guests would cost \$814.00 — over. Evaluate: \$799.50 sits just under the budget and one more head jumps \$14.50 past it ✓ — 41 is the largest guest input that fits.

Q14. (a) Arrive by: $15:00 - 30 \text{ min} = 14:30$. Leave by: $14:30 - 25 \text{ min} = 14:05$. Spare after chores: $13:30 \rightarrow 14:05 = 35 \text{ min}$. (b) $15:00 + 90 \text{ min} = 16:30$. (c) $16:30 + 25 \text{ min} = 16:55$. Gap to 18:30 = 95 min = 1 h 35 min. (d) Leave at 14:00; arrive $14:00 + 25 \text{ min} = 14:25$, which is before 14:30 ✓ — still 5 min of spare. Evaluate: working backwards twice (start $\rightarrow$ arrive-by $\rightarrow$ leave-by) and forwards twice all land inside the day ✓.

Q15. (a) Total = 192 km. (b) Mean = $192 \div 14 = 13.7142... = 13.7 \text{ km}$ to 1 decimal place. Sorted, the 7th and 8th values are 15 and 15, so the median = 15 km. Range = $22 - 0 = 22 \text{ km}$. (c) No: the mean of 13.7 km per day is below the 15 km goal. (d) Riding days: $192 \div 12 = 16 \text{ km}$ exactly. The two rest days (0 km) sit inside the fortnight mean but not inside this one, so the riding-day mean is higher. Evaluate: $12 \times 16 = 192$ ✓ rebuilds the total; and $14 \times 13.7 = 191.8$, close to 192 (the small gap is the 1 dp rounding) ✓.

Q16. (a) Route 1: $38 \div 100 \times 6.5 = 2.47 \text{ L}$; fuel cost = $2.47 \times \$1.90 = \$4.693 = \$4.69$ to the nearest cent. (b) Route 1 total: $\$4.693 + \$8.60 = \$13.293 = \$13.29$ to the nearest cent. Route 2: $52 \div 100 \times 6.5 = 3.38 \text{ L}$; fuel cost = $3.38 \times \$1.90 = \$6.422 = \$6.42$; no toll, so the total is \$6.42. (c) Time saved: $58 - 45 = 13 \text{ min}$. Extra cost: $\$13.293 - \$6.422 = \$6.871 = \$6.87$ to the nearest cent. Justify (one defensible line): 13 min for \$6.87 is worth taking when a flight is close; on a relaxed day the main road keeps \$6.87 in your pocket. Evaluate: carrying the unrounded \$4.693 and \$6.422 through to the last step keeps the cents honest — rounding early would shift the difference ✓.

Q17. (a) Town A: sum 175; mean = $175 \div 7 = 25.0 \text{ }^\circ\text{C}$ to 1 dp (exact). Town B: sum 166; mean = $166 \div 7 = 23.7142... = 23.7 \text{ }^\circ\text{C}$ to 1 dp. (b) A: $27 - 23 = 4 \text{ }^\circ\text{C}$. B: $30 - 20 = 10 \text{ }^\circ\text{C}$. (c) Town A: its mean is warmer (25.0 against 23.7 $^\circ\text{C}$) and its range is less than half of B's (4 against 10 $^\circ\text{C}$), so A is both warmer and steadier — the reliable beach week. Evaluate: A's seven days all sit within 4 $^\circ\text{C}$ of each other while B swings through 10 $^\circ\text{C}$ — the spreads confirm what the means suggest ✓.

Q18. (a) Tickets: $2 \times \$32.50 + 3 \times \$21.00 = \$65.00 + \$63.00 = \$128.00$. (b) Lunch: $5 \times \$15 = \$75.00$. Total: $\$128.00 + \$75.00 + \$27.50 = \$230.50$. Per person: $\$230.50 \div 5 = \$46.10$. Budget: $\$230.50 \leq \$250$ ✓, with $\$250 - \$230.50 = \$19.50$ left over. (c) Train: $10:12 + 52 \text{ min} = 11:04$. Walk: $500 + 300 = 800 \text{ m}$ at $4 \text{ km/h} = 12 \text{ min}$. At the entrance: $11:04 + 12 \text{ min} = 11:16$. (d) Walk back: $15:30 + 12 \text{ min} = 15:42$ at the station. Trains leave at 56 min past each hour, so the first service after 15:42 is the 15:56. Home: $15:56 + 52 \text{ min} = 16:48$. Evaluate: $5 \times \$46.10 = \$230.50$ ✓ — the shares rebuild the day; and arriving 11:16 leaves the whole middle of the day inside the aquarium ✓, a realistic visit.

Theory

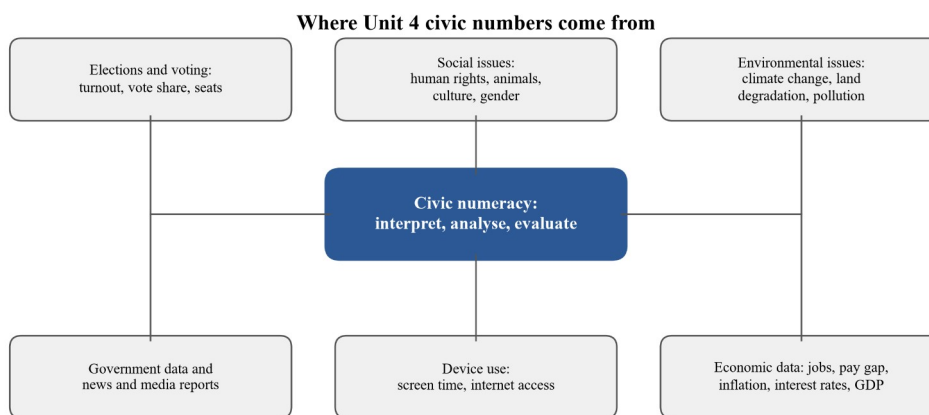
Civic numeracy in Unit 4. Section 6B showed how to compute civic numbers: turnout rates, unemployment rates, price indices and the rest. Unit 4 asks for more. The study design (Unit 4, Outcome 1) describes civic numeracy as making sense of the statistics and other numbers that governments, the news media and other data sources put out. You understand them, interpret them and judge them, so you can deal with what life asks of you in your local area, your state, the nation and the world.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-07.

Notice the verbs. In Unit 4 you **apply** the maths, **critically analyse** the data, **evaluate** claims and **justify** your conclusions. Computing the number is only the middle of the job. The two big jobs around it are:

- **interpreting data** (Area of Study 6) — reading tables and graphs, choosing the right measure of centre and spread, describing trends, and drawing conclusions; and
- **testing claims with likelihood** (Area of Study 7) — turning data into probabilities, and checking whether a claim in an advertisement, a headline or a media release actually matches the data.

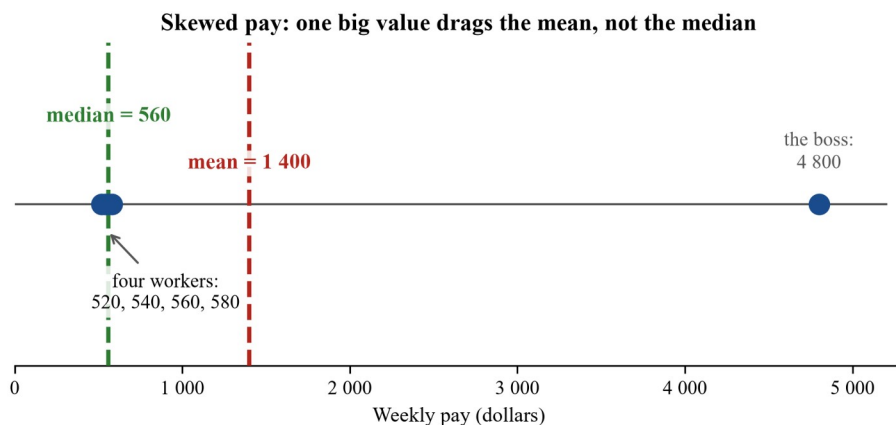
Civic data arrives from six directions, and this section visits all of them.



- **Elections and voting** — turnout, vote shares, seats.
- **Social issues** — data on human rights, animal welfare, and cultural and gender issues.
- **Environmental issues** — climate change, land degradation and pollution, at local, national and global level.
- **Government data and news and media reports** — how residents use government services, and the numbers that appear in news and media reports.
- **Device use** — statistics about how people use phones, computers and the internet, and what governments do with those numbers.
- **Economic data** — unemployment, underemployment, participation, the gender pay gap, inflation, official interest rates and GDP.

Toolkit 1 — interpreting civic data. Chapter 8 built these tools; here is what each one is worth in a civic report.

Mean or median? Civic data about money is usually **skewed**: most values are similar, and a few are very large. The **mean** follows those extreme values; the **median** (the middle value of the ordered data) does not. Five workers at a tiny made-up firm earn \$520, \$540, \$560, \$580 and \$4 800 per week. The mean is $\$7\,000 \div 5 = \$1\,400$, but the median is \$560. A report saying “average pay at the firm is \$1 400” is technically true and badly misleading — four of the five workers earn far less. When pay or income data is skewed, the median is the fairer summary, and reports often say “median” for exactly this reason.



Outliers. An **outlier** is a value that sits far away from all the others. The test used in this book (Section 8D) is the **gap test**: order the data, and look for a value separated from its neighbour by a gap much bigger than the gaps between the other values. An outlier pulls the mean towards it but barely moves the median — so when one is present, report both and say what the outlier is.

Trends. A line graph shows how something changes over time. Describe a trend in three parts: the **direction** (rising, falling, steady), the **speed** (how much per year), and any **turning points** (where the direction changes).

“Unemployment fell” is a start; “unemployment rose from 5.6% to 6.2% during year 1, then fell steadily to 5.4% by the end of year 2” is an analysis.

Counts or rates? “More crimes reported” can simply mean “more people”. A rate ($\text{part} \div \text{whole} \times 100$, or per 100 000 people) lets you compare big places with small ones fairly. Always find the **whole** before you judge a count.

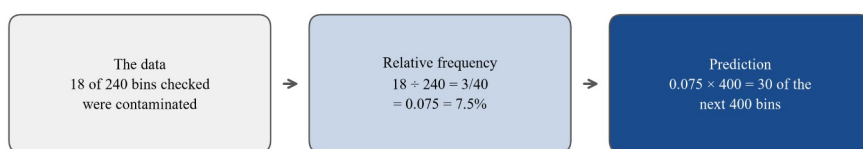
Toolkit 2 — testing claims with likelihood. Chapter 9 built the probability tools; civic life uses them like this.

Probability from data. When outcomes are not equally likely, estimate a probability from past data as a **relative frequency**:

$\text{probability} \approx (\text{number of times it happened}) \div (\text{number of chances})$

In a made-up suburb, 18 of the 240 recycling bins checked last year were contaminated (contained the wrong waste). The estimated probability that a bin chosen at random is contaminated is $18 \div 240 = 3/40 = 0.075 = 7.5\%$. That is an **estimate** — next year’s true proportion may differ a little.

From past data to probability to prediction



Conversions. Claims arrive in different clothes, so convert them to compare: $3/40 = 0.075 = 7.5\%$; “1 in 4” = 25%; “4 in 5” = 80%. A claim of “1 in 4” against data of 22% is close; against data of 7.5% it is way off.

Predictions. Multiply a probability by the number of cases to predict a count: at $3/40$, about $3/40 \times 400 = 30$ of the next 400 bins would be expected to be contaminated.

Small counts make big percentages. If reported crashes at an intersection rise from 3 to 9, that is a rise of $(9 - 3) \div 3 \times 100 = 200\%$ — true arithmetic on tiny counts. Six extra crashes is serious for the people involved, but “up 200%” is designed to shock. Always ask what the counts behind a percentage were.

Civic words, refreshed. These were defined in 6B; Unit 4 uses them constantly, so they are worth repeating.

- **Unemployment rate:** $\text{unemployed} \div \text{labour force} \times 100$. The **labour force** is employed + unemployed (people with no paid work who are actively looking).

- **Participation rate:** $\text{labour force} \div \text{working-age population} \times 100$. For example, a region with 2 280 000 employed people and 120 000 unemployed has a labour force of 2 400 000, so its unemployment rate is $120\,000 \div 2\,400\,000 \times 100 = 5\%$; against a working-age population of 4 000 000, its participation rate is $2\,400\,000 \div 4\,000\,000 \times 100 = 60\%$.
- **Underemployed:** people with part-time work who want more hours. They count as employed, so the unemployment rate does not see them.
- **Gender pay gap:** in this section, the difference between men's and women's average earnings (mean or median), written as a percentage of **men's** earnings. Other definitions exist — for example, comparing the same role only — and they are not interchangeable with this one. If men's median weekly pay is \$1 950 and women's is \$1 716, the gap is \$234 and the pay gap is $234 \div 1\,950 \times 100 = 12\%$. The same facts read as “women earn 88 cents for every dollar men earn”.
- **Inflation:** the percentage rise in prices over a period, measured by a price **index** (a number with a base period set to 100). If an index rises from 108.0 to 112.5, inflation was $(112.5 - 108.0) \div 108.0 \times 100 = 4.166\ldots\%$, which is 4.2% to 1 decimal place.
- **Official interest rate** (the “cash rate”): the interest rate set by the central bank, quoted as a percentage per year.
- **GDP** (gross domestic product): the total value of all the goods and services a country produces in a year. **GDP per person** = $\text{GDP} \div \text{population}$. A made-up country with a GDP of \$330 billion and 12 million people has a GDP per person of $330\,000\,000\,000 \div 12\,000\,000 = \$27\,500$.

Percentage points and per cent are still different things (6B): a rate moving from 5.8% to 6.4% rose 0.6 **percentage points**, which is a rise of $0.6 \div 5.8 \times 100 = 10.3\%$ to 1 decimal place. Headlines mix the two up; your job is to know which is which.

Before you believe a civic number, ask.

Before you believe a civic number, ask ...

?	?	?	?
What is the WHOLE ? (a percentage needs one)	Count or rate? (more events can just mean more people)	Mean or median? (is the data skewed?)	Percentage points or per cent?
?	?	?	?
Over what period ? (steady, or jumpy?)	Any outliers or extreme values behind the number?	Does the probability match the data?	Who collected it? (is the source stated?)

- What is the **whole**? A percentage without its whole is not a fact yet.
- **Count or rate?** More events can just mean more people.
- **Mean or median?** Which one is the report calling “average”, and is the data skewed?
- **Percentage points or per cent?**
- Over **what period**, and is the trend steady or jumpy?
- Are there **outliers** or extreme values behind the number?
- If it is a chance claim, does the **probability match the data**?
- **Who collected** the data, and is the source stated?

The problem-solving cycle. Unit 4 civic tasks run the same four stages as always. For the media-release claim “Unemployment has fallen steadily — the economy is recovering”:

Stage	What it looks like for this claim
Stage 1 — Identify	The claim is about the unemployment rate over time: $\text{unemployed} \div \text{labour force} \times 100$, quarter by quarter. The word to test is “steadily”.

Stage	What it looks like for this claim
Stage 2 — Act	Read each quarter's rate from the graph, find the changes, and note the highest and lowest points.
Stage 3 — Evaluate	Check whether the fall really was steady, or whether the rate rose in between. Check the size of the fall in percentage points.
Stage 4 — Report	Give a verdict with numbers: the claim is (or is not) supported, quoting the turning points and the overall change.

About the data in this section. Every election, council, region, country, company, charity, survey and gauge in this section is **made up** (not real). The numbers are built for this book so you can practise the maths on data that looks like a real news report. Nothing here is real data about a real place, person, election or organisation.

Worked examples

Example 1 — scaffolded

A made-up shire held a council election. The electoral commission published the turnout (votes cast as a percentage of enrolled voters) for each of its eight booths. The voting machines at one booth were out of order for most of the day.

Booth	Turnout
Central	78%
Eastside	82%
Harbour	76%
Hillcrest	84%
Lakeside	80%
Northend	74%
Southgate	86%
Westvale	41%

Made-up data: the names and every number in this table are made up for this section.

- Find the mean turnout of the eight booths, correct to 1 decimal place.
- Find the median turnout of the eight booths.
- One booth is an outlier. Identify it and give a reason using the gaps in the ordered data.
- Find the mean and the median of the other seven booths.
- A community group says “about 4 in every 5 enrolled voters cast a vote at a typical booth”. Evaluate this claim using your answers to (d).

(a) $78 + 82 + 76 + 84 + 80 + 74 + 86 + 41 = 601$

$601 \div 8 = 75.125$

75.1%, correct to 1 decimal place

(b) ordered: 41, 74, 76, 78, 80, 82, 84, 86

median = $(78 + 80) \div 2 = 79$

(c) $74 - 41 = 33$

gaps between the other values are at most 2

Westvale, 41%, is the outlier

(d) $74 + 76 + 78 + 80 + 82 + 84 + 86 = 560$

mean = $560 \div 7 = 80$

median = 80 (the 4th of 7 values)

(e) $4 \div 5 \times 100 = 80$

80% = mean = median of the seven booths

The claim is supported

Add all eight turnouts.

Divide by the number of booths.

Round as the question asks.

Order the data first — the median needs it.

Eight values, so the median is halfway between the 4th and 5th.

The gap from 41 up to the next value is 33 points.

74, 76, 78, ..., 86 sit 2 apart.

A gap of 33 against gaps of 2 marks it as the odd one out.

Add the seven booths without the outlier.

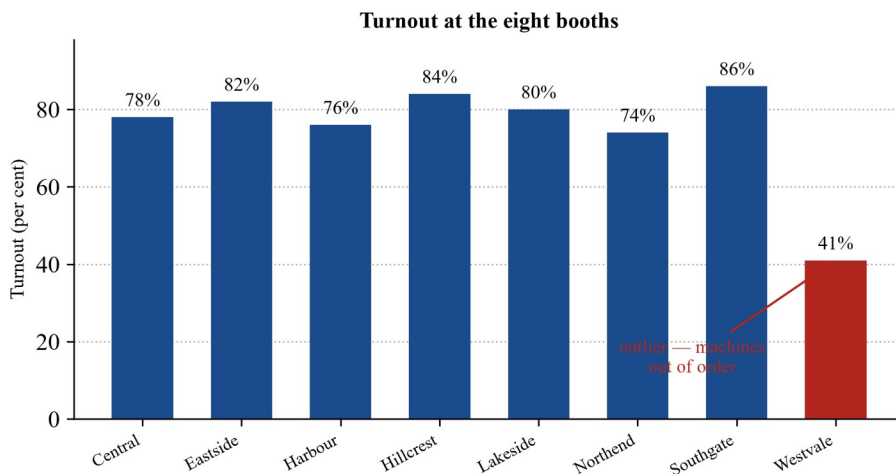
The mean of the seven is 80%.

With the outlier gone, mean and median agree.

Convert the claim to a percentage.

The claim matches both measures.

“About 4 in 5” is exactly the typical booth’s turnout.



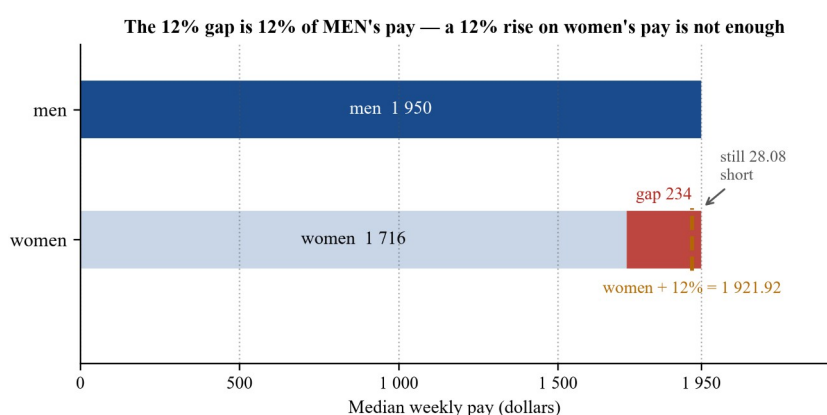
The bar chart shows why the outlier matters: with Westvale included, the mean (75.1%) sits below six of the eight booths — only Westvale (41%) and Northend (74%) are below it. The broken machines made that booth real but unusual — which is what an outlier usually is.

Example 2 — scaffolded

A made-up industry report gives the median weekly earnings of full-time workers in that industry: men \$1 950, women \$1 716.

- Find the difference in the median weekly earnings.
- Find the gender pay gap as a percentage of men’s earnings.
- Find women’s earnings as a percentage of men’s earnings, and evaluate the report’s claim that “women in this industry earn about 88 cents for every dollar a man earns”.
- A journalist writes: “A 12% pay rise for the women would close the gap.” Evaluate this claim. Give the rise actually needed as a percentage, correct to 1 decimal place.

Working	Comment
(a) $1\,950 - 1\,716 = 234$	The gap is \$234 per week.
(b) $234 \div 1\,950 \times 100 = 12$	The whole is men's earnings — that is this section's definition.
The pay gap is 12%	No rounding needed — it comes out exact.
(c) $1\,716 \div 1\,950 \times 100 = 88$	Women's earnings as a percentage of men's.
88% = 88 cents for every dollar	The claim is correct.
(d) rise needed = $234 \div 1\,716 \times 100 = 13.636\dots$	The rise is applied to women's pay, so the whole is \$1 716.
13.6%, correct to 1 decimal place	Round as the question asks.
check: $1\,716 \times 1.12 = 1\,921.92$	What a 12% rise actually delivers.
$\$1\,921.92 < \$1\,950$, short by \$28.08	A 12% rise does not reach men's pay.
The journalist's claim is false	Two different wholes: 12% of \$1 950 is not 12% of \$1 716.



The same gap produced two different percentages — 12% and 13.6% — purely because the whole changed. Percentages of different wholes are not interchangeable, and mixing them up is one of the most common errors in civic reporting.

Example 3 — unscaffolded

A made-up secondary college surveyed 30 students about their recreational screen time (movies, games, social media — not schoolwork) on a typical school day. Each student's time, rounded to the nearest hour, is summarised below.

Screen
time
(hours per
day)

	1	2	3	4	5	6
Number of students	2	7	9	6	4	2

Number of students

Made-up data: the names and every number in this table are made up for this section.

- Find the mean screen time, correct to 1 decimal place.
- Find the median, the mode and the range.
- A news article about the survey claims “students at this school typically spend 4 hours or more a day on recreational screens”. Evaluate this claim.
- One of the 30 surveyed students is chosen at random. Find the probability that this student spends 5 hours or more, as a fraction, a decimal and a percentage.

- (e) Another school in the district has 150 students. Predict how many of them spend 5 hours or more on a typical school day, assuming the same rate as the survey.

For (a), multiply each time by its frequency and add: $1 \times 2 + 2 \times 7 + 3 \times 9 + 4 \times 6 + 5 \times 4 + 6 \times 2 = 2 + 14 + 27 + 24 + 20 + 12 = 99$ hours in total. The mean is $99 \div 30 = 3.3$ hours, correct to 1 decimal place.

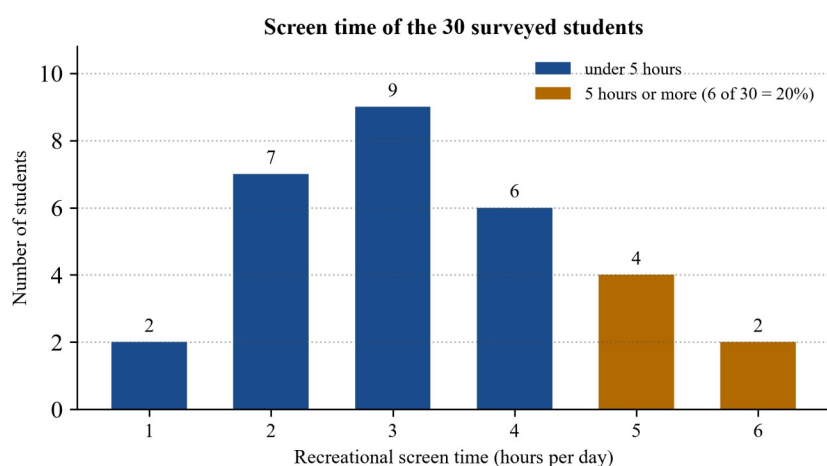
For (b), the 30 ordered values have cumulative counts 2, 9, 18, 24, 28, 30, so the 15th and 16th values are both 3: the median is 3 hours. The most common value is also 3 hours, so the mode is 3 hours. The range is $6 - 1 = 5$ hours.

For (c), all three measures of centre sit below 4 hours: mean 3.3, median 3, mode 3. Count the students at 4 hours or more: $6 + 4 + 2 = 12$ of the 30, which is $12 \div 30 \times 100 = 40\%$, less than half. The word “typically” should describe the centre of the data, and every centre measure says under 4 hours. The claim is **not supported**.

For (d), the students spending 5 hours or more are the 4 at five hours plus the 2 at six hours, so 6 students out of 30. The probability is $6/30 = 1/5 = 0.2 = 20\%$.

For (e), apply the probability to the new group: $1/5 \times 150 = 30$ students.

$\therefore$ the mean is 3.3 hours, the median and mode are 3 hours and the range is 5 hours; the “4 hours or more” claim is not supported by any centre measure; $P(5 \text{ or more hours}) = 1/5 = 0.2 = 20\%$; and about 30 of the 150 students at the other school are predicted to spend 5 hours or more.



Example 4 — unscaffolded

A made-up city’s air authority counts **smoke days** each year: days when the air quality is rated poor because of smoke or dust. The counts for the last ten years are

6, 8, 7, 9, 8, 11, 10, 34, 12, 13

In the year with 34 smoke days, a large bushfire burnt on the edge of the city.

Made-up data: the place and every number here are made up for this section.

- Find the median and the mean of the ten years, the mean correct to 1 decimal place.
- Identify the outlier and give a reason using the gaps in the ordered data.
- Find the mean and the median of the other nine years, the mean correct to 1 decimal place.
- Using the nine years without the fire year, estimate the probability that a year chosen at random from that period had more than 10 smoke days. Give your answer as a fraction, as a decimal correct to 2 decimal places, and as a percentage correct to 1 decimal place.
- A residents’ group tells the council “poor-air days happen about once a fortnight on average”. Evaluate this claim. (A fortnight is two weeks, so “once a fortnight” is about 26 days per year.)

For (a), order the data: 6, 7, 8, 8, 9, 10, 11, 12, 13, 34. Ten values, so the median is halfway between the 5th and 6th: $(9 + 10) \div 2 = 9.5$ days. The sum is $6 + 7 + 8 + 8 + 9 + 10 + 11 + 12 + 13 + 34 = 118$, so the mean is $118 \div 10 = 11.8$ days, correct to 1 decimal place.

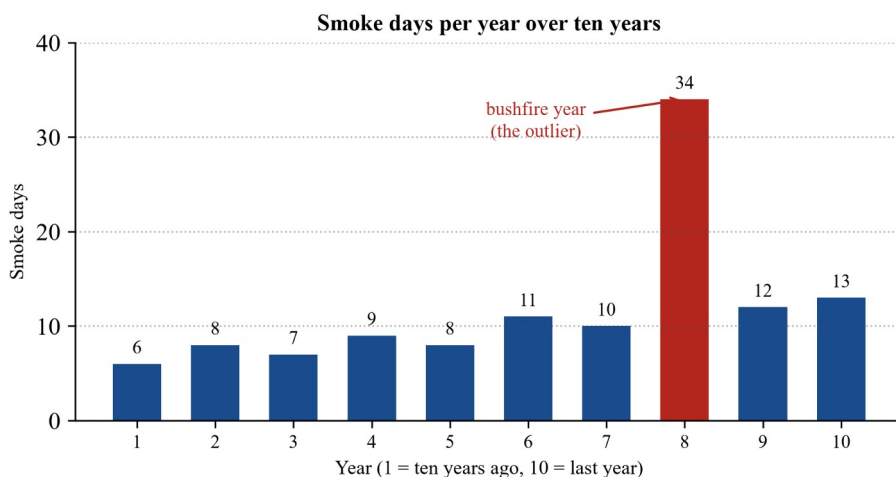
For (b), the gap from 13 up to 34 is 21 days, while every other gap in the ordered data is at most 1. The value 34 (the fire year) is the outlier.

For (c), without the fire year the sum is $118 - 34 = 84$ over 9 years, so the mean is $84 \div 9 = 9.333\dots$, which is 9.3 days correct to 1 decimal place. The median of the nine ordered values 6, 7, 8, 8, 9, 10, 11, 12, 13 is the 5th value, 9 days. Notice the outlier's effect: it dragged the mean from 9.3 up to 11.8, but the median barely moved (9 to 9.5).

For (d), among the nine years, more than 10 smoke days happened in 3 of them (11, 12 and 13). The estimated probability is $3 \div 9 = 1/3 = 0.33$ to 2 decimal places = 33.3% to 1 decimal place.

For (e), “once a fortnight” means about 26 poor-air days per year. The typical year in the data has a median of 9.5 and a nine-year mean of 9.3 — nowhere near 26. Only one year in ten, the fire year with 34, got past 26. The claim is **not supported** as a description of an average year; it would only be true in a serious fire year, and the group should have said so.

$\therefore$ median 9.5 days, mean 11.8 days; the outlier is 34 (gap of 21 against gaps of at most 1); without it the mean is 9.3 and the median is 9; $P(\text{more than 10 smoke days}) = 1/3 = 0.33 = 33.3\%$; and the “once a fortnight” claim (≈ 26 days) is not supported by the average year.



Practice questions

Scaffolded

Q1. In a made-up council election, 52 500 voters were enrolled and 41 475 votes were cast.

- Find the turnout as a percentage of enrolled voters.
- Write the probability that an enrolled voter chosen at random cast a vote, as a decimal.
- A newspaper reported that “more than 4 in every 5 enrolled voters cast a vote”. Evaluate this claim.

Q2. A made-up animal shelter took in 250 animals last year, and 175 of them were adopted.

- Write the fraction of the intake that was adopted, in simplest form.
- Find the probability that an animal from last year's intake, chosen at random, was adopted — as a decimal and as a percentage.
- The shelter expects to take in 320 animals next year. Predict how many will be adopted, assuming the same rate as last year.

Q3. In a made-up town, 24 000 people are in the labour force and 1 560 of them are unemployed.

- Find the unemployment rate.
- Find the number of employed people.
- The mayor says “about 1 in every 15 people in our labour force is unemployed”. Evaluate this claim.

Q4. A made-up city has 38 000 households, and 9 500 of them speak a language other than English at home.

- (a) Find this as a percentage of households.
- (b) Write the same rate in the form “1 in n”, where n is a whole number.
- (c) Find the probability that a household chosen at random speaks only English at home, as a decimal.

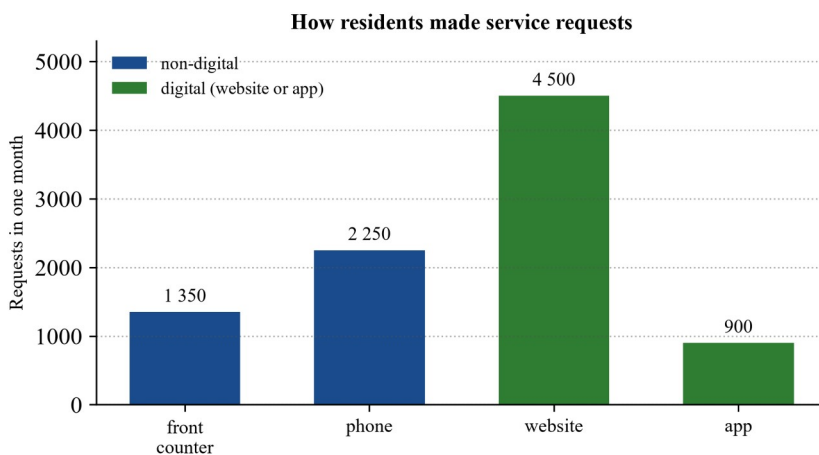
Q5. A made-up environment agency tested nine sites along a river and recorded, at each site, the percentage of water samples that met the safe-swimming standard:

92, 88, 95, 64, 90, 85, 93, 89, 91

Made-up data: the places and every number here are made up for this section.

- (a) Find the mean, correct to 1 decimal place.
- (b) Find the median and the range.
- (c) One site is an outlier. Identify it and give a reason using the gaps in the ordered data.

Q6. A made-up council asked residents how they made a service request during one month. The bar chart shows the results.



Made-up data: the council and every number in the chart are made up for this section.

- (a) Find the total number of requests.
- (b) Find the probability that a request chosen at random came through the phone, as a decimal.
- (c) The council claims “most residents now use a digital channel — the website or the app”. Evaluate this claim.

Un scaffolded

Q7. The table shows a made-up state election for a parliament with 45 seats.

Party	Formal votes	Seats won
Party A	792 000	24
Party B	594 000	14
Party C	270 000	5
Independents	144 000	2
Total	1 800 000	45

Made-up data: the names and every number in this table are made up for this section.

- Find each party's share of the formal vote, as a percentage.
- Find Party A's share of the seats as a percentage, correct to 1 decimal place.
- A majority means more than half of the 45 seats. Find the smallest number of seats that is a majority, and how many seats Party A holds above that number.
- A commentator says Party A "won nearly half the votes and nearly half the seats". Evaluate this claim.

Q8. The line graph shows the unemployment rate of a made-up country over eight quarters (two years).



Made-up data: the country and every number in the graph are made up for this section.

- Write down the rate in year 1 quarter 3, and in year 2 quarter 4.
- Describe the trend over the eight quarters, including the highest and lowest points.
- Find the fall from the highest point to the end of the period, in percentage points.
- A government media release says "unemployment fell steadily throughout the period". Evaluate this claim.

Q9. A made-up region has a working-age population of 2 500 000. Its labour force is 1 600 000, of whom 96 000 are unemployed. A further 176 000 people are underemployed: they have part-time work but want more hours.

- Find the unemployment rate and the participation rate.
- Find the underemployment rate: underemployed people as a percentage of the labour force.
- Find the total number of unemployed and underemployed people, and write it as a percentage of the labour force.
- A minister says "about 1 in every 6 people in the labour force would like more work than they have". Evaluate this claim using your answer to (c).

Q10. A made-up council employs 240 staff, and 156 of them are women. Of its 40 managers, 14 are women. Across all staff, the mean weekly pay is \$1 840 for men and \$1 656 for women.

Made-up data: the council and every number here are made up for this section.

- Find the percentage of women among all staff, and the percentage of women among managers.
- Find the gender pay gap as a percentage of men's mean pay.
- The council says the gap you found in (b) "means women are paid less than men for the same work". Evaluate this statement.
- Use your answer to (a) to give one reason why an overall pay gap can exist even when men and women are paid the same for the same role.

Q11. A made-up country publishes this price index.

Year	2022	2023	2024	2025
Price index	102.6	105.4	108.0	111.9

Made-up data: the country and every number in this table are made up for this section.

- Find the inflation rate for 2023, 2024 and 2025, each correct to 1 decimal place.
- Describe the trend in the inflation rate across these years.
- A pension was \$520.00 per week in 2022 and \$561.60 per week in 2025. Find the pension's rise as a percentage, and evaluate whether the pension kept pace with prices from 2022 to 2025. Give the total price rise correct to 1 decimal place.
- In response to 2025's inflation, the central bank raised the official interest rate from 3.85% to 4.10% per year. Find the rise in percentage points, and as a percentage of the earlier rate correct to 1 decimal place.

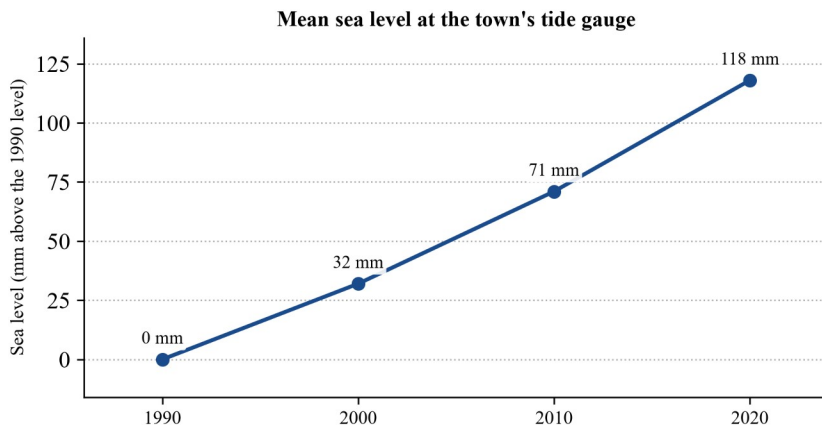
Q12. Two made-up countries report these figures for one year.

Country	GDP	Population
Alphaland	\$540 billion	18 million
Betaland	\$400 billion	8 million

Made-up data: the countries and every number in this table are made up for this section.

- Find the GDP per person for each country.
- Which country has the bigger total GDP, and which has the higher GDP per person? Explain how both answers can be true at the same time.
- The next year, Betaland's GDP grew by 2.4% to \$409.6 billion, and its population grew to 8.1 million. Find Betaland's new GDP per person, correct to the nearest dollar.
- A news report says "Betaland's economy grew, so everyone in Betaland is better off". Find the rise in Betaland's GDP per person as a percentage, correct to 1 decimal place, and evaluate the report's claim.

Q13. A tide gauge (an instrument that measures sea level) at a made-up coastal town records the mean sea level for each decade, in millimetres above the 1990 level.



Made-up data: the town and every number in the graph are made up for this section.

- Find the rise in each decade, and say which decade rose the most.
- Find the total rise over the 30 years, and the mean rise per year, correct to 1 decimal place.
- Predict the mean sea level in 2030 if the rise continues at the 2010–2020 decade’s rate, and give one reason why this prediction could be wrong.
- A report claims “sea level at this town is rising by about 4 mm per year”. Evaluate this claim.

Q14. A made-up farming district has 120 000 hectares (ha) of farmland. The area affected by salinity (salt in the soil) was recorded as 4 200 ha in 2005, 6 720 ha in 2015 and 9 000 ha in 2025.

Made-up data: the district and every number here are made up for this section.

- Find the percentage of the farmland affected in each of the three years.
- Describe the change from 2005 to 2025 in percentage points, and as a percentage increase correct to 1 decimal place.
- Find the average growth in the affected area, in ha per year, from 2005 to 2025.
- At that rate, how many more years after 2025 would it take for the affected area to reach 15 000 ha, and in what year would that be?
- A farmer says “at this rate, half the district will be affected within 100 years”. Evaluate this claim.

Q15. A made-up wildlife charity counted the animals it rescued in each of eight years:

320, 356, 388, 425, 470, 512, 560, 990

The last year included a large bushfire, and the charity’s rescues jumped.

Made-up data: the charity and every number here are made up for this section.

- Find the median.
- Find the mean, correct to 1 decimal place.
- Identify the outlier and give a reason using the gaps in the ordered data.
- Find the mean of the other seven years.
- The charity’s appeal makes two claims: “our rescues have risen every year” and “we now rescue over 500 animals a year on average”. Evaluate each claim.

Q16. A made-up global report on internet access gives these facts.

- Region A: 3 people in every 8 have no internet access; population 24 million.
- Region B: 17% of people have no internet access; population 52 million.

Made-up data: the regions and every number here are made up for this section.

- (a) For Region A, write the rate as a percentage and as a decimal probability.
- (b) Find the number of people without internet access in each region.
- (c) Which region has the higher rate of people without access, and which has more people without access?
- (d) A connectivity program gives internet access to 450 000 people in Region A. Find this as a percentage of Region A's people without access, and as a percentage of Region A's whole population, correct to 1 decimal place. A headline says "Program connects 5% of Region A". Evaluate the headline.

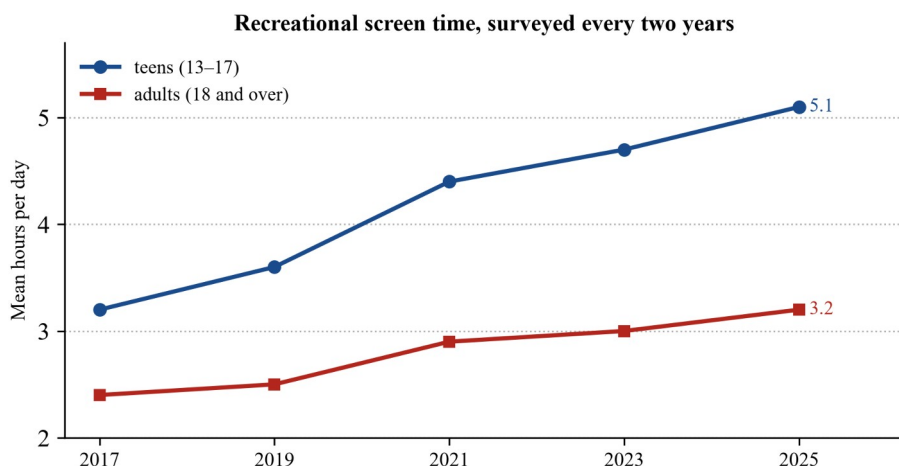
Q17. A made-up road-safety advertisement claims: "Crashes at this intersection are up 200%!" Last year there were 3 reported crashes at the intersection. This year there were 9, and the monthly counts this year were

2, 1, 2, 0, 1, 1, 0, 1, 0, 1, 0, 0

Made-up data: the intersection and every number here are made up for this section.

- (a) Show that the rise from 3 crashes to 9 crashes is a rise of 200%.
- (b) Find the mean number of crashes per month this year, and per month last year.
- (c) Find the probability that a month of this year, chosen at random, had 2 or more crashes — as a fraction and as a percentage correct to 1 decimal place.
- (d) Find the probability that a month of this year, chosen at random, had at least 1 crash, as a percentage correct to 1 decimal place. Hence evaluate the advertisement's suggestion that drivers now face a crash at this intersection "almost every month".

Q18. A made-up city surveys recreational screen time every two years. The graph shows the mean hours per day for two age groups.



Made-up data: the city and every number in the graph are made up for this section.

- Describe the trend for each group over the five surveys.
- Find the teens' rise from 2017 to 2025 in hours, and as a percentage correct to 1 decimal place.
- Find the adults' rise over the same surveys as a percentage, correct to 1 decimal place. How many percentage points larger is the teens' percentage rise than the adults'? Give your answer correct to 1 decimal place.
- In the 2025 survey, 260 of the 400 teens surveyed spent 5 hours or more on a typical day. Find the probability that a surveyed teen, chosen at random, spent 5 hours or more, as a decimal. Hence predict how many of the city's 1 200 teens spend 5 hours or more on a typical day, assuming the same rate.
- The council proposes phone-free activities at youth centres, arguing that "most teens now spend 5 hours or more a day on recreational screens". Evaluate the council's argument using (d), and give one caution about the data behind it.

Answers

Example 1. (a) 75.1% (b) 79% (c) Westvale, 41% — gap of 33 to the next value; every other gap is at most 2 (d) mean 80%, median 80% (e) supported: 4 in 5 = 80%, which matches both the mean and the median of the seven booths

Example 2. (a) \$234 (b) 12% (c) 88%; the claim is correct (d) false: the rise needed is 13.6%, and a 12% rise only reaches \$1 921.92 — \$28.08 short

Example 3. (a) 3.3 hours (b) median 3 hours, mode 3 hours, range 5 hours (c) not supported: mean 3.3, median 3 and mode 3 are all under 4 hours, and only 40% of students are at 4 or more (d) $1/5 = 0.2 = 20\%$ (e) 30 students

Example 4. (a) median 9.5 days, mean 11.8 days (b) 34 — gap of 21 to the next value; every other gap is at most 1 (c) mean 9.3 days, median 9 days (d) $1/3 = 0.33 = 33.3\%$ (e) not supported: ≈ 26 days per year is far above the median 9.5 and the nine-year mean 9.3; only the fire year (34) passed 26

Q1. (a) 79% (b) 0.79 (c) false: 4 in 5 = 80%, and 79% is less than 80%

Q2. (a) 7/10 (b) 0.7; 70% (c) 224 animals

Q3. (a) 6.5% (b) 22 440 people (c) slightly overstated: 1 in 15 of 24 000 would be 1 600 people, but the actual number is 1 560

Q4. (a) 25% (b) 1 in 4 (c) 0.75

Q5. (a) 87.4% (b) median 90%, range 31 percentage points (c) 64 — gap of 21 to the next value; every other gap is at most 3

Q6. (a) 9 000 requests (b) 0.25 (c) supported: website + app = 5 400 = 60%, which is more than half

Q7. (a) A 44%; B 33%; C 15%; Independents 8% (b) 53.3% (c) 23 seats; 1 seat above (d) the votes part is fair (44% is close to half), but the seats part is wrong: 53.3% is more than half, not nearly half

Q8. (a) 5.9%; 5.4% (b) falling overall but not steadily: it rose from 5.6% (year 1 quarter 2) to a peak of 6.2% (year 1 quarter 4), then fell quarter after quarter to 5.4% at the end (c) 0.8 percentage points (d) false: the rate rose through the middle of year 1, so the fall was not steady

Q9. (a) 6%; 64% (b) 11% (c) 272 000 people; 17% (d) close but slightly understated: 1 in 6 = 16.666...%, and the true figure is 17%

Q10. (a) 65%; 35% (b) 10% (c) not necessarily true: the gap compares averages across all roles, not pay for the same role (d) women are only 35% of managers but 65% of all staff; if managers are paid more than other staff, fewer women in management creates an overall gap even with equal pay in every role

Q11. (a) 2.7%; 2.5%; 3.6% (b) inflation eased from 2023 to 2024, then rose again in 2025 to the highest of the three years (c) 8%; prices rose 9.1%, so the pension did not keep pace (d) 0.25 percentage points; 6.5%

Q12. (a) Alphaland \$30 000; Betaland \$50 000 (b) Alphaland has the bigger total GDP; Betaland has the higher GDP per person — Alphaland's total is spread over more than twice as many people (c) \$50 568 (d) GDP per person rose \$568, which is 1.1%; the claim is too strong — an average says nothing about who received the growth

Q13. (a) 32 mm, 39 mm, 47 mm; the 2010s rose most (b) 118 mm; 3.9 mm per year (c) 165 mm; the rises are getting bigger each decade, so the 2010s rate may not continue (the true level could be higher) (d) reasonable: 3.9 mm per year rounds to 4 mm per year

Q14. (a) 3.5%; 5.6%; 7.5% (b) up 4.0 percentage points, an increase of 114.3% (c) 240 ha per year (d) 25 more years; 2050 (e) false: half the district is 60 000 ha, which is 212.5 more years away at 240 ha per year

Q15. (a) 447.5 (b) 502.6 (c) 990 — gap of 430 to the next value; the biggest other gap is 48 (d) 433 (e) “risen every year”: true, the counts increase year by year. “Over 500 on average”: misleading — it is true only with the fire year included (mean 502.6); without it the mean is 433, and the median is 447.5

Q16. (a) 37.5%; 0.375 (b) Region A 9 000 000; Region B 8 840 000 (c) Region A has the higher rate; Region A also has more people without access, by 160 000 (d) 5% of the people without access, but 1.9% of the whole population; the headline is misleading — “5%” is only true if the whole is Region A’s people without access

Q17. (a) $\text{rise} = 9 - 3 = 6$; $6 \div 3 \times 100 = 200$ (b) 0.75 this year; 0.25 last year (c) $1/6$; 16.7% (d) 58.3%; overstated: at least 1 crash happened in 7 of the 12 months — a little more than half, not “almost every month”; and the 200% headline stands on counts of only 3 and 9

Q18. (a) both groups rose over the five surveys; the teens rose faster and the gap between the groups widened (b) 1.9 hours; 59.4% (c) 33.3%; 26.0 percentage points (d) 0.65; 780 teens (e) supported: 65% of surveyed teens is a majority, and the 2025 mean of 5.1 hours is above 5. Caution: the survey covers only this city, and people report their own screen time, which may be under- or over-estimated

Fully-worked solutions

Example 1. (a) $\text{Sum} = 78 + 82 + 76 + 84 + 80 + 74 + 86 + 41 = 601$; $\text{mean} = 601 \div 8 = 75.125 = 75.1\%$ to 1 d.p.
(b) Ordered: 41, 74, 76, 78, 80, 82, 84, 86; $\text{median} = (78 + 80) \div 2 = 79\%$.
(c) Westvale, 41%, is the outlier: $74 - 41 = 33$, while the gaps between the other seven values are at most 2.
(d) Sum of the seven = 560; $\text{mean} = 560 \div 7 = 80\%$; $\text{median} = 80\%$ (the 4th of the 7 ordered values).
(e) 4 in 5 = $4 \div 5 \times 100 = 80\%$. Both measures in (d) equal 80%, so the claim is supported: about 4 in 5 enrolled voters cast a vote at a typical booth.

Example 2. (a) $\$1\,950 - \$1\,716 = \$234$ per week.
(b) $234 \div 1\,950 \times 100 = 12\%$.
(c) $1\,716 \div 1\,950 \times 100 = 88\%$, and 88% of a dollar is 88 cents, so the “88 cents in the dollar” claim is correct.
(d) The rise is applied to women’s pay, so the whole is \$1 716: $234 \div 1\,716 \times 100 = 13.636\dots = 13.6\%$ to 1 d.p.
Check: $\$1\,716 \times 1.12 = \$1\,921.92$, which is \$28.08 short of \$1 950. The journalist’s claim is false — 12% is the gap measured against men’s pay, not the rise needed on women’s (smaller) pay.

Example 3. (a) Total hours = $1 \times 2 + 2 \times 7 + 3 \times 9 + 4 \times 6 + 5 \times 4 + 6 \times 2 = 2 + 14 + 27 + 24 + 20 + 12 = 99$; $\text{mean} = 99 \div 30 = 3.3$ hours to 1 d.p.
(b) Cumulative counts: 2, 9, 18, 24, 28, 30 — the 15th and 16th values are both 3, so the median is 3 hours; the mode is 3 hours; the range is $6 - 1 = 5$ hours.
(c) Mean 3.3, median 3 and mode 3 are all below 4. Students at 4 hours or more: $6 + 4 + 2 = 12$ of 30 = $12 \div 30 \times 100 = 40\%$, under half. “Typically” describes the centre, so the claim is not supported.
(d) At 5 hours or more: $4 + 2 = 6$ of 30; $P = 6/30 = 1/5 = 0.2 = 20\%$.
(e) $1/5 \times 150 = 30$ students.

Example 4. (a) Ordered: 6, 7, 8, 8, 9, 10, 11, 12, 13, 34; $\text{median} = (9 + 10) \div 2 = 9.5$ days. Sum = 118; $\text{mean} = 118 \div 10 = 11.8$ days to 1 d.p.
(b) 34 is the outlier: $34 - 13 = 21$, and every other gap is at most 1.
(c) Sum without 34 = $118 - 34 = 84$; $\text{mean} = 84 \div 9 = 9.333\dots = 9.3$ days to 1 d.p.; median of 6, 7, 8, 8, 9, 10, 11, 12, 13 = 9 days.
(d) Years with more than 10 smoke days: 11, 12, 13 — that is 3 of the 9. $P = 3 \div 9 = 1/3 = 0.33$ to 2 d.p. = 33.3% to 1 d.p.
(e) “Once a fortnight” ≈ 26 days per year. The median is 9.5 and the nine-year mean is 9.3, both far below 26; only the fire year (34) passed 26. The claim is not supported as a description of an average year.

Q1. (a) $41\,475 \div 52\,500 \times 100 = 79\%$.
(b) $41\,475 \div 52\,500 = 0.79$.
(c) 4 in 5 = $4 \div 5 \times 100 = 80\%$. The actual turnout was 79%, which is less than 80%, so “more than 4 in every 5” is false. (Check: $52\,500 - 41\,475 = 11\,025$ voters did not cast a vote.)

Q2. (a) $175/250 = 7/10$ (divide top and bottom by 25).
(b) $7 \div 10 = 0.7 = 70\%$.
(c) $0.7 \times 320 = 224$ animals.

Q3. (a) $1\,560 \div 24\,000 \times 100 = 6.5\%$.
(b) $24\,000 - 1\,560 = 22\,440$ employed people.

(c) 1 in 15 of 24 000 would be $24\,000 \div 15 = 1\,600$ people. The actual number is 1 560, which is 40 fewer, so the mayor's claim is close but slightly overstated.

Q4. (a) $9\,500 \div 38\,000 \times 100 = 25\%$.

(b) $25\% = 1/4$, so 1 in 4 households.

(c) English-only households: $38\,000 - 9\,500 = 28\,500$; $P = 28\,500 \div 38\,000 = 0.75$.

Q5. (a) Sum = $92 + 88 + 95 + 64 + 90 + 85 + 93 + 89 + 91 = 787$; mean = $787 \div 9 = 87.444... = 87.4\%$ to 1 d.p.

(b) Ordered: 64, 85, 88, 89, 90, 91, 92, 93, 95; median = 90% (the 5th of 9); range = $95 - 64 = 31$ percentage points.

(c) 64 is the outlier: $85 - 64 = 21$, while the gaps between the other eight values are at most 3.

Q6. (a) $1\,350 + 2\,250 + 4\,500 + 900 = 9\,000$ requests.

(b) $P(\text{phone}) = 2\,250 \div 9\,000 = 0.25$.

(c) Digital = website + app = $4\,500 + 900 = 5\,400$; $5\,400 \div 9\,000 \times 100 = 60\%$. That is more than half, so "most residents use a digital channel" is supported.

Q7. (a) A: $792\,000 \div 1\,800\,000 \times 100 = 44\%$. B: $594\,000 \div 1\,800\,000 \times 100 = 33\%$. C: $270\,000 \div 1\,800\,000 \times 100 = 15\%$. Independents: $144\,000 \div 1\,800\,000 \times 100 = 8\%$. (Check: $44 + 33 + 15 + 8 = 100$.)

(b) $24 \div 45 \times 100 = 53.333... = 53.3\%$ to 1 d.p.

(c) Half of 45 is 22.5, so a majority needs 23 seats. Party A holds $24 - 23 = 1$ seat above that.

(d) 44% of the votes is close to half, so the first part is fair. But 53.3% of the seats is **more** than half, not "nearly half", so the second part is wrong: Party A's seat share is bigger than its vote share, and the claim understates it.

Q8. (a) Year 1 quarter 3: 5.9%. Year 2 quarter 4: 5.4%.

(b) The rate fell overall, but not steadily: it dropped from 5.8% to 5.6% in the first two quarters, then rose to a peak of 6.2% in year 1 quarter 4, then fell in every quarter after that to the lowest point, 5.4%, at the end.

(c) $6.2 - 5.4 = 0.8$ percentage points.

(d) False. The rate **rose** by 0.6 percentage points through the middle of year 1 (5.6% to 6.2%), so the fall was not steady over the whole period. (From first to last quarter the fall was $5.8 - 5.4 = 0.4$ percentage points; the mean rate over the eight quarters was 5.76% to 2 d.p.)

Q9. (a) Unemployment rate = $96\,000 \div 1\,600\,000 \times 100 = 6\%$. Participation rate = $1\,600\,000 \div 2\,500\,000 \times 100 = 64\%$.

(b) $176\,000 \div 1\,600\,000 \times 100 = 11\%$.

(c) $96\,000 + 176\,000 = 272\,000$ people; $272\,000 \div 1\,600\,000 \times 100 = 17\%$.

(d) 1 in 6 = $1 \div 6 \times 100 = 16.666...%$, which is a little below the true 17%. The minister's claim is close but slightly understates the figure. (Also note: $2\,500\,000 - 1\,600\,000 = 900\,000$ working-age people are not in the labour force at all, and the claim ignores them.)

Q10. (a) All staff: $156 \div 240 \times 100 = 65\%$. Managers: $14 \div 40 \times 100 = 35\%$.

(b) Gap = $\$1\,840 - \$1\,656 = \$184$; $184 \div 1\,840 \times 100 = 10\%$.

(c) Not necessarily true. The 10% gap compares the **average** pay of all men with the **average** pay of all women, across different roles. The data given does not compare men with women doing the same job, so the council's statement assumes something it has not shown.

(d) Women are 65% of all staff but only 35% of managers (26 of the 40 managers are men). If managers are paid more than other staff, having fewer women in the higher-paid roles creates an overall gap even when every role pays men and women the same. (Women's mean pay is 90% of men's: $1\,656 \div 1\,840 \times 100 = 90\%$.)

Q11. (a) 2023: $(105.4 - 102.6) \div 102.6 \times 100 = 2.729... = 2.7\%$ to 1 d.p. 2024: $(108.0 - 105.4) \div 105.4 \times 100 = 2.466... = 2.5\%$ to 1 d.p. 2025: $(111.9 - 108.0) \div 108.0 \times 100 = 3.611... = 3.6\%$ to 1 d.p.

(b) Inflation eased from 2.7% (2023) to 2.5% (2024), then rose sharply to 3.6% in 2025 — the highest of the three years.

(c) Pension rise = $\$561.60 - \$520.00 = \$41.60$; $41.60 \div 520.00 \times 100 = 8\%$. Prices over the same years rose $(111.9 - 102.6) \div 102.6 \times 100 = 9.064... = 9.1\%$ to 1 d.p. Because $8\% < 9.1\%$, the pension did **not** keep pace with prices.

(d) Percentage points: $4.10 - 3.85 = 0.25$. As a percentage of the earlier rate: $0.25 \div 3.85 \times 100 = 6.493... = 6.5\%$ to 1 d.p.

Q12. (a) Alphaland: $\$540\,000\,000 \div 18\,000\,000 = \$30\,000$ per person. Betaland: $\$400\,000\,000 \div 8\,000\,000 = \$50\,000$ per person.

(b) Alphaland has the bigger total GDP (\$540 billion against \$400 billion); Betaland has the higher GDP per person (\$50 000 against \$30 000). Both are true because Alphaland's bigger total is spread over more than twice as many people — totals measure the size of an economy, per-person figures divide that size by the population.

(c) $\$409\,600\,000\,000 \div 8\,100\,000 = \$50\,567.90\dots = \$50\,568$ to the nearest dollar.

(d) Rise per person = $\$50\,568 - \$50\,000 = \$568$; $568 \div 50\,000 \times 100 = 1.136\dots = 1.1\%$ to 1 d.p. The claim is too strong: a 1.1% rise in an **average** does not show who received it — some households may have gained much more and others nothing, so “everyone is better off” does not follow from GDP growth.

Q13. (a) 1990s: $32 - 0 = 32$ mm. 2000s: $71 - 32 = 39$ mm. 2010s: $118 - 71 = 47$ mm. The 2010s rose the most.

(b) Total rise = 118 mm (which is 11.8 cm); mean rise per year = $118 \div 30 = 3.933\dots = 3.9$ mm per year to 1 d.p.

(c) $118 + 47 = 165$ mm. The prediction could be wrong because the rises are getting bigger each decade (32, then 39, then 47) — if that continues, the real 2030 level would be higher than 165 mm; a flat-rate prediction assumes a trend that the data itself says is not flat.

(d) The measured rate is 3.9 mm per year, which rounds to 4 mm per year, so “about 4 mm per year” is a reasonable description of the 30-year average.

Q14. (a) 2005: $4\,200 \div 120\,000 \times 100 = 3.5\%$. 2015: $6\,720 \div 120\,000 \times 100 = 5.6\%$. 2025: $9\,000 \div 120\,000 \times 100 = 7.5\%$.

(b) Percentage points: $7.5 - 3.5 = 4.0$. Percentage increase: $(9\,000 - 4\,200) \div 4\,200 \times 100 = 114.285\dots = 114.3\%$ to 1 d.p.

(c) Growth = $9\,000 - 4\,200 = 4\,800$ ha over 20 years; $4\,800 \div 20 = 240$ ha per year.

(d) Extra area needed: $15\,000 - 9\,000 = 6\,000$ ha; $6\,000 \div 240 = 25$ years, so the year $2025 + 25 = 2050$.

(e) Half the district = $120\,000 \div 2 = 60\,000$ ha. Extra needed from 2025: $60\,000 - 9\,000 = 51\,000$ ha; $51\,000 \div 240 = 212.5$ years. That is more than double 100 years, so the farmer's claim is false.

Q15. (a) Ordered: 320, 356, 388, 425, 470, 512, 560, 990; median = $(425 + 470) \div 2 = 447.5$.

(b) Sum = 4 021; mean = $4\,021 \div 8 = 502.625 = 502.6$ to 1 d.p.

(c) 990 is the outlier: $990 - 560 = 430$, while the largest gap among the other seven values is 48.

(d) Sum without 990 = 3 031; mean = $3\,031 \div 7 = 433$.

(e) Claim 1, “risen every year”: true — each year's count is bigger than the one before ($320 < 356 < \dots < 560 < 990$). Claim 2, “over 500 a year on average”: misleading — the mean is over 500 (502.6) only because the fire year is included; without the outlier the mean is 433 and the median is 447.5, both under 500. (For reference, the count rose 75% across the seven non-fire years: $(560 - 320) \div 320 \times 100 = 75\%$, and 209.4% including the fire year.)

Q16. (a) $3 \div 8 \times 100 = 37.5\%$; as a decimal, $3 \div 8 = 0.375$.

(b) Region A: $0.375 \times 24\,000\,000 = 9\,000\,000$ people. Region B: $0.17 \times 52\,000\,000 = 8\,840\,000$ people.

(c) Region A has the higher rate (37.5% against 17%) and also more people without access (9 000 000 against 8 840 000, a difference of 160 000) — despite having less than half Region B's population.

(d) Of the people without access: $450\,000 \div 9\,000\,000 \times 100 = 5\%$. Of the whole population: $450\,000 \div 24\,000\,000 \times 100 = 1.875 = 1.9\%$ to 1 d.p. The headline is misleading: “connects 5% of Region A” reads as 5% of everyone, but the true whole-population figure is 1.9%; the 5% only holds when the whole is Region A's people without access.

Q17. (a) Rise in crashes = $9 - 3 = 6$. Percentage rise = $6 \div 3 \times 100 = 200$. The rise is 200%.

(b) This year: $2 + 1 + 2 + 0 + 1 + 1 + 0 + 1 + 0 + 1 + 0 + 0 = 9$ crashes over 12 months; mean = $9 \div 12 = 0.75$ per month. Last year: $3 \div 12 = 0.25$ per month.

(c) Months with 2 or more crashes: January and March — 2 of the 12. $P = 2/12 = 1/6 = 16.666\dots = 16.7\%$ to 1 d.p.

(d) Months with at least 1 crash: 7 of the 12. $P = 7 \div 12 \times 100 = 58.333\dots = 58.3\%$ to 1 d.p. That is a little more than half the months, so “almost every month” is overstated. The “up 200%” figure is arithmetically true, but it stands on counts of only 3 and 9 — small counts make big-sounding percentages.

- Q18.** (a) Both groups rose at every survey. Teens rose from 3.2 to 5.1 hours and adults from 2.4 to 3.2 hours, so the teens rose faster and the gap between the groups widened from 0.8 hours (2017) to 1.9 hours (2025).
- (b) Hours: $5.1 - 3.2 = 1.9$. Percentage: $1.9 \div 3.2 \times 100 = 59.375 = 59.4\%$ to 1 d.p.
- (c) Adults: $(3.2 - 2.4) \div 2.4 \times 100 = 33.333\ldots = 33.3\%$ to 1 d.p. Difference: $59.375 - 33.333\ldots = 26.041\ldots = 26.0$ percentage points to 1 d.p. (using the full-precision values, not the rounded ones).
- (d) $P = 260 \div 400 = 0.65$. Prediction: $0.65 \times 1\,200 = 780$ teens.
- (e) Supported: $0.65 = 65\%$ of surveyed teens is a majority, and the survey mean for teens in 2025 (5.1 hours) is also above 5, so “most teens spend 5 hours or more” matches this data. Caution: the survey covers only this city, and screen times are self-reported — people may under- or over-estimate their own use, so the true figure could differ.

Theory

In Unit 3 (§6C) you met the mechanics of money: wages, GST, interest and budgets. Unit 4 raises the bar — you now work with financial **data**. Prices, wages, house values and tax collections change over time, and your job is to read those changes, compare them, and say what they mean. The verbs here are Unit 4 verbs: apply, critically analyse, evaluate and justify. The maths is already in your toolkit — percentage change (§2F), mean, median and outliers (§8C, §8D), probability (§9A, §9B) and risk (§9D), and spreadsheets (§10B).

Comparing costs over time.

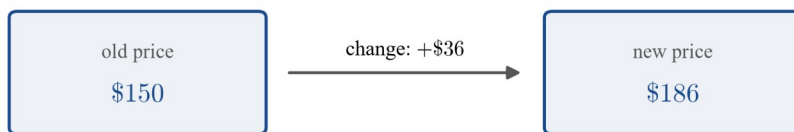
Petrol prices, groceries, phone plans — costs rarely stay still. To compare a price now with a price from before, two numbers tell the story:

- the **change**: new – old, in dollars or cents;
- the **percentage change**: the change measured against the old price.

$$\text{percentage change} = \frac{\text{new} - \text{old}}{\text{old}} \times 100$$

Worked model. A shopping basket cost \$150 last year and \$186 this year. The change is \$186 – \$150 = \$36. The percentage change is $\$36 \div \$150 \times 100 = 24\%$. Prices rose 24%.

Percentage change: one basket, one year



$$36 \div 150 \times 100 = 24\% \text{ — prices rose } 24\%$$

Made-up data: this basket is invented for the model.

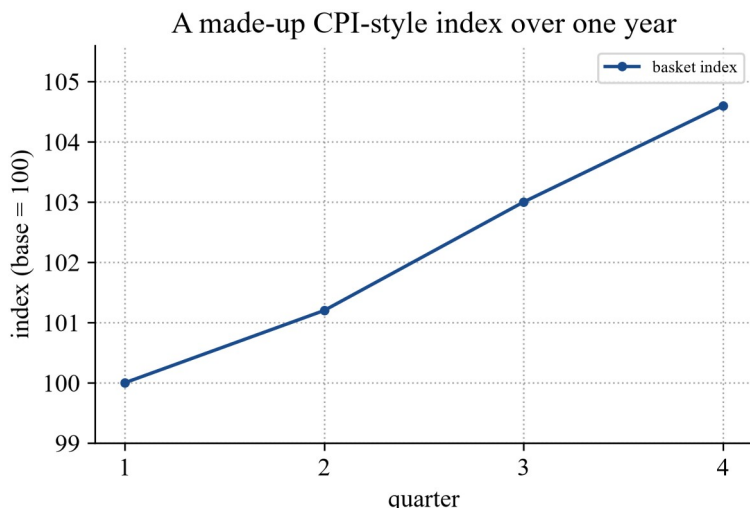
Percentage change matters when you compare things of different sizes. A 20-cent rise on a litre of petrol and a \$5 rise on a concert ticket are both “a rise” — but they are not the same story. The percentage change compares them fairly.

When a change happens over several years, the **average yearly change** is the total change divided by the number of years. Worked model: a town’s median house price went from \$380 000 to \$455 000 over 3 years. The total change is $\$455\,000 - \$380\,000 = \$75\,000$, so the average yearly change is $\$75\,000 \div 3 = \$25\,000$ per year. This is an average — in real life some years rise more and some rise less.

Cost of living and the CPI.

The **cost of living** is what everyday things cost — food, rent, fuel, bills. In Australia a government statistics bureau tracks it with the **Consumer Price Index (CPI)**. The bureau follows the price of a fixed “basket” of everyday items and reports the result as an **index number**: the basket in a base period is set at 100, and later readings show what the same basket would cost relative to that base.

- Worked model: the index goes from 120 to 126. The rise is $126 - 120 = 6$ index points. As a percentage: $6 \div 120 \times 100 = 5\%$. The same basket costs 5 % more.



Made-up data: this index is invented. From 100.0 to 104.6 is a rise of 4.6 %.

When the CPI rises we call it **inflation** — each dollar buys a little less than it did. People on fixed incomes feel inflation hardest.

Are wages keeping up?

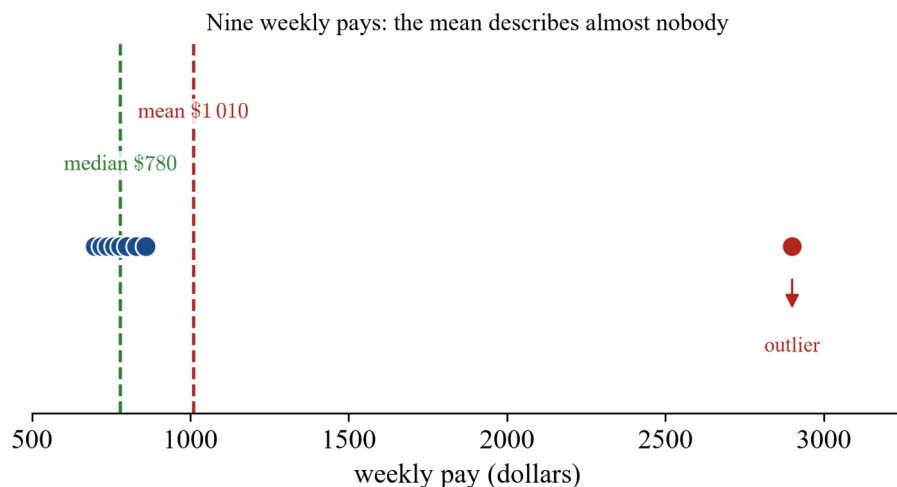
The key comparison in cost-of-living data is between two percentage changes: how fast **wages** rise, and how fast **prices** rise.

- Worked model: a basket costs \$100. Prices rise 4 %, so it now costs $\$100 \times 1.04 = \$104$. A worker earns \$100 a week and gets a 3 % raise — now $\$100 \times 1.03 = \$103$. The worker's pay rose, but their purchasing power fell: \$103 does not cover \$104. The gap is $\$104 - \$103 = \$1$ a week, every week.

When prices rise faster than wages, a pay rise can still leave a person worse off. Comparing the two percentage changes is one way to critically analyse this cost-of-living risk.

House prices and pay: mean or median?

House prices and pay are usually reported as a **median** — the middle value when all values are sorted — rather than a **mean**. The reason is outliers (§8D): a few very large values (a mansion sale, an executive's pay) drag the mean upward, while the median stays near the typical case.



Made-up data: nine weekly pays. Mean = \$1 010; median = \$780.

Worked model. The figure shows nine weekly pays. The mean is \$1 010; the median is \$780. Eight of the nine workers earn **less than the mean** — it describes almost nobody. The median sits in the middle of the cluster and

describes the typical worker well. When a question asks you to choose between the two measures, **justify** your choice: name the outlier and say how it moves the mean.

Government money as data: taxation, GST, superannuation.

Governments publish data about the money they collect, and Unit 4 asks you to read that data.

- **Taxation** — the share of income or profit that goes to government. Worked model: a person earns \$55 000 and pays \$8 800 in tax. Their tax is $\$8\,800 \div \$55\,000 \times 100 = 16.0\%$ of their income — 16 cents in every dollar.
- **GST** — the 10 % goods and services tax on most purchases (mechanics in §6C). Worked model: a tax-inclusive price of \$297 contains GST of $\$297 \div 11 = \$27$.
- **Superannuation** (almost always called **super**) — a percentage of a worker's gross pay that the employer pays into a fund for the worker's retirement. Rates change over time, so super data is a trend to read. Worked model: on a \$48 000 salary at a 12 % rate, super is $0.12 \times \$48\,000 = \$5\,760$ a year.

Big revenue tables get read the same way: find each source's share of the total, and its growth, as percentage changes. Every rate and dollar figure used in this section is made up and is stated in the question.

Gambling and sporting odds.

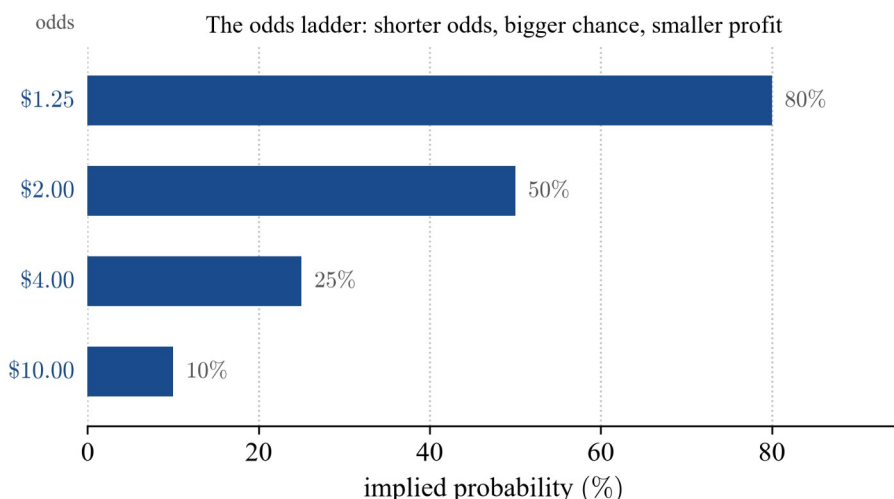
In Australia, bookmakers — businesses that take bets — quote **decimal odds**. Decimal odds tell you what comes back for every \$1 bet, *including the stake* (the amount bet). If the outcome happens:

- **return** = stake $\times$ odds;
- **profit** = return – stake.

Worked model: a \$10 bet at odds of \$3.00 returns $\$10 \times 3.00 = \$30$, a profit of $\$30 - \$10 = \$20$.

Odds also imply a probability. The **implied probability** is the chance the odds suggest:

$$\text{implied probability} = \frac{1}{\text{odds}}$$



Made-up data: a ladder of odds and their implied probabilities.

The ladder says it all: **shorter** (lower) odds mean the bookmaker thinks the outcome is **more likely** — and the profit on a win is **smaller**. Worked model: odds of \$4.00 imply $1 \div 4.00 = 0.25 = 25\%$.

Two facts about betting markets matter for Unit 4 evaluation:

1. **The bookmaker's margin.** Add up the implied probabilities of every outcome in a market and you get more than 100 %. The excess is the bookmaker's cut, built into every price they offer. Example 2 works through a market that totals 104.1 %.

2. **The long-run average return.** If an outcome has probability p and a winning bet returns R , the long-run average return per bet is $p \times R$ — what comes back, on average, if the same bet could be repeated many times. Worked model: a team with a 35 % chance pays \$25 on a \$10 win-bet. The average return is $0.35 \times \$25 = \$8.75$ — an average **loss** of $\$10 - \$8.75 = \$1.25$ per bet. When the average return is less than the stake, the person betting loses money over time, whatever any single weekend brings.

The maths evaluates gambling this way: it is a way to pay for excitement, not a way to earn income. Risk thinking from §9D applies — both the likelihood and the consequences matter. If gambling is causing harm to you or someone you know, free confidential support services run in every state; a doctor or a trusted adult is a good first contact.

Budgets and technology.

Spreadsheets and budgeting apps (§10B) keep a budget live: each number sits in a **cell**, and a **formula** (like $=B2 - \text{SUM}(B3 : B7)$) does the arithmetic. Change one input — a rent rise, a cut to takeaways — and every total updates instantly. This is the Systematics idea (AoS 8): inputs, process, outputs. Adjust a parameter, see the new output, decide if it is better.

The technology does the adding; it does not do the judging. Always check the output with a quick estimate, then ask whether the budget still works.

- Worked model: weekly income \$960; expenses rent \$400, food \$190, transport \$65, phone \$25, other \$105. Total expenses: $\$400 + \$190 + \$65 + \$25 + \$105 = \$785$. Surplus: $\$960 - \$785 = \$175$. A quick estimate — about $\$960 - \$800 = \$160$ — confirms the \$175 is sensible.

Working the four stages.

Everything here runs through the problem-solving cycle from §1A and §6C: **identify** what the question needs and estimate an answer; **act** with the maths, one step per line; **evaluate** — check against your estimate and say whether the answer is reasonable; **communicate** in a sentence, with units and the rounding stated.

About the data in this section. Every price, wage, odds line, index number, house sale and business in this section is **made up** (not real): pretend people, pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person, team, town or price. The systems named — the GST at 10 %, the CPI, superannuation — are real Australian ones; every number attached to them here is invented for practice.

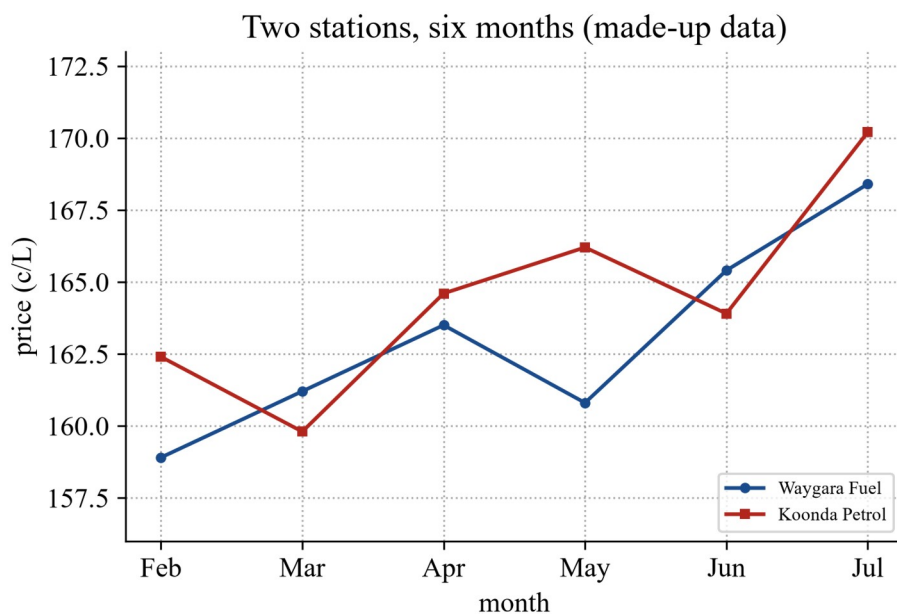
Worked examples

Example 1 — scaffolded

Casey compares two service stations near her work: Waygara Fuel and Koonda Petrol. She records the price of unleaded petrol once a month for six months.

Month	Waygara Fuel (c/L)	Koonda Petrol (c/L)
Feb	158.9	162.4
Mar	161.2	159.8
Apr	163.5	164.6
May	160.8	166.2
Jun	165.4	163.9
Jul	168.4	170.2

Made-up data: both stations and all prices are invented for this section.



- Which station was cheaper in February?
- Find the change in price at each station from February to July.
- Find the percentage change at each station over the six months, correct to 1 decimal place.
- In July, Casey fills her tank with 45 litres at each station. Find each cost to the nearest cent, and which station is cheaper and by how much.

Working	Comment
Feb: Waygara 158.9 c/L, Koonda 162.4 c/L; $158.9 < 162.4$.	Identify: read the table (or the left end of the graph) and compare.
Waygara is cheaper in February.	Communicate the comparison in words.
Waygara change: $168.4 - 158.9 = 9.5$ c/L.	Act: change = new – old.
Koonda change: $170.2 - 162.4 = 7.8$ c/L.	Koonda rose by fewer cents.
Waygara: $9.5 \div 158.9 \times 100 = 5.978\ldots\%$; correct to 1 decimal place: 6.0 %.	Percentage change = change $\div$ old $\times 100$; round only at the stated precision.
Koonda: $7.8 \div 162.4 \times 100 = 4.802\ldots\%$; correct to 1 decimal place: 4.8 %.	Same formula with Koonda's numbers.
Waygara 45 L: $45 \times \$1.684 = \$75.78$; Koonda 45 L: $45 \times \$1.702 = \$76.59$.	$168.4 \text{ c} = \$1.684$; cost = litres $\times$ price per litre, to the nearest cent.
Difference: $\$76.59 - \$75.78 = \$0.81$; Waygara is cheaper.	A 1.8 c/L gap across 45 litres.
Check: about 10 c on about 160 c is $10 \div 160 \times 100 = 6.25\%$.	Evaluate: the exact answers, 6.0 % and 4.8 %, sit near this estimate ✓.

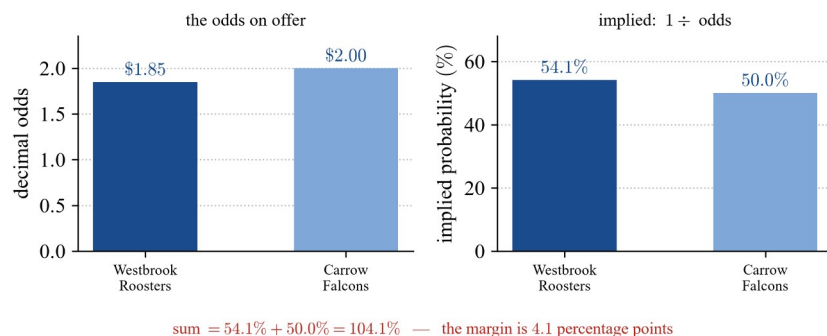
Example 2 — scaffolded

Sonny looks at a bookmaker's head-to-head market for a football match: the Westbrook Roosters play the Carrow Falcons, and the market offers two outcomes only — one team must win. The odds are:

- Westbrook Roosters: \$1.85
- Carrow Falcons: \$2.00

Made-up data: the teams, the match and the odds are invented for this section.

Head-to-head market: one team must win (made-up data)



- Which team is the bookmaker's favourite? How do the odds tell you?
- Find the implied probability of each team winning, as a percentage correct to 1 decimal place.
- Sonny bets \$20 on the Falcons. Find his return and his profit if the Falcons win.
- Add the two implied probabilities. What does the total tell you about this market?

Working	Comment
$1.85 < 2.00$, so the Roosters have the shorter odds.	Identify: shorter (lower) odds = more likely = smaller profit.
The Roosters are the favourite .	Communicate in words.
Roosters: $1 \div 1.85 = 0.54054\dots$; as a percentage, 54.1 % (1 d.p.).	Act: implied probability = $1 \div \text{odds}$.
Falcons: $1 \div 2.00 = 0.50$; as a percentage, 50.0 %.	Odds of exactly \$2.00 imply exactly 50 %.
Return: $\$20 \times 2.00 = \$40.00$; profit: $\$40.00 - \$20.00 = \$20.00$.	Return = stake $\times$ odds; profit = return – stake.
Sum: $54.1\% + 50.0\% = 104.1\%$.	Add the two implied probabilities.
Unrounded: $54.054\dots\% + 50\% = 104.054\dots\%$, also 104.1 % to 1 d.p.	Evaluate: rounding the parts or the total gives the same answer here.
Excess: $104.1 - 100 = 4.1$ percentage points — the bookmaker's margin .	One winner should mean probabilities total 100 %; the excess is the bookmaker's cut.
Check: odds of \$1.85 sit between \$1 and \$2, so the implied probability sits between 50 % and 100 % — 54.1 % fits.	A quick sanity check before moving on.

Example 3 — unscaffolded

Alana is researching house prices in Aldergate. She collects the nine most recent sale prices:

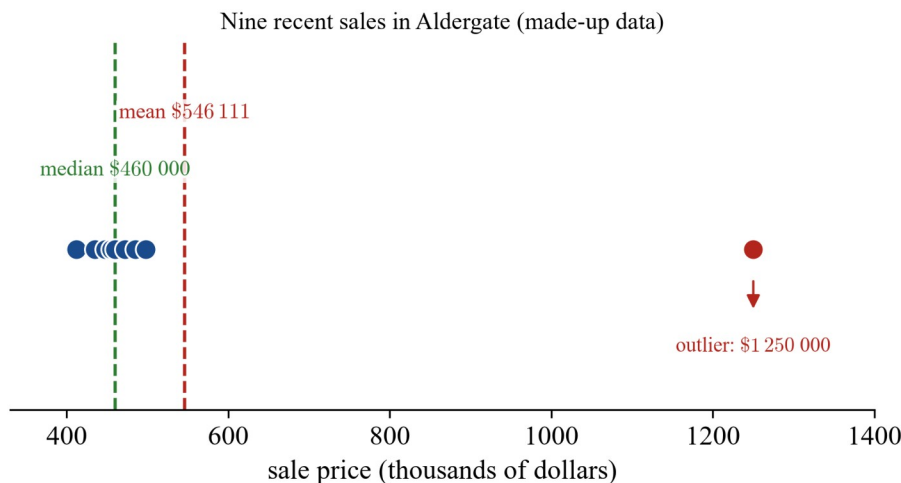
\$412 000, \$435 000, \$448 000, \$455 000, \$460 000, \$472 000, \$485 000, \$498 000, \$1 250 000

Three years ago, the median sale price in Aldergate was \$400 000.

Made-up data: Aldergate and all nine sales are invented for this section.

- Find the mean of the nine sale prices, to the nearest dollar.
- Find the median sale price and the range of the nine sales.
- Identify the outlier, and explain why the median is the better measure of a typical sale in Aldergate.

(d) Find the percentage change in the median sale price over the three years.



Solution:

The sum of the nine sales:

$$\$412\,000 + \$435\,000 + \$448\,000 + \$455\,000 + \$460\,000 + \$472\,000 + \$485\,000 + \$498\,000 + \$1\,250\,000 = \$4\,915\,000$$

(a) Mean: $\$4\,915\,000 \div 9 = \$546\,111.11\dots$

To the nearest dollar, the mean is **\$546 111**.

(b) With nine values sorted, the median is the 5th value: **\$460 000**.

Range: $\$1\,250\,000 - \$412\,000 = \$838\,000$.

(c) The outlier is the \$1 250 000 sale — more than two and a half times the next highest ($2.5 \times \$498\,000 = \$1\,245\,000$, still below \$1 250 000). Without it, the remaining eight sales span only $\$498\,000 - \$412\,000 = \$86\,000$. The outlier drags the mean up to \$546 111, which is more than eight of the nine sales — it describes almost no house in the data. The median, \$460 000, sits in the middle of the cluster of eight ordinary sales and barely moves when one huge value is present, so the median is the better measure of a typical Aldergate sale.

(d) Change: $\$460\,000 - \$400\,000 = \$60\,000$.

Percentage change: $\$60\,000 \div \$400\,000 \times 100 = 15.0\%$.

Check: $0.15 \times \$400\,000 = \$60\,000$ and $\$400\,000 + \$60\,000 = \$460\,000$ ✓ — consistent.

∴ The median Aldergate sale price is \$460 000 — a better typical value than the outlier-inflated mean of \$546 111 — and the median has risen 15.0 % in three years.

Example 4 — unscaffolded

Elise tracks her money in a budgeting app. For one month the app shows:

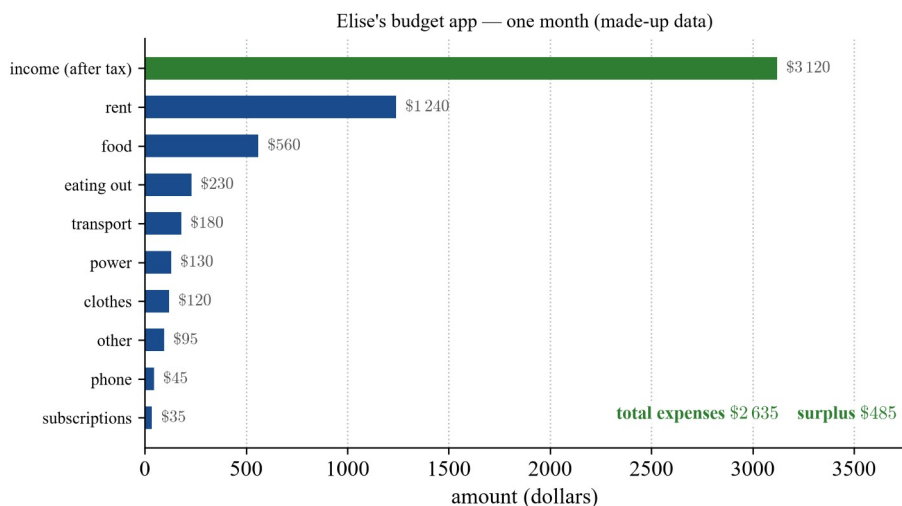
- Income (after tax): \$3 120
- Expenses: rent \$1 240, food \$560, transport \$180, phone \$45, power \$130, subscriptions \$35, clothes \$120, eating out \$230, other \$95

Elise's goal is \$1 600 for a laptop and an online course.

Made-up data: Elise, her app and all amounts are invented for this section.

- Find her total monthly expenses and her surplus.
- She cancels two subscriptions (a cut of \$20 per month) and cuts eating out by \$60 per month. Find her new total expenses and her new surplus.

- (c) Find how many whole months it takes to reach \$1 600 before and after the changes, rounding any part-month up to a whole month. How many months do the changes save?
- (d) Check your surplus from (a) with an estimate.



Solution:

- (a) Total expenses:

$$\$1\,240 + \$560 + \$180 + \$45 + \$130 + \$35 + \$120 + \$230 + \$95 = \$2\,635$$

Surplus: $\$3\,120 - \$2\,635 = \$485$.

- (b) The cuts total $\$20 + \$60 = \$80$ per month.

New total expenses: $\$2\,635 - \$80 = \$2\,555$.

New surplus: $\$3\,120 - \$2\,555 = \$565$.

- (c) Before the changes: $\$1\,600 \div \$485 = 3.298\dots$

Three months would save only $3 \times \$485 = \$1\,455$ — not enough. Rounding the part-month **up**, the goal takes 4 **whole months** ($4 \times \$485 = \$1\,940$).

After the changes: $\$1\,600 \div \$565 = 2.831\dots$

Two months would save only $2 \times \$565 = \$1\,130$ — not enough. Rounding up, the goal takes 3 **whole months** ($3 \times \$565 = \$1\,695$).

The changes save 1 **month**.

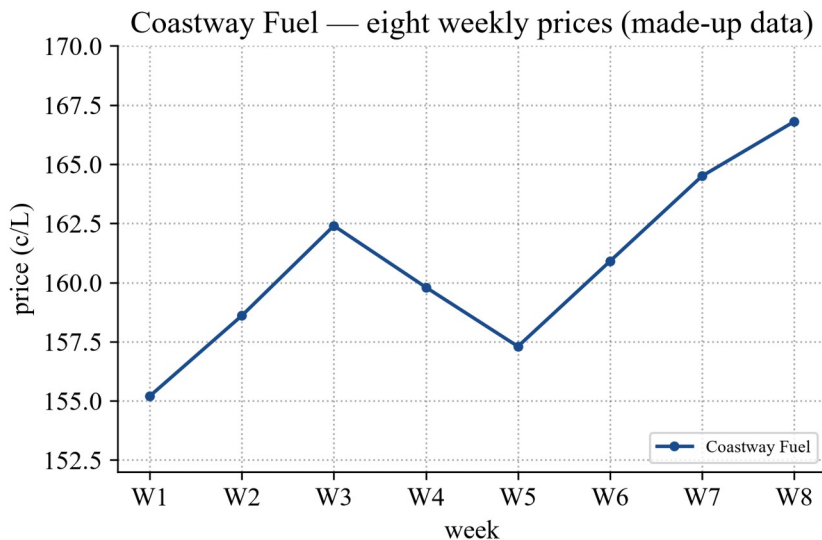
- (d) Estimate: round income to about \$3 100 and expenses to about \$2 600. About $\$3\,100 - \$2\,600 = \$500$. The exact surplus, \$485, sits close to the estimate ✓ — reasonable.

$\therefore$ Elise's surplus rises from \$485 to \$565 a month, cutting her \$1 600 goal from 4 whole months to 3.

Practice questions

Scaffolded

Q1. Coastway Fuel records its unleaded price each week for eight weeks.



The prices, in c/L: 155.2, 158.6, 162.4, 159.8, 157.3, 160.9, 164.5, 166.8 (week 1 to week 8).

Made-up data: the station and all prices are invented for this section.

- Write down the price in week 3 and the price in week 5.
- Find the change in price from week 1 to week 8, and the percentage change, correct to 1 decimal place.
- A driver fills with 40 litres in week 1 and 40 litres in week 8. Find each cost to the nearest cent, and the difference between them.

Q2. Fresh Fields Supermarket tracks six items.

Item	Five years ago	This year
Loaf of bread	\$2.50	\$3.20
2 L milk	\$3.00	\$3.90
Dozen eggs	\$4.20	\$5.60
1 kg pasta twists	\$2.80	\$3.50
Cinema ticket	\$16.00	\$21.50
Bus fare	\$4.20	\$5.00

Made-up data: the supermarket and all prices are invented for this section.

- Find the dollar rise for the eggs and for the cinema ticket.
- Find the percentage rise for the milk and for the bread, each correct to 1 decimal place.
- Fresh Fields also sells 1.5 kg of pasta shells for \$5.40. Find the price per kilogram of the twists and of the shells, to the nearest cent, and say which is the better buy.

Q3. A bookmaker's head-to-head market (two outcomes only, one must win) offers:

- Ashford United: \$1.55
- Darley Rovers: \$2.45

Made-up data: the teams and the odds are invented for this section.

- Find the implied probability that Ashford United wins, as a percentage correct to 1 decimal place.
- Find the implied probability for Darley Rovers and the sum of the two probabilities, each correct to 1 decimal place.
- A fan bets \$15 on Darley Rovers. Find the return and the profit if Darley Rovers win.

Q4. Jarrod keeps his weekly budget in a spreadsheet.

Cell	A (label)	B (value)
B2	income (weekly)	980
B3	rent	385
B4	food	190
B5	transport	72
B6	phone	25
B7	fun	96
B8	other	60
B10	surplus	=B2-SUM(B3:B8)

Made-up data: Jarrod and all amounts are invented for this section.

- Calculate what the formula in B10 displays: the total expenses and the surplus.
- Jarrod changes B7 from 96 to 66. Find the new total expenses and the new surplus.
- At the new surplus, he saves every dollar towards \$500 for tools. Find how many whole weeks this takes, rounding any part-week up to a whole week.

Q5. A statistics bureau publishes this made-up CPI-style index for a basket of goods (Year 1 = 100).

Year	1	2	3	4	5
Index	100.0	102.8	106.4	109.1	113.2

Made-up data: the index is invented for this section.

- Find the one-year rise in the index for each step (Year 1→2, 2→3, 3→4, 4→5). In which year was the rise biggest?
- Find the total percentage change in the index from Year 1 to Year 5, correct to 1 decimal place.
- A basket of groceries cost \$86.40 in Year 1. Using the index change from (b), estimate its cost in Year 5, to the nearest cent.

Q6. This made-up table shows the superannuation rate applied to Nola's salary over five years. Nola's salary is \$52 000 per year throughout.

Year	2021	2022	2023	2024	2025
Super rate	9.5 %	10.5 %	11 %	11.5 %	12 %

Made-up data: the rates are invented for this section; the real super system works as described in the Theory.

- Find her employer's super contribution in 2021.
- Find the contribution in 2025.
- Find how much more per year the 2025 contribution is than the 2021 contribution.

Un scaffolded

Q7. Ravi compares two internet plans. Coastlink Internet charges \$72 per month in Year 1, \$75 in Year 2 and \$78 in Year 3. Northline Telecom charges \$66 in Year 1, \$72 in Year 2 and \$80 in Year 3.

Made-up data: both providers and all prices are invented for this section.

- Find each provider's total cost for Year 1 and for Year 3.
- Which plan is cheaper in Year 1, and which is cheaper in Year 3? State the difference in each year.
- Find the percentage rise for each plan from Year 1 to Year 3, correct to 1 decimal place, and use them to justify why the cheaper plan changed.

Q8. The median house price in Cedar Vale was \$380 000 in 2020 and \$456 000 in 2023.

Made-up data: the town and both prices are invented for this section.

- Find the change in the median price.
- Find the percentage change over the three years.
- Find the average yearly change over the three years, to the nearest dollar.
- Using the average yearly change from (c) **without rounding it**, project the median price two more years ahead, to the nearest dollar. State one reason this projection might be wrong.

Q9. The nine people at Marlowe Electrical are paid these amounts per week:

\$720, \$745, \$780, \$800, \$830, \$880, \$915, \$950, and the owner, Ms Voss, \$3 200.

Made-up data: the business and all pays are invented for this section.

- Find the mean weekly pay, to the nearest dollar, and the median weekly pay.
- Identify the outlier.
- A local news item says “the average worker at Marlowe Electrical earns \$1 091 a week”. Evaluate this claim: which measure should the news item have used, and why?

Q10. Cody earns \$920 per week. Over one year his wage rises by 2.5 %, while his weekly basket of living costs rises by 3.6 %. His basket cost \$920 per week a year ago.

Made-up data: Cody and all amounts are invented for this section.

- Find the dollar rise in his wage and his new weekly wage.
- Find the new cost of his basket, to the nearest cent.
- Is Cody better off or worse off after the year? Justify your answer with a number.

Q11. A bookmaker's head-to-head market (two outcomes only) offers:

- Granite Falls FC: \$1.75
- Harbourview SC: \$2.20

Made-up data: the teams and the odds are invented for this section.

- Find the implied probability of each team winning, as a percentage correct to 1 decimal place.
- Find the sum of the two implied probabilities, correct to 1 decimal place, and the bookmaker's margin in percentage points.
- Who does the margin benefit, and how?
- Gwen bets \$40 each week for 52 weeks. Find her total stake for the year. Using likelihood language, explain why she should treat that money as the cost of entertainment rather than as income.

Q12. The Koorana Swifts won 9 of their last 36 matches. A bookmaker offers odds of \$3.60 for the Swifts in their next match. A fan bets \$10.

Made-up data: the team, its record and the odds are invented for this section.

- Using the record, estimate the Swifts' probability of winning as a percentage.
- Find the implied probability from the odds, correct to 1 decimal place. Compared with the estimate from (a), are the odds generous or stingy to the person betting?
- Find the return and the profit if the \$10 bet wins.
- Using the 25 % estimate from (a), find the long-run average return on the \$10 bet. On average, does the person betting win or lose money?

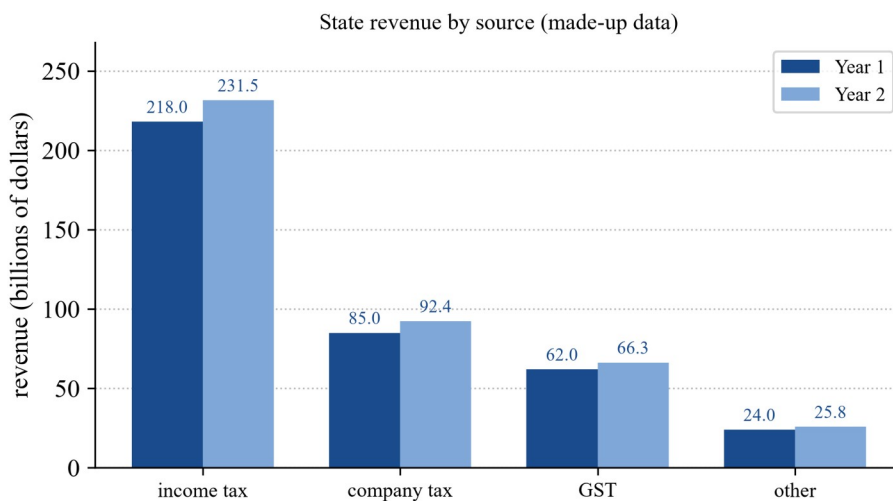
Q13. Marcus's budgeting app shows this month:

- Income: \$2 860
- Expenses: rent \$1 150, food \$480, transport \$160, phone \$55, power \$120, subscriptions \$45, eating out \$240, gym \$65, other \$90

Made-up data: Marcus and all amounts are invented for this section.

- Find his total expenses and his surplus.
- His hours are cut and his income falls to \$2 650. Find his new surplus.
- His income falls again, to \$2 280. Find his deficit. Marcus then cuts eating out from \$240 to \$150 and subscriptions from \$45 to \$10. Show that his budget then balances exactly — surplus \$0.
- Evaluate Marcus's situation: what does part (c) show about budgets when income can change?

Q14. A state government publishes this made-up table of revenue by source.



Revenue in \$ billions: income tax 218.0 (Year 1) and 231.5 (Year 2); company tax 85.0 and 92.4; GST 62.0 and 66.3; other 24.0 and 25.8.

Made-up data: the state and every figure are invented for this section.

- Find the total revenue for Year 1 and for Year 2.
- Find GST as a percentage of total revenue in Year 2, correct to 1 decimal place.
- Find the percentage growth of each source from Year 1 to Year 2, correct to 1 decimal place. Which source grew fastest?

Q15. The Nguyen family’s monthly spending, and the price rise each category faced this year:

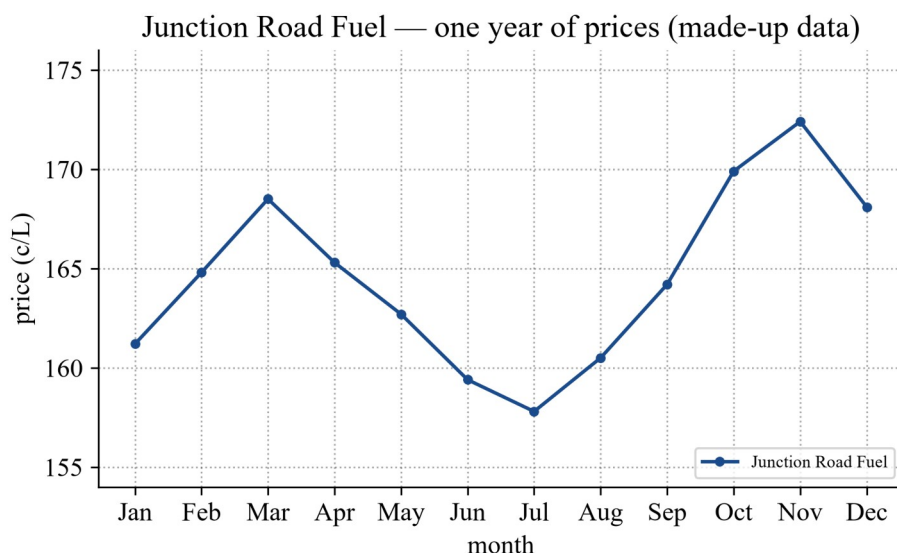
Category	Monthly spend	This year’s rise
Rent	\$1 450	5.0 %
Food	\$820	4.5 %
Transport	\$310	2.0 %
Other	\$420	1.5 %

A headline says “cost of living up 3.4 %”.

Made-up data: the family, all amounts and the headline are invented for this section.

- Find the family’s total monthly spending.
- Find the dollar rise in each category, and the total dollar rise.
- Find the family’s own percentage rise, correct to 1 decimal place. Evaluate the 3.4 % headline for this family — is it a fair summary of their year? Justify your answer.

Q16. Junction Road Fuel records its unleaded price on the first of each month for a full year.



The prices, in c/L: Jan 161.2, Feb 164.8, Mar 168.5, Apr 165.3, May 162.7, Jun 159.4, Jul 157.8, Aug 160.5, Sep 164.2, Oct 169.9, Nov 172.4, Dec 168.1.

Made-up data: the station and all prices are invented for this section.

- Write down the highest price and its month, the lowest price and its month, and the range of the twelve prices.
- Find the mean of the twelve prices, correct to 1 decimal place.
- Find the percentage change from January to December, correct to 1 decimal place, and describe the shape of the year in one sentence.

Q17. Rex bought a unit for \$420 000. Over the next three years its value changed: +6 % in Year 1, – 4 % in Year 2, +3 % in Year 3.

Made-up data: Rex, the unit and all values are invented for this section.

- Find the value at the end of each year. Give the Year 3 value to the nearest dollar.
- Find the total percentage change over the three years, correct to 1 decimal place.
- Rex’s friend says, “Houses always go up, so you can’t lose.” Evaluate this claim using your answers from (a) and (b).

Q18. The made-up town of Kirra Vale tracks three indices over five years (Year 1 = 100):

Year	1	2	3	4	5
Median house price	100.0	104.5	112.0	118.5	126.0
Average wage	100.0	102.0	104.5	106.5	109.0
CPI (prices)	100.0	102.5	105.5	108.0	111.5

In Year 1, the median house price was \$385 000 and the average wage was \$61 000.

Made-up data: the town and every figure are invented for this section.

- (a) Find the total percentage change from Year 1 to Year 5 for each of the three measures, each correct to 1 decimal place.
 - (b) Find the median house price and the average wage in Year 5.
 - (c) Find the ratio median house price $\div$ average wage for Year 1 and for Year 5, each correct to 1 decimal place. Evaluate what the change in this ratio means for a first-home buyer in Kirra Vale.
-

Answers

Q1. (a) 162.4 c/L; 157.3 c/L. (b) 11.6 c/L; 7.5 % (to 1 d.p.). (c) \$62.08; \$66.72; difference \$4.64. **Q2.** (a) \$1.40; \$5.50. (b) 30.0%; 28.0% (to 1 d.p.). (c) \$3.50 per kg; \$3.60 per kg; the twists are the better buy, \$0.10 per kg cheaper. **Q3.** (a) 64.5 %. (b) 40.8%; 105.3% (to 1 d.p.). (c) Return \$36.75; profit \$21.75. **Q4.** (a) Expenses \$828; surplus \$152. (b) Expenses \$798; surplus \$182. (c) 3 weeks. **Q5.** (a) 2.8; 3.6; 2.7; 4.1 — biggest in Year 4→5. (b) 13.2% (to 1 d.p.). (c) \$97.80 (to the nearest cent). **Q6.** (a) \$4 940. (b) \$6 240. (c) \$1 300 more per year. **Q7.** (a) Coastlink \$864 and \$936; Northline \$792 and \$960. (b) Northline cheaper in Year 1 by \$72; Coastlink cheaper in Year 3 by \$24. (c) 8.3%; 21.2% (to 1 d.p.). **Q8.** (a) \$76 000. (b) 20 %. (c) \$25 333 (to the nearest dollar). (d) \$506 667 (to the nearest dollar). **Q9.** (a) Mean \$1 091 (to the nearest dollar); median \$830. (b) \$3 200. (c) the median — the mean is inflated by the outlier. **Q10.** (a) \$23.00; \$943.00. (b) \$953.12 (to the nearest cent). (c) worse off; the gap is \$10.12 per week. **Q11.** (a) 57.1%; 45.5% (to 1 d.p.). (b) 102.6%; 2.6 percentage points. (d) \$2 080. **Q12.** (a) 25 %. (b) 27.8% (to 1 d.p.); stingy. (c) Return \$36.00; profit \$26.00. (d) \$9.00; loses — on average \$1.00 per \$10 bet. **Q13.** (a) Expenses \$2 405; surplus \$455. (b) \$245. (c) Deficit \$125. **Q14.** (a) \$389.0 billion; \$416.0 billion. (b) 15.9% (to 1 d.p.). (c) Income tax 6.2%; company tax 8.7%; GST 6.9%; other 7.5%; company tax grew fastest. **Q15.** (a) \$3 000. (b) \$72.50; \$36.90; \$6.20; \$6.30; total \$121.90. (c) 4.1% (to 1 d.p.). **Q16.** (a) Highest 172.4 c/L (Nov); lowest 157.8 c/L (Jul); range 14.6 c/L. (b) 164.6 c/L (to 1 d.p.). (c) 4.3% (to 1 d.p.). **Q17.** (a) \$445 200; \$427 392; \$440 214 (to the nearest dollar). (b) 4.8% (to 1 d.p.). **Q18.** (a) House + 26.0%; wages + 9.0%; CPI + 11.5% (to 1 d.p.). (b) \$485 100; \$66 490. (c) 6.3; 7.3 (to 1 d.p.).

Fully-worked solutions

Q1.

(a) Week 3: 162.4 c/L. Week 5: 157.3 c/L.

(b) Change: $166.8 - 155.2 = 11.6$ c/L.

Percentage change: $11.6 \div 155.2 \times 100 = 7.474\dots\%$. Correct to 1 decimal place: 7.5%.

(c) Week 1: $40 \times \$1.552 = \$62.08$. Week 8: $40 \times \$1.668 = \$66.72$. Both exact to the nearest cent.

Difference: $\$66.72 - \$62.08 = \$4.64$.

Check: about 12 c on about 160 c is about $12 \div 160 \times 100 = 7.5\%$ — the exact answer, 7.5%, matches ✓.

Q2.

(a) Eggs: $\$5.60 - \$4.20 = \$1.40$. Cinema: $\$21.50 - \$16.00 = \$5.50$.

(b) Milk: rise $\$3.90 - \$3.00 = \$0.90$; $\$0.90 \div \$3.00 \times 100 = 30.0\%$, so 30.0% (1 d.p.).

Bread: rise $\$3.20 - \$2.50 = \$0.70$; $\$0.70 \div \$2.50 \times 100 = 28.0\%$, so 28.0% (1 d.p.).

For interest, the others: eggs $\$1.40 \div \$4.20 \times 100 = 33.333\ldots\%$, so 33.3%; pasta $\$0.70 \div \$2.80 \times 100 = 25.0\%$; cinema $\$5.50 \div \$16.00 \times 100 = 34.375\%$, so 34.4%; bus $\$0.80 \div \$4.20 \times 100 = 19.047\ldots\%$, so 19.0% (each to 1 d.p.). The cinema ticket rose most in percentage terms.

(c) Twists: $\$3.50$ for 1 kg, so **$\$3.50$ per kg**. Shells: $\$5.40 \div 1.5 = \$3.60$ per kg (exact, to the nearest cent).

Difference: $\$3.60 - \$3.50 = \$0.10$ per kg. The **pasta twists are the better buy**, $\$0.10$ per kg cheaper.

Q3.

(a) Ashford: $1 \div 1.55 = 0.64516\ldots$. As a percentage, correct to 1 decimal place: 64.5%.

(b) Darley: $1 \div 2.45 = 0.40816\ldots = 40.8\%$ (1 d.p.).

Sum: $64.5\% + 40.8\% = 105.3\%$. (Unrounded: $105.33\ldots\%$ — also 105.3% to 1 d.p., so the rounded parts and the exact total agree.) The market carries a margin of 5.3 percentage points for the bookmaker.

(c) Return: $\$15 \times 2.45 = \$36.75$. Profit: $\$36.75 - \$15.00 = \$21.75$.

Q4.

(a) $\text{SUM}(B3:B8) : 385 + 190 + 72 + 25 + 96 + 60 = \$828$ total expenses.

Surplus: $980 - 828 = \$152$.

(b) The cut is $96 - 66 = \$30$. New total: $828 - 30 = \$798$.

New surplus: $980 - 798 = \$182$.

(c) $500 \div 182 = 2.747\ldots$. Two weeks save only $2 \times 182 = \$364$ — not enough. Rounding the part-week up: 3 **whole weeks** ($3 \times 182 = \$546$).

Q5.

(a) Year 1→2: $102.8 - 100.0 = 2.8$. Year 2→3: $106.4 - 102.8 = 3.6$. Year 3→4: $109.1 - 106.4 = 2.7$. Year 4→5: $113.2 - 109.1 = 4.1$.

The biggest rise is 4.1, **from Year 4 to Year 5**.

(b) Total rise: $113.2 - 100.0 = 13.2$ index points. Percentage change: $13.2 \div 100.0 \times 100 = 13.2\%$ (1 d.p.).

(c) $\$86.40 \times 1.132 = \$97.8048$. To the nearest cent: **$\$97.80$** .

Check: 13% of about $\$86$ is about $\$11$, and about $\$86 + \$11 = \$97$ ✓ — reasonable.

Q6.

(a) 2021: $0.095 \times \$52\,000 = \$4\,940$.

(b) 2025: $0.12 \times \$52\,000 = \$6\,240$.

(c) $\$6\,240 - \$4\,940 = \$1\,300$ more per year.

For interest, 2023: $0.11 \times \$52\,000 = \$5\,720$.

Q7.

(a) Coastlink: Year 1, $12 \times \$72 = \$864$; Year 3, $12 \times \$78 = \$936$.

Northline: Year 1, $12 \times \$66 = \$792$; Year 3, $12 \times \$80 = \$960$.

(b) Year 1: $\$864 - \$792 = \$72$ — **Northline is cheaper by \$72.**

Year 3: $\$960 - \$936 = \$24$ — **Coastlink is cheaper by \$24.**

(c) Coastlink: $\$6 \div \$72 \times 100 = 8.333\ldots\%$; correct to 1 decimal place: 8.3%.

Northline: $\$14 \div \$66 \times 100 = 21.212\ldots\%$; correct to 1 decimal place: 21.2%.

Northline's monthly price rose about 2.5 times as fast as Coastlink's. Starting \$72 a year cheaper, that steep rise carried Northline past Coastlink by Year 3. The cheaper plan is not a fixed fact — it depends on the trend, so judging a plan on today's price alone can cost more over time.

Q8.

(a) $\$456\,000 - \$380\,000 = \$76\,000$.

(b) $\$76\,000 \div \$380\,000 \times 100 = 20\%$.

(c) $\$76\,000 \div 3 = \$25\,333.33\ldots$ To the nearest dollar: **\$25 333 per year.**

(d) Carry the unrounded average: two more years add $2 \times \$25\,333.33\ldots = \$50\,666.67$, so the projection is $\$456\,000 + \$50\,666.67 = \$506\,666.67$. To the nearest dollar: **\$506 667.**

The projection assumes the same average rise keeps going. It might be wrong because house prices do not rise steadily — they can slow, stall or fall (see Q17).

Q9.

(a) Sum: $\$720 + \$745 + \$780 + \$800 + \$830 + \$880 + \$915 + \$950 + \$3\,200 = \$9\,820$.

Mean: $\$9\,820 \div 9 = \$1\,091.11\ldots$ To the nearest dollar: **\$1 091.**

Median (the 5th of 9 sorted values): **\$830.**

(b) The outlier is **\$3 200** — the owner's pay, more than three times the next highest ($3 \times \$950 = \$2\,850$, still below \$3 200).

(c) The claim is misleading. The \$1 091 figure is the mean, and the mean is inflated by the \$3 200 outlier: **eight of the nine people earn less than \$1 091** — none of the eight workers earns it. The news item should have used the **median, \$830**, which sits in the middle of the workers' pay and describes a typical person at Marlowe Electrical.

Q10.

(a) Wage rise: $0.025 \times \$920 = \$23.00$. New wage: $\$920 + \$23 = \$943.00$.

(b) Basket rise: $0.036 \times \$920 = \$33.12$. New basket: $\$920 + \$33.12 = \$953.12$ (to the nearest cent).

(c) His costs rose \$33.12 but his wage rose only \$23.00 — a gap of $\$33.12 - \$23.00 = \$10.12$ per week. Cody is **worse off**: the 3.6% price rise outran his 2.5% wage rise, so a pay rise still left him behind.

Q11.

- (a) Granite Falls: $1 \div 1.75 = 0.5714 \dots = 57.1\%$ (1 d.p.). Harbourview: $1 \div 2.20 = 0.4545 \dots = 45.5\%$ (1 d.p.).
- (b) Sum: $57.1\% + 45.5\% = 102.6\%$ (unrounded: $102.597 \dots\%$, also 102.6% to 1 d.p.). Margin: $102.6 - 100 = 2.6$ percentage points.
- (c) The margin benefits the **bookmaker**. One team must win, so the true probabilities total 100% ; the extra 2.6 points is built into the odds, which makes every payout slightly smaller than a fair one. Repeated across all bets, that is how the bookmaker makes a profit whoever wins.
- (d) Stake: $\$40 \times 52 = \$2\,080$ for the year. Even the favourite wins with implied probability only 57.1% , so losing bets are common — and because of the margin, the long-run average return is less than the stake (see the Theory model). Gwen should treat the $\$2\,080$ as the **cost of entertainment**, like concert tickets: money spent on fun that she can afford to lose, never as income she expects back.

Q12.

- (a) $9 \div 36 = 0.25 = 25\%$.
- (b) Implied: $1 \div 3.60 = 0.2777 \dots = 27.8\%$ (1 d.p.). The odds suggest a 27.8% chance, above the 25% the record supports — the bookmaker acts as if a win is more likely than the data says, which keeps the payout lower than fair. The odds are **stingy** to the person betting.
- (c) Return: $\$10 \times 3.60 = \$36.00$. Profit: $\$36.00 - \$10.00 = \$26.00$.
- (d) Average return: $0.25 \times \$36.00 = \$9.00$. That is $\$10.00 - \$9.00 = \$1.00$ less than the stake, so on average the person betting **loses \$1.00 per \$10 bet** — 10% of every stake, every time, in the long run.

Q13.

- (a) Total expenses: $\$1\,150 + \$480 + \$160 + \$55 + \$120 + \$45 + \$240 + \$65 + \$90 = \$2\,405$.

Surplus: $\$2\,860 - \$2\,405 = \$455$.

- (b) New surplus: $\$2\,650 - \$2\,405 = \$245$.
- (c) $\$2\,280 - \$2\,405 = -\$125$, a deficit of **\$125**.

After the cuts, one line per step:

Eating-out cut: $\$240 - \$150 = \$90$.

Subscriptions cut: $\$45 - \$10 = \$35$.

Total cut: $\$90 + \$35 = \$125$.

New expenses: $\$2\,405 - \$125 = \$2\,280$.

New surplus: $\$2\,280 - \$2\,280 = \$0$.

The surplus is $\$0$ — exactly the target, so the budget balances.

- (d) Marcus's fixed costs (rent, power, phone) did not change, but his income fell twice and wiped out his $\$455$ surplus. Part (c) shows a budget is not a one-off document: when income can change, the budget must be revisited, and the levers are the flexible items — eating out and subscriptions here. A surplus in good weeks is also the buffer that makes bad weeks survivable.

Q14.

(a) Year 1: $218.0 + 85.0 + 62.0 + 24.0 = \$389.0$ billion.

Year 2: $231.5 + 92.4 + 66.3 + 25.8 = \$416.0$ billion.

(b) GST share: $66.3 \div 416.0 \times 100 = 15.9375\%$; correct to 1 decimal place: 15.9% .

(c) Income tax: rise $231.5 - 218.0 = 13.5$; $13.5 \div 218.0 \times 100 = 6.192\ldots\%$ $= 6.2\%$ (1 d.p.).

Company tax: rise $92.4 - 85.0 = 7.4$; $7.4 \div 85.0 \times 100 = 8.705\ldots\%$ $= 8.7\%$ (1 d.p.).

GST: rise $66.3 - 62.0 = 4.3$; $4.3 \div 62.0 \times 100 = 6.935\ldots\%$; correct to 1 decimal place: 6.9% .

Other: rise $25.8 - 24.0 = 1.8$; $1.8 \div 24.0 \times 100 = 7.5\%$.

Company tax grew fastest, at 8.7% . (Total revenue grew $416.0 - 389.0 = 27.0$;
 $27.0 \div 389.0 \times 100 = 6.940\ldots\%$ $= 6.9\%$ — the same as GST to 1 d.p.)

Q15.

(a) $\$1450 + \$820 + \$310 + \$420 = \$3000$.

(b) Rent: $0.05 \times \$1450 = \$72.50$. Food: $0.045 \times \$820 = \$36.90$.

Transport: $0.02 \times \$310 = \$6.20$. Other: $0.015 \times \$420 = \$6.30$.

Total rise: $\$72.50 + \$36.90 + \$6.20 + \$6.30 = \$121.90$.

(c) $\$121.90 \div \$3000 \times 100 = 4.063\ldots\%$; correct to 1 decimal place: 4.1% .

The headline is **not a fair summary for this family**. The CPI is one average basket; the Nguyens' own basket weighs rent and food heavily — $\$1450 + \$820 = \$2270$ of their $\$3000$ — and those rose fastest (5.0% and 4.5%), pulling their own rise to 4.1% , well above the 3.4% headline. An average can hide what any one family actually feels: cost-of-living impact depends on *your* mix of spending.

Q16.

(a) Highest: **172.4 c/L in November**. Lowest: **157.8 c/L in July**.

Range: $172.4 - 157.8 = 14.6$ c/L.

(b) Sum of the twelve prices: 1974.8 c/L. Mean: $1974.8 \div 12 = 164.566\ldots$ Correct to 1 decimal place: **164.6 c/L**.

(c) January to December: $168.1 - 161.2 = 6.9$ c/L. Percentage: $6.9 \div 161.2 \times 100 = 4.280\ldots\%$; correct to 1 decimal place: **4.3%**.

Shape: prices **climbed to a March peak, slid to the July low, then rose steadily to the November high before easing in December** — a year that dipped mid-way and ended higher than it started.

Check: the mean, 164.6 , sits between the lowest (157.8) and highest (172.4) prices ✓.

Q17.

(a) Year 1: $1.06 \times \$420\,000 = \$445\,200$.

Year 2: $0.96 \times \$445\,200 = \$427\,392$.

Year 3: $1.03 \times \$427\,392 = \$440\,213.76$. To the nearest dollar: **\$440 214**.

(b) Total change: $\$440\,213.76 - \$420\,000 = \$20\,213.76$. Percentage:
 $\$20\,213.76 \div \$420\,000 \times 100 = 4.8128\%$; correct to 1 decimal place: 4.8%.

(c) The claim does not survive the data. In Year 2 the value **fell** by $\$445\,200 - \$427\,392 = \$17\,808$ — prices can go down. And even with two up-years and one down-year, the three years produced a total rise of only 4.8% — less than the naive sum of the percentages ($6 - 4 + 3 = 5\%$), because each percentage applies to a different base. Houses can go up, down, or barely move; treating them as a guaranteed rise ignores real risk.

Q18.

(a) House: $(126.0 - 100.0) \div 100.0 \times 100 = +26.0\%$. Wages: $(109.0 - 100.0) \div 100.0 \times 100 = +9.0\%$. CPI: $(111.5 - 100.0) \div 100.0 \times 100 = +11.5\%$ (each to 1 d.p.).

(b) House price: $1.26 \times \$385\,000 = \$485\,100$. Wage: $1.09 \times \$61\,000 = \$66\,490$.

(c) Year 1: $\$385\,000 \div \$61\,000 = 6.311\dots$; correct to 1 decimal place: 6.3. Year 5:
 $\$485\,100 \div \$66\,490 = 7.2958\dots$; correct to 1 decimal place: 7.3.

The ratio rose from 6.3 to 7.3 — a change of $7.3 - 6.3 = 1.0$: a median house now costs about **one extra full year of the average wage** compared with Year 1. For a first-home buyer this is a double squeeze — house prices (+26.0%) grew about three times as fast as wages (+9.0%), and wages even lagged general prices (+11.5%), so everyday costs bite at the same time as saving a deposit gets further away. Buying in Kirra Vale carries more financial risk in Year 5 than in Year 1, even for a buyer whose wage rose.

Theory

This section is the health context for Unit 4. The maths comes from two Areas of Study you have already met: **Data** (Chapter 8 — mean, median, range, outliers, tables, graphs and trends) and **Uncertainty** (Chapter 9 — probability, chance language and risk). The context is health: your own body and habits, your workplace, your town and the health information that reaches you from clinics, websites and the news.

Unit 4 asks for more than Unit 3 did. As well as *applying* the maths, you are asked to **critically analyse** health data (pull it apart and test it), **evaluate** claims built on it (decide whether the numbers really support the claim) and **justify** your verdict (give the reason in words, with your numbers). Every task here still runs through the four-stage problem-solving cycle from Section 1A — **Stage 1 — Identify, Stage 2 — Act, Stage 3 — Evaluate, Stage 4 — Report**.

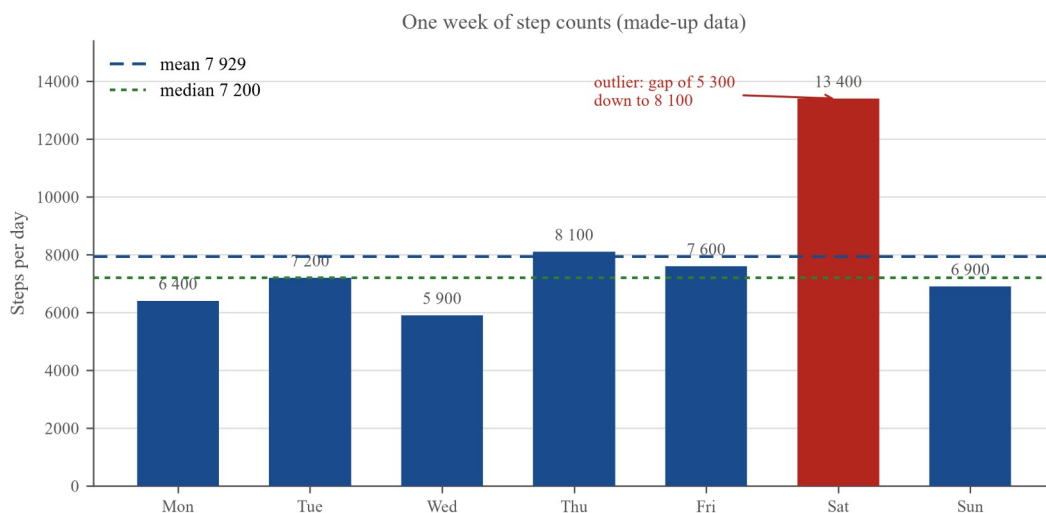
This section works through six kinds of health task: fitness and nutrition tracking, social health trends, workplace safety data, public health chance and long-term risk, access to health care outside the city, and chemical-safety data.

Health data arrives as data sets.

A phone app, a fitness band or a food diary records numbers day after day: steps, hours of sleep, kilojoules (kJ) of food energy, heart rate. That list of numbers is a **data set**, and Chapter 8's summary tools describe it in a few numbers:

- the **mean** is the sum of the values divided by how many there are;
- the **median** is the middle value when the data are sorted (for an even count, the mean of the two middle values);
- the **range** is the highest value minus the lowest;
- an **outlier** is a value that sits far away from all the others — look for a big empty gap in the sorted data.

An outlier drags the mean towards it, so the mean can stop looking like a typical day. The median is not moved by one extreme value. A **worked model**: one week of step counts (in steps per day) is 6 400, 7 200, 5 900, 8 100, 7 600, 13 400, 6 900.



Made-up data: this week of step counts is invented for this book.

The sum is 55 500, so the mean is $55\,500 \div 7 = 7\,928.571\dots$, which is 7 929 steps to the nearest whole number. Sorted, the middle value is 7 200, so the median is 7 200 steps. The range is $13\,400 - 5\,900 = 7\,500$ steps. The 13 400 is an outlier: the next value down is 8 100, a gap of 5 300, while the other gaps are about 1 000 or less — it was a long walk day. Without it, the mean of the other six days is $42\,100 \div 6 = 7\,016.666\dots$, which is 7 017 steps to the nearest whole number. So the one big day pulled the mean up by about 912 steps and left it about 729 steps above the median. For this data set the **median** describes a typical day better than the mean does — that judgement is exactly the kind of critical analysis Unit 4 wants.

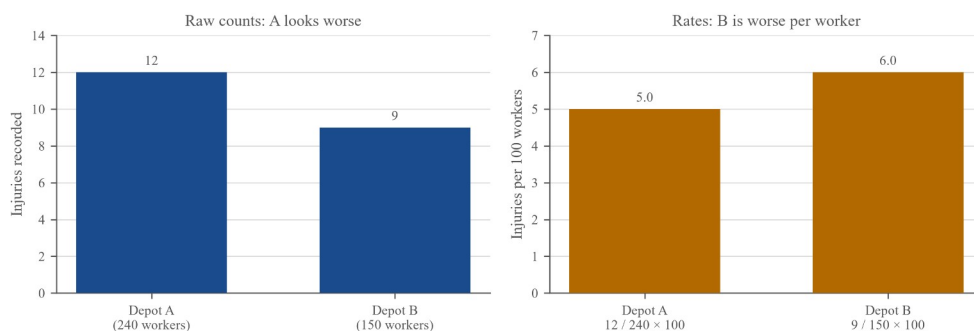
Comparing fairly: rates per 100 workers.

Workplaces count injuries, but a raw count is not a fair comparison when the sites have different numbers of workers. A bigger site collects more of everything — more injuries included. The fix is a **rate per 100 workers**:

$$\text{rate per 100 workers} = \frac{\text{number of injuries}}{\text{number of workers}} \times 100$$

It answers: *if this site had 100 workers, how many injuries would it be recording at the same rate?* Worked model: depot A records 12 injuries among 240 workers, and depot B records 9 injuries among 150 workers.

Comparing two depots of different sizes (made-up data)



Made-up data: these depots and their injury counts are invented for this book.

Depot A: $12 \div 240 \times 100 = 5.0$ injuries per 100 workers. Depot B: $9 \div 150 \times 100 = 6.0$ injuries per 100 workers. The raw counts say depot A is the worse site (12 is bigger than 9). The rates say the opposite: per worker, depot B is the more dangerous site (6.0 is bigger than 5.0). When two groups are different sizes, always compare rates, not counts — and say so when you justify a verdict.

Trends over time.

A **trend** is the direction data moves in over time — up, down, or steady. Health reports show trends in tables and line or column graphs: flu cases month by month, injuries year by year, survey percentages every few years. To describe a trend properly, give the start value, the end value and the direction (“cases rose from 4 in June to a peak of 31 in September, then fell to 18 in October”).

To measure the size of a change, use a **percentage change**:

$$\text{percentage change} = \frac{\text{new value} - \text{old value}}{\text{old value}} \times 100$$

A negative result is a fall. Worked model: a survey reports that 38 % of adults in a region were in the healthy-weight band in 2015, and 33 % in 2025. Two different statements are both true, and mixing them up is a classic media error:

- the **percentage-point fall** is $38 - 33 = 5$ percentage points — the plain gap between the two percentages;
- the **percentage fall** is $(33 - 38) \div 38 \times 100 = -13.157\ldots\%$, a fall of 13.2 % to 1 d.p. — the gap measured against the starting value.

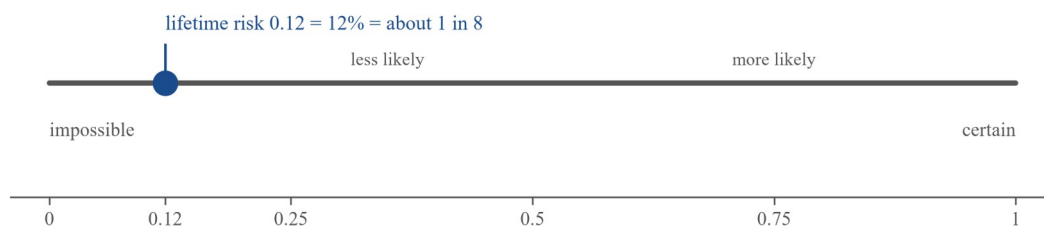
“Down 5 points” and “down 13.2 %” describe the same data. Percentage *points* subtract; percentage *change* divides by the old value. Say which one you mean.

Long-term chance and likelihood.

Public health information often quotes **long-term risk**: the chance something happens over a long stretch — a career, or a lifetime — rather than in one day or one year. A health website might say that 12 people in every 100 get a certain condition at some point in their lives. That sentence is a probability in disguise, and Chapter 9’s conversions turn it into any form you need:

$$\frac{12}{100} = 0.12 = 12\%$$

A long-term chance on the probability scale



The scale runs from 0 (impossible) to 1 (certain), as in Section 9A.

For the “1 in how many” form (Section 9D), divide 1 by the probability: $1 \div 0.12 = 8.333\dots$, so a probability of 0.12 is about **1 in 8**. Long-term risks are usually easier to picture this way.

A probability also gives an **expected number** — how many cases you would expect, on average, in a group of a given size:

$$\text{expected number} = \text{probability} \times \text{group size}$$

In a town of 2 500 people, a lifetime probability of 0.12 expects $0.12 \times 2500 = 300$ cases. The expected number is an average over many repeats, not a promise about one person: nobody’s personal future is exactly 12%. And small chances add up over long periods — a 0.02 chance each year expects $0.02 \times 10 = 0.2$ cases per person over ten years, that is, about 2 cases per 10 people. That is why health advice acts on small long-term risks instead of ignoring them.

Access to health care outside the city.

Where you live changes how fast help reaches you and how many services are near you. Three numbers do most of the work in access data:

- **distance** to the nearest service, in km;
- **travel time** = distance $\div$ speed (then $\times 60$ for minutes);
- a **service ratio**, such as 1 GP per 1 800 people. A **GP** (general practitioner) is a family doctor — usually the first health professional people see.

Worked model: a town of 6 000 people with 1 GP per 1 500 people has $6\,000 \div 1\,500 = 4$ GPs. A city suburb with 1 GP per 500 people would need $6\,000 \div 500 = 12$ GPs for the same town — a gap of 8. Ratios like this let you compare a country town with a city fairly, and evaluate claims that care is “the same everywhere”.

Chemical-safety data.

Workplaces and homes both store chemicals: solvents, acids, cleaners, fuels. A chemical **audit** is a formal count-and-check: every product is listed and its **hazard symbol** recorded. The three symbols used in this section are **flammable** (catches fire easily), **corrosive** (burns skin or materials) and **toxic** (poisonous). Audit data supports three kinds of maths:

- **percentages** of products in each hazard class;
- **simple probability**: if one product is chosen at random, the chance it is corrosive is $\frac{\text{corrosive count}}{\text{total count}}$ — equally likely outcomes, as in Section 9B. Model: a shelf of 40 products holds 12 flammable, 6 corrosive, 2 toxic and 20 with no symbol, so $P(\text{corrosive}) = \frac{6}{40} = \frac{3}{20} = 0.15 = 15\%$;
- **workplace-versus-home comparisons**: audits often find that home cupboards carry hazard symbols just as often as workplace shelves do — a claim worth testing with percentages before anyone believes it.

Precision and rounding.

Carry full precision through every intermediate step and round only where the question says to. Every item in this section states its precision — “to 1 d.p.”, “to 2 decimal places”, “to the nearest whole number”, “to the nearest cent”. When a value sits exactly halfway, this book rounds up (the school **half-up** rule): 2.85 rounds to 2.9 to 1 d.p.

Tools that help.

A phone app collects the tracking data, and a calculator or spreadsheet totals it and draws the graphs in seconds — that is the Outcome 3 toolkit doing its job. But the judgements stay yours: which measure describes the data best, whether a rate beats a count, whether a sample supports a claim about a whole town. Every task in this section can also be done with pen, paper and a basic calculator.

About the data in this section. Every clinic, depot, website, town, survey and data set here is **made up** (not real): pretend people, pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real person, business or place. The only real-world values are the two simplified daily guides used for comparison — about 8 700 kJ of food energy and no more than 50 g of added sugars for an average adult — and even those are rounded practice values, not medical advice.

Not medical advice. Every band, guide and probability in this section is simplified for maths practice. Never use this section to make a real decision about health or medicine — follow your doctor, pharmacist or nurse, and follow the labels on products.

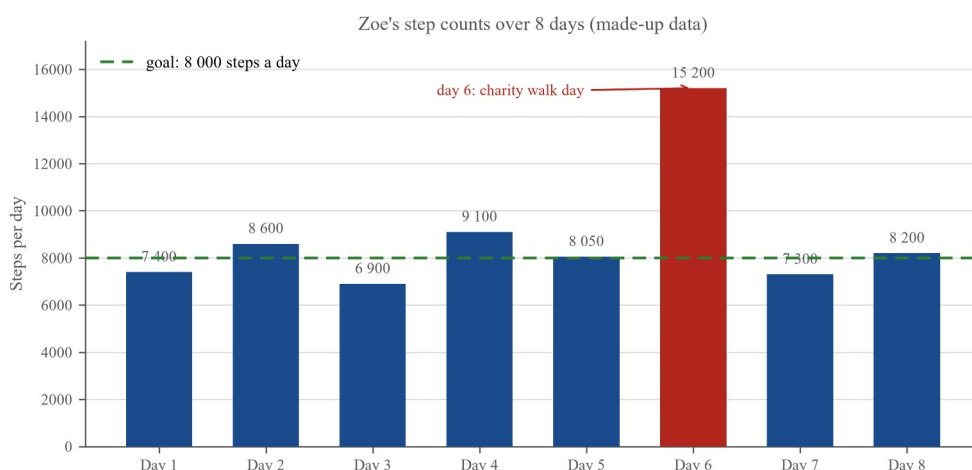
Worked examples

Example 1 — scaffolded

Zoe’s phone app records her steps for 8 days. Her goal is a mean of at least 8 000 steps a day over the 8 days.

Day	1	2	3	4	5	6	7	8
Steps	7 400	8 600	6 900	9 100	8 050	15 200	7 300	8 200

Day 6 was a charity walk day. Find the mean (to the nearest whole step), the median, the range and the number of days at or above 8 000 steps; identify the outlier and find the mean without it (to the nearest whole step); and decide whether Zoe’s goal is really being met.



Made-up data: Zoe, her app and every step count are invented for this book.

Working

Comment

Stage 1 — Identify: the data is 8 daily step counts; the goal is a mean of at least 8 000. Plan: sum and divide for the mean; sort for the median; highest – lowest for the range; count the days at or above 8 000; look for a

What is asked? Five numbers and one judgement about the goal.

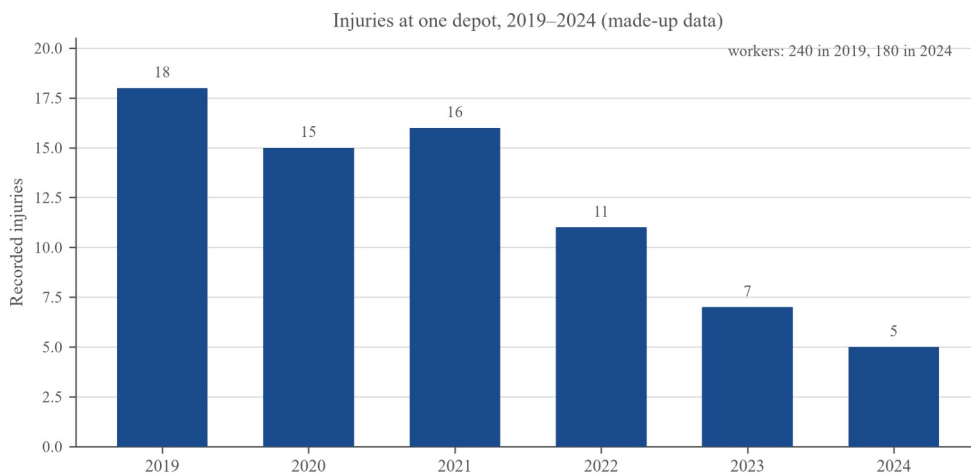
Working	Comment
big gap for the outlier; redo the mean without it.	
Stage 2 — Act: sum = 70 750; mean = $70\,750 \div 8 = 8\,843.75$, so 8 844 steps to the nearest whole step.	Round only at the end, at the stated precision.
Stage 2 — Act: sorted: 6 900, 7 300, 7 400, 8 050, 8 200, 8 600, 9 100, 15 200. Eight values, so the median is the mean of the two middle ones: $(8\,050 + 8\,200) \div 2 = 8\,125$ steps.	For an even count, the median sits between the two middle values.
Stage 2 — Act: range = $15\,200 - 6\,900 = 8\,300$ steps. Days at or above 8 000: days 2, 4, 5, 6 and 8 — that is 5 days of 8.	The range is one subtraction; the day count is a careful tick-off.
Stage 2 — Act: the 15 200 is the outlier — the next value down is 9 100, a gap of 6 100, while the other gaps are 800 or less. Mean without it: $(70\,750 - 15\,200) \div 7 = 55\,550 \div 7 = 7\,935.714\dots$, so 7 936 steps to the nearest whole step.	A big empty gap in the sorted data marks the outlier. Subtract it from the sum rather than re-adding seven numbers.
Stage 3 — Evaluate: the full mean, 8 844, is above the 8 000 goal — but one special day is doing the work. Without it the mean is 7 936, just under the goal. The median, 8 125, sits between the two. Sanity check: 5 of 8 days reached 8 000, so a mean just under 8 000 on ordinary days fits.	Critically analyse: does the goal measure ordinary days, or special ones? The two means answer differently — say so.
Stage 4 — Report: $\therefore$ mean = 8 844 steps, median = 8 125 steps, range = 8 300 steps, 5 of 8 days at or above 8 000; the 15 200 is an outlier and the mean without it is 7 936 steps. Zoe’s goal is met on paper but not on ordinary days — she is close, and one more regular walking day a week would put the everyday mean over 8 000.	Report the numbers and the judgement, in one place.

Example 2 — scaffolded

A delivery company (pretend) keeps its injury records for one depot over six years. The depot employed 240 workers in 2019 and 180 workers in 2024.

Year	2019	2020	2021	2022	2023	2024
Recorded injuries	18	15	16	11	7	5

Find the mean number of injuries per year, the median and the range; describe the trend; find the rate per 100 workers for 2019 and for 2024 (each to 1 d.p.); find the percentage fall in the number of injuries from 2019 to 2024 (to 1 d.p.); and evaluate the claim “our depot is much safer now than in 2019”.



Made-up data: this depot, its injuries and its workforce numbers are invented for this book.

Working

Comment

Stage 1 — Identify: the data is six yearly injury counts, plus two workforce sizes. Plan: mean, median and range from the six counts; trend from their order over time; rate = injuries $\div$ workers $\times$ 100 for the two end years; percentage change from 2019 to 2024; then judge the claim with all of it.

Six numbers, five tasks, one judgement. List them before starting.

Stage 2 — Act: sum = $18 + 15 + 16 + 11 + 7 + 5 = 72$; mean = $72 \div 6 = 12.0$ injuries per year.

This mean comes out exact; write it as 12.0.

Stage 2 — Act: sorted: 5, 7, 11, 15, 16, 18; median = $(11 + 15) \div 2 = 13$. Range = $18 - 5 = 13$.

Even count again — median is the mean of the two middle values.

Stage 2 — Act: trend: injuries fell from 18 in 2019 to 5 in 2024, with a small rise in 2021 (15 to 16); overall strongly down.

Describe direction, start and end, and any wobble on the way.

Stage 2 — Act: 2019 rate = $18 \div 240 \times 100 = 7.5$ per 100 workers. 2024 rate = $5 \div 180 \times 100 = 2.777\dots$, which is 2.8 per 100 workers to 1 d.p.

The workforce shrank, so the counts alone would not be a fair comparison — the rates are.

Stage 2 — Act: percentage change = $(5 - 18) \div 18 \times 100 = -72.222\dots\%$, a fall of 72.2% to 1 d.p.

Negative means a fall; report the size and the direction.

Stage 3 — Evaluate: cross-check the rate fall: from 7.5 to 2.8 is a drop of about 63% — slightly less than the 72.2% drop in counts, because the workforce also shrank. Both measures fell a long way, and the counts, the rates and the trend all point the same way.

When counts and rates agree, the claim is on solid ground. When they disagree (see Q9), say which one you trust and why.

Stage 4 — Report: $\therefore$ mean = 12.0 injuries per year, median = 13, range = 13; the trend is strongly down, 18 to 5; the rate fell from 7.5 to 2.8 per 100 workers and the count fell by 72.2% (each to 1 d.p.). The claim is supported: by counts and by rates, the depot is much safer than in 2019.

The judgement names the evidence it rests on.

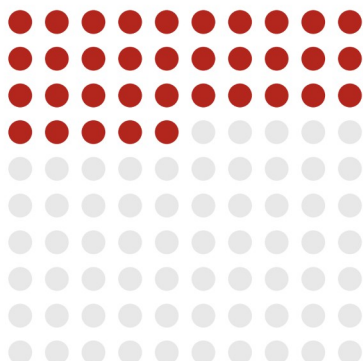
Example 3 — unscaffolded

A workplace health website (pretend) reports the long-term risk of hearing damage for machine operators: over a 20-year career the probability is 0.35 for an operator who never wears hearing protection, and 0.05 for one who always does. A factory employs 120 machine operators, all just starting 20-year careers. Express each probability as a percentage and as a “1 in how many” statement (to the nearest whole number); find the expected number of the 120

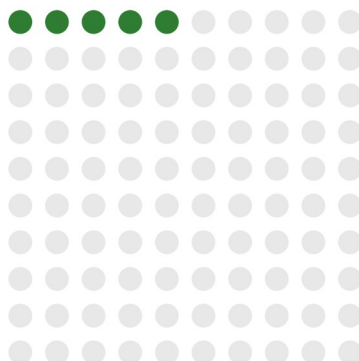
operators who end a career with hearing damage, without and with protection; find how many cases protection is expected to avoid; and evaluate whether it is worth the factory buying every operator a \$ 24.50 pair of ear muffs.

Long-term risk over a 20-year career, per 100 operators (made-up data)

No hearing protection: probability 0.35
(35 of every 100 operators)



With hearing protection: probability 0.05
(5 of every 100 operators)



Made-up data: this website, these probabilities and this factory are invented for this book.

Stage 1 — Identify. The probabilities are 0.35 (no protection) and 0.05 (with protection); the group size is 120. The operations: $\times 100$ for percentages; $1 \div \text{probability}$ for the “1 in” form, rounded to the nearest whole number; probability $\times 120$ for each expected number; subtract for the cases avoided; $\$ 24.50 \times 120$ for the cost of the muffs.

Stage 2 — Act. Percentages: $0.35 = 35\%$ and $0.05 = 5\%$. The “1 in” forms: $1 \div 0.35 = 2.857\dots$, so about 1 in 3 to the nearest whole number; $1 \div 0.05 = 20$, so exactly 1 in 20. Expected numbers: $0.35 \times 120 = 42$ operators without protection; $0.05 \times 120 = 6$ with protection. Cases avoided: $42 - 6 = 36$. Cost of the muffs: $24.50 \times 120 = \$ 2940$.

Stage 3 — Evaluate. Sanity checks: 35% is close to $\frac{1}{3}$, so “about 1 in 3” fits; 42 is a little over a third of 120 ✓; 6 is a twentieth of 120 ✓. The two sides of the decision are 36 expected cases of permanent hearing damage against \$ 2940 — about \$ 82 per case avoided ($2940 \div 36 = 81.666\dots$, or \$ 81.67 to the nearest cent). Real hearing damage costs a person far more than that, so the estimates clearly support buying the muffs. One caution: the probabilities are estimates over 20 years, so the expected numbers are averages, not certainties — but even if the true risk were half as big, the muffs would still pay for themselves in cases avoided.

Stage 4 — Report. $\therefore$ without protection the risk is 35 %, about 1 in 3, expecting 42 of the 120 operators to finish a career with hearing damage; with protection it is 5 %, or 1 in 20, expecting 6 cases. Protection is expected to avoid 36 cases, and 120 pairs of ear muffs cost \$ 2940 — about \$ 81.67 per case avoided (to the nearest cent). On these numbers, buying the muffs is clearly worth it.

Example 4 — unscaffolded

A workshop completes a chemical audit of one shelf: 25 products in total — 4 flammable, 7 corrosive, 3 toxic and 11 with no hazard symbol. The company’s safety target is that no more than half of the products on a shelf carry a hazard symbol. Find the percentage of products on the shelf that carry a hazard symbol and decide whether the target is met; find the probability that one product chosen at random from the shelf is corrosive, as a fraction in simplest form, a decimal and a percentage; and evaluate the supervisor’s claim that “chemical hazards are a workplace problem — homes are fine”, given that a home-cupboard audit found 8 of 20 products carrying a hazard symbol.

Workshop shelf audit: 25 products (made-up data)

F	F	F	F	C
C	C	C	C	C
C	T	T	T	—
—	—	—	—	—
—	—	—	—	—

■ Flammable (4)
 ■ Corrosive (7)
 ■ Toxic (3)
 ■ No hazard symbol (11)

Made-up data: this shelf, its products and the home cupboard are invented for this book.

Stage 1 — Identify. Shelf: 25 products, symbol counts 4 flammable, 7 corrosive, 3 toxic, 11 none. Target: at most half with a symbol. The operations: add the three symbol counts; divide by 25 and $\times 100$ for the percentage; $\frac{7}{25}$ for the corrosive probability; $8 \div 20 \times 100$ for the home percentage; then compare home with workplace.

Stage 2 — Act. Products with a symbol: $4 + 7 + 3 = 14$. Percentage: $14 \div 25 \times 100 = 56\%$. The target is “no more than half”, and half of 25 is 12.5; $14 > 12.5$, so the target is **not met** ($56\% > 50\%$). Corrosive probability:

$P(\text{corrosive}) = \frac{7}{25} = 0.28 = 28\%$ — already in simplest form, since 7 and 25 share no factors. Home cupboard: $8 \div 20 \times 100 = 40\%$.

Stage 3 — Evaluate. Check the fraction-to-decimal step: $\frac{7}{25} = \frac{28}{100} = 0.28 \checkmark$. The claim says homes are fine and workplaces are the problem — but the audit found 56 % of workshop products carrying a symbol against 40 % of home products. The home figure is lower, so the workplace is worse on these two cupboards — yet 40 % is not “fine”: two products in five in a home cupboard carry a hazard symbol. The claim is only half right, and a claim built on half the data should not drive a safety decision.

Stage 4 — Report. $\therefore$ 56 % of the shelf’s products carry a hazard symbol, so the 50 % target is not met;

$P(\text{corrosive}) = \frac{7}{25} = 0.28 = 28\%$; and the supervisor’s claim is not supported — the home cupboard’s 40 % is lower than the workshop’s 56 %, but it is far too high to call homes “fine”.

Practice questions

Scaffolded

Q1. Ravi's phone app records his sleep for seven nights, in hours: 7.5, 8.0, 6.5, 9.0, 7.0, 8.5, 7.5. His goal is at least 8.0 hours a night.

Made-up data: Ravi and his sleep records are invented for this book.

- (a) Find the mean number of hours of sleep, to 1 d.p.
- (b) Find the median and the range.
- (c) How many nights meet Ravi's goal?

Q2. Nadia logs her food energy for five days, in kJ: 9 100, 8 400, 10 200, 7 800, 8 900. The daily guide for an average adult is about 8 700 kJ.

Made-up data: Nadia's food log is invented for this book; the 8 700 kJ guide is a simplified real-world value.

- (a) Express day 1 (9 100 kJ) as a percentage of the daily guide, to 1 d.p.
- (b) Find Nadia's mean daily kJ, to the nearest whole kJ, and express it as a percentage of the guide, to 1 d.p.
- (c) On how many of the five days was Nadia above the guide?

Q3. In the pretend town of Wirrala, the nearest hospital with an emergency department is 95 km away, and the trip averages 60 km/h. In a city suburb, the nearest such hospital is 12 km away at the same average speed.

Made-up data: Wirrala and the distances are invented for this book.

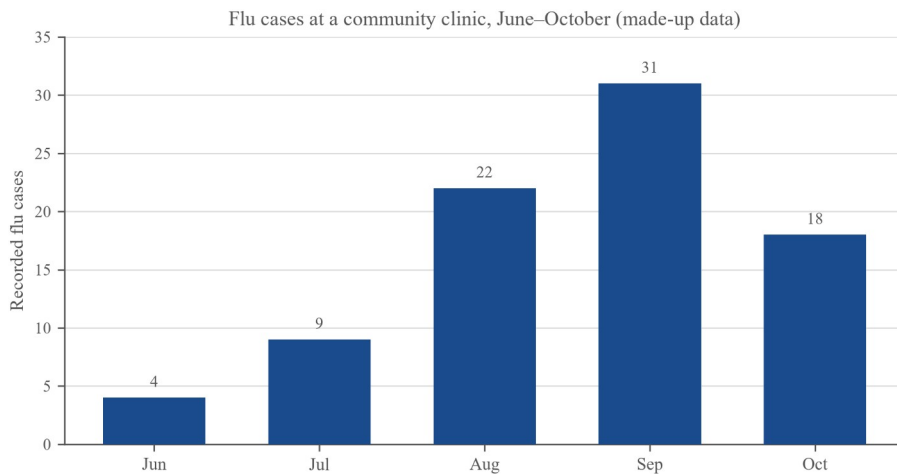
- (a) Find the trip time for each, in minutes.
- (b) How many times longer is the country trip than the city trip? Give your answer to 1 d.p.
- (c) Wirrala has 1 GP per 1 800 people; the city suburb has 1 GP per 400 people. Wirrala's population is 7 200. How many GPs does Wirrala have, and how many more would it need to match the city suburb's ratio?

Q4. A school science storeroom audit counts 30 bottles: 9 corrosive, 6 flammable, 3 toxic and 12 with no hazard symbol. One bottle is chosen at random for a shelf check.

Made-up data: this storeroom and its bottles are invented for this book.

- (a) Find $P(\text{corrosive})$ as a fraction in simplest form, a decimal and a percentage.
- (b) Find $P(\text{toxic})$ as a percentage.
- (c) What percentage of the bottles carry any hazard symbol?

Q5. A pretend community clinic counts the flu cases it records each month over the flu season.



Made-up data: this clinic and its case counts are invented for this book.

- (a) Which month is the peak, and how many cases does it record?
- (b) Find the mean number of cases per month, to 1 d.p., and the range.
- (c) Describe the trend from June to October in one or two sentences.

Q6. Last year a pretend bakery with 50 workers recorded 5 injuries that needed time off work, and a pretend warehouse with 160 workers recorded 8.

Made-up data: these workplaces and their injury counts are invented for this book.

- (a) Find the injury rate per 100 workers for each workplace, to 1 d.p.
- (b) Which workplace is safer per worker?
- (c) Do the raw counts (5 against 8) give the same answer as the rates? Give a reason.

Unscaffolded

Q7. Tama rides his bike to work and back. His app records ten rides, in km: 9.2, 10.4, 8.8, 11.0, 10.2, 24.6, 9.6, 10.8, 9.0, 10.6. The 24.6 km ride was a weekend charity event. Tama says: “My average ride is over 10 km.”

Made-up data: Tama and his rides are invented for this book.

- (a) Find the mean of all ten rides, to 2 decimal places.
- (b) Find the median and the range.
- (c) Identify the outlier, then find the mean without it, to 2 decimal places.
- (d) Evaluate Tama’s claim. Is it true, and is it fair? Justify your answer.

Q8. A pretend survey asks teenagers whether they drink soft drink at least once a day. The percentage saying yes: 41 % in 2015, 37 % in 2018, 30 % in 2021 and 26 % in 2024.

Made-up data: this survey and its percentages are invented for this book.

- (a) Find the fall from 2015 to 2024 in percentage points.
- (b) Find the percentage change from 2015 to 2024, to 1 d.p.
- (c) The answers to (a) and (b) are different numbers describing the same fall. Explain, in your own words, why.

Q9. A pretend factory recorded 21 injuries among 350 workers in 2023, and 16 injuries among 250 workers in 2024 . Some roles were automated during the two years, which is why the workforce changed size.

Made-up data: this factory and its records are invented for this book.

- Find the injury rate per 100 workers for each year, to 1 d.p.
- Find the percentage fall in the number of injuries from 2023 to 2024, to 1 d.p.
- The manager says: “Injuries fell, so our safety record improved.” Evaluate this claim, using your rates from (a).

Q10. A pretend health website states: an outdoor worker who takes no sun protection has a 1 in 5 chance of a serious sunburn each summer.

Made-up data: this website and its chance figure are invented for this book.

- Write this chance as a decimal and as a percentage.
- Over a 30-summer career, how many summers is such a worker expected to be seriously sunburnt?
- With shade breaks and a broad-brimmed hat, the chance drops to 0.08 per summer. Find the expected number of sunburn summers over 30 summers, to 1 d.p., and how many expected summers the protection avoids.

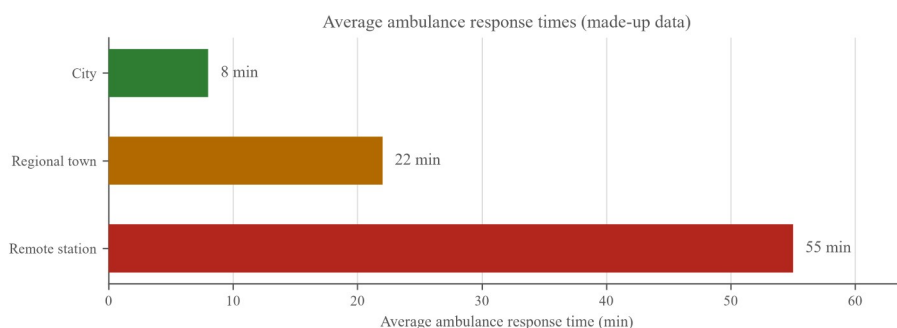
Q11. At a pretend free health-check day, 400 residents have their blood pressure measured, and 96 of the readings are high.

Made-up data: this health-check day and its numbers are invented for this book.

- Find the probability that one person chosen at random from the check day had a high reading, as a fraction in simplest form, a decimal and a percentage.
- The town has 2 500 residents. Using this probability, how many residents would be expected to have high blood pressure?
- Evaluate: is it reasonable to use the check day’s probability for the whole town? Give a reason.

Q12. A pretend state health report gives average ambulance response times and distances to the nearest hospital emergency department.

Region	Average response time	Distance to nearest emergency department
City	8 min	4 km
Regional town	22 min	38 km
Remote station	55 min	260 km



Made-up data: these regions, and every figure in the table and graph, are invented for this book.

- How many times longer is the remote average response than the city average? Give your answer to 1 d.p.
- The 260 km trip to the remote station’s hospital is driven at an average of 80 km/h. Find the driving time in hours and minutes.
- A brochure claims people in the bush get “the same emergency care” as people in the city. Using the numbers in the table, justify whether the claim is supported.

Q13. A pretend workshop’s chemical audit counts 48 products: 14 flammable, 10 corrosive, 6 toxic and 18 with no hazard symbol. An audit of one home cupboard counts 20 products: 2 flammable, 5 corrosive, 1 toxic and 12 with no hazard symbol.

Made-up data: these audits and products are invented for this book.

- What percentage of the workshop’s products carry any hazard symbol?
- What percentage of the home cupboard’s products carry any hazard symbol?
- One workshop product is chosen at random. Find $P(\text{corrosive})$ as a fraction in simplest form, a decimal to 3 decimal places and a percentage to 1 d.p.
- Evaluate the claim “hazardous chemicals are mainly a workplace problem”, using your two percentages.

Q14. A pretend 175 g packet of chips carries a nutrition information panel: energy 2 180 kJ per 100 g; sugars 7.2 g per 100 g. The daily guides for an average adult are about 8 700 kJ of energy and no more than 50 g of added sugars.

Made-up data: this product and its panel are invented for this book; the two daily guides are simplified real-world values.

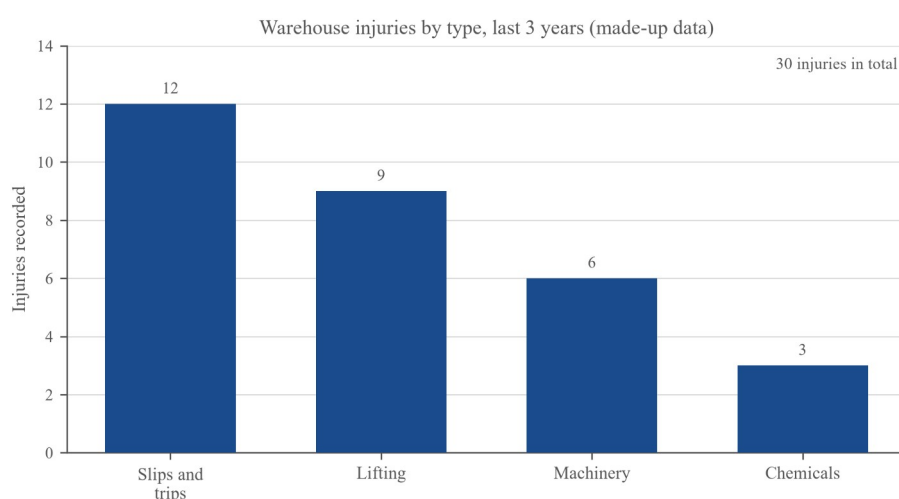
- Find the energy in the whole packet, in kJ.
- Express it as a percentage of the daily energy guide, to 1 d.p.
- Find the sugars in the whole packet, to 1 d.p., and express them as a percentage of the 50 g guide, to 1 d.p.
- How many kJ of the 8 700 kJ guide are left after the whole packet? Would you say the packet “fits into” an average day? Justify briefly.

Q15. In a pretend survey, 150 students are asked whether they get at least 60 minutes of activity on most days; 96 say yes.

Made-up data: this survey and its numbers are invented for this book.

- What percentage of the surveyed students say yes?
- One surveyed student is chosen at random. Find $P(\text{student did not say yes})$ as a fraction in simplest form, a decimal and a percentage.
- The year level has 220 students next year. Using the survey’s probability, how many would be expected to say yes, to the nearest whole student?

Q16. A pretend warehouse sorts its last 30 recorded injuries by type.



Made-up data: this warehouse and its injury records are invented for this book.

- One of the 30 records is chosen at random. Find $P(\text{slip or trip})$ as a fraction in simplest form, a decimal and a percentage.
- What percentage of the injuries were lifting or machinery?
- A worker says: “Machinery is our biggest safety problem.” Evaluate this claim using the data.

Q17. Ava's fitness band records her average heart rate for six training sessions, in beats per minute (bpm): 128, 135, 141, 122, 138, 152. Her coach wants each session average inside the zone 118–147 bpm, inclusive.

Made-up data: Ava and her six sessions are invented for this book.

- (a) Find the mean of the six session averages, to 1 d.p., and the range.
- (b) How many sessions are inside the zone? Give the session average that is outside it, and say which side of the zone it is on.
- (c) Express the number of in-zone sessions as a percentage of the six sessions, to 1 d.p.

Q18. In a pretend council district, 3 500 people are in a risk group for a health condition called condition Y. The estimated probability that a person in the group needs hospital treatment for condition Y within the next 10 years is 0.06. Each treatment costs \$ 4 800. A prevention program would cost \$ 180 000 to run once, and is estimated to reduce the probability to 0.02.

Made-up data: this district, its program and every number here are invented for this book.

- (a) Find the expected number of people needing treatment over 10 years without the program.
 - (b) Find the expected number with the program.
 - (c) Find the expected total treatment cost without the program, with the program, and the saving.
 - (d) Using these numbers alone, evaluate whether the program is worth funding. Give a reason.
-

Answers

Q1. (a) 7.7 hours to 1 d.p. (b) median 7.5 hours; range 2.5 hours. (c) 3 nights. **Q2.** (a) 104.6 % to 1 d.p. (b) 8880 kJ; 102.1 % to 1 d.p. (c) 3 days. **Q3.** (a) city 12 min; country 95 min (1 h 35 min). (b) 7.9 times to 1 d.p. (c) 4 GPs; 14 more. **Q4.** (a) $\frac{3}{10} = 0.3 = 30\%$. (b) 10 %. (c) 60 %. **Q5.** (a) September, 31 cases. (b) mean 16.8 cases to 1 d.p.; range 27. (c) sample answer: cases rose from 4 in June to a peak of 31 in September, then fell to 18 in October. **Q6.** (a) bakery 10.0 per 100 workers; warehouse 5.0 per 100 workers. (b) the warehouse, per worker. (c) no — the raw counts say the bakery is safer ($5 < 8$), but the bakery has far fewer workers; rates correct for size. **Q7.** (a) 11.42 km to 2 d.p. (b) median 10.3 km; range 15.8 km. (c) 24.6 km; mean without it 9.96 km to 2 d.p. (d) sample answer: true only with the outlier in — $11.42 > 10$; without the event ride the mean is 9.96 km, under 10, so the claim overstates Tama's ordinary riding. **Q8.** (a) 15 percentage points. (b) a fall of 36.6 % to 1 d.p. (c) sample answer: (a) is the plain gap between two percentages; (b) measures that same gap against the starting value of 41 %, so the same fall reads as a bigger number. **Q9.** (a) 2023: 6.0 per 100 workers; 2024: 6.4 per 100 workers (to 1 d.p.). (b) a fall of 23.8 % to 1 d.p. (c) sample answer: not supported — the count fell only because the workforce shrank; per worker the rate rose from 6.0 to 6.4, so safety got slightly worse. **Q10.** (a) $0.2 = 20\%$. (b) 6 summers. (c) 2.4 summers to 1 d.p.; 3.6 expected summers avoided (to 1 d.p.). **Q11.** (a) $\frac{6}{25} = 0.24 = 24\%$. (b) 600 residents. (c) sample answer: only if the 400 are representative of the town; people who attend a free check day may be older or more health-aware than average, so 0.24 may over- or under-estimate the town. **Q12.** (a) 6.9 times to 1 d.p. (b) 3 h 15 min. (c) sample answer: not supported — the remote response is 6.9 times the city's and the hospital is 65 times further away, so the care cannot be "the same". **Q13.** (a) 62.5 %. (b) 40 %. (c) $\frac{5}{24} = 0.208$ to 3 d.p. = 20.8 % to 1 d.p. (d) sample answer: partly — the workshop's 62.5 % is higher than the home's 40 %, but 40 % is far from "no problem", so homes need chemical safety too. **Q14.** (a) 3815 kJ. (b) 43.9 % to 1 d.p. (c) 12.6 g; 25.2 % to 1 d.p. (d) 4885 kJ left; sample answer: it can fit only if the rest of the day is chosen carefully — the packet alone is nearly half the energy guide and a quarter of the sugars cap. **Q15.** (a) 64 %. (b) $\frac{9}{25} = 0.36 = 36\%$. (c) 141 students to the nearest whole student. **Q16.** (a) $\frac{2}{5} = 0.4 = 40\%$. (b) 50 %. (c) sample answer: not supported by the counts — slips and trips (12) are double machinery (6); machinery injuries may be more severe, but the data given says nothing about severity. **Q17.** (a) mean 136.0 bpm to 1 d.p.; range 30 bpm. (b) 5 sessions; 152 bpm, above the 147 top of the zone. (c) 83.3 % to 1 d.p. **Q18.** (a) 210 people. (b) 70 people. (c) without: \$1 008 000; with: \$336 000; saving \$672 000. (d) sample answer: yes — the saving of \$672 000 is far more than the \$180 000 cost (a net gain of \$492 000), on these estimates alone.

Fully-worked solutions

Q1. (a) Sum = $7.5 + 8.0 + 6.5 + 9.0 + 7.0 + 8.5 + 7.5 = 54.0$; mean = $54.0 \div 7 = 7.714285\dots$, which is 7.7 hours to 1 d.p. (b) Sorted: 6.5, 7.0, 7.5, 7.5, 8.0, 8.5, 9.0; the middle value is 7.5, so the median is 7.5 hours. Range = $9.0 - 6.5 = 2.5$ hours. (c) Nights at or above 8.0: 8.0, 8.5 and 9.0 — 3 nights.

Q2. (a) $9\,100 \div 8\,700 \times 100 = 104.5977\dots\%$, which is 104.6 % to 1 d.p. (b) Sum = $9\,100 + 8\,400 + 10\,200 + 7\,800 + 8\,900 = 44\,400$; mean = $44\,400 \div 5 = 8\,880$ kJ (exact). As a percentage: $8\,880 \div 8\,700 \times 100 = 102.0689\dots\%$, which is 102.1 % to 1 d.p. (c) Above 8 700: 9 100, 10 200 and 8 900 — 3 days.

Q3. (a) Time = distance $\div$ speed, then $\times 60$ for minutes. City: $12 \div 60 = 0.2$ h, and $0.2 \times 60 = 12$ min. Country: $95 \div 60 \times 60 = 95$ min, that is 1 h 35 min. (b) $95 \div 12 = 7.91666\dots$, which is 7.9 times to 1 d.p. (c) GPs now: $7\,200 \div 1\,800 = 4$. At the city ratio: $7\,200 \div 400 = 18$. Extra needed: $18 - 4 = 14$ GPs.

Q4. (a) $P(\text{corrosive}) = \frac{9}{30} = \frac{3}{10} = 0.3 = 30\%$. (b) $P(\text{toxic}) = \frac{3}{30} = \frac{1}{10} = 10\%$. (c) With a symbol: $9 + 6 + 3 = 18$; $18 \div 30 \times 100 = 60\%$.

Q5. (a) The tallest column is September, with 31 cases. (b) $\text{Sum} = 4 + 9 + 22 + 31 + 18 = 84$; $\text{mean} = 84 \div 5 = 16.8$ cases (exact, so 16.8 to 1 d.p.). $\text{Range} = 31 - 4 = 27$ cases. (c) Sample answer: recorded flu cases rose steadily from 4 in June to a peak of 31 in September, then fell to 18 in October — the season peaked in spring.

Q6. (a) Bakery: $5 \div 50 \times 100 = 10.0$ injuries per 100 workers. Warehouse: $8 \div 160 \times 100 = 5.0$ injuries per 100 workers (each to 1 d.p.). (b) The warehouse, at 5.0 per 100 workers against the bakery's 10.0. (c) No. The raw counts say the bakery is safer (5 is less than 8), but the bakery has only 50 workers against the warehouse's 160. Per worker, the bakery is worse — rates correct for the different sizes.

Q7. (a) $\text{Sum} = 114.2$ km; $\text{mean} = 114.2 \div 10 = 11.42$ km, which is 11.42 km to 2 d.p. (exact at 2 d.p.). (b) Sorted: 8.8, 9.0, 9.2, 9.6, 10.2, 10.4, 10.6, 10.8, 11.0, 24.6; $\text{median} = (10.2 + 10.4) \div 2 = 10.3$ km. $\text{Range} = 24.6 - 8.8 = 15.8$ km. (c) The 24.6 is the outlier: the next value down is 11.0, a gap of 13.6 km, while every other gap is 0.8 km or less. Mean without it: $(114.2 - 24.6) \div 9 = 89.6 \div 9 = 9.9555\dots$, which is 9.96 km to 2 d.p. (d) Sample answer: the claim is true only as stated — with the event ride included the mean is 11.42 km, over 10. But it is not fair: the one charity ride lifts the mean by about 1.5 km, and without it the mean is 9.96 km, under 10. Tama's ordinary commute rides average just under 10 km, so the claim makes his regular riding sound stronger than it is.

Q8. (a) Percentage-point fall $= 41 - 26 = 15$ percentage points. (b) Percentage change $= (26 - 41) \div 41 \times 100 = -36.5853\dots\%$, a fall of 36.6% to 1 d.p. (c) Sample answer: (a) simply subtracts the two percentages — the gap on the percentage scale. (b) measures that same gap against where the data started: 15 points out of a starting 41%. The same fall looks bigger as a percentage change because the starting value is less than 100.

Q9. (a) 2023: $21 \div 350 \times 100 = 6.0$ injuries per 100 workers. 2024: $16 \div 250 \times 100 = 6.4$ injuries per 100 workers (each to 1 d.p.). (b) $(16 - 21) \div 21 \times 100 = -23.8095\dots\%$, a fall of 23.8% to 1 d.p. (c) Sample answer: the claim is not supported. The count fell from 21 to 16, but the workforce also shrank, from 350 to 250. Per worker, the rate rose from 6.0 to 6.4 per 100 workers, so an individual worker's chance of being injured actually got slightly worse. A fall in counts with a fall in workers is not evidence of better safety.

Q10. (a) $1 \text{ in } 5 = \frac{1}{5} = 0.2 = 20\%$. (b) Expected number $= 0.2 \times 30 = 6$ summers. (c) Expected number $= 0.08 \times 30 = 2.4$ summers to 1 d.p. Avoided: $6 - 2.4 = 3.6$ expected summers to 1 d.p.

Q11. (a) $P(\text{high}) = \frac{96}{400} = \frac{6}{25} = 0.24 = 24\%$. (b) Expected number $= 0.24 \times 2500 = 600$ residents. (c) Sample answer: only if the 400 people checked are representative of the town — that is, similar to the whole town in age and health. People who choose to attend a free check day are often older or more health-aware than average, so the 0.24 could over-estimate (or, if only the worried attended, differ from) the town-wide probability. The estimate is a starting point, not proof.

Q12. (a) $55 \div 8 = 6.875$, which is 6.9 times to 1 d.p. (b) $260 \div 80 = 3.25$ h; $0.25 \text{ h} = 15 \text{ min}$, so 3 h 15 min. (c) Sample answer: the claim is not supported. The remote average response takes 6.9 times as long as the city's (55 min against 8), and the nearest emergency department is 65 times as far away (260 km against 4 km), a drive of over 3 hours. In an emergency those differences can decide outcomes, so the care cannot honestly be called “the same”.

Q13. (a) With a symbol: $14 + 10 + 6 = 30$; $30 \div 48 \times 100 = 62.5\%$ (exact). (b) With a symbol: $2 + 5 + 1 = 8$; $8 \div 20 \times 100 = 40\%$. (c) $P(\text{corrosive}) = \frac{10}{48} = \frac{5}{24}$ (simplest form) $= 0.208333\dots$, which is 0.208 to 3 d.p., and $10 \div 48 \times 100 = 20.8333\dots\%$, which is 20.8% to 1 d.p. (d) Sample answer: the claim is only half right. The workshop's 62.5% is well above the home's 40%, so workplaces do carry more hazardous products per shelf — but 40% means two products in five at home carry a hazard symbol, which is far from “mainly a workplace problem”. Home cupboards need the same storage and labelling care.

Q14. (a) The packet is 175 g = 1.75 lots of 100 g: $2\,180 \times 1.75 = 3\,815$ kJ (exact). (b) $3\,815 \div 8\,700 \times 100 = 43.8505\dots\%$, which is 43.9% to 1 d.p. (c) Sugars: $7.2 \times 1.75 = 12.6$ g (exact, so 12.6 g to 1 d.p.). Percentage: $12.6 \div 50 \times 100 = 25.2\%$ to 1 d.p. (d) $8\,700 - 3\,815 = 4\,885$ kJ left. Sample answer: one packet uses nearly half the day's energy guide and a quarter of the sugars cap while offering little nutrition, so it only "fits" if the rest of the day is chosen carefully — on these numbers, sharing the packet would be the safer call.

Q15. (a) $96 \div 150 \times 100 = 64\%$. (b) Did not say yes: $150 - 96 = 54$ students. $P(\text{not yes}) = \frac{54}{150} = \frac{9}{25} = 0.36 = 36\%$. (c) Expected number = $0.64 \times 220 = 140.8$, which is 141 students to the nearest whole student.

Q16. (a) $P(\text{slip or trip}) = \frac{12}{30} = \frac{2}{5} = 0.4 = 40\%$. (b) Lifting or machinery: $9 + 6 = 15$; $15 \div 30 \times 100 = 50\%$. (c)

Sample answer: the claim is not supported by these counts. Slips and trips (12) are the most common type — double machinery (6) — so on frequency alone, floors and walkways are the bigger problem, not machines. Machinery injuries could be more severe, but the data given records type only, not severity, so the claim cannot be justified from it.

Q17. (a) Sum = $128 + 135 + 141 + 122 + 138 + 152 = 816$; mean = $816 \div 6 = 136.0$ bpm to 1 d.p. (exact). Range = $152 - 122 = 30$ bpm. (b) Inside 118–147: 128, 135, 141, 122 and 138 — 5 sessions. The session outside is 152 bpm, which is above the top of the zone ($152 > 147$). (c) $5 \div 6 \times 100 = 83.333\dots\%$, which is 83.3% to 1 d.p.

Q18. (a) Expected cases = $0.06 \times 3\,500 = 210$ people. (b) Expected cases = $0.02 \times 3\,500 = 70$ people. (c) Without: $210 \times \$4\,800 = \$1\,008\,000$. With: $70 \times \$4\,800 = \$336\,000$. Saving: $\$1\,008\,000 - \$336\,000 = \$672\,000$. (d) Sample answer: yes, on these numbers alone. The program costs \$180 000 and is expected to save \$672 000 in treatment costs — a net gain of $\$672\,000 - \$180\,000 = \$492\,000$ — while also sparing an expected $210 - 70 = 140$ people a hospital stay. The probabilities are estimates, so the exact figures could shift, but the saving would have to fall by about 73.2% (to 1 d.p.) — from \$672 000 down to the \$180 000 cost — before the program stopped paying for itself.

Theory

Vocational numeracy in Unit 4. *Vocational* means to do with work. In §6E you met the documents workplaces run on: dockets, labels, plans, timesheets and check sheets. Unit 4 uses the same documents but asks more of you. The verbs step up from *find* and *calculate* to **apply**, **critically analyse**, **evaluate** and **justify**. That means a question may hand you a claim — “the new system is twice as fast”, “Yard A is the safer yard” — and your job is not just to do the maths but to decide whether the numbers *support* the claim, and to say why.

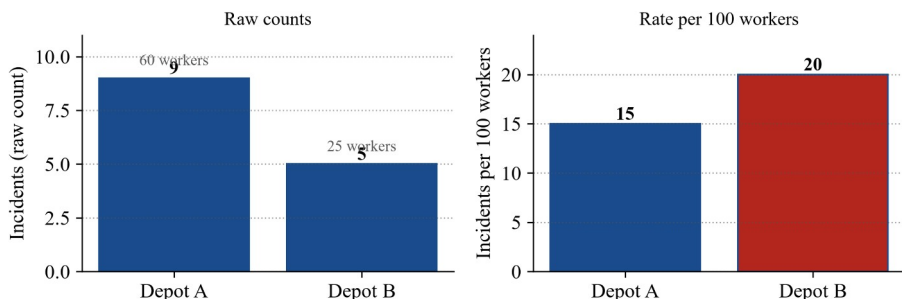
Before digital and after digital. Workplaces often compare an old paper method with a new digital one, exactly as in §6E: person-hours = number of workers × hours each, and the change written as a percentage decrease (§2F). Unit 4 comparisons are fuller. Compare the *typical* time with the mean (§8C), compare the *consistency* with the range — a method whose times are all near the mean is easier to plan around than one that swings wildly — and compare the *errors*, because paper methods produce mis-keys and mis-picks while digital methods bring new failure modes of their own, like flat batteries and wi-fi dropouts. A fair verdict uses all three: time, consistency and errors.

OHS data and statistics. *OHS* means occupational health and safety — the rules and checks that keep people unharmed at work. An *incident* is an event where someone was hurt, or could have been hurt; a *near miss* (a forklift that narrowly misses a walker, a box that falls short of a person) counts as an incident, because it shows a hazard that is live. Workplaces count incidents by type in a *frequency table* — a table of counts, one row per type — and the mode (§8C) tells them which type to fix first. Bar charts show the same counts as bars.

Raw counts alone can mislead, because a bigger site has more of everything. The fair comparison is a **rate per 100 workers**:

$$\text{rate per 100 workers} = \text{incidents} \div \text{workers} \times 100$$

Depot A looks worse on raw counts — Depot B is worse per worker



Made-up data: pretend depots and pretend numbers.

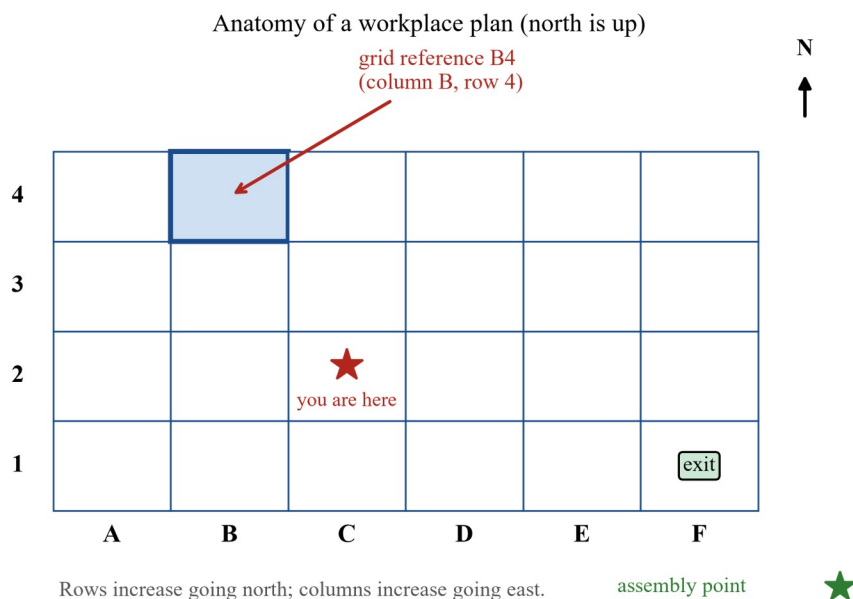
Depot A recorded 9 incidents with 60 workers: $9 \div 60 \times 100 = 15$ incidents per 100 workers. Depot B recorded only 5 incidents — but with just 25 workers: $5 \div 25 \times 100 = 20$ per 100 workers. On raw counts A looks worse (9 against 5); per worker, **B is worse** (20 against 15). Whenever two groups are different sizes, compare rates, not counts.

OHS trends. Safety officers also watch incidents *over time* — per month, per quarter (a quarter is three months) or per year — usually on a line chart or a bar chart. Read a trend in two parts: the **overall direction** (down, up, or flat) and any **bumps** against it. One rising year inside a five-year fall does not cancel the fall, but it deserves a question. Percentage change first-to-last measures the size of the trend (§2F), and the mean, median and range (§8C) summarise it — with outliers judged by the big-empty-gap rule of §8D: a value sitting far away from the rest of the ordered data, with a big empty gap beside it, is an outlier, and you then ask whether it is a recording mistake or real-but-unusual.

Workplace plans, diagrams and directions. A workplace plan is a drawing of a building or yard seen from above. Its parts:

- a **grid** of squares, lettered across and numbered up, so every spot has a *grid reference* like B4 (column B, row 4);

- a **north arrow** — with north marked, the other compass points follow: east to the right, south down, west to the left;
- a **scale** (§5C), such as 1:200, where 1 cm on the plan is 200 cm (2 m) on the ground;
- a **legend** (a key) giving each symbol its meaning — first aid station, fire extinguisher, forklift zone, hazard;
- on escape plans, a **you-are-here** mark, the exits, the escape routes and the **assembly point** — the safe meeting spot outside where the **roll call** (a head count against the expected list) happens.



Made-up data: a pretend floor plan drawn for this book.

Escape routes are measured in legs, and walking time comes from

$$\text{time} = \text{distance} \div \text{speed}$$

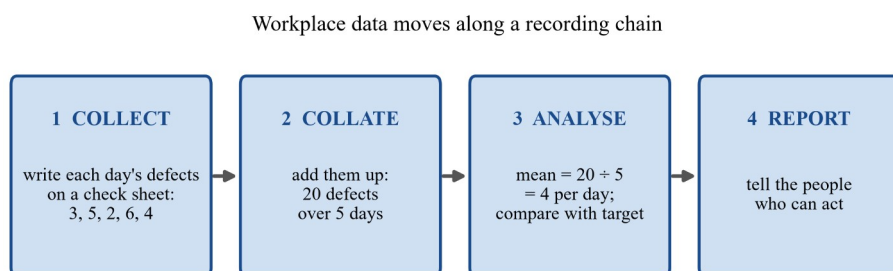
with a typical brisk walk around 1.2–1.4 m/s. Giving or following directions on a plan uses the §7C format: start point and facing first (“start at the door, facing north”), then each leg with its distance, and each turn called as a left or a right — a quarter turn. Good directions can be followed by someone who has never walked the route before.

QA data and recording information. *Quality assurance* (QA) is the checking that keeps product up to standard, and its core number is the **defect rate**:

$$\text{defect rate} = \text{defects} \div \text{items checked} \times 100\%$$

compared against a target such as “no more than 2%” — a rate *on* the target still meets a “ $\leq 2\%$ ” rule. A batch with 8 defects in 400 items checked has a rate of $8 \div 400 \times 100 = 2\%$, right on the limit.

QA lives or dies on how information is *recorded*. Workplace data moves along a chain:



Made-up data: pretend counts for a pretend line.

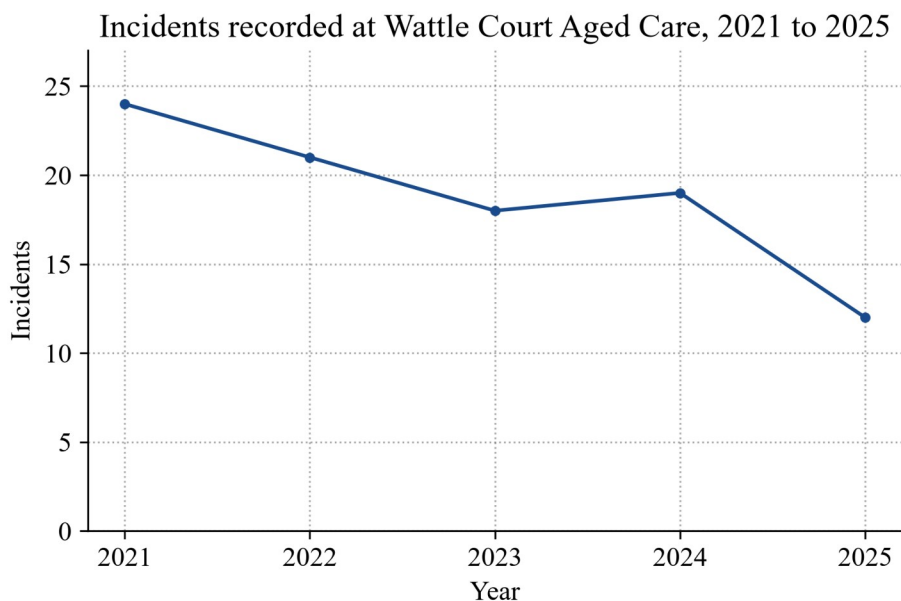
Collect (write each day’s defects on a check sheet: 3, 5, 2, 6, 4), **collate** (add them up: $3 + 5 + 2 + 6 + 4 = 20$ defects over 5 days), **analyse** (mean = $20 \div 5 = 4$ defects per day; compare with target), **report** (tell the people who can act). A

check sheet needs fields that let someone else re-do the maths later: date, batch or sample ID, sample size, defects found, defect rate, verdict, and the checker's name. Spreadsheets do the collating and analysing automatically (§10A, §10B) — formulas in, answers out — but they obey *garbage in, garbage out*: a formula is only as good as the numbers typed into it. One wrong input can flip a pass into a fail without any formula changing, so recorded data is always worth **evaluating** before it is trusted: does every value lie inside its possible range, and does the total match the source sheets?

About the data in this section. The tables, plans, check sheets, charts and spreadsheets in this section are **made up** (not real): pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Worked examples

Example 1 — scaffolded



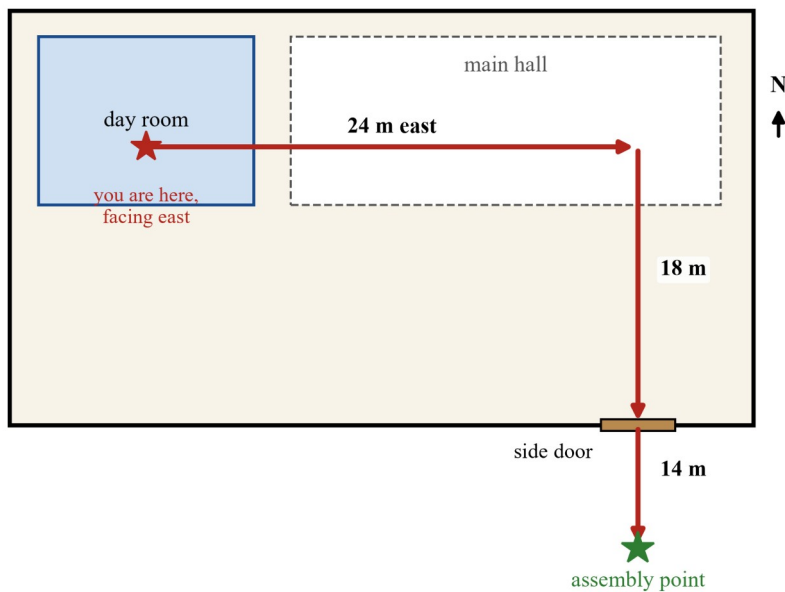
Made-up data: a pretend aged-care centre and pretend incident counts.

Wattle Court Aged Care recorded workplace incidents over five years: 24 in 2021, 21 in 2022, 18 in 2023, 19 in 2024 and 12 in 2025. Find (a) the total number of incidents over the five years, (b) the mean number of incidents per year, to 1 decimal place, (c) the percentage decrease from 2021 to 2025, to the nearest whole percent, and (d) describe the trend, including any bump.

Working	Comment
(a) $24 + 21 + 18 + 19 + 12 = 94$ incidents	add all five years
(b) $94 \div 5 = 18.8$ incidents per year	mean, to 1 decimal place
(c) decrease = $24 - 12 = 12$; $12 \div 24 \times 100 = 50\%$	percentage decrease first-to-last, to the nearest whole percent
(d) Overall downward, with a small bump in 2024 (19 after 18)	trend = overall direction + bumps against it
Check: median = 19, range = $24 - 12 = 12$	a typical year sits near 19, and the counts fall overall (§8C)

Example 2 — scaffolded

Wattle Court Aged Care — east wing escape plan



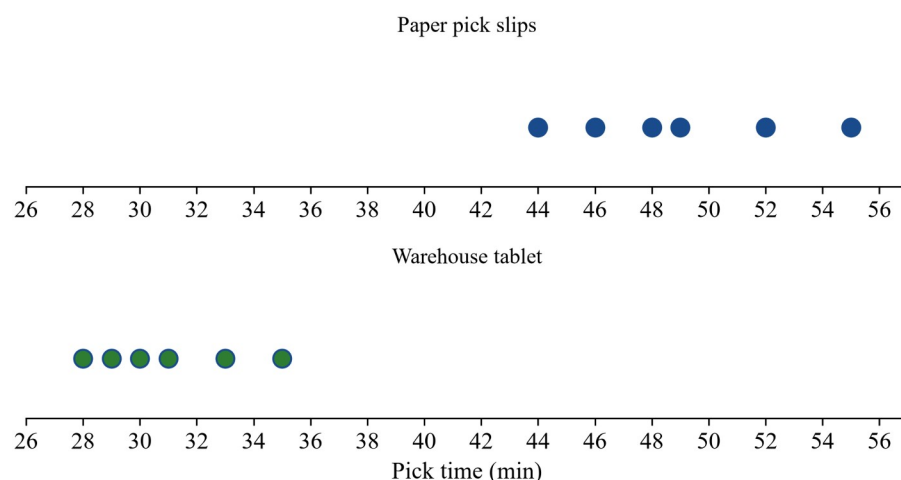
Made-up plan: a pretend building and pretend distances.

The escape plan for the east wing of Wattle Court Aged Care shows this route: from the day room, walk 24 m east to the main hall; turn right and walk 18 m to the side door; go through the door and walk 14 m to the assembly point. The drill walks the route at 1.4 m/s. Find (a) the total distance from the day room to the assembly point, (b) the time the walk takes, in seconds, (c) the number of people the roll call expects if there are 34 staff and 21 residents, and (d) how many people are missing if the roll call counts 53.

Working	Comment
(a) $24 + 18 + 14 = 56$ m	add the three legs of the route
(b) $56 \div 1.4 = 40$ s	time = distance $\div$ speed
(c) $34 + 21 = 55$ people	staff and residents are all on the expected list
(d) $55 - 53 = 2$ people missing	expected – counted = who the wardens search for
Check: facing east, a right turn faces south, which matches the plan; $40 \times 1.4 = 56$ m	the turn and the time both agree with the plan (§7C)

Example 3 — unscaffolded

Linden Plastics — six batches picked each way



Made-up data: pretend picking times for a pretend business.

Linden Plastics picks each order batch either from paper pick slips or from a warehouse tablet. The times, in minutes, for six batches each way were — paper: 46, 52, 48, 55, 44, 49; tablet: 31, 28, 33, 29, 35, 30. Over the same six batches the paper method produced 27 mis-picks in total and the tablet method 6. The operations manager claims the tablet “more than halves the picking time”. Find the mean, median and range for each method, find the percentage decrease in the mean time, to 1 decimal place, and evaluate the manager’s claim.

Order the paper times: 44, 46, 48, 49, 52, 55. The sum is $44 + 46 + 48 + 49 + 52 + 55 = 294$, so the mean is $294 \div 6 = 49$ minutes. The median is the halfway pair: $(48 + 49) \div 2 = 48.5$ minutes. The range is $55 - 44 = 11$ minutes.

Order the tablet times: 28, 29, 30, 31, 33, 35. The sum is 186, so the mean is $186 \div 6 = 31$ minutes. The median is $(30 + 31) \div 2 = 30.5$ minutes. The range is $35 - 28 = 7$ minutes.

The mean time saved per batch is $49 - 31 = 18$ minutes, so the percentage decrease in the mean is

$$18 \div 49 \times 100 = 36.73\ldots \% \approx 36.7\% \text{ (to 1 decimal place)}$$

Now test the claim. “More than halves” would need the tablet mean at or below $49 \div 2 = 24.5$ minutes. The tablet mean is 31 minutes, and $31 > 24.5$, so the claim is not supported — 36.7% is a large saving, but it is not more than 50%.

On errors, the paper method averaged $27 \div 6 = 4.5$ mis-picks per batch against the tablet’s $6 \div 6 = 1$ per batch, and the tablet’s range (7 minutes) is smaller than the paper’s (11 minutes), so tablet times are also more consistent.

Check: each mean sits inside its own range of times, and $49 - 18 = 31$, the tablet mean.

$\therefore$ the tablet cuts the mean pick time from 49 minutes to 31 minutes, a decrease of 36.7% (to 1 decimal place) — the “more than halves” claim is not supported, but the tablet does cut mis-picks from a mean of 4.5 to 1 per batch and is the more consistent method.

Example 4 — unscaffolded

Linden Plastics QA check sheet (as recorded)

Day	Sample size	Defects	Rate	Verdict
Monday	250	4	?	?
Tuesday	250	7	?	?
Wednesday	300	6	?	?

QA target: defect rate no more than 2%. The Rate and Verdict columns are filled in from the other three columns — that filling-in is the example.

Made-up data: a pretend check sheet for a pretend production line.

The QA target at Linden Plastics is a defect rate of no more than 2% ($\leq 2\%$), checked each day on a sample of 250 items. The check sheet records — Monday: 4 defects; Tuesday: 7 defects; Wednesday: 6 defects from a sample recorded as 300. Find (a) the defect rates for Monday and Tuesday, to 1 decimal place, and which days meet the target, (b) Wednesday's rate as recorded, to 1 decimal place, and the verdict it gives, (c) Wednesday's actual rate if an audit finds the sample really was 200 items, to 1 decimal place, and the new verdict, and (d) evaluate why this recording error matters more than a slip in a sum, and list two check-sheet fields that would catch it.

Monday: $4 \div 250 \times 100 = 1.6\%$ (to 1 decimal place). Since $1.6\% \leq 2\%$, Monday meets the target.

Tuesday: $7 \div 250 \times 100 = 2.8\%$ (to 1 decimal place). Since $2.8\% > 2\%$, Tuesday fails the target.

Wednesday as recorded: $6 \div 300 \times 100 = 2.0\%$ (to 1 decimal place). A rate exactly on the limit meets a " $\leq 2\%$ " rule, so the sheet records Wednesday as a pass.

Wednesday actually: $6 \div 200 \times 100 = 3.0\%$ (to 1 decimal place), and $3.0\% > 2\%$ — a fail. The verdict has flipped: the day the sheet calls a pass was really a fail, so product that may be out of specification has already moved on. That is why a recording error matters more than a slip in a sum — a sum slip is caught by re-calculating, but this error changed a *decision*, and nothing downstream re-checks decisions. Re-auditing Wednesday's batch is justified.

Two fields that would catch it: a **sample size** field cross-checked against the standing sampling plan (250 every day), so a written "300" is spotted at once; and the **checker's name**, so the audit knows who to ask. (Date and batch ID also let the auditors find the batch again.)

Check: back-calculate Monday — $250 \times 1.6\% = 4$ defects, the number on the sheet.

$\therefore$ Monday passes at 1.6%, Tuesday fails at 2.8%, and Wednesday flips from a recorded pass at 2.0% to an actual fail at 3.0% (all to 1 decimal place) — because the recording error changed the verdict, Wednesday's batch must be re-audited.

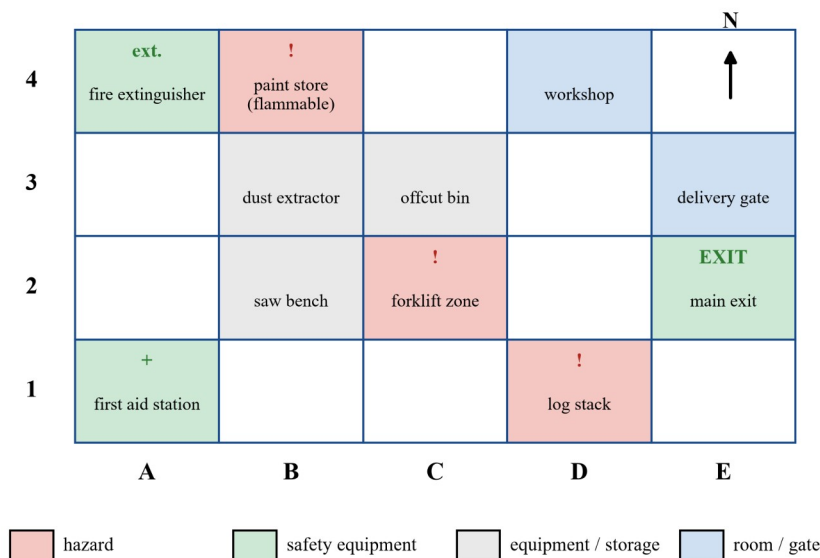
Practice questions

Scaffolded

Q1. The figure shows the hazard map of Ironbark Timber Yard. The grid has lettered columns A–E (A at the west end) and numbered rows 1–4 (row 1 at the south end), north is up the page, and one grid square is 10 m on each side.

Ironbark Timber Yard hazard map (north is up)

1 square = 10 m



Made-up data: a pretend yard map drawn for this book.

- (a) Give the grid reference of the paint store. (b) What is at grid square B3? (c) Name the hazard that lies in row 2, and give its grid reference.

Q2. Harrowfield Freight counted its recorded incidents for the year by type.

Incident type	Count
Slips and trips	8
Manual handling	7
Forklift near misses	5
Falling objects	3
Other	2

Made-up data: every name and number in this table is made up for this book.

- (a) How many incidents were recorded in total? (b) What is the mode of the incident types? (c) What percentage of all incidents were slips and trips, to the nearest whole percent?

Q3. In one year, Harrowfield Freight's North depot recorded 12 incidents with 75 workers, and its South depot recorded 9 incidents with 50 workers. (a) Find the North depot's incident rate per 100 workers, to 1 decimal place. (b) Find the South depot's rate per 100 workers, to 1 decimal place. (c) Which depot has the worse rate per worker, and why do the raw counts (12 against 9) not answer that question?

Q4. In an evacuation drill at Wattle Court Aged Care, the west-wing route has three legs: 32 m, then 15 m, then 13 m to the assembly point. The group walks at 1.2 m/s, and the drill target is a total time under 90 s. (a) What is the total distance of the route? (b) How many seconds does the walk take? (c) Does the drill meet its target? Justify your answer.

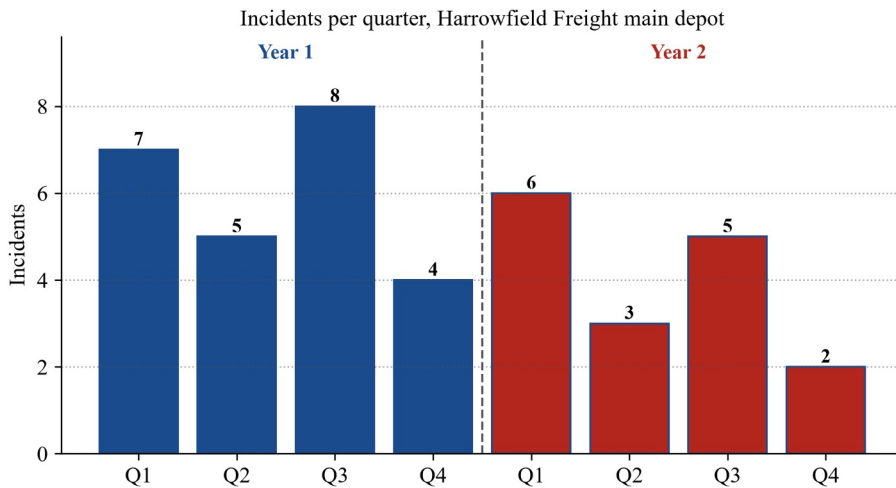
Q5. Each of Harrowfield Freight's 15 drivers completes an end-of-day log. On paper a log takes 25 minutes per driver; on the new app it takes 8 minutes per driver. (a) How many minutes did the paper logs take in total each day?

(b) How many minutes a day does the app save, and what is the percentage decrease, to the nearest whole percent? (c) Over a 5-day week, how much time is saved in total? Give your answer in hours and minutes.

Q6. A QA check at Linden Plastics finds 3 defective items in a sample of 200. The target defect rate is no more than 2%. (a) Find the defect rate, to 1 decimal place. (b) Does the batch meet the target? (c) Name two fields that every QA check sheet needs so that someone else can re-do the calculation later.

Un scaffolded

Q7. The bar chart shows incidents recorded at Harrowfield Freight’s main depot over eight quarters — Year 1: 7, 5, 8, 4; Year 2: 6, 3, 5, 2.



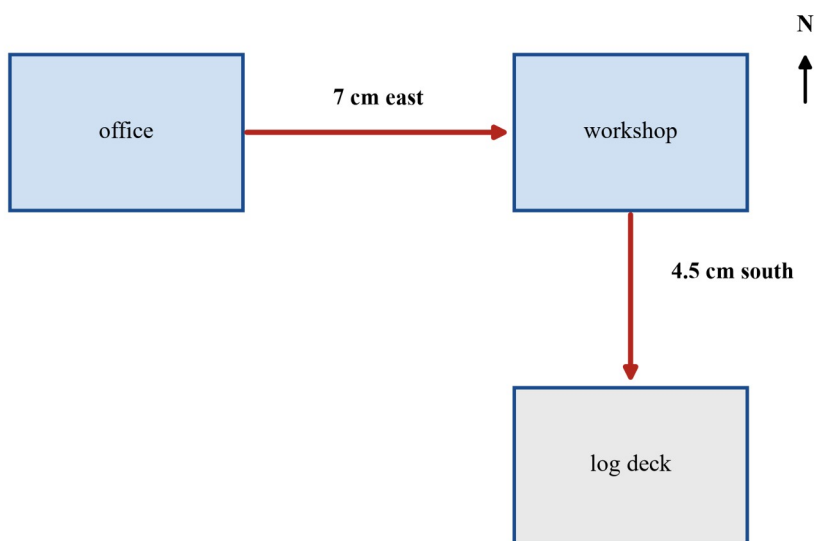
Made-up data: pretend incident counts for a pretend depot.

- (a) What was the total number of incidents in Year 1? (b) What was the total in Year 2? (c) Find the percentage decrease from Year 1 to Year 2, to the nearest whole percent. (d) Describe the trend over the eight quarters, including any bump, and find the mean number of incidents per quarter over all eight quarters.

Q8. Ironbark Timber Yard runs two yards. Last year Yard A recorded 10 incidents with 40 workers; Yard B recorded 14 incidents with 80 workers. The yard manager says: “Yard A is the safer yard — 10 incidents is less than 14.” (a) Find each yard’s incident rate per 100 workers, to 1 decimal place. (b) Critically analyse the manager’s claim: do the numbers support it? (c) Explain why comparing the raw counts misleads here.

Q9. The site plan of Ironbark Timber Yard is drawn at a scale of 1 : 200. On the plan, the walk from the office to the workshop measures 7 cm due east, and the walk from the workshop to the log deck measures 4.5 cm due south.

Ironbark Timber Yard site plan (scale 1 : 200)



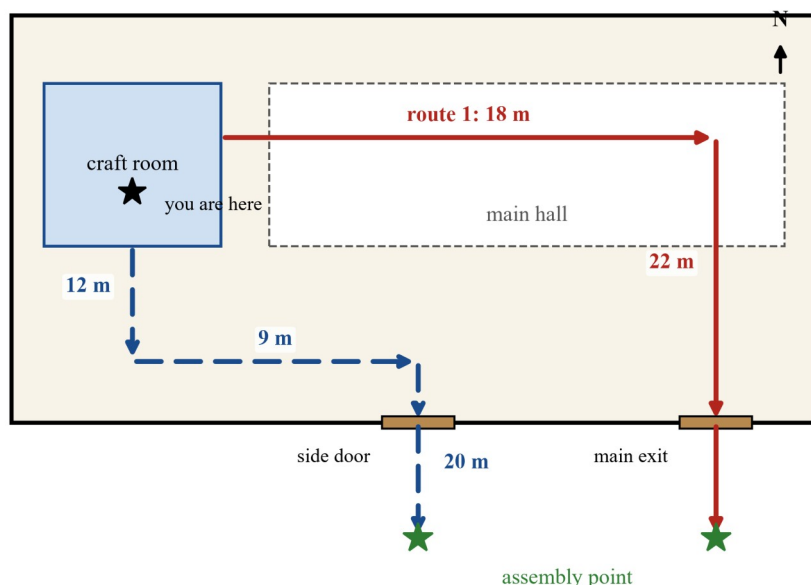
Scale 1 : 200

Made-up plan: a pretend yard drawn for this book.

- (a) Find the real distance of each leg, in metres. (b) What is the total walk from the office to the log deck? (c) Write directions for the return walk from the log deck to the office, in the §7C form: start point and facing, then each leg with its distance, and each turn called as a left or a right.

Q10. The escape plan for the craft room at Wattle Court Aged Care shows two routes out. Route 1 goes through the main hall: 18 m, then 22 m. Route 2 goes through the side door: 12 m, 9 m, then 20 m.

Wattle Court Aged Care — craft room escape routes

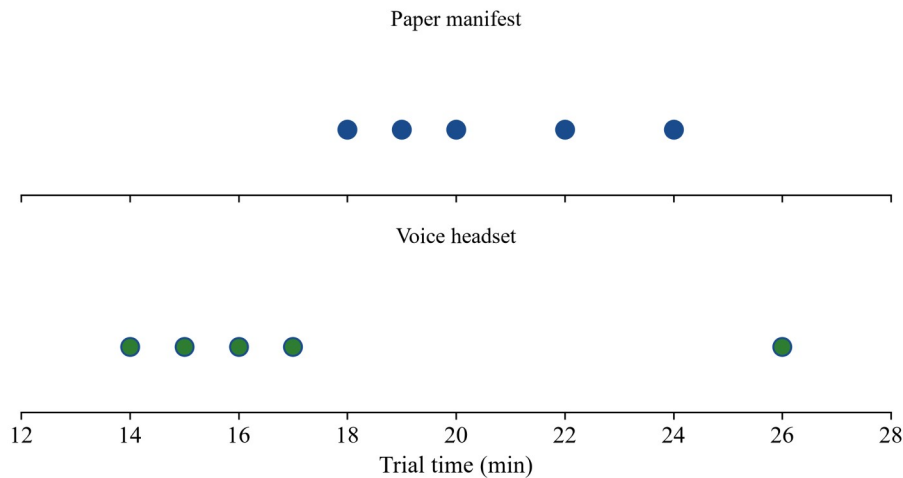


Made-up plan: a pretend building and pretend distances.

- (a) How long is each route? (b) Which route is shorter, and by how much? (c) During a drill, smoke is reported in the main hall. Which route should the craft room use? Justify your choice. (d) Find the time to walk the route you chose at 1.2 m/s, to 1 decimal place, in seconds.

Q11. Harrowfield Freight trialled voice headsets against paper manifests for stock picking. Five trial picks each way took these times, in minutes — paper: 18, 22, 19, 24, 20; headset: 14, 17, 15, 26, 16.

Harrowfield Freight — five trial picks each way



Made-up data: pretend trial times for a pretend business.

- (a) For each method, find the mean (to 1 decimal place), the median and the range. (b) Which method is the more consistent? Justify your answer using the ranges. (c) Find the percentage decrease in the mean time from paper to headset, to 1 decimal place. (d) The 26-minute headset trial happened during a wi-fi dropout. Evaluate whether the 26 should stay in the headset mean, using the outlier ideas of §8D.

Q12. Linden Plastics checked five batches of 250 items each in one week. The defects found were:

Batch	1	2	3	4	5
Defects	3	8	5	2	7

Made-up data: pretend defect counts for a pretend line.

The QA target is a defect rate of no more than 2% per batch. (a) Find the defect rate for each batch, to 1 decimal place. (b) How many of the five batches meet the target? (c) Find the mean number of defects per batch, and the mean defect rate it corresponds to, to 1 decimal place. (d) Evaluate whether the mean rate alone tells the QA manager the week was acceptable. Justify what should happen next.

Q13. The safety officer at Harrowfield Freight keeps incident totals in a spreadsheet. Cells B2 to B7 hold the incidents for January to June: 4, 6, 5, 3, 7, 4. Cell C2 holds the number of workers, 60. Cell B8 holds the formula $=\text{SUM}(B2:B7)$ and cell B9 holds $=B8/C2*100$, the incident rate per 100 workers.

Harrowfield Freight incident spreadsheet

A	B	C	D
Month	Incidents	Workers	Displays
Jan	4	60	
Feb	6		
Mar	5		
Apr	3		
May	7		
Jun	4		
Total	$=\text{SUM}(B2:B7)$		?
Rate per 100	$=B8/C2*100$		?

The Displays column shows what cells B8 and B9 print out; those values are what the question asks you to find.

Made-up data: a pretend spreadsheet for a pretend business.

- (a) What number does B8 show? (b) Show that B9 shows 48.3, to 1 decimal place. (c) An audit finds February's incidents were double-counted; the correct number is 2. With the formulas untouched, what do B8 and B9 now show? Give B9 to 1 decimal place. (d) Evaluate the claim: "The formulas are correct, so the report must be right."

Q14. At Harrowfield Freight, a supervisor scores the daily safety check out of 10. Over ten days the recorded scores were: 9, 8, 9, 10, 8, 9, 7, 9, 8, 19. (a) Identify the value that cannot be correct, and explain how you know. (b) Find the mean of the scores as recorded, and the mean after correcting 19 to 9 — each to 1 decimal place. (c) Find the median before and after the correction. What do you notice, and why does the median behave this way? (d) Recommend one recording practice that would catch this kind of error, and justify your recommendation.

Q15. The weekly inspection roster at Ironbark Timber Yard covers six zones:

Zone	A	B	C	D	E	F
Time (min)	45	30	60	45	30	45

Made-up data: a pretend roster for a pretend yard.

- (a) Find the total inspection time, in hours and minutes. (b) Can one inspector complete all six zones in a single 4-hour shift? Justify your answer. (c) An inspector starts zone A at 08:00, then takes a 5-minute break before starting zone B. At what time does zone A finish, and at what time does zone B finish? (d) Propose a split of the six zones across two 4-hour shifts that fits, and justify it by showing each shift's total.

Q16. Use the Ironbark Timber Yard hazard map from Q1 (grid columns A–E west to east, rows 1–4 south to north, north up, one square 10 m). The saw bench is at B2 and the paint store is at B4. (a) In which compass direction does a worker walk from the saw bench to the paint store? (b) How far is it, in metres? (c) The yard rule says a fire extinguisher must be within 20 m of the paint store. The extinguisher is at A4. Does the yard comply? Justify your answer.

Q17. Harrowfield Freight used to prepare its monthly delivery run sheets by hand: 8 staff members, each spending 2.5 hours. Routing software now does the same job with 3 staff members, each spending 2.5 hours. Show that the person-hours spent on run sheets each month have decreased by 62.5%.

Q18. Wattle Court Aged Care recorded incidents per month for its day team and its night team over six months:

Month	1	2	3	4	5	6
Day team	3	4	2	5	9	3
Night team	1	2	1	3	2	3

Made-up data: pretend incident counts for a pretend centre.

- (a) For each team, find the mean (to 1 decimal place), the median and the range. (b) Identify the outlier in the day team's data using the gap rule of §8D. Records show the 9 happened in the month contractors were replacing the roof. Is it a mistake or a real-but-unusual value? (c) Find the day team's mean, to 1 decimal place, and its range with the outlier removed. (d) The manager claims: "The day team averages more than twice the night team per month." Evaluate the claim — which figures support or contradict it, and which set of figures should the manager use? Justify your answer.

Answers

Q1. (a) B4. (b) The dust extractor. (c) The forklift zone, at C2.

Q2. (a) 25 incidents. (b) Slips and trips. (c) 32% (to the nearest whole percent).

Q3. (a) 16.0 per 100 workers (to 1 d.p.). (b) 18.0 per 100 workers (to 1 d.p.). (c) South — the raw counts ignore that North has 75 workers against South's 50.

Q4. (a) 60 m. (b) 50 s. (c) Yes — 50 s is under the 90 s target.

Q5. (a) 375 minutes. (b) 255 minutes saved; 68% decrease (to the nearest whole percent). (c) 1 275 minutes = 21 h 15 min.

Q6. (a) 1.5% (to 1 d.p.). (b) Yes — 1.5% is no more than 2%. (c) Any two of: date, batch/sample ID, sample size, defects found, defect rate, verdict, checker's name.

Q7. (a) 24. (b) 16. (c) 33% (to the nearest whole percent). (d) Overall downward, with a bump at Quarter 3 of Year 1 (8); mean 5 incidents per quarter.

Q8. (a) Yard A 25.0, Yard B 17.5 per 100 workers (each to 1 d.p.). (b) Not supported — per worker, B is the safer yard. (c) B has twice as many workers, so its raw count is bigger even though its rate is lower.

Q9. (a) 14 m east, then 9 m south. (b) 23 m. (c) Start at the log deck, facing north. Walk 9 m north to the workshop. Turn left (now facing west). Walk 14 m west to the office.

Q10. (a) Route 1: 40 m; Route 2: 41 m. (b) Route 1, by 1 m. (c) Route 2 — a safe route beats a shorter blocked one. (d) 34.2 s (to 1 d.p.).

Q11. (a) Paper: mean 20.6 min (1 d.p.), median 20 min, range 6 min. Headset: mean 17.6 min (1 d.p.), median 16 min, range 12 min. (b) Paper — range 6 min against 12 min. (c) 14.6% (to 1 d.p.). (d) Report both ways: with the 26 the mean is 17.6; without it, 15.5 — see solution.

Q12. (a) 1.2%, 3.2%, 2.0%, 0.8%, 2.8% (each to 1 d.p.). (b) 3 batches. (c) Mean 5 defects per batch; mean rate 2.0% (to 1 d.p.). (d) No — the mean hides two failing batches; investigate batches 2 and 5.

Q13. (a) 29. (b) $29 \div 60 \times 100 = 48.33 \dots \approx 48.3$ (1 d.p.). (c) $B8 = 25$; $B9 = 41.7$ (to 1 d.p.). (d) Not right — formulas cannot fix wrong inputs (garbage in, garbage out).

Q14. (a) 19 — a score out of 10 cannot exceed 10. (b) 9.6 as recorded; 8.6 corrected (each to 1 d.p.). (c) Median 9 both ways — the middle barely moves when one end value changes. (d) Any sensible practice, e.g. a printed range check “scores are 0–10” on the sheet.

Q15. (a) 255 minutes = 4 h 15 min. (b) No — 15 min over a 4-hour (240 min) shift. (c) Zone A ends 08:45; zone B ends 09:20. (d) E.g. shift 1: A, B, C, D = 180 min; shift 2: E, F = 75 min — both within 240 min.

Q16. (a) North. (b) 20 m. (c) Yes — the extinguisher at A4 is 10 m from the paint store, within the 20 m rule.

Q17. Old: $8 \times 2.5 = 20$ person-hours. New: $3 \times 2.5 = 7.5$ person-hours. Saved: $20 - 7.5 = 12.5$. Percentage: $12.5 \div 20 \times 100 = 62.5\%$, as required.

Q18. (a) Day: mean 4.3 (1 d.p.), median 3.5, range 7. Night: mean 2.0 (1 d.p.), median 2, range 2. (b) 9 — gap of 4 to the next value; real-but-unusual (roof contractors), not a mistake. (c) Mean 3.4 (1 d.p.), range 3. (d) With the outlier $4.3 > 2 \times 2.0$, the claim holds; without it $3.4 < 4.0$, it fails — see solution.

Fully-worked solutions

Q1. (a) Find the paint store's column and row: column B, row 4, so the grid reference is B4. (b) Row 3, column B holds the dust extractor. (c) Row 2 contains the saw bench (B2), the forklift zone (C2) and the main exit (E2); the forklift zone is the hazard, at C2. Check: each answer names a square that the map's legend marks with that symbol.

Q2. (a) $8 + 7 + 5 + 3 + 2 = 25$ incidents. (b) The mode is the type with the largest count: slips and trips, with 8. (c) $8 \div 25 \times 100 = 32\%$, to the nearest whole percent. Check: 32% of 25 is 8, the slips count.

Q3. (a) North: $12 \div 75 \times 100 = 16.0$ incidents per 100 workers, to 1 decimal place. (b) South: $9 \div 50 \times 100 = 18.0$ per 100 workers, to 1 decimal place. (c) South has the worse rate per worker ($18.0 > 16.0$). The raw counts reverse the answer because the groups are different sizes: North spreads 12 incidents over 75 workers, South only 9 incidents over 50 workers — with fewer workers, each incident counts for more. Check: both rates are below the theory model's Depot B rate of 20 per 100.

Q4. (a) $32 + 15 + 13 = 60$ m. (b) Time = distance $\div$ speed: $60 \div 1.2 = 50$ s. (c) Yes, the drill meets its target: 50 s is less than 90 s, with 40 s to spare. Check: $50 \times 1.2 = 60$ m, the route length.

Q5. (a) Paper: $25 \times 15 = 375$ minutes a day. (b) App: $8 \times 15 = 120$ minutes a day; saved $375 - 120 = 255$ minutes. Percentage decrease: $255 \div 375 \times 100 = 68\%$, to the nearest whole percent. (c) Over 5 days: $255 \times 5 = 1275$ minutes; $1275 \div 60 = 21$ remainder 15, so 21 h 15 min. Check: $120 + 255 = 375$ minutes, the old daily total.

Q6. (a) $3 \div 200 \times 100 = 1.5\%$, to 1 decimal place. (b) Yes: the target is no more than 2%, and $1.5\% \leq 2\%$. (c) For example, the **sample size** (200) and the **date** — with those and the defects count, anyone can re-do $3 \div 200 \times 100$ and check the verdict. (Other valid fields: batch ID, defect rate, checker's name.)

Q7. (a) Year 1: $7 + 5 + 8 + 4 = 24$ incidents. (b) Year 2: $6 + 3 + 5 + 2 = 16$ incidents. (c) Decrease = $24 - 16 = 8$; $8 \div 24 \times 100 = 33.33\ldots\% \approx 33\%$, to the nearest whole percent. (d) The trend is overall downward — every quarter of Year 2 is at or below the quarters of Year 1 around it — with one bump: Quarter 3 of Year 1 rises to 8 after 5. Mean over eight quarters: $(24 + 16) \div 8 = 40 \div 8 = 5$ incidents per quarter. Check: the mean 5 sits between the lowest bar (2) and the highest (8).

Q8. (a) Yard A: $10 \div 40 \times 100 = 25.0$ incidents per 100 workers; Yard B: $14 \div 80 \times 100 = 17.5$ per 100 workers, each to 1 decimal place. (b) The claim is not supported. "Safer" is about the risk each worker carries, and per worker Yard B is safer: $17.5 < 25.0$. The manager's raw-count comparison gets the answer backwards. (c) Yard B has twice as many workers (80 against 40), so it records more incidents even though each of its workers is less likely to be in one. Different-sized groups must be compared by rates, not counts. Check: if Yard B had A's rate of 25.0 per 100, it would record $80 \div 100 \times 25.0 = 20$ incidents — more than its actual 14.

Q9. (a) At 1:200, every 1 cm on the plan is 200 cm = 2 m on the ground. Office to workshop: $7 \times 2 = 14$ m east. Workshop to log deck: $4.5 \times 2 = 9$ m south. (b) Total: $14 + 9 = 23$ m. (c) The return walk reverses each leg and each turn. Start at the log deck, facing north. Walk 9 m north to the workshop. Turn left — facing north, a left turn faces west. Walk 14 m west to the office. Check: the return covers $9 + 14 = 23$ m, the same total, and ends where the outward walk began.

Q10. (a) Route 1: $18 + 22 = 40$ m. Route 2: $12 + 9 + 20 = 41$ m. (b) Route 1 is shorter, by $41 - 40 = 1$ m. (c) The craft room should use route 2. Escape planning puts safety before distance: route 1 passes through the main hall, and the hall is reported full of smoke, so the 1 m saving is worthless against the risk. A route you cannot safely use is not the shorter route. (d) Time = distance $\div$ speed: $41 \div 1.2 = 34.16\ldots \approx 34.2$ s, to 1 decimal place. Check: $34.2 \times 1.2 \approx 41$ m, route 2's length.

Q11. (a) Paper, ordered: 18, 19, 20, 22, 24. Mean = $(18 + 19 + 20 + 22 + 24) \div 5 = 103 \div 5 = 20.6$ min, to 1 decimal place; median = 20 min (the middle value); range = $24 - 18 = 6$ min. Headset, ordered: 14, 15, 16, 17, 26. Mean = $88 \div 5 = 17.6$ min, to 1 decimal place; median = 16 min; range = $26 - 14 = 12$ min. (b) Paper is the more consistent method: its range is 6 min against the headset's 12 min, so paper times sit much closer together. (c) Decrease of means = $20.6 - 17.6 = 3.0$ min; $3.0 \div 20.6 \times 100 = 14.56\ldots\% \approx 14.6\%$, to 1 decimal place. (d) The 26 is an outlier by the gap rule of §8D: ordered, the gap from 17 to 26 is 9 minutes while every other gap is at most 3. It is not a recording mistake — it really happened — but its cause (a wi-fi dropout) is a fault, not normal headset working, so it is real-but-unusual. The fair report gives both figures: with the 26, the mean is 17.6 min; without it, the mean is $62 \div 4 = 15.5$ min and the range drops to $17 - 14 = 3$ min. Judgement: exclude it when comparing normal performance, but record the dropout separately, because wi-fi reliability is part of evaluating the headset system. Check: the medians (20 and 16) are unaffected by the decision, as §8D predicts.

Q12. (a) Rate = defects $\div$ 250 $\times$ 100: batch 1: $3 \div 250 \times 100 = 1.2\%$; batch 2: $8 \div 250 \times 100 = 3.2\%$; batch 3: $5 \div 250 \times 100 = 2.0\%$; batch 4: $2 \div 250 \times 100 = 0.8\%$; batch 5: $7 \div 250 \times 100 = 2.8\%$ — each to 1 decimal place. (b) The target is $\leq 2\%$, and a rate exactly on the limit meets it, so batches 1, 3 and 4 pass — 3 of the 5 batches. (c) Mean defects = $(3 + 8 + 5 + 2 + 7) \div 5 = 25 \div 5 = 5$ per batch; that corresponds to $5 \div 250 \times 100 = 2.0\%$, to 1 decimal place. (d) The mean alone does not show an acceptable week. At 2.0% it sits exactly on the limit — which reads like a pass — yet two batches (3.2% and 2.8%) failed it. A mean smooths away exactly the spikes QA exists to catch. Next step: investigate the two failing batches — same machine, same shift, same material? — and report batch-level rates alongside any average. Check: $1.2 + 3.2 + 2.0 + 0.8 + 2.8 = 10.0$, and $10.0 \div 5 = 2.0\%$, the mean rate.

Q13. (a) B8 adds B2:B7 — January to June: $4 + 6 + 5 + 3 + 7 + 4 = 29$. (b) B9 computes $= B8 / C2 \times 100$, so it shows $29 \div 60 \times 100 = 48.33\dots$, which displays as 48.3 to 1 decimal place, as required. (c) Replacing February's 6 with 2 lowers the sum by 4: B8 now shows $29 - 4 = 25$, and B9 shows $25 \div 60 \times 100 = 41.66\dots \approx 41.7$, to 1 decimal place. The formulas never changed — only the input did. (d) The claim is wrong. A spreadsheet guarantees the *arithmetic*, not the *data*: garbage in, garbage out (§10A, §10B). Here a single double-counted month inflated the reported rate from 41.7 to 48.3 per 100 workers — big enough to change what head office believes about the depot. Inputs need their own checks: totals tied back to source sheets, and values tested against what is possible. Check: the corrected monthly figures still lie in a plausible 2-to-7 band.

Q14. (a) The 19 cannot be correct: the score is out of 10, so no possible score exceeds 10 — a quick range test (§8D's "is this value possible?") catches it. It is almost certainly a keying error for 9. (b) As recorded: sum $= 9 + 8 + 9 + 10 + 8 + 9 + 7 + 9 + 8 + 19 = 96$; mean $= 96 \div 10 = 9.6$, to 1 decimal place. Corrected (19 becomes 9): sum $= 86$; mean $= 86 \div 10 = 8.6$, to 1 decimal place — the single error inflated the mean by a full point. (c) Median as recorded: ordered 7, 8, 8, 8, 9, 9, 9, 9, 10, 19, the middle pair is 9 and 9, so the median is 9. Corrected: ordered 7, 8, 8, 8, 9, 9, 9, 9, 10, the middle pair is still 9 and 9 — median 9, unchanged. The median barely moved because it depends only on the middle of the ordered data, not on how extreme the ends are (§8D); the mean uses every value, so one wild value drags it. (d) One good practice: print the allowed range on the sheet itself — "scores are 0 to 10" — so anyone recording or collating sees at a glance that 19 is impossible; a second-person check at collation would also catch it. Justification: the error survived ten days of recording, so the catch must happen where the number is written, not in someone's head later. Check: corrected values all lie between 7 and 10.

Q15. (a) Total $= 45 + 30 + 60 + 45 + 30 + 45 = 255$ minutes; $255 = 4 \times 60 + 15$, so 4 h 15 min. (b) No. A 4-hour shift is $4 \times 60 = 240$ minutes, and $255 > 240$ — the roster is 15 minutes over before any break is counted, so one inspector cannot finish all six zones in one shift. (c) Zone A: 08:00 + 45 min ends at 08:45. A 5-minute break ends at 08:50, when zone B starts; zone B takes 30 min, ending at 09:20. (d) One fitting split: shift 1 takes zones A, B, C and D — $45 + 30 + 60 + 45 = 180$ min = 3 h; shift 2 takes zones E and F — $30 + 45 = 75$ min = 1 h 15 min. Both totals are within 240 min, and every zone is covered exactly once. (Other splits also work if both totals fit inside 4 hours and all six zones are covered — e.g. A, B, C, E = 165 min and D, F = 90 min.) Check: $180 + 75 = 255$ min, the full roster total.

Q16. (a) Columns give east–west and rows give north–south, with row numbers increasing northward. B2 to B4 stays in column B and moves from row 2 to row 4, so the worker walks **north**. (b) Rows 2 to 4 is 2 squares, and one square is 10 m: $2 \times 10 = 20$ m. (c) Yes, the yard complies. A4 to B4 is one square along row 4: $1 \times 10 = 10$ m, and 10 m is within the 20 m rule — with 10 m to spare. Check: on the map, the extinguisher and the paint store share row 4, one column apart.

Q17. The old method's person-hours are

$$8 \times 2.5 = 20 \text{ person-hours}$$

The new method's person-hours are

$$3 \times 2.5 = 7.5 \text{ person-hours}$$

The person-hours saved are

$$20 - 7.5 = 12.5 \text{ person-hours}$$

The percentage decrease is

$$12.5 \div 20 \times 100 = 62.5 \%$$

$\therefore$ the person-hours spent on run sheets each month have decreased by 62.5%, as required.

Q18. (a) Day team, ordered: 2, 3, 3, 4, 5, 9. Sum = 26; mean = $26 \div 6 = 4.33 \dots \approx 4.3$, to 1 decimal place; median = $(3 + 4) \div 2 = 3.5$; range = $9 - 2 = 7$. Night team, ordered: 1, 1, 2, 2, 3, 3. Sum = 12; mean = $12 \div 6 = 2.0$, to 1 decimal place; median = $(2 + 2) \div 2 = 2$; range = $3 - 1 = 2$. (b) In the ordered day data the gap from 5 up to 9 is 4, while every other gap is at most 1 — a big empty gap, so 9 is an outlier (§8D). It is not a mistake: the incident count is real and the cause is known (roof-replacement contractors on site that month). It is a real-but-unusual value. (c) Without the 9, the day data is 2, 3, 3, 4, 5: mean = $17 \div 5 = 3.4$, to 1 decimal place; range = $5 - 2 = 3$. (d) Twice the night mean is $2 \times 2.0 = 4.0$. With all six months, the day mean is 4.3 and $4.3 > 4.0$ — the claim is supported. With the outlier removed, the day mean is 3.4 and $3.4 < 4.0$ — the claim fails; the day median, 3.5, is also below 4.0. So the claim is true or false depending entirely on which figures are used. The manager should use the figures that answer the question being asked: the 9 was real, so for “what did we actually record this half-year” the full data (4.3) is honest; but for “how do the teams typically compare” the roof month was a one-off with contractors on site, so the outlier-excluded mean (3.4) — or either median (3.5 against 2) — is the fairer comparison. Either way the choice must be stated, not left hidden inside the word “averages”. Check: night figures are unaffected by the decision, so the comparison point (4.0) is solid whichever day figure is used.

Theory

Recreation is what you do in your own time for fun and for rest. In Unit 3 you costed events, ran scoring systems and measured community spaces. Unit 4 goes further into the **data** and the **direction** side of free time: reading statistics about sport, screen time and community activities and judging whether the claims built on them are fair; seeing the chance hiding inside gambling odds; navigating with compass bearings when you orienteer, sail, bushwalk or ride; and planning a trip with maps, scales and a GPS display. Unit 4 also asks more of you: not just *calculate*, but **critically analyse** (pull a claim apart), **evaluate** (judge which answer or measure is better, with reasons) and **justify** (give the mathematical reason for your call).

About the data in this section. Every club, team, player, app, bookmaker, odds board, map, track and number in this section is **made up** (not real), built for this book so you can practise recreational numeracy. Nothing here is real data about a real person, business or place. The maths itself is real — odds boards work the way this section says, and compasses read the way this section shows.

Sport and activity statistics.

Sport and recreation run on numbers: goals per game, runs per innings, members per club, hours per week. Chapter 8 gave you the tools — the **mean** (add the values and divide by how many there are), the **median** (the middle value once the data is ordered), the **range** (biggest value minus smallest) and the **outlier** (a value that sits far away from all the others, spotted by a big empty gap in the ordered data).

The Unit 4 skill is *choosing* between the measures and defending the choice. One huge game drags the mean up, so the mean can paint a typical performance as better than it really is; the median ignores how big the extreme value is, so it usually describes the typical game better. *Worked model:* a player's points in five games are 12, 15, 14, 30 and 14. The mean is $85 \div 5 = 17$ points, but the ordered data is 12, 14, 14, 15, 30, so the median is 14 points and the range is $30 - 12 = 18$ points. Four of the five games are 15 points or fewer, so the median of 14 describes a typical game better than the mean of 17, which the single 30-point game has pulled up.

Membership and participation data usually arrives in a table. To compare one part with the whole, use a percentage:

$$\text{percentage} = \frac{\text{part}}{\text{whole}} \times 100.$$

Screen time: use and overuse.

Screen recreation is measured in hours, and hours add up fast. This section uses a **2 h-a-day recreational screen guideline** as its comparison line, exactly as §6F did. A weekly log is a small data set: you can total it, find its mean and median, count the days over the guideline, and describe its pattern (for example, “weekends are heavier”).

To see how big a habit is, compare it with the 168 hours in a week. *Worked model:* 2.5 h a day of social media is $2.5 \times 7 = 17.5$ h in a week, and $17.5 \div 168 \times 100 = 10.4\%$ of the whole week (to 1 decimal place) — over a 12-week school term that is $17.5 \times 12 = 210$ hours, which is the same as being awake for $210 \div 24 = 8.75$, so almost 9 full days and nights, non-stop. That is the danger of overuse in one calculation: hours that feel small each day stack into whole days each term — time not spent sleeping, moving, working or with people face-to-face. The numbers on screen can mislead in another way too: follower counts and like counts are data, but they can be bought and faked, so a big count is not by itself evidence of anything.

Gambling 1: reading the odds.

A **bookmaker** is a business that takes bets on sport and other events. The money you risk on a bet is the **stake**. Australian bookmakers quote **decimal odds**: the odds number is the payout for every \$1 of stake, and the payout includes your stake back. So

$$\text{payout} = \text{stake} \times \text{decimal odds}$$

and, because the stake came out of your pocket first,

$$\text{profit} = \text{payout} - \text{stake}.$$



If the bet loses, the whole \$10.00 stake is gone.

The odds chain for a made-up \$10 bet at decimal odds of 3.20: $\text{payout} = \text{stake} \times \text{odds}$; $\text{profit} = \text{payout} - \text{stake}$.

Worked model: a \$10 stake at decimal odds of 3.20 pays $10 \times 3.20 = \$32.00$ if it wins, a profit of $32.00 - 10.00 = \$22.00$. If it loses, the \$10 stake is simply gone.

Gambling 2: the chance inside the odds.

Odds are really a probability in disguise. The chance the bookmaker's number represents is called the **implied probability**:

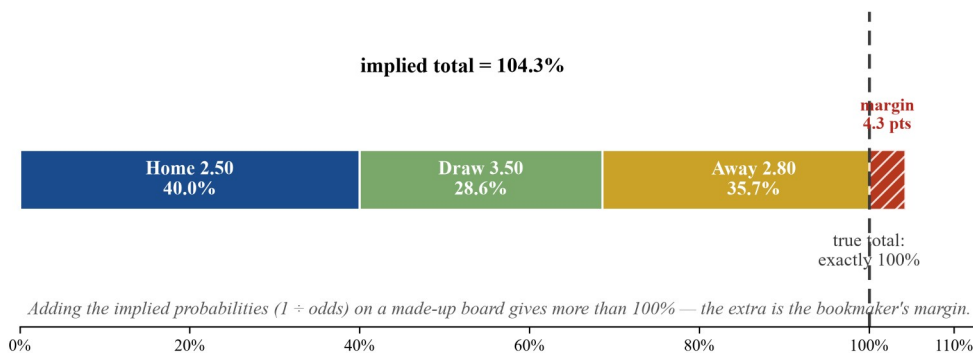
$$\text{implied probability} = \frac{1}{\text{decimal odds}}.$$

Worked model: odds of 3.20 give $1 \div 3.20 = 0.3125 = 31.25\%$, that is 31.3% to 1 decimal place. Smaller odds mean the bookmaker is saying the result is *more* likely — odds of 1.40 imply $1 \div 1.40 = 71.4\%$ (to 1 decimal place).

Now here is the part worth analysing critically. Every possible result of an event is certain to produce exactly one winner, so the true probabilities of all the results must add to exactly 100%. But add up the implied probabilities on a real odds board and you get **more** than 100%. *Worked model:* a soccer match quoted at home 2.50, draw 3.50, away 2.80 gives

$$\frac{1}{2.50} + \frac{1}{3.50} + \frac{1}{2.80} = 40.0\% + 28.6\% + 35.7\% = 104.3\%$$

(each to 1 decimal place). The extra 4.3 percentage points is the **bookmaker's margin** — it is built into every price on the board, and it is how the bookmaker makes money.



Over many bets, the margin means more money flows back to the bookmaker than flows out to the people betting, so the typical person who bets loses money — no matter how sure a single bet feels. That is the mathematics of the danger: gambling is priced so the house wins over time, and losing more than you can afford is how gambling harms people and families. If gambling is hurting you or someone you know, free and confidential help exists — talk with a trusted adult or a doctor, or ring your state's gambling help line.

Chance from form data.

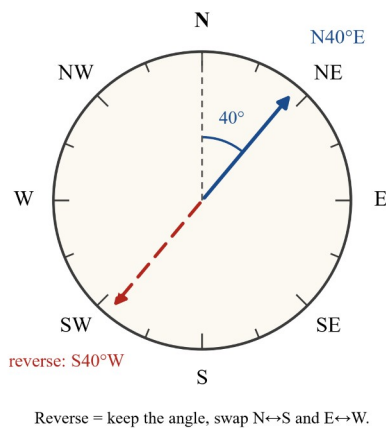
A bookmaker is not the only source of a probability. Chapter 9 estimated chances from data, and sport is full of exactly that kind of data: a team's record over its recent games. The estimate is

$$P(\text{win}) = \frac{\text{number of wins}}{\text{number of games played}}.$$

Worked model: 14 wins in the last 20 games gives $P(\text{win}) = 14 \div 20 = 0.7 = 70\%$. Two cautions come with any estimate like this. The sample is small — 20 games is not the whole story, and a short run of form can flatter or damn a team. And conditions change — injuries, new players, home or away, and the strength of the next opponent all move the true chance. So when a form estimate and a bookmaker's implied probability disagree (Q11), neither number is simply “wrong”; you evaluate where each one comes from.

Navigation: compass points and bearings.

Orienteering (a race to find checkpoints with a map and compass), sailing, bushwalking and bike touring all use the direction language of Chapter 7. The **eight-point compass** names directions N, NE, E, SE, S, SW, W and NW, each 45° apart. A **bearing** writes a direction as an angle: start from north or south, then turn toward east or west, so N 45° E means “face north, turn 45° toward the east” — the same direction as NE.



An eight-point compass rose with the bearing N40°E and its reverse (worked model in the Theory).

Every direction has a **reverse** — the way straight back. For a bearing, keep the angle and swap the letters: north swaps with south, east swaps with west. *Worked model:* the reverse of N 40° E is S 40° W. On a course with several legs, each leg has its own bearing, and turns are angles you add or subtract from the heading you are on (Q15).

Maps, scale and GPS.

A **scale** tells you how map distances become real distances. At a scale of 1:25 000, every 1 cm on the map stands for 25 000 cm in real life:

$$\text{real distance} = \text{map distance} \times \text{scale factor}.$$

Worked model: at 1:25 000, a track measuring 4 cm on the map is $4 \times 25\,000 = 100\,000$ cm long, and $100\,000 \text{ cm} = 1\,000 \text{ m} = 1 \text{ km}$. A useful shortcut: at 1:25 000, 1 cm stands for 250 m, so map centimetres times 250 gives metres directly.

Trip planning joins scale with speed: once you know the real distance, the travel time is

$$\text{time} = \frac{\text{distance}}{\text{speed}}.$$

Worked model: 12 km at 4 km/h takes $12 \div 4 = 3$ hours.

A phone map app or a handheld **GPS** (Global Positioning System) unit shows your position as **coordinates** — a latitude and a longitude, the two numbers that fix a spot on Earth — often with an arrow pointing the way you are travelling and a distance to your destination. You *read* coordinates; you do not calculate with them in this section. GPS is a fine tool, but batteries go flat and phone signal drops out, so a paper map and the scale-and-bearing skills above are the backup that always works.

The problem-solving cycle and the toolkit.

Every task here runs through the four-stage problem-solving cycle: **identify the mathematics** (is this a data question, a chance question or a direction question — and which numbers actually matter?); **act on and use mathematics** (do the averaging, the odds arithmetic, the scale conversion or the bearing work); **evaluate and reflect** (is the mean fair when there is an outlier? does the implied probability sit between 0 and 1? is the finish time realistic for the distance?); and **communicate and report** (state the answer with its unit, its precision and your reason). For the toolkit: a calculator handles odds and percentages; a spreadsheet totals a screen-time log or a membership table and finds the mean in one step; a map app or GPS plans a route and shows coordinates. All of these are demonstrated or referenced in this section, and none of them is required — every item here works with pen, paper and a basic calculator.

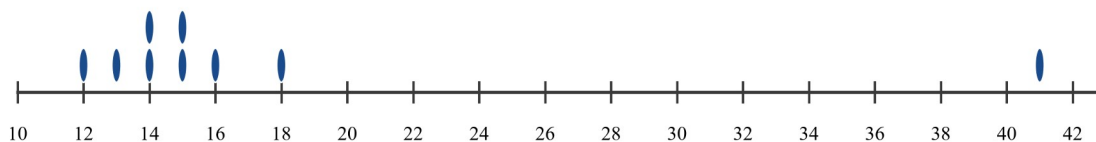
Rounding, units and checking.

Carry every digit your calculator shows through the working, and round **only** where the question tells you to — “to 1 decimal place”, “to 2 decimal places”, “to the nearest cent”, “to the nearest minute”, “to the nearest whole number”. Money is stated to the cent. Probabilities live between 0 and 1, and percentages of chance between 0 % and 100 % — a sum of implied probabilities over 100 % is not an error, it is the bookmaker’s margin; but a single probability above 1 always is an error. Keep units attached: distances in m or km, speeds in km/h, times as clock times or as hours and minutes, angles in degrees. And sanity-check every answer against the situation before you report it.

Worked examples

Example 1 — scaffolded

Deng’s points in nine basketball games for the Ferny Creek Falcons are shown in the dotplot below.



Deng's points scored in nine games for the Ferny Creek Falcons (made-up data).

Made-up data: Deng, the club and every number in the dotplot are made up for this section.

- Order the nine scores from smallest to largest and find the median.
- Find the mean, correct to 1 decimal place, and find the range.
- Identify the outlier, and say which measure of centre better describes a typical Deng game. Give a reason.

Working	Comment
Ordered: 12, 13, 14, 14, 15, 15, 16, 18, 41	The median needs the data in order, smallest to largest.
Median = 15 points	Nine values, so the middle one — the 5th value — is the median.
Sum = 158, so mean = $158 \div 9 = 17.555\dots$, that is 17.6 points (1 d.p.)	Mean = sum $\div$ count. Keep all the digits, then round once, to the precision the question asked for.
Range = $41 - 12 = 29$ points	Range = highest value – lowest value.
Outlier: 41 — the next value down is 18, a gap of 23	A big empty gap between a value and the rest of the ordered data marks an outlier.
The median, 15 points, better describes a typical game.	Eight of the nine games are 18 points or fewer. The one 41-point game pulls the mean up to 17.6, above every game except two.

Example 2 — scaffolded

The odds board for the district tennis final is shown below. Bailey bets \$25.00 on Marnie Doyle.

DISTRICT TENNIS FINAL — HEAD-TO-HEAD	
Marnie Doyle	3.20
Chris Vale	1.40
Decimal odds — payout per \$1 of stake, stake included (made-up board).	

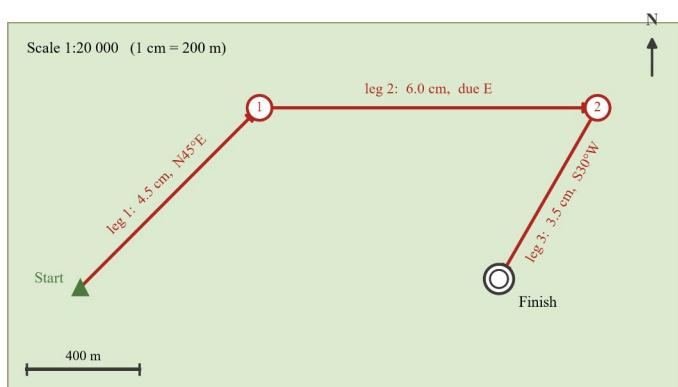
Made-up data: the players, the bookmaker and every number on the board are made up for this section.

- Find the payout if Marnie Doyle wins, to the nearest cent.
- Find Bailey's profit in that case, to the nearest cent.
- Find the implied probability that Marnie Doyle wins, as a percentage correct to 1 decimal place.

Working	Comment
Payout: $25 \times 3.20 = \$80.00$	Decimal odds are the payout per \$1 of stake, stake included: multiply the stake by the odds.
Profit: $80.00 - 25.00 = \$55.00$	Profit = payout – stake. If Marnie loses, Bailey instead loses the whole \$25.00 stake.
Implied probability: $1 \div 3.20 = 0.3125 = 31.25\%$, so 31.3% (1 d.p.)	Implied probability = $1 \div$ decimal odds. Round once, at the end, to the stated precision.
Check: Chris Vale's implied probability is $1 \div 1.40 = 71.4\%$ (1 d.p.)	Smaller odds mean a more likely result — Vale is the bookmaker's favourite.
$31.3\% + 71.4\% = 102.7\%$, which is more than 100%	The two results cover every outcome, so true chances would add to exactly 100%. The extra 2.7 points is the bookmaker's margin.

Example 3 — unscaffolded

Mei is running an orienteering course at Kookaburra Ridge. The course map below is drawn at a scale of 1:20 000. Leg 1 runs 4.5 cm on a bearing of N 45° E, leg 2 runs 6.0 cm due east, and leg 3 runs 3.5 cm on a bearing of S 30° W to the finish.



Mei's made-up orienteering course at Kookaburra Ridge, drawn at 1:20 000. The legs are drawn to the given bearings and map distances.

Made-up data: the course, the map and every number on it are made up for this section.

- Find the real length of each leg, in metres.
- Find the total length of the course, in kilometres.
- Mei runs at an average speed of 5 km/h. Find the time she takes to complete the course, to the nearest minute.

Solution.

At a scale of 1:20 000, 1 cm on the map stands for 20 000 cm in real life, and $20\,000\text{ cm} = 200\text{ m}$. So each map centimetre is 200 m on the ground:

$$4.5 \times 200 = 900\text{ m}, 6.0 \times 200 = 1\,200\text{ m}, 3.5 \times 200 = 700\text{ m}.$$

The total length is

$$900 + 1\,200 + 700 = 2\,800\text{ m} = 2.8\text{ km}.$$

The time is distance divided by speed:

$$2.8 \div 5 = 0.56\text{ h},$$

and, converting to minutes,

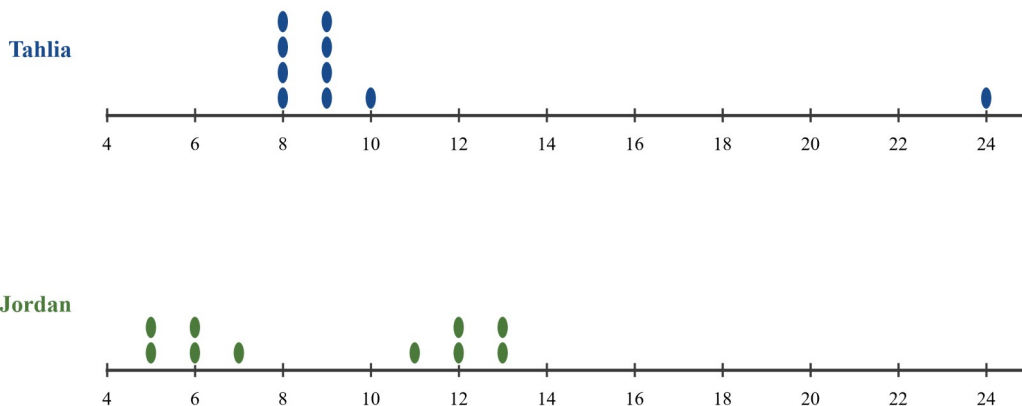
$$0.56 \times 60 = 33.6\text{ min},$$

which is 34 min to the nearest minute.

$\therefore$ the legs are 900 m, 1 200 m and 700 m; the course is 2.8 km long in total; and at 5 km/h Mei takes about 34 minutes.

Example 4 — unscaffolded

Tahlia and Jordan each shot goals for their netball teams over 10 games. Their goals per game are in the paired dotplot below. The coach says: “Tahlia averages more goals per game.”



Goals per game over 10 games: Tahlia (top) and Jordan (bottom) — made-up data.

Made-up data: the players, the teams and every number in the dotplot are made up for this section.

- Find each player’s mean goals per game, correct to 1 decimal place, and say whether the coach’s claim is supported by the means.
- Find each player’s median and range.
- Evaluate the coach’s claim. Justify what the statistics really say about the two shooters.

Solution.

Tahlia’s goals add to $8 + 9 + 8 + 10 + 9 + 8 + 9 + 24 + 8 + 9 = 102$, so her mean is

$102 \div 10 = 10.2$ goals per game (1 d.p. not needed — the value is exact to 1 d.p.).

Jordan's goals add to $12 + 6 + 13 + 5 + 11 + 7 + 12 + 6 + 13 + 5 = 90$, so Jordan's mean is

$$90 \div 10 = 9.0 \text{ goals per game.}$$

Since $10.2 > 9.0$, the coach's claim **is** supported by the means.

For the medians, order each list. Tahlia: 8, 8, 8, 8, 9, 9, 9, 9, 10, 24 — with 10 values the median is halfway between the 5th and 6th, so $(9 + 9) \div 2 = 9$ goals. Jordan: 5, 5, 6, 6, 7, 11, 12, 12, 13, 13 — the median is $(7 + 11) \div 2 = 9$ goals. The ranges are $24 - 8 = 16$ goals for Tahlia and $13 - 5 = 8$ goals for Jordan.

Now evaluate the claim. Tahlia's mean is pulled up by a single 24-goal game — an outlier, with a gap of $24 - 10 = 14$ goals down to her next-best score. Strip that one game out and her typical performance sits at the median: 9 goals, exactly the same typical game as Jordan. The ranges add to the story: Jordan's spread of 8 goals is half Tahlia's spread of 16, so Jordan is the more consistent shooter, while Tahlia is the one capable of a huge game.

$\therefore$ the claim is true of the means (10.2 against 9.0) but misleading about a typical game: the medians are equal at 9 goals, Tahlia's higher mean comes from one outlier game, and Jordan is the more consistent shooter. Which player you pick depends on what you value — a possible big game (Tahlia) or a reliable typical game (Jordan) — and either choice can be justified from these statistics.

Practice questions

Scaffolded

Q1. Use the compass rose in the Theory. (a) Write the compass direction NE as a bearing. (b) Write the bearing $S 22.5^\circ W$ as a point of the 16-point compass. (c) Write the reverse of the bearing $N 40^\circ E$.

Q2. A cricket batter scored 23, 18, 31, 20, 18, 25 and 40 runs in seven innings (an innings is one turn at batting). (a) Find the mean number of runs. (b) Find the median number of runs. (c) Find the range.

All numbers in this question are made up.

Q3. A bookmaker quotes decimal odds of 2.75 for a horse to win its race. A person bets \$20.00 on the horse. (a) Find the payout if the horse wins, to the nearest cent. (b) Find the profit in that case, to the nearest cent. (c) Find the implied probability of the win, as a percentage correct to 1 decimal place.

The odds, the horse and all amounts in this question are made up.

Q4. A soccer team has played 25 games this season: 16 wins and 9 losses. (a) Using this record, estimate $P(\text{win next game})$ as a decimal and as a percentage. (b) Estimate $P(\text{lose next game})$ the same way, as a decimal and as a percentage. (c) Estimate the number of wins the team will make in its next 30 games, to the nearest whole number.

The team and its record are made up.

Q5. A trip map is drawn at a scale of 1:50 000. (a) Two towns are 3 cm apart on the map. Find the real distance between them, in kilometres. (b) A real distance of 6 km is marked on the map. Find its length on the map, in centimetres. (c) A bike path measures 7.5 cm on the map. Find its real length, in kilometres.

Q6. Nadia logged her recreational screen time for one week: Monday 1.5 h, Tuesday 2.5 h, Wednesday 2 h, Thursday 3 h, Friday 2 h, Saturday 4.5 h, Sunday 3.5 h. The guideline used in this section is 2 h a day. (a) Find Nadia's total screen time for the week, in hours. (b) Find the number of days over the guideline, and name them. (c) Find the mean screen time per day, correct to 1 decimal place.

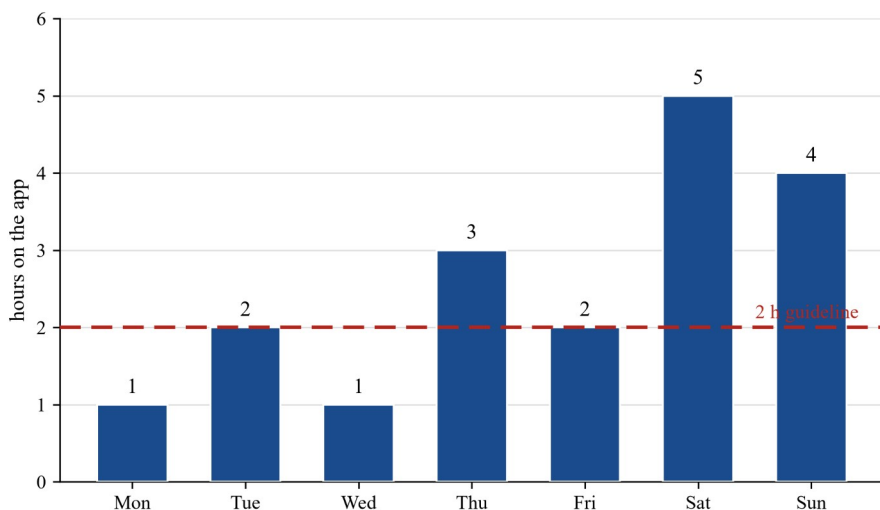
Nadia and her log are made up.

Un scaffolded

Q7. A cricket batter scored 34, 28, 41, 22, 37, 30, 112, 26, 33 and 29 runs in ten innings. (a) Find the mean and the median number of runs. (b) Find the range, identify the outlier, and give a reason using the gap in the ordered data. (c) A club report says the batter “averages about 39 runs”. Critically analyse this statement: is the mean or the median the fairer description of a typical innings? Justify your answer.

All numbers in this question are made up.

Q8. The bar chart shows the hours Elena spent on one video app each day of a week, against the 2 h-a-day guideline used in this section.



Elena's hours on one video app, day by day (made-up data), against the 2 h-a-day guideline used in this section.

- Find the total hours for the week, and the mean hours per day, correct to 2 decimal places.
- Find the median and the range of the daily hours.
- List the days over the guideline and find the total hours over the guideline across the week. Elena says, “I only go over the guideline at the weekend.” Evaluate this claim.

Made-up data: Elena, the app and every number in the chart are made up for this question.

Q9. The Rivergum Community Club keeps a membership table for its five activities.

Activity	Members
Swimming	84
Soccer	60
Cycling	36
Netball	45
Bushwalking	25

Made-up data: the club and every number in the table are made up for this section.

- Find the total number of members.
- Find the swimming members as a percentage of the total, correct to 1 decimal place.
- Find the mean number of members per activity, and list the activities above that mean.

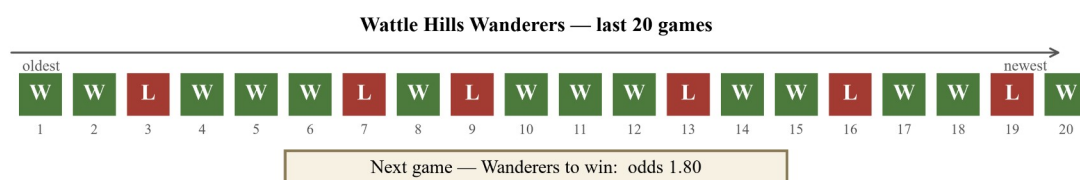
Q10. A bookmaker’s board for Saturday’s soccer match is shown below. There are three possible results: a home win, a draw, or an away win.

SATURDAY SOCCER — MATCH RESULT	
Ferny Creek United (home)	2.40
Draw	3.60
Rivergum Rovers (away)	3.00
Decimal odds — one of these three results must happen (made-up board).	

Made-up data: the teams, the bookmaker and every number on the board are made up for this question.

- Find the implied probability of each of the three results, as percentages correct to 1 decimal place.
- Add the three implied probabilities, correct to 1 decimal place, and find how many percentage points the total is over 100 %.
- The three results cover every possible outcome, so their true probabilities add to exactly 100 %. Evaluate what the extra you found in (b) means for people betting on this match over many bets, and justify why the bookmaker cannot lose money over the long run at these prices.

Q11. The Wattle Hills Wanderers’ results over their last 20 games are shown below, oldest game first. For their next game, a bookmaker quotes odds of 1.80 for the Wanderers to win.



The Wanderers' made-up form strip (W = win, L = loss) and the made-up odds for their next game.

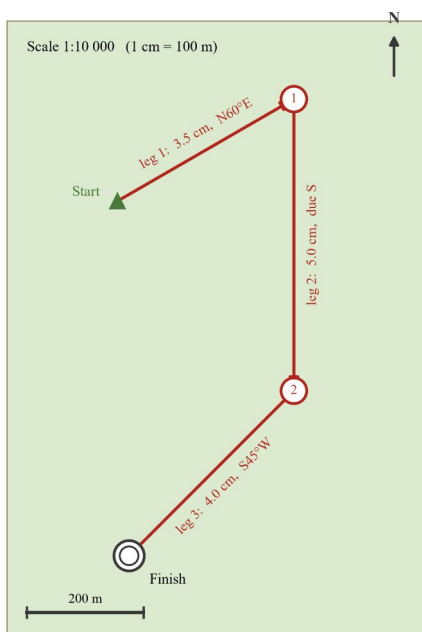
Made-up data: the team, its record and the odds are made up for this question.

- Count the wins, and use the 20-game record to estimate $P(\text{Wanderers win})$ as a decimal and as a percentage.
- Find the implied probability from the odds of 1.80, as a percentage correct to 1 decimal place.
- Your two probabilities disagree. Give two reasons why a bookmaker’s number might differ from a form estimate, and justify whether “70% from the last 20 games” is on its own a safe reason to bet.

Q12. At the club fete, two raffles are running. Raffle A sold 250 tickets and Zoe bought 5 of them. Raffle B sold 100 tickets and Kai bought 2 of them. Each raffle has exactly one winning ticket, drawn at random. (a) Find $P(\text{Zoe wins raffle A})$ as a fraction, a decimal and a percentage. (b) Find $P(\text{Kai wins raffle B})$ as a decimal and a percentage. (c) Zoe says, “I have 5 tickets and Kai has only 2, so I am more likely to win.” Evaluate this claim and justify your answer with the probabilities from (a) and (b).

The raffles and all numbers in this question are made up.

Q13. An orienteering course at Mount Marra is drawn on the map below at a scale of 1:10 000. Leg 1 runs 3.5 cm on a bearing of $N 60^\circ E$ to control 1; leg 2 runs 5.0 cm due south to control 2; leg 3 runs 4.0 cm on a bearing of $S 45^\circ W$ to the finish.



The made-up orienteering course at Mount Marra, drawn at 1:10 000. The legs are drawn to the given bearings and map distances.

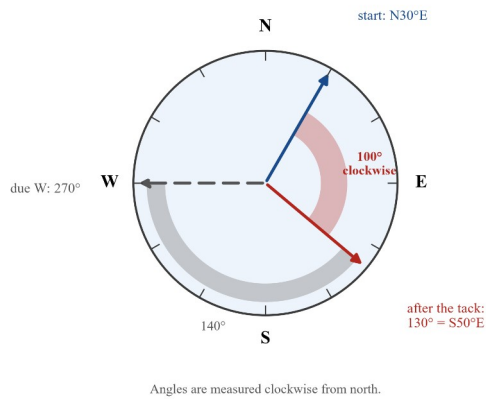
Made-up data: the course, the map and every number on it are made up for this question.

- Find the real length of each leg, in metres.
- Find the total length of the course, in kilometres.
- Write the bearing of leg 3 as a compass point, and write the reverse of the bearing of leg 1.

Q14. A bushwalking group walks the 8.4 km Ridge Track at an average speed of 3.5 km/h. They stop for a 45-minute lunch at the halfway shelter, and they start walking at 09:40. (a) Find the walking time, in hours and minutes (lunch not included). (b) Find the total time elapsed including the lunch stop, and the clock time at which the group finishes. (c) The group leader estimated “about 2 hours in total — back at the car by 12:00”. Critically analyse this estimate: how far out is it, and in which direction?

The track, the group and all numbers in this question are made up.

Q15. A sailing boat is steering a heading of $N 30^\circ E$ when the wind changes. The skipper tacks — turns the boat — 100° clockwise.



The made-up sailing headings: $N30^\circ E$, a 100° clockwise tack to 130° ($S50^\circ E$), and the 140° clockwise turn to due west.

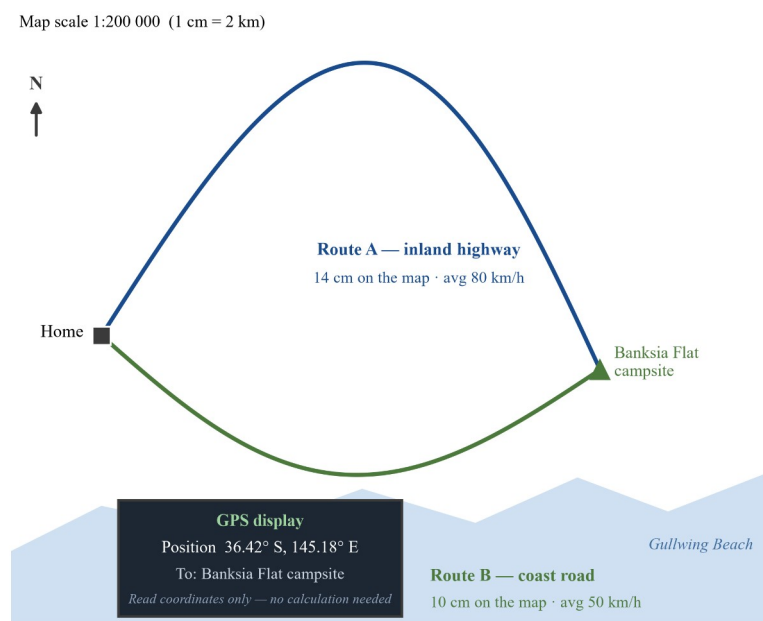
- Find the new heading as an angle measured clockwise from north, and write it as a bearing.
- Later the skipper steers due west. From the heading in (a), find the smaller turn needed, state whether it is clockwise or anticlockwise, and give the angle in degrees.
- Write the reverse of the original $N 30^\circ E$ heading.

The boat and its headings are made up.

Q16. On Saturday, Asha rode her bike 45 km in 1 h 48 min. On Sunday she rode 52 km in 2 h 20 min. (a) Find Asha's average speed on Saturday, in km/h. (b) Find her average speed on Sunday, in km/h, correct to 1 decimal place. (c) Find the difference between the two speeds, correct to 1 decimal place, and say which day was faster.

Asha and both rides are made up.

Q17. A family is driving to the Banksia Flat campsite at Gullwing Beach. The map below is drawn at a scale of 1:200 000 and shows two routes, with the GPS display they use on the day. Route A follows the inland highway (14 cm on the map, travelling at an average 80 km/h). Route B follows the coast road (10 cm on the map, travelling at an average 50 km/h).



The made-up trip map and GPS display: Route A is drawn 14 cm long and Route B 10 cm long, matching the map distances in Q17 (scale 1:200 000).

Made-up data: the places, the map, the GPS display and every number in this question are made up.

- Find the real distance of each route, in kilometres.
- Find the travel time of each route, to the nearest minute.
- Which route is quicker, and by how many minutes? Justify why the route that is shorter on the map is not always the quicker route.

Q18. The Rivergum Riders club is planning its summer ride days. Nine members each suggest a ride distance, in kilometres: 15, 20, 18, 25, 20, 60, 22, 20, 16. (a) Find the mean and the median of the suggested distances, and identify the outlier, giving a reason using the gap in the ordered data. (b) The club chooses the median distance, 20 km, for each ride. On the club's planning map at a scale of 1:250 000, find how long a 20 km ride is, in centimetres. (c) For each planned ride day, the weather app gives $P(\text{rain}) = 0.3$. Find $P(\text{ride goes ahead})$ for one ride day, and find the expected number of wet ride days over the 8 planned days, to the nearest whole number. Evaluate whether the club should still plan the rides, and justify your answer.

The club, the weather chances and all numbers in this question are made up.

Answers

Q1. (a) $N 45^\circ E$. (b) SSW. (c) $S 40^\circ W$. **Q2.** (a) 25 runs. (b) 23 runs. (c) 22 runs. **Q3.** (a) \$55.00. (b) \$35.00. (c) 36.4 % (1 d.p.). **Q4.** (a) $0.64 = 64\%$. (b) $0.36 = 36\%$. (c) 19 wins (nearest whole number). **Q5.** (a) 1.5 km. (b) 12 cm. (c) 3.75 km. **Q6.** (a) 19 h. (b) 4 days: Tuesday, Thursday, Saturday, Sunday. (c) 2.7 h (1 d.p.). **Q7.** (a) mean 39.2 runs, median 31.5 runs. (b) range 90 runs; outlier 112 (the gap down to the next value, 41, is 71). (c) the median is fairer — the single 112 drags the mean up (reasoning in the solutions). **Q8.** (a) 18 h; mean 2.57 h (2 d.p.). (b) median 2 h; range 4 h. (c) Thu, Sat, Sun — 3 days, 6 h over in total; the claim is false (Thursday is a weekday). **Q9.** (a) 250 members. (b) 33.6 % (1 d.p.). (c) mean 50 members per activity; above the mean: Swimming (84) and Soccer (60). **Q10.** (a) home 41.7 %, draw 27.8 %, away 33.3 % (each 1 d.p.). (b) 102.8 % (1 d.p.), which is 2.8 percentage points over 100 %. (c) the extra is the bookmaker's margin — over many bets, more money flows in than flows back (reasoning in the solutions). **Q11.** (a) 14 wins; $0.7 = 70\%$. (b) 55.6 % (1 d.p.). (c) for example, the margin inside the odds, and changed conditions or a small sample (evaluation in the solutions). **Q12.** (a) $\frac{5}{250} = 0.02 = 2\%$. (b) $0.02 = 2\%$. (c) the claim is wrong — the two chances are equal (reasoning in the solutions). **Q13.** (a) 350 m, 500 m, 400 m. (b) 1.25 km. (c) SW; $S 60^\circ W$. **Q14.** (a) 2.4 h = 2 h 24 min. (b) 3 h 9 min; finishes 12:49. (c) the estimate is too low — the group finishes 49 minutes after 12:00. **Q15.** (a) 130° clockwise from north = $S 50^\circ E$. (b) 140° , clockwise. (c) $S 30^\circ W$. **Q16.** (a) 25 km/h. (b) 22.3 km/h (1 d.p.). (c) 2.7 km/h (1 d.p.); Saturday was faster. **Q17.** (a) Route A 28 km; Route B 20 km. (b) Route A 21 min; Route B 24 min. (c) Route A, by 3 min; a slower road can eat a shorter distance (reasoning in the solutions). **Q18.** (a) mean 24.0 km, median 20 km; outlier 60 km (the gap down to 25 is 35). (b) 8 cm. (c) $P(\text{goes ahead}) = 0.7 = 70\%$; expected wet days 2.4, so 2 to the nearest whole number; yes, still plan the rides (reasoning in the solutions).

Fully-worked solutions

Q1. (a) NE is halfway between N and E, that is 45° from north toward the east: $N 45^\circ E$. (b) $S 22.5^\circ W$ is 22.5° west of south — one 16-point step — which is the compass point SSW. (c) Swap the letters and keep the angle: north becomes south, east becomes west, so the reverse of $N 40^\circ E$ is $S 40^\circ W$.

Q2. (a) Sum: $23 + 18 + 31 + 20 + 18 + 25 + 40 = 175$ runs. Mean $= 175 \div 7 = 25$ runs. (b) Ordered: 18, 18, 20, 23, 25, 31, 40. Seven values, so the median is the 4th value: 23 runs. (c) Range $= 40 - 18 = 22$ runs.

Q3. (a) Payout $= 20 \times 2.75 = \$55.00$, to the nearest cent. (b) Profit $= 55.00 - 20.00 = \$35.00$, to the nearest cent. (c) Implied probability $= 1 \div 2.75 = 0.363636\dots = 36.3636\dots\%$, which is 36.4 % correct to 1 decimal place.

Q4. (a) $P(\text{win}) = 16 \div 25 = 0.64 = 64\%$. (b) $P(\text{lose}) = 9 \div 25 = 0.36 = 36\%$. Check: $64\% + 36\% = 100\% \checkmark$. (c) Expected wins = probability $\times$ number of games $= 0.64 \times 30 = 19.2$, which is 19 wins to the nearest whole number.

Q5. At 1:50 000, 1 cm on the map stands for 50 000 cm = 500 m in real life. (a) $3 \times 500 = 1500$ m = 1.5 km. (b) 6 km = 6 000 m, and $6000 \div 500 = 12$ cm on the map. (c) $7.5 \times 500 = 3750$ m = 3.75 km.

Q6. (a) Total $= 1.5 + 2.5 + 2 + 3 + 2 + 4.5 + 3.5 = 19$ h. (b) Days strictly over 2 h: Tuesday (2.5), Thursday (3), Saturday (4.5) and Sunday (3.5) — 4 days. Wednesday and Friday are exactly at the guideline, not over it. (c) Mean $= 19 \div 7 = 2.714285\dots$, which is 2.7 h per day correct to 1 decimal place.

Q7. (a) Sum $= 34 + 28 + 41 + 22 + 37 + 30 + 112 + 26 + 33 + 29 = 392$ runs. Mean $= 392 \div 10 = 39.2$ runs. Ordered: 22, 26, 28, 29, 30, 33, 34, 37, 41, 112; ten values, so the median is halfway between the 5th and 6th: $(30 + 33) \div 2 = 31.5$ runs. (b) Range $= 112 - 22 = 90$ runs. The outlier is 112: in the ordered data the next value below it is 41, a gap of 71 runs, while every other gap is 9 runs or smaller. (c) The mean of 39.2 counts the one big innings of 112 exactly as much as each small innings, so a single outstanding game drags it well above nine of the ten scores. The median of 31.5 sits in the middle of the batter's ordinary performances and is not moved by how huge the 112 was. So "averages about 39" is literally true of the mean but is not a fair description of a typical innings; the median of 31.5 runs is the fairer typical score. A report quoting the mean should also quote the median, or mention the 112.

Q8. (a) Total = $1 + 2 + 1 + 3 + 2 + 5 + 4 = 18$ h. Mean = $18 \div 7 = 2.571428\dots$, which is 2.57 h correct to 2 decimal places. (b) Ordered: 1, 1, 2, 2, 3, 4, 5; seven values, so the median is the 4th value, 2 h. Range = $5 - 1 = 4$ h. (c) Days over 2 h: Thursday (3 h, over by 1), Saturday (5 h, over by 3) and Sunday (4 h, over by 2) — 3 days, $1 + 3 + 2 = 6$ h over the guideline in total. Elena's claim is **false**: Thursday is a weekday, and at 3 h it is over the guideline too. The pattern is still weekend-heavy (Saturday and Sunday hold 9 of the 18 hours), but “only at the weekend” does not survive the data.

Q9. (a) Total = $84 + 60 + 36 + 45 + 25 = 250$ members. (b) $\frac{84}{250} \times 100 = 33.6\%$, correct to 1 decimal place (the value is exact at 33.6). (c) Mean = $250 \div 5 = 50$ members per activity. Above the mean: Swimming (84) and Soccer (60). The other three activities (36, 45, 25) are all below it — the mean is lifted by the two big activities, so no activity is actually near the “average” size.

Q10. (a) Home win: $1 \div 2.40 = 0.416666\dots = 41.7\%$ (1 d.p.). Draw: $1 \div 3.60 = 0.277777\dots = 27.8\%$ (1 d.p.). Away win: $1 \div 3.00 = 0.333333\dots = 33.3\%$ (1 d.p.). (b) Total = $41.7\% + 27.8\% + 33.3\% = 102.8\%$ (1 d.p.). Over 100% by $102.8 - 100 = 2.8$ percentage points. (c) The true probabilities of home win, draw and away win must add to exactly 100%, because exactly one of the three results happens. The board's numbers add to 102.8%, so the prices are squeezed: the extra 2.8 points is the bookmaker's margin, built into every price. For people betting, the odds pay slightly less than true chances would — so across many bets at these prices, more money flows in to the bookmaker than flows back out, and the typical person betting loses money. That is why the bookmaker cannot lose over the long run: its profit is priced into the board itself, whoever wins the match.

Q11. (a) The strip shows 14 wins and 6 losses in 20 games. $P(\text{win}) \approx 14 \div 20 = 0.7 = 70\%$. (b) Implied probability = $1 \div 1.80 = 0.555555\dots = 55.6\%$, correct to 1 decimal place. (c) Two reasons the numbers differ: first, the odds of 1.80 carry the bookmaker's margin, so the implied probability is not a pure estimate of the chance; second, the form estimate rests on only 20 past games, and conditions change — injuries, new players, home or away, and the strength of *this* opponent are not in the old record. And no: “70%” is not on its own a safe reason to bet. A 70% chance still loses 30% of the time, the true chance may well be nearer the bookmaker's 55.6%, and the margin is only a few points of squeeze — far too small to close the 14.4-point gap between the form's 70% and the board's 55.6%. Betting on this basis risks money on a shaky estimate.

Q12. (a) $P(\text{Zoe wins}) = \frac{5}{250} = 0.02 = 2\%$. (b) $P(\text{Kai wins}) = \frac{2}{100} = 0.02 = 2\%$. (c) Zoe's claim is **wrong**. Chance does not depend on how many tickets a person holds by itself — it depends on what fraction of *all the tickets* that person holds. Zoe holds $\frac{5}{250}$ of raffle A and Kai holds $\frac{2}{100}$ of raffle B, and $\frac{5}{250} = \frac{2}{100} = 2\%$. Their chances are exactly equal, even though Zoe holds more pieces of paper.

Q13. At 1:10 000, 1 cm stands for 10 000 cm = 100 m. (a) Leg 1: $3.5 \times 100 = 350$ m. Leg 2: $5.0 \times 100 = 500$ m. Leg 3: $4.0 \times 100 = 400$ m. (b) Total = $350 + 500 + 400 = 1\,250$ m = 1.25 km. (c) S 45° W is exactly halfway between S and W, so leg 3 runs SW. The reverse of N 60° E swaps the letters and keeps the angle: S 60° W.

Q14. (a) Walking time = $8.4 \div 3.5 = 2.4$ h. Converting the decimal part: $0.4 \times 60 = 24$, so the walking time is 2 h 24 min. (b) Total elapsed = 2 h 24 min + 45 min = 3 h 9 min. Starting at 09:40, the group finishes at 09:40 + 3 h 9 min = 12:49. (c) The estimate is too low, in both parts. The walking alone takes 2 h 24 min, already 24 minutes more than “about 2 hours”, and the 45-minute lunch pushes the total to 3 h 9 min. Against the promised 12:00 return, the group arrives back at 12:49 — 49 minutes late. A realistic estimate has to include every block: walking time *and* breaks.

Q15. (a) The original heading N 30° E is 30° clockwise from north. Turning 100° clockwise gives $30 + 100 = 130^\circ$ clockwise from north. Since 130° is past east (90°) and short of south (180°), it is measured from south instead: $180 - 130 = 50$, so the bearing is S 50° E. (b) Due west is 270° clockwise from north. From 130° , turning clockwise takes $270 - 130 = 140^\circ$; turning anticlockwise takes $360 - 140 = 220^\circ$. The smaller turn is 140° , clockwise. (c) Swap the letters and keep the angle: the reverse of N 30° E is S 30° W.

Q16. (a) Saturday: $48 \text{ min} = 48 \div 60 = 0.8 \text{ h}$, so the time is 1.8 h. Speed = $45 \div 1.8 = 25 \text{ km/h}$. (b) Sunday: $20 \text{ min} = 20 \div 60 = 0.333 \dots \text{ h}$, so the time is 2.333... h. Speed = $52 \div 2.333 \dots = 22.285714 \dots$, which is 22.3 km/h correct to 1 decimal place. (c) Carrying full precision, the difference is $25 - 22.285714 \dots = 2.714285 \dots$, which is 2.7 km/h correct to 1 decimal place. Saturday was the faster day.

Q17. At 1:200 000, 1 cm stands for 200 000 cm = 2 km. (a) Route A: $14 \times 2 = 28 \text{ km}$. Route B: $10 \times 2 = 20 \text{ km}$. (b) Route A: $28 \div 80 = 0.35 \text{ h}$, and $0.35 \times 60 = 21 \text{ min}$. Route B: $20 \div 50 = 0.4 \text{ h}$, and $0.4 \times 60 = 24 \text{ min}$. Both are exact, so to the nearest minute they are 21 min and 24 min. (c) Route A is quicker, by $24 - 21 = 3 \text{ minutes}$. Route B is 8 km shorter on the map, but it is a slower road: at 50 km/h the coast road takes 1.2 minutes per kilometre while the highway takes 0.75. Distance is only half of travel time — speed is the other half — so the shorter route is not automatically the quicker one. For a trip, compare *times*, not map lengths.

Q18. (a) Ordered: 15, 16, 18, 20, 20, 20, 22, 25, 60. Sum = 216, so the mean = $216 \div 9 = 24.0 \text{ km}$. Nine values, so the median is the 5th value: 20 km. The outlier is 60 km — the gap down to the next value, 25, is 35 km, while every other gap is 7 km or smaller. (b) At 1:250 000, 1 cm stands for 250 000 cm = 2.5 km. $20 \div 2.5 = 8$, so the ride is 8 cm long on the planning map. Check: $8 \times 250\,000 = 2\,000\,000 \text{ cm} = 20 \text{ km}$ ✓. (c)

$P(\text{goes ahead}) = 1 - P(\text{rain}) = 1 - 0.3 = 0.7 = 70\%$. Expected wet days = $0.3 \times 8 = 2.4$, which is 2 days to the nearest whole number. Yes — the club should still plan the rides. Each day is more likely to be dry than wet (70% against 30%), and the expected 2.4 wet days is an average over many runs of 8 days, not a promise that 2 particular days will fail. The sensible precaution is a wet-weather plan — a swap date or a shorter backup route — for any day the forecast turns bad.

Chapter 11 — Test A (multiple choice)

Chapter 11 (Unit 4 numeracy in context), sections 11A to 11F. Materials: pen, paper; a scientific calculator may be used. Test A: 12 multiple-choice questions (12 marks). Approximate time: 25 minutes.

About the data in this test. The wages, prices, times, survey results and other numbers here are **made up** (not real): pretend people, pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place, and nothing here is medical or financial advice.

Choose the response that is correct for the question.

Question 1

A family drives 420 km to a holiday spot at an average speed of 84 km/h. For safety, the driver takes a 15-minute break after every 2 hours of driving. A break is only taken if it comes before the arrival. How long does the whole trip take, including breaks?

- A. 5 hours
- B. 5 hours 15 minutes
- C. 5 hours 30 minutes
- D. 5 hours 45 minutes

Question 2

A car uses 8 L of fuel per 100 km. Fuel costs \$1.75 per litre. What is the fuel cost of a 250 km trip, to the nearest cent?

- A. \$ 14.00
- B. \$ 17.50
- C. \$ 28.00
- D. \$ 35.00

Question 3

In a town, 57 600 people have jobs and 2 400 people do not have jobs but are actively looking for work. What is the town's unemployment rate?

- A. 4.2 %
- B. 4 %
- C. 0.4 %
- D. 96 %

Question 4

Over one year, a region's unemployment rate fell from 8 % to 6 %. Which statement correctly describes the fall?

- A. It fell by 25 percentage points.
- B. It fell by 2 percentage points.
- C. It fell by 2 %.
- D. It fell by 0.2 percentage points.

Question 5

A phone plan costs \$66 per month, including GST (the goods and services tax). The GST inside a tax-inclusive price is found by dividing the price by 11. What is the amount of GST in the monthly price?

- A. \$6.00
- B. \$6.60
- C. \$7.26
- D. \$59.40

Question 6

A town's rents go up by 10% in one year, and then down by 10% the next year. Compared with the rent at the start, the rent at the end shows

- A. a 20% decrease
- B. no change
- C. a 1% increase
- D. a 1% decrease

Question 7

A health study finds that about 0.4% of people in one age group develop a certain condition each year. In a town with 2500 people in this age group, how many people would be expected to develop the condition each year?

- A. 1
- B. 25
- C. 10
- D. 100

Question 8

A muesli bar wrapper says the bar has 850 kJ of energy per 100 g. One whole bar weighs 50 g. How much energy is in one whole bar?

- A. 425 kJ
- B. 850 kJ
- C. 1700 kJ
- D. 170 kJ

Question 9

A factory floor plan is drawn at a scale of 1:200, so 1 cm on the plan represents 2 m in real life. A workshop measures 6 cm on the plan. What is the real length of the workshop?

- A. 1.2 m
- B. 12 m
- C. 3 m
- D. 1200 m

Question 10

A quality check finds 9 defective items in a batch of 500. The factory's target is a defect rate of at most 2 %, and a batch with a rate equal to the target still passes. Which statement about this batch is correct?

- A. The rate is 1.8 %, so the batch meets the target.
- B. The rate is 1.8 %, so the batch does not meet the target.
- C. The rate is 9.0 %, so the batch does not meet the target.
- D. The rate is 0.018 %, so the batch meets the target.

Question 11

A runner is at decimal odds of 4.00. Mei bets \$ 15 on the runner. With decimal odds, the payout is the stake times the odds, and the profit is the payout minus the stake. If the runner wins, what is Mei's profit?

- A. \$ 15.00
- B. \$ 60.00
- C. \$ 75.00
- D. \$ 45.00

Question 12

A boat sails with a heading of north. It then turns clockwise through 135° . On an 8-point compass, the points are 45° apart. What is the boat's new direction?

- A. North-east
- B. North-west
- C. South-east
- D. South-west

End of Test A

Test A — Answers

Question	1	2	3	4	5	6	7	8	9	10	11	12
Answer	C	D	B	B	A	D	C	A	B	A	D	C

Test A — Fully-worked solutions

Question	Answer	Working
1	C	Driving time = $420 \div 84 = 5$ hours. Breaks come after 2 hours and after 4 hours of driving — both fall before arrival, so there are 2 breaks: $2 \times 15 = 30$ minutes. Total = 5 hours 30 minutes. Option A ignores the breaks; option B allows only one break; option D counts a break at the moment of arrival, which is not taken.
2	D	Fuel used = $\frac{250}{100} \times 8 = 2.5 \times 8 = 20$ L. Cost = $20 \times \\$1.75 = \\$35.00$. Option A (\$14.00) is the cost for only 100 km ($8 \times \\$1.75$); option B (\$17.50) is the cost for 125 km — half the trip; option C (\$28.00) uses 16 L, multiplying by 2 instead of 2.5.
3	B	The labour force is the people with jobs plus the people looking for work: $57\,600 + 2\,400 = 60\,000$. Unemployment rate = $\frac{2\,400}{60\,000} \times 100 = 4\%$. Option A (4.2%) divides by the employed only ($2\,400 \div 57\,600 \approx 4.2\%$); option C (0.4%) slips the decimal place; option D (96%) is the employed share of the labour force, not the unemployment rate.
4	B	The rate itself went from 8% down to 6%, so on the percentage-point scale it fell by $8 - 6 = 2$ percentage points. Option C (“2%”) would mean the rate fell by 2% of itself — only 0.16 of a percentage point. Option A confuses the relative fall ($2 \div 8 = 25\%$, a fall of 25%) with a fall of 25 percentage points, which would take the rate below zero.
5	A	GST inside a tax-inclusive price = $\\$66 \div 11 = \\$6.00$. Option B takes 10% of the full price (\$6.60), but 10% of a GST-inclusive price is not the GST; option C takes 11% of the price (\$7.26); option D (\$59.40) is the price minus that wrong 10%. Check: $\\$6.00 + \\$60.00 = \\$66.00$, where \$60.00 is the price before

Question	Answer	Working
6	D	GST. Successive percentage changes multiply; they do not add. Combined multiplier = $1.10 \times 0.90 = 0.99$, so the final rent is 99 % of the starting rent — a 1 % decrease. Option A adds the two changes; option B assumes they cancel, but 10 % up is a bigger dollar move than 10 % back down from the higher rent.
7	C	Expected number $= p \times N = 0.4 \% \times 2500 = 0.004 \times 25$ people. Option B treats the risk as 1 %; option D treats it as 4 %; option A slips the decimal to 0.04 %
8	A	The bar weighs 50 g, which is half of 100 g, so energy = $850 \div 2 = 425$ kJ. Option C doubles the energy instead of halving it; option D divides by 5.
9	B	1 cm on the plan = 2 m in real life, so 6 cm = $6 \times 2 = 12$ m. Option D forgets to convert cm to m ($6 \times 200 = 1200$ cm, which is 12 m, not 1200 m); option C divides instead of multiplying; option A slips the decimal place.
10	A	Defect rate = $\frac{9}{500} \times 100 = 1.8 \%$. The target is “at most 2 %”, and $1.8 \% \leq 2 \%$, so the batch meets the target. Option B has the right rate but the wrong verdict; option C divides by 100 instead of 500; option D forgets to multiply by 100.
11	D	Payout = $\\$15 \times 4.00 = \\$60.00$. Profit = payout – stake $= \\$60.00 - \\$15.00 = \\$45.00$. Option A is just the stake; option B is the payout, not the profit; option C adds the stake on again.
12	C	The 8 compass points are 45° apart, so $135^\circ \div 45^\circ = 3$ steps clockwise: north $\rightarrow$ north-east (45°) $\rightarrow$ east (90°) $\rightarrow$ south-east (135°). Option A is only one step; option B turns anticlockwise; option D is a 225° clockwise turn.

Chapter 11 — Test B (written response)

Chapter 11 (Unit 4 numeracy in context), sections 11A to 11F. Materials: pen, paper; a scientific calculator may be used. Test B: 7 questions (33 marks). Approximate time: 45 minutes. Answer all questions in the spaces provided. In all questions where a numerical answer is required, you should only round when instructed to do so, and then to the precision stated. Where more than one mark is available, appropriate working must be shown.

About the data in this test. The wages, prices, times, survey results and other numbers here are **made up** (not real): pretend people, pretend businesses and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place, and nothing here is medical or financial advice.

Question 1 (5 marks)

Anh's family drives 330 km to visit relatives at an average speed of 66 km/h. For safety, the driver takes a 15-minute break after every 2 hours of driving. A break is only taken if it comes before the arrival.

a. Find the driving time, in hours, without any breaks. 1 mark

b. How many 15-minute breaks does the trip need, and how many minutes of break time is this in total? 1 mark

c. Find the total time for the trip, including breaks. 1 mark

d. The family wants to arrive by 15:30. Find the latest time they can leave home. Give your answer in 24-hour time. 2 marks

Question 2 (5 marks)

A small business employs 9 people. Their weekly wages, in dollars, are

550, 600, 620, 650, 680, 700, 750, 800, 1850.

a. Find the mean weekly wage. 1 mark

b. Find the median weekly wage. 1 mark

c. The top wage, \$1850, is the owner's wage. Is \$1850 an outlier? Give a numerical reason. 1 mark

d. The owner says: "A typical wage at this business is \$800 per week." Evaluate this claim. 2 marks

Question 3 (5 marks)

Jen keeps a monthly budget. Her income and expenses are shown below.

Budget item	Monthly amount
Income (take-home pay)	\$3 240
Rent	\$1 250
Food	\$560
Transport	\$245
Phone and internet	\$95
Electricity	\$180
Entertainment	\$150
Other	\$320

a. Find Jen's total monthly expenses. 1 mark

b. Is Jen's budget in surplus or in deficit? Find the amount. 1 mark

c. Jen wants to save \$2 000 for a trip, and she saves her full surplus each month. Find how many months Jen needs to save for. Round your answer up to a whole number of months, and say why rounding up is needed. 2 marks

d. The next year, Jen's rent increases by 4%. Find the new monthly rent. 1 mark

Question 4 (4 marks)

A country town has 8 400 residents and 3 GPs (doctors). A recommended guide is 1 GP for every 1 200 residents. The nearest specialist clinic is 75 km from the town.

a. Find the current number of residents per GP in the town. 1 mark

b. Find the number of GPs the town would need to meet the recommended guide. 1 mark

c. How many more GPs does the town need? 1 mark

d. A resident drives the 75 km to the specialist clinic at an average speed of 60 km/h. Find the travel time, in hours and minutes. 1 mark

Question 5 (5 marks)

A warehouse crew fills the day's orders. Before new scanning software was introduced, 6 workers each worked a 7.5-hour shift. After the change, 5 workers each work 6 hours to fill the same orders. In a practice fire drill, 38 workers are expected at the assembly point.

a. Find the number of person-hours used each day before the change. 1 mark

b. Find the number of person-hours used each day after the change. 1 mark

c. Find the percentage decrease in person-hours, correct to one decimal place. 2 marks

d. At the drill's roll call, 35 workers are counted at the assembly point. How many workers are missing, and what should the warden do next? 1 mark

Question 6 (4 marks)

A community football club sells raffle tickets and publishes its match results.

a. The club sells 400 raffle tickets and Maya buys 8 of them. Find Maya's chance of winning, as a fraction in simplest form and as a percentage. 1 mark

b. In the last 20 matches, the club's team won 14. Use this form to estimate the probability that the team wins its next match, as a percentage. 1 mark

c. Give one reason why this estimate might not be reliable. 1 mark

d. At the club's 5-day carnival, the weather forecast gives a 30 % chance of rain on each day. Find the expected number of wet days over the 5 days. 1 mark

Question 7 (5 marks)

A bookmaker offers these decimal odds for a football match: home team win, 2.00; draw, 3.20; away team win, 4.00. The implied probability of an outcome is $1 \div \text{odds}$.

- a.** Find the implied probability of each of the three outcomes, as a percentage. 2 marks

- b.** Find the sum of the three implied probabilities. 1 mark

- c.** Explain what the sum in part b tells you about the odds the bookmaker is offering. 1 mark

- d.** Find the bookmaker's margin, in percentage points. 1 mark

End of Test B

Test B — Answers

Q1. a. 5 hours b. 2 breaks; 30 minutes in total c. 5 hours 30 minutes d. 10:00

Q2. a. \$ 800 b. \$ 680 c. Yes — the gap from \$ 800 to \$ 1850 is \$ 1050, far bigger than any other gap (at most \$ 50)
d. Misleading: the mean is pulled up by the owner's wage; 7 of the 9 workers earn less than \$ 800, so the median, \$ 680, better describes a typical wage

Q3. a. \$ 2800 b. surplus; \$ 440 c. 5 months ($2000 \div 440 = 4.545\dots$; after 4 months Jen has only \$ 1760, so a 5th month is needed) d. \$ 1300

Q4. a. 2800 residents per GP b. 7 GPs c. 4 more GPs d. 1 hour 15 minutes

Q5. a. 45 person-hours b. 30 person-hours c. 33.3 % d. 3 workers missing; the warden reports the missing people to the person in charge (or emergency services) so a search can start

Q6. a. $\frac{1}{50}$; 2 % b. 70 % c. for example, 20 matches is a small sample, or the next match may be against a stronger team d. 1.5 days

Q7. a. 50 %; 31.25 %; 25 % b. 106.25 % c. the sum is over 100 %, so the odds include a margin for the bookmaker — in the long run, punters get back less than a fair bet d. 6.25 percentage points

Test B — Fully-worked solutions

Question 1.

- a. Time = distance $\div$ speed = $330 \div 66 = 5$ **hours**.
- b. Breaks come after 2 hours and after 4 hours of driving. The next break would fall at the 6-hour mark, which is after arrival, so it is not taken: 2 **breaks**, which is $2 \times 15 = 30$ **minutes** of break time.
- c. Total time = 5 hours + 30 minutes = 5 **hours 30 minutes**.
- d. Work backwards from the arrival time: 5 hours 30 minutes before 15:30 is 10:00. The latest departure time is **10:00**. Check: leave at 10:00, drive 2 hours to 12:00, break to 12:15, drive 2 hours to 14:15, break to 14:30, drive 1 hour to 15:30 — arrival is exactly on time.

Question 2.

- a. Sum = $550 + 600 + 620 + 650 + 680 + 700 + 750 + 800 + 1850 = 7200$. Mean = $7200 \div 9 = \$800$.
- b. With $n = 9$, the median is the middle (5th) value in the ordered list: \$680.
- c. **Yes, it is an outlier.** The gap from the next wage up (\$800) to \$1850 is \$1050. Every other gap in the list is at most \$50. A value separated from the rest of the data by a gap this large is an outlier.
- d. The claim uses the **mean**, which the \$1850 outlier pulls up: 7 of the 9 workers earn **less** than \$800. The **median**, \$680, sits among the wages most workers actually earn, so it is the better measure of a “typical” wage. The owner’s statement is true of the mean but **misleading** as a description of typical pay.

Question 3.

- a. Total expenses = $1250 + 560 + 245 + 95 + 180 + 150 + 320 = \$2800$.
- b. Income – expenses = $3240 - 2800 = \$440$. Income is greater than expenses, so Jen’s budget is in **surplus** by \$440 each month.
- c. $2000 \div 440 = 4.545\dots$ After 4 months Jen has saved only $4 \times 440 = \$1760$ — short of the \$2000 goal — so she must save for a 5th month ($5 \times 440 = \$2200$). Rounding **up** to 5 **months** is needed because a part-month of saving still has to happen.
- d. New rent = $1250 \times 1.04 = \$1300$ per month.

Question 4.

- a. $8400 \div 3 = 2800$ **residents per GP** — more than double the recommended load.
- b. $8400 \div 1200 = 7$ **GPs** are needed to meet the guide.
- c. $7 - 3 = 4$ **more GPs**.
- d. Time = distance $\div$ speed = $75 \div 60 = 1.25$ hours. 0.25 of an hour is 15 minutes, so the trip takes 1 **hour 15 minutes**.

Question 5.

a. Person-hours = workers $\times$ hours each = $6 \times 7.5 = 45$ **person-hours**.

b. $5 \times 6 = 30$ **person-hours**.

c. Decrease = $45 - 30 = 15$ person-hours. Percentage decrease = $\frac{15}{45} \times 100 = 33.333\ldots\%$; correct to one decimal place: 33.3%.

d. Missing = expected – counted = $38 - 35 = 3$ **workers**. The warden **reports the 3 missing people to the person in charge** (or the emergency services) straight away so a search can start — a roll call is not finished until everyone is accounted for.

Question 6.

a. Chance = $\frac{8}{400}$. Divide top and bottom by the HCF, 8: $\frac{1}{50}$. As a percentage: $\frac{1}{50} \times 100 = 2\%$.

b. $P(\text{win}) = \frac{14}{20} = 0.7 = 70\%$.

c. Any one reason is enough, for example: 20 matches is a **small sample**, so the estimate can swing a long way; the next match may be against a **stronger team** (such as in a final); or players, conditions or venues may have **changed**, so past form may not carry over.

d. Expected wet days = $p \times \text{days} = 0.30 \times 5 = 1.5$ **days**.

Question 7.

a. Home win: $1 \div 2.00 = 0.5 = 50\%$. Draw: $1 \div 3.20 = 0.3125 = 31.25\%$. Away win: $1 \div 4.00 = 0.25 = 25\%$.

b. Sum = $50 + 31.25 + 25 = 106.25\%$.

c. For fair odds covering every outcome, the implied probabilities would add to exactly 100%. Adding to **more than** 100% shows the bookmaker has built in a **margin**: whatever the result, the bookmaker expects to keep part of the money bet, so in the long run punters are paid back less than a fair bet would pay.

d. Margin = $106.25 - 100 = 6.25$ **percentage points**.