GCSE MATHEMATICS

HIGHER TIER

COMPREHENSIVE LESSON NOTEBOOK

UNIT 6 | STATISTICS

TEACH-FROM-SCRATCH • FREE WEBSITE EDITION

18 detailed chapters • original diagrams • worked examples • guided practice • answers

Student: _____ Target grade: _____

START HERE

STUDY ROUTINE

How to learn from this notebook

Meaning first. Method second. Practice third.

THE FIVE-PASS ROUTINE

1 Read the key idea without a calculator. 2 Cover each solution and reproduce it. 3 Complete the practice independently. 4 Mark in a different colour and repair errors. 5 Retest after 2–7 days.

What a complete mathematics answer contains

- A clear model or calculation, not only a calculator display.
- Enough working for another person to follow the reasoning.
- Exact values until approximation is requested.
- Units and sensible rounding in context.
- A final sentence when the result must be interpreted.

Error log

REPAIR, DO NOT MERELY CORRECT

Label each error: concept, operation, arithmetic, calculator entry, accuracy, unit or interpretation. Write the corrected step and one sentence explaining the change.

Higher statistics requires critical interpretation

Higher Tier rewards secure fluency and connected reasoning. Grade 4–5 questions often combine several familiar skills, hide the required operation inside a context, or ask whether an answer is reasonable. The notebook therefore explains why methods work as well as how to use them.

SPECIFICATION MAP

PEARSON EDEXCEL 1MA1

Unit 6 coverage map

Statistics content organised into a teachable sequence.

CH 01	S1	Populations, samples and reliable data collection
CH 02	S2, S4	Frequency tables, tally charts and two-way tables
CH 03	S2	Pictograms, bar charts and comparative charts
CH 04	S2	Pie charts and proportional representation
CH 05	S4	Mean, median, mode and range
CH 06	S4, S5	Frequency distributions and weighted means
CH 07	S4, S5	Grouped data and estimated averages
CH 08	S2, S4, S5	Stem-and-leaf diagrams and comparing distributions
CH 09	S2, S6	Scatter graphs, correlation and lines of best fit
CH 10	S2, S5, S6	Time series, misleading graphs and statistical conclusions
CH 11	S2, S4	Data types, chart choice and vertical line charts
CH 12	S3	Histograms and frequency density
CH 13	S3, S4	Cumulative frequency curves and percentile estimates
CH 14	S3, S4	Box plots, quartiles and interquartile range
CH 15	S4, S5	Comparing distributions and evaluating summaries
CH 16	S1, S5	Capture-recapture and population estimation
CH 17	S3, S4, S5	Grouped-data interpolation and advanced estimates
CH 18	S1-S6 synthesis	Higher statistical investigation and critical conclusions

IMPORTANT TIER NOTE

This notebook follows the complete Higher Tier content identified in the Pearson Edexcel GCSE Mathematics (1MA1) specification. Shared foundations and Higher-only histogram, cumulative-frequency and box-plot content are integrated into the sequence.

REFERENCE

STATISTICS FACTS AND METHODS

Fast-reference method bank

Understand each formula before memorising it.

Stratified allocation	subgroup/total × sample size
Mean	sum of values ÷ number of values
Frequency-table mean	$\Sigma fx \div \Sigma f$
Grouped midpoint	(lower+upper)/2
Estimated grouped mean	$\Sigma(f \times \text{midpoint}) \div \Sigma f$
Range	maximum−minimum
Pie-chart angle	frequency/total × 360°
Pie-chart frequency	angle/360° × total
Percentage change	change/original × 100%
Best-fit gradient	vertical change ÷ horizontal change

CHAPTER 01 • S1

S1

Populations, samples and reliable data collection

A useful conclusion begins with a well-defined question and representative evidence.

SPECIFICATION FOCUS

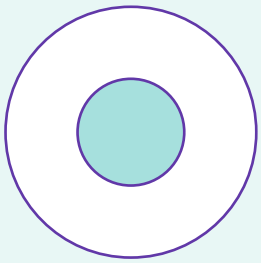
Pearson Edexcel content references S1. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A population is the entire group of interest; a sample is the part actually observed. A census studies every member. Sampling saves time and cost, but a biased method systematically over-represents some responses. Random selection gives each population member a known fair chance, while stratified sampling preserves important subgroup proportions.

KEY VOCABULARY

population • census • sample • sampling frame • random • systematic • stratified • bias • representative



population

sample

representative selection matters

Why the method works

- A large biased sample can be less useful than a smaller representative sample.
- Random sampling reduces selection bias when the sampling frame is complete.
- Stratified allocation=subgroup size/total population×sample size.
- Question wording, non-response and collection time can bias results after selection.

CHECK BEFORE MOVING ON

Answer mentally: 1) State population for survey of Year 11 travel. 2) Name study of every population member. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 01 • S1 • METHODS

S1

Populations, samples and reliable data collection — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Define the target population and the variable to measure.
- Choose a sampling frame covering that population.
- Select a random, systematic or stratified method and justify it.
- Identify practical limitations and avoid leading questions.

WORKED EXAMPLE 1

A school has 480 pupils: 300 lower school and 180 upper school. Stratified sample size 80. Find upper-school allocation.

1. Allocation=180/480×80.

ANSWER: 30 pupils

WORKED EXAMPLE 2

Critique asking gym members whether the town exercises enough.

1. Gym members are more likely to exercise than the town population.

ANSWER: Biased sampling frame

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Find 20th item after random start 7, step 13. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 01 • S1 • APPLICATION

S1

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Retailers sample customers to estimate satisfaction. Surveying only customers who made a complaint exaggerates dissatisfaction; surveying only loyalty-card users may omit occasional shoppers.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain why sample size alone cannot remove bias. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 01 • S1 • PRACTICE

S1

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **State population for survey of Year 11 travel.**

2. **Name study of every population member.**

3. **Find 20th item after random start 7, step 13.**

4. **Stratify 120 of 600 from subgroup 150.**

5. **Give one benefit of random sampling.**

6. **Identify bias in online voluntary poll.**

7. **Rewrite “Don’t you agree lessons are too long?” neutrally.**

8. **Explain why sample size alone cannot remove bias.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 02 • S2, S4

S2, S4

Frequency tables, tally charts and two-way tables

Organise raw observations so totals and comparisons become visible.

SPECIFICATION FOCUS

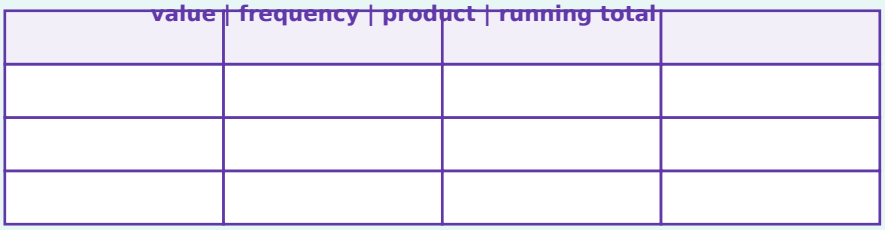
Pearson Edexcel content references S2, S4. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A tally records each observation once; the frequency is the completed count. A frequency table groups identical values or categories. Two-way tables classify the same individuals by two variables and include row, column and grand totals. Missing cells are found by subtraction, but every marginal total must remain consistent.

KEY VOCABULARY

tally • frequency • category • discrete • two-way table • row total • column total • grand total



Why the method works

- Tally groups of five support accurate counting and checking.
- The sum of frequencies equals the number of observations.
- Rows and columns in a two-way table describe the same grand total.
- A modal category is the category with greatest frequency.

CHECK BEFORE MOVING ON

Answer mentally: 1) Sum frequencies 6,11,8,5. 2) Mode category frequencies A4,B9,C7. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 02 • S2, S4 • METHODS

S2, S4

Frequency tables, tally charts and two-way tables — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Choose non-overlapping categories covering every possible response.
- Tally each raw value once.
- Add frequencies and verify against the data count.
- For a two-way table, complete inner cells before marginal totals.

WORKED EXAMPLE 1

Frequencies 4,7,9,5. Find total and modal position.

1. Total=4+7+9+5=25.
2. Greatest frequency is 9, the third category.

ANSWER: 25; third category

WORKED EXAMPLE 2

60 pupils: 28 boys, 35 bus users, 16 boys use bus. Find girls not using bus.

1. Girls=32; girls using bus=35−16=19.
2. Girls not bus=32−19.

ANSWER: 13

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Total 50,male 23: female. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 02 • S2, S4 • APPLICATION

S2, S4

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Transport planners cross-classify travel mode by age group. A complete two-way table distinguishes a large category because the population is large from a high proportion within that category.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

State one check on two-way table. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 02 • S2, S4 • PRACTICE

S2, S4

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Sum frequencies 6,11,8,5.**

2. **Mode category frequencies A4,B9,C7.**

3. **Total 50,male 23: female.**

4. **Total 80,yes 46,male yes 21: female yes.**

5. **Female total 44,female yes 25: female no.**

6. **Row entries 12,x,total 31: x.**

7. **Why must categories not overlap?**

8. **State one check on two-way table.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 03 • S2 S2

Pictograms, bar charts and comparative charts

Match the display to the data and read the scale before the bar.

SPECIFICATION FOCUS

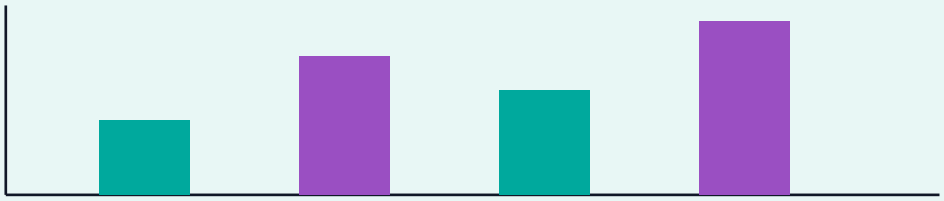
Pearson Edexcel content references S2. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Pictograms use repeated symbols with a stated key; partial symbols represent corresponding fractions of the key. Bar charts display discrete or categorical data with separated equal-width bars. Comparative bar charts place corresponding groups together using a common scale. Bar height represents frequency, not visual area created by decorative width.

KEY VOCABULARY

pictogram • key • bar chart • discrete • category • comparative • axis • scale



equal scale, equal widths, separated categories

Why the method works

- A pictogram symbol has no numerical meaning without its key.
- Separated bars signal distinct categories rather than continuous intervals.
- Equal vertical scales are essential for honest visual comparison.
- The vertical axis should normally begin at zero for bar-length comparison.

CHECK BEFORE MOVING ON

Answer mentally: 1) Key icon=6; 4 icons. 2) Key icon=10; 2.5 icons. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 03 • S2 • METHODS

S2

Pictograms, bar charts and comparative charts — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Read the title, axes, units and pictogram key.
- Determine the value of one small grid interval.
- Read bar height from the numbered scale, not by appearance.
- Calculate differences or totals only after extracting exact values.

WORKED EXAMPLE 1

A pictogram key says one icon=8 pupils. A row has 3.5 icons. Find frequency.

1. 3.5×8=28.

ANSWER: 28 pupils

WORKED EXAMPLE 2

Bar heights for A and B are 42 and 57. Find percentage increase A to B.

1. Increase=15.
2. 15/42×100=35.714...%.

ANSWER: 35.7%

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Bars 18,25,21: total. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 03 • S2 • APPLICATION

S2

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

A company comparing monthly complaints should keep a common scale across branches. A truncated axis may be suitable for locating precise values in a line graph, but can exaggerate bar-length differences.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain danger of vertical axis starting 95 for values 98 and 100. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 03 • S2 • PRACTICE

S2

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Key icon=6; 4 icons.**

2. **Key icon=10; 2.5 icons.**

3. **Bars 18,25,21: total.**

4. **Difference between 46 and 29.**

5. **Increase 30 to 39: percentage.**

6. **Why gaps between categorical bars?**

7. **Name chart for two groups across same categories.**

8. **Explain danger of vertical axis starting 95 for values 98 and 100.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 04 • S2

S2

Pie charts and proportional representation

Translate between frequency, fraction, percentage and central angle.

SPECIFICATION FOCUS

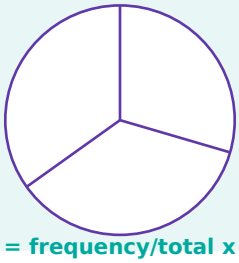
Pearson Edexcel content references S2. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A pie chart represents a whole data set by 360 degrees. Each sector angle is proportional to category frequency. Sector angle=frequency/total×360; reversing gives frequency=angle/360×total. Pie charts compare proportions effectively, but sector sizes alone do not reveal the sample total.

KEY VOCABULARY

sector • angle • proportion • frequency • total • percentage • radius



sector angle = frequency/total x 360 degrees

Why the method works

- The complete circle is one whole: 360° and 100%.
- Equal frequencies create equal sector angles.
- A sector fraction angle/360 equals its data fraction frequency/total.
- Two equally shaped pie charts may represent very different sample sizes.

CHECK BEFORE MOVING ON

Answer mentally: 1) Frequency 25 of 100: angle. 2) Frequency 14 of 60: angle. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 04 • S2 • METHODS

S2

Pie charts and proportional representation — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Find the total frequency.
- Calculate angle per item as 360÷total when convenient.
- Multiply by category frequency and check sector angles total 360°.
- Use a protractor from a common centre and label sectors clearly.

WORKED EXAMPLE 1

In 120 responses, 35 choose A. Find sector angle.

1. Angle=35/120×360.

ANSWER: 105°

WORKED EXAMPLE 2

A 72° sector represents 18 people. Find total.

1. 72/360=1/5 of total.
2. Total=18×5.

ANSWER: 90

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

90° sector: percentage. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 04 • S2 • APPLICATION

S2

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Election reports use pie charts to show vote share. Comparing the number of voters requires both sector proportion and total turnout; a larger angle in a smaller sample can still represent fewer people.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain why sector angles total 360°. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 04 • S2 • PRACTICE

S2

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Frequency 25 of 100: angle.**

2. **Frequency 14 of 60: angle.**

3. **90° sector: percentage.**

4. **144° sector of total 250: frequency.**

5. **Angles 80°,120°,x: find x.**

6. **Total 72: angle per person.**

7. **Can two equal pie sectors prove equal frequencies across different charts?**

8. **Explain why sector angles total 360°.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 05 • S4

S4

Mean, median, mode and range

Choose an average for the question, then pair it with a measure of spread.

SPECIFICATION FOCUS

Pearson Edexcel content references S4. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

The mean shares the total equally across all values. The median is the central value after ordering, the mode is the most frequent value, and the range measures total spread from minimum to maximum. Each summary loses detail. Extreme values strongly affect mean and range but may leave median and mode unchanged.

KEY VOCABULARY

mean • median • mode • range • outlier • average • spread

median 5 | mode 5 | mean 8 | range 17

Why the method works

- Mean=sum of values÷number of values.
- Median requires ordered data and uses the mean of two middle values when the count is even.
- Mode may be absent or have more than one value.
- Range=maximum−minimum and describes spread, not typical value.

CHECK BEFORE MOVING ON

Answer mentally: 1) Mean of 4,7,9,10. 2) Median of 2,5,8,11,14. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 05 • S4 • METHODS

S4

Mean, median, mode and range — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Order the data before finding median, mode or range.
- Count observations carefully.
- For mean, calculate the total then divide by count.
- Interpret average and spread together in the original units.

WORKED EXAMPLE 1

Find summaries for 3,5,5,7,20.

1. Sum=40, count=5, mean=8.
2. Median=5, mode=5, range=17.

ANSWER: mean 8; median 5; mode 5; range 17

WORKED EXAMPLE 2

Five values have mean 12. Four total 43. Find fifth.

1. Required total=5×12=60.
2. Missing=60−43.

ANSWER: 17

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Median of 3,6,9,12. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 05 • S4 • APPLICATION

S4

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

For salaries with one extremely high value, median may better describe a typical worker. Mean remains valuable when every value should contribute, such as total resource use per person.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain outlier effect on mean. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 05 • S4 • PRACTICE

S4

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Mean of 4,7,9,10.**

2. **Median of 2,5,8,11,14.**

3. **Median of 3,6,9,12.**

4. **Mode of 1,2,2,3,3.**

5. **Range of −4,3,11.**

6. **Six values mean 8: total.**

7. **Mean 10 for 5 values; four sum 37: missing.**

8. **Explain outlier effect on mean.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 06 • S4-S5

S4, S5

Frequency distributions and weighted means

Multiply each value by its frequency before sharing the complete total.

SPECIFICATION FOCUS

Pearson Edexcel content references S4, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

In a frequency table, each value occurs several times. The data total is Σfx and the number of observations is Σf, so mean=Σfx/Σf. This is a weighted mean: values with larger frequencies contribute more. Median position is located using cumulative frequency through the table, while mode is the value with greatest frequency.

KEY VOCABULARY

frequency distribution • weighted mean • Σfx • cumulative frequency • median position

value	frequency	product	running total

Why the method works

- Multiplying x by f reconstructs the contribution of repeated values.
- Σf counts observations, not distinct table rows.
- Median positions refer to ordered observations and are located by running totals.
- The modal value corresponds to maximum frequency.

CHECK BEFORE MOVING ON

Answer mentally: 1) x 1,2,3; f 4,3,3: mean. 2) x 2,4,6; f 1,5,4: Σfx. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 06 • S4-S5 • METHODS

S4, S5

Frequency distributions and weighted means — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Create columns for x, f and fx.
- Add Σf and Σfx independently.
- Divide Σfx by Σf for the mean.
- Use cumulative frequency to locate middle observation(s).

WORKED EXAMPLE 1

Values 1,2,3 with frequencies 2,5,3. Find mean.

1. Σf=10.
2. Σfx=2+10+9=21.
3. Mean=21/10.

ANSWER: 2.1

WORKED EXAMPLE 2

Scores 0,1,2,3 have frequencies 1,4,6,3. Find mode and median.

1. Mode=2.
2. There are 14 values; 7th and 8th both lie in score 2.

ANSWER: mode 2; median 2

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Previous table: mean. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 06 • S4-S5 • APPLICATION

S4, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

A star-rating average is weighted: one-star and five-star ratings contribute according to their frequencies. Averaging the category labels without frequencies would answer a different question.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

State check for calculated mean. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 06 • S4-S5 • PRACTICE

S4, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **x 1,2,3; f 4,3,3: mean.**

2. **x 2,4,6; f 1,5,4: Σfx.**

3. **Previous table: mean.**

4. **Frequencies 2,7,5: modal position.**

5. **Total frequency 25: median observation position.**

6. **Eight values mean 6.5: Σfx.**

7. **Why not divide Σfx by number of rows?**

8. **State check for calculated mean.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 07 • S4-S5

S4, S5

Grouped data and estimated averages

A class interval hides individual values, so use midpoints and label the result an estimate.

SPECIFICATION FOCUS

Pearson Edexcel content references S4, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Grouped data record how many observations lie inside intervals. The exact values are unavailable. The modal class has greatest frequency. An estimated mean replaces every observation in a class by its midpoint, then calculates Σ(f×midpoint)/Σf. The estimate may differ from the true mean because values need not cluster at midpoints.

KEY VOCABULARY

class interval • boundary • midpoint • grouped frequency • modal class • estimated mean

value	frequency	product	running total	

Why the method works

- Class midpoint=(lower boundary+upper boundary)/2.
- Midpoint multiplication estimates a class total.
- The modal class is an interval, not necessarily a single mode.
- Non-overlapping intervals must assign boundary values unambiguously.

CHECK BEFORE MOVING ON

Answer mentally: 1) Midpoint of $20<x\leq30$. 2) Midpoint of $1.5\leq x<2.5$. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 07 • S4-S5 • METHODS

S4, S5

Grouped data and estimated averages — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- List each class midpoint.
- Multiply midpoint by class frequency.
- Add estimated totals and divide by total frequency.
- Write “estimated mean” and appropriate units.

WORKED EXAMPLE 1

Classes 0–10,10–20,20–30 have frequencies 3,5,2. Estimate mean using midpoints 5,15,25.

1. Σfm=15+75+50=140; Σf=10.
2. Estimate=140/10.

ANSWER: 14

WORKED EXAMPLE 2

Frequencies 4,9,7 across increasing classes. State modal class position.

1. Greatest frequency is 9.

ANSWER: second class

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Class frequencies 3,8,6: modal position. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 07 • S4-S5 • APPLICATION

S4, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Travel times grouped into 10-minute intervals support quick summaries, but midpoint estimates can hide clustering near one boundary. Retaining raw data gives more precise statistics.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Give one requirement for class intervals. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 07 • S4-S5 • PRACTICE

S4, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Midpoint of $20<x\leq 30$.**

2. **Midpoint of $1.5\leq x<2.5$.**

3. **Class frequencies 3,8,6: modal position.**

4. **Midpoints 5,15; frequencies 4,6: estimated mean.**

5. **Midpoints 10,30,50; f 2,5,3: Σfm.**

6. **Previous: estimated mean.**

7. **Why is grouped mean estimated?**

8. **Give one requirement for class intervals.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 08 • S2, S4-S5

S2, S4, S5

Stem-and-leaf diagrams and comparing distributions

Preserve individual values while displaying shape, centre and spread.

SPECIFICATION FOCUS

Pearson Edexcel content references S2, S4, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A stem-and-leaf diagram splits each ordered value into a stem and leaf while retaining the original data. A key defines place value. Back-to-back diagrams compare two groups using a shared stem. Meaningful comparison needs both location, such as median, and spread, such as range, stated in context.

KEY VOCABULARY

stem • leaf • key • ordered • back-to-back • distribution • consistency

1	2 5 5
2	1 4

key: 1 | 2 means 12

Why the method works

- Every leaf represents one observation, including repeated values.
- A key such as 2|7=27 defines the scale.
- Leaves are ordered away from the stem as specified.
- Comparing only medians ignores consistency; comparing only ranges ignores typical size.

CHECK BEFORE MOVING ON

Answer mentally: 1) Read 3|7 if key 3|7=37. 2) Leaves 1,4,4,9: frequency. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 08 • S2, S4-S5 • METHODS

S2, S4, S5

Stem-and-leaf diagrams and comparing distributions — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Write a key before entering data.
- Place each value on its correct stem.
- Order leaves and count against the original data.
- Calculate and compare a typical value and spread.

WORKED EXAMPLE 1

Data 12,15,15,21,24. Write stems.

1. Stem 1 leaves 2,5,5; stem 2 leaves 1,4.

ANSWER: 1|255 and 2|14

WORKED EXAMPLE 2

Group A median 18 range 7; B median 21 range 14. Compare.

1. B has higher typical value; A has smaller spread.

ANSWER: B higher; A more consistent

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Data 8,11,13: range. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 08 • S2, S4-S5 • APPLICATION

S2, S4, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Sports performance is compared using centre and spread. A player with higher median but much larger range may perform better typically yet less consistently.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Write a complete comparison sentence using median and range. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 08 • S2, S4-S5 • PRACTICE

S2, S4, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Read 3|7 if key 3|7=37.**

2. **Leaves 1,4,4,9: frequency.**

3. **Data 8,11,13: range.**

4. **Ordered 12,15,17,20,22: median.**

5. **A median 50,B 46: typical comparison.**

6. **A range 9,B 15: consistency.**

7. **Why include a key?**

8. **Write a complete comparison sentence using median and range.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 09 • S2, S6

S2, S6

Scatter graphs, correlation and lines of best fit

Describe association without claiming that one variable causes the other.

SPECIFICATION FOCUS

Pearson Edexcel content references S2, S6. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A scatter graph plots paired values for two variables. Positive correlation trends upward, negative correlation downward, and no correlation shows no clear direction. A line of best fit passes through the centre of the pattern with roughly balanced points and supports approximate predictions. Interpolation is within the observed range; extrapolation is less reliable.

KEY VOCABULARY

bivariate • scatter graph • positive • negative • correlation • outlier • line of best fit • interpolation

Why the method works

- Each point represents one paired observation.
- Correlation describes direction and strength of association.
- A line of best fit models the overall pattern rather than joining points.
- Correlation does not prove causation because other variables or coincidence may explain it.

CHECK BEFORE MOVING ON

Answer mentally: 1) Name correlation for points rising left to right. 2) Name correlation falling left to right. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 09 • S2, S6 • METHODS

S2, S6

Scatter graphs, correlation and lines of best fit — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Label both axes with variable and units.
- Plot every coordinate accurately.
- Describe direction and strength and mention outliers.
- Use the best-fit line only across a sensible data range.

WORKED EXAMPLE 1

A best-fit line passes through (2,15) and (8,39). Find gradient.

1. Gradient=(39−15)/(8−2)=24/6.

ANSWER: 4

WORKED EXAMPLE 2

Ice-cream sales and temperature show positive correlation. Does heat cause every sale?

1. Association alone cannot prove causation.

ANSWER: No

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

What is an outlier? First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 09 • S2, S6 • APPLICATION

S2, S6

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Health studies often report correlations. Age, income or behaviour may be confounding variables, so evidence beyond a scatter plot is needed to support a causal claim.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain why correlation does not prove causation. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 09 • S2, S6 • PRACTICE

S2, S6

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Name correlation for points rising left to right.**

2. **Name correlation falling left to right.**

3. **What is an outlier?**

4. **Prediction inside data range is called?**

5. **Prediction outside range is called?**

6. **Why not join every scatter point?**

7. **Gradient from (1,6),(5,18).**

8. **Explain why correlation does not prove causation.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 10 • S2, S5-S6

S2, S5, S6

Time series, misleading graphs and statistical conclusions

Read trends critically and connect every conclusion to the evidence.

SPECIFICATION FOCUS

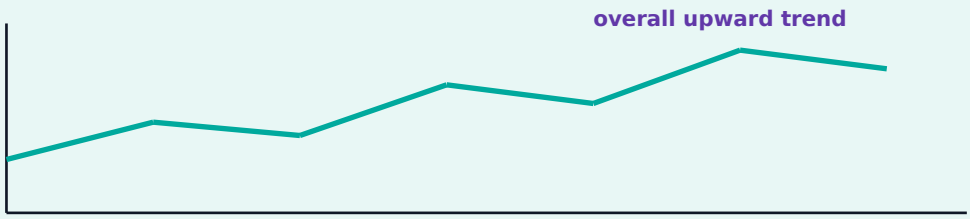
Pearson Edexcel content references S2, S5, S6. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A time series plots a variable in chronological order. A trend is the overall direction; seasonal or cyclic effects repeat; random fluctuations are shorter irregular changes. Graph design affects perception: truncated axes, unequal intervals, pictorial area and selective time windows can distort comparisons. A responsible conclusion considers source, sample, scale and uncertainty.

KEY VOCABULARY

time series • trend • seasonal • fluctuation • axis break • misleading • inference • reliability



Why the method works

- Joining time-series points shows chronological change, unlike a scatter graph.
- Trend concerns overall movement, not every local rise or fall.
- Equal horizontal distances must represent equal time intervals.
- Statistical evidence supports qualified conclusions rather than certainty about individuals.

CHECK BEFORE MOVING ON

Answer mentally: 1) Values 80 to 92: absolute increase. 2) Same values: percentage increase. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 10 • S2, S5-S6 • METHODS

S2, S5, S6

Time series, misleading graphs and statistical conclusions — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Read title, source, axes, units and interval.
- Describe overall trend, repeated pattern and unusual points separately.
- Calculate absolute or percentage change when comparison is required.
- Evaluate sampling, display choices and whether the conclusion overreaches.

WORKED EXAMPLE 1

Sales rise from 240 to 300. Find percentage increase.

1. Increase=60.
2. 60/240×100.

ANSWER: 25%

WORKED EXAMPLE 2

A bar axis begins at 980 and compares 990 with 1000. Explain risk.

1. The 10-unit difference occupies a large visual fraction.

ANSWER: Difference is exaggerated

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Name overall long-term direction. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 10 • S2, S5-S6 • APPLICATION

S2, S5, S6

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Energy demand data show seasonal peaks in winter. Planning should use several years because one unusual winter may not represent the repeating pattern.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Write cautious conclusion for sample mean higher than another. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 10 • S2, S5-S6 • PRACTICE

S2, S5, S6

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Values 80 to 92: absolute increase.**

2. **Same values: percentage increase.**

3. **Name overall long-term direction.**

4. **Name repeating annual pattern.**

5. **Why equal time spacing?**

6. **State issue with 3D pictogram doubled in height and width.**

7. **Give one question about data source.**

8. **Write cautious conclusion for sample mean higher than another.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 11 • S2, S4

S2, S4

Data types, chart choice and vertical line charts

The variable type determines which display communicates it honestly.

SPECIFICATION FOCUS

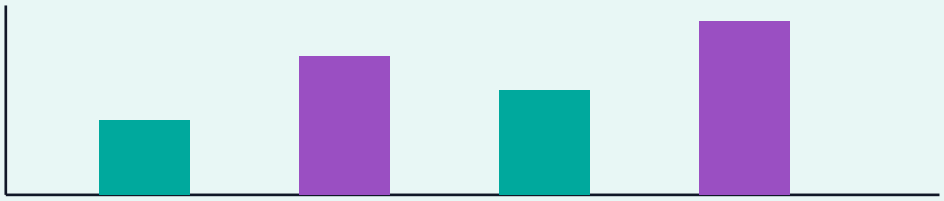
Pearson Edexcel content references S2, S4. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Categorical data use labels; numerical data use numbers. Discrete numerical data take separate countable values, while continuous data can take any value within a measurement interval. A vertical line chart represents ungrouped discrete data with a thin line above each value. Continuous or grouped data require intervals and should not be shown as isolated categories.

KEY VOCABULARY

categorical • numerical • discrete • continuous • grouped • vertical line chart • frequency



equal scale, equal widths, separated categories

Why the method works

- A count such as number of siblings is discrete.
- A measurement such as height is continuous even if recorded to the nearest unit.
- Vertical line charts preserve the numerical spacing between discrete values.
- A chart is appropriate only when its axis structure matches the data type.

CHECK BEFORE MOVING ON

Answer mentally: 1) Classify eye colour. 2) Classify number of pets. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 11 • S2, S4 • METHODS

S2, S4

Data types, chart choice and vertical line charts — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Identify the variable and its data type.
- Choose categories, separate numerical values or intervals.
- Label axes with variable, frequency and units.
- Check that spacing and total frequency are accurate.

WORKED EXAMPLE 1

Classify number of goals in a match.

1. Only whole-number counts are possible.

ANSWER: discrete numerical

WORKED EXAMPLE 2

Values 0,1,2,3 have frequencies 2,5,7,4. What is plotted above x=2?

1. The vertical line height equals its frequency.

ANSWER: 7

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Classify exact mass. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 11 • S2, S4 • APPLICATION

S2, S4

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

A transport survey may record categorical travel mode, discrete number of journeys and continuous journey time. Each requires a different display.

Common mistakes and how to repair them

MISTAKE 1

Using joined line segments for unrelated categories. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Calling rounded height discrete because the record is a whole number. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Spacing numerical values equally when their actual gaps differ. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

State one essential axis label. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 11 • S2, S4 • PRACTICE

S2, S4

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Classify eye colour.**

2. **Classify number of pets.**

3. **Classify exact mass.**

4. **Best display for ungrouped discrete frequencies.**

5. **At x=4 frequency 9: line height.**

6. **Should bars touch for categorical data?**

7. **Why is measured time continuous?**

8. **State one essential axis label.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 12 • S3

S3

Histograms and frequency density

Make bar area represent frequency when class widths are unequal.

SPECIFICATION FOCUS

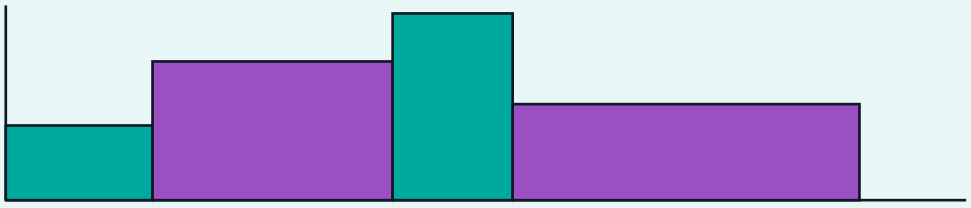
Pearson Edexcel content references S3. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A histogram represents grouped continuous data. Class boundaries touch because the measurement scale is continuous. The area of each bar, not its height alone, is proportional to frequency. Frequency density=frequency/class width, so frequency=class width×frequency density. Unequal class widths make density essential: a wide class can contain more observations even with a lower bar.

KEY VOCABULARY

histogram • class boundary • class width • frequency density • bar area • continuous data



bar area = class width x frequency density = frequency

Why the method works

- Frequency density=frequency divided by class width.
- Bar area=class width×frequency density=frequency.
- Histogram bars touch at true class boundaries.
- The tallest bar identifies greatest density, not necessarily greatest frequency.

CHECK BEFORE MOVING ON

Answer mentally: 1) Width5,frequency30:density. 2) Width12,density2.5:frequency. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 12 • S3 • METHODS

S3

Histograms and frequency density — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Write exact class boundaries and widths.
- Calculate density for every class.
- Use a numerical horizontal scale and density vertical scale.
- Recover missing frequencies from bar areas.

WORKED EXAMPLE 1

Class $10<x\leq20$ has frequency 35. Find density.

1. Class width=10.
2. Density=35/10.

ANSWER: 3.5

WORKED EXAMPLE 2

A histogram bar covers width 8 with density 2.75. Find frequency.

1. Frequency=area=8×2.75.

ANSWER: 22

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Class20-35:width. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 12 • S3 • APPLICATION

S3

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Transport and manufacturing measurements often use unequal intervals. Density prevents wide intervals from looking important merely because they occupy more horizontal space.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Explain area meaning. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 12 • S3 • PRACTICE

S3

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Width5,frequency30:density.**

2. **Width12,density2.5:frequency.**

3. **Class20-35:width.**

4. **Densities4 and3,widths5 and8:larger frequency.**

5. **Why bars touch?**

6. **Why not compare heights only?**

7. **State vertical-axis label.**

8. **Explain area meaning.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 13 • S3-S4

S3, S4

Cumulative frequency curves and percentile estimates

Accumulate frequencies at upper class boundaries and read positions from the total.

SPECIFICATION FOCUS

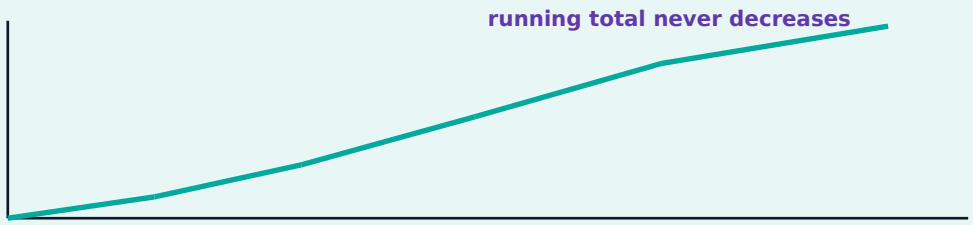
Pearson Edexcel content references S3, S4. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Cumulative frequency is the number of observations at or below a boundary. A cumulative-frequency graph plots running totals against upper class boundaries, beginning at the lowest boundary with cumulative frequency zero. For n observations, the median is read near n/2, lower quartile near n/4 and upper quartile near 3n/4. Values read from a grouped curve are estimates.

KEY VOCABULARY

cumulative frequency • upper boundary • median • quartile • percentile • interpolation



Why the method works

- Running totals never decrease.
- Points use upper class boundaries because the total includes the completed class.
- Median and quartile levels are fractions of total frequency.
- Graph readings are estimates within grouped intervals.

CHECK BEFORE MOVING ON

Answer mentally: 1) Frequencies3,8,6,3:cumulative totals. 2) Total120:median position. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 13 • S3-S4 • METHODS

S3, S4

Cumulative frequency curves and percentile estimates — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Build a running-total column.
- Plot lowest boundary at zero and each upper boundary at its cumulative total.
- Read horizontally from the required cumulative position to the curve.
- Drop vertically to estimate the data value.

WORKED EXAMPLE 1

Frequencies 4,7,9,5. Find cumulative totals.

1. Add successively.

ANSWER: 4,11,20,25

WORKED EXAMPLE 2

A curve represents 80 values. State cumulative positions for Q1,median,Q3.

1. Use n/4,n/2,3n/4.

ANSWER: 20,40,60

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Total120:Q1 position. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 13 • S3-S4 • APPLICATION

S3, S4

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Delivery-time percentiles help organisations set service targets, but grouped estimates should not be reported with false precision.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Why quartiles are estimates. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 13 • S3-S4 • PRACTICE

S3, S4

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Frequencies3,8,6,3:cumulative totals.**

2. **Total120:median position.**

3. **Total120:Q1 position.**

4. **Total120:Q3 position.**

5. **Why plot upper boundary?**

6. **Can curve decrease?**

7. **Meaning of 90th percentile.**

8. **Why quartiles are estimates.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 14 • S3-S4

S3, S4

Box plots, quartiles and interquartile range

Summarise centre and middle spread with five ordered values.

SPECIFICATION FOCUS

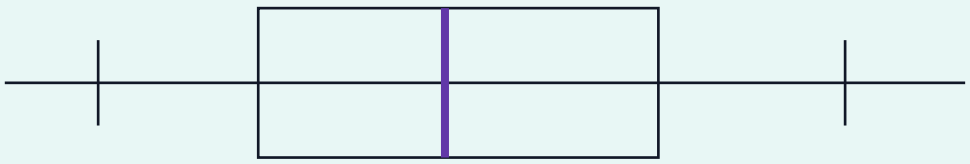
Pearson Edexcel content references S3, S4. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A box plot displays minimum, lower quartile, median, upper quartile and maximum on one numerical scale. The interquartile range IQR=Q3-Q1 measures the spread of the middle 50% and is less affected by extremes than the range. Whiskers show outer spread but do not reveal every observation. Comparisons should use both median and IQR or range in context.

KEY VOCABULARY

five-number summary • lower quartile • median • upper quartile • IQR • whisker • outlier



minimum | Q1 | median | Q3 | maximum

Why the method works

- Values must satisfy minimum≤Q1≤median≤Q3≤maximum.
- The box contains the middle 50% of observations.
- IQR=Q3-Q1;range=max-min.
- A smaller IQR indicates greater consistency in the middle half.

CHECK BEFORE MOVING ON

Answer mentally: 1) Q1=18,Q3=31:IQR. 2) Min7,max46:range. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 14 • S3-S4 • METHODS

S3, S4

Box plots, quartiles and interquartile range — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Mark all five values on one accurate scale.
- Draw box from Q1 toQ3 and median line inside.
- Extend whiskers to minimum and maximum.
- Compare typical value and spread using data context.

WORKED EXAMPLE 1

Summary: min8,Q1=14,median19,Q3=27,max35. Find IQR and range.

1. IQR=27-14=13.
2. Range=35-8=27.

ANSWER: 13 and27

WORKED EXAMPLE 2

A median42,IQR8; B median39,IQR5. Compare.

1. A is typically higher;B is more consistent.

ANSWER: A higher, B less spread

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Box from12 to28: middle percentage. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 14 • S3-S4 • APPLICATION

S3, S4

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Exam scores and delivery times are compared efficiently with paired box plots. A higher median does not automatically mean every value is higher.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

State two-part comparison. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 14 • S3-S4 • PRACTICE

S3, S4

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Q1=18,Q3=31:IQR.**

2. **Min7,max46:range.**

3. **Box from12 to28: middle percentage.**

4. **Which line marks typical middle?**

5. **A IQR6,B IQR11:more consistent.**

6. **A median54,B61:higher typical.**

7. **Why IQR resists extremes.**

8. **State two-part comparison.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 15 • S4-S5

S4, S5

Comparing distributions and evaluating summaries

Use a measure of location and a measure of spread, then qualify the inference.

SPECIFICATION FOCUS

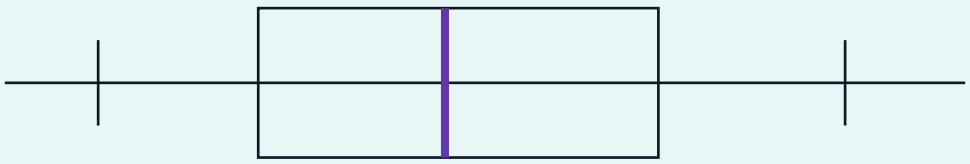
Pearson Edexcel content references S4, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A distribution comparison requires at least one measure of location and one measure of spread. Median pairs naturally with IQR; mean often pairs with standard deviation beyond GCSE, but at GCSE range or graphical spread may be used. Shape, skew and outliers can explain why mean and median differ. Sample statistics describe the observed sample; population conclusions depend on representativeness.

KEY VOCABULARY

distribution • location • spread • skew • outlier • representative • inference



minimum | Q1 | median | Q3 | maximum

Why the method works

- A higher median means a higher typical central value, not every observation.
- A smaller IQR means the middle half is more consistent.
- Outliers affect mean and range more strongly than median and IQR.
- Population inference inherits the limitations of the sample.

CHECK BEFORE MOVING ON

Answer mentally: 1) Medians18,23:which higher. 2) IQRs9,5:which more consistent. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 15 • S4-S5 • METHODS

S4, S5

Comparing distributions and evaluating summaries — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Identify comparable centre measures.
- Identify comparable spread measures.
- Write one contextual sentence for each.
- Add a limitation based on sample design or display.

WORKED EXAMPLE 1

A median70,IQR12;B median66,IQR20. Compare.

1. A has higher typical score.
2. A has smaller middle spread.

ANSWER: A higher and more consistent

WORKED EXAMPLE 2

Mean exceeds median substantially. Suggest shape.

1. Large high values may pull the mean upward.

ANSWER: Possible positive skew

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Why no claim every B value higher? First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 15 • S4-S5 • APPLICATION

S4, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Education and healthcare comparisons require both performance level and consistency. A single average can conceal unequal spread or exceptional cases.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Write cautious population inference. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 15 • S4-S5 • PRACTICE

S4, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Medians18,23:which higher.**

2. **IQRs9,5:which more consistent.**

3. **Why no claim every B value higher?**

4. **Which measures resist outliers?**

5. **Mean below median suggests which skew direction?**

6. **State sample limitation.**

7. **Why compare like measures?**

8. **Write cautious population inference.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 16 • S1, S5

S1, S5

Capture-recapture and population estimation

Use overlap between two representative samples to estimate an unseen population.

SPECIFICATION FOCUS

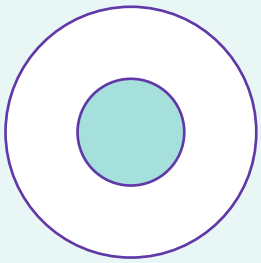
Pearson Edexcel content references S1, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Capture-recapture estimates population size when a census is impractical. In a first sample M individuals are marked and released. Later a second sample of size C contains R marked individuals. If the marked proportion in the second sample represents the whole population, $M/N \approx R/C$, so $N \approx MC/R$. The model needs mixing, unchanged marks, a closed population and equal catchability.

KEY VOCABULARY

capture • recapture • marked • population estimate • closed population • mixing • assumption



population

sample

representative selection matters

Why the method works

- Marked proportion in population is estimated by marked proportion in recapture.
- Estimate N=first marked×second sample/marked recaptured.
- A small overlap creates an unstable large estimate.
- Broken assumptions can bias the result systematically.

CHECK BEFORE MOVING ON

Answer mentally: 1) M30,C50,R10:estimate. 2) M45,C72,R9. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 16 • S1, S5 • METHODS

S1, S5

Capture-recapture and population estimation — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Record M,C,R clearly.
- Form M/N=R/C.
- Rearrange and calculate N.
- Round sensibly and evaluate assumptions.

WORKED EXAMPLE 1

40 fish marked; later60 caught,12 marked. Estimate population.

1. N≈40×60/12.

ANSWER: 200

WORKED EXAMPLE 2

50 marked;80 recaptured sample; only4 marked. Estimate and comment.

1. N≈1000.
2. Small overlap makes estimate uncertain.

ANSWER: 1000; low reliability

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Why release and mix? First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 16 • S1, S5 • APPLICATION

S1, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Ecology uses capture-recapture, but migration, births, deaths, lost marks and behavioural changes can invalidate the model.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

State proportional equation. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 16 • S1, S5 • PRACTICE

S1, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **M30,C50,R10:estimate.**

2. **M45,C72,R9.**

3. **Why release and mix?**

4. **State closed-population assumption.**

5. **Effect if marks fall off.**

6. **Effect if marked animals avoid traps.**

7. **Why small R unstable?**

8. **State proportional equation.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 17 • S3-S5

S3, S4, S5

Grouped-data interpolation and advanced estimates

Make assumptions inside a class explicit before estimating positions.

SPECIFICATION FOCUS

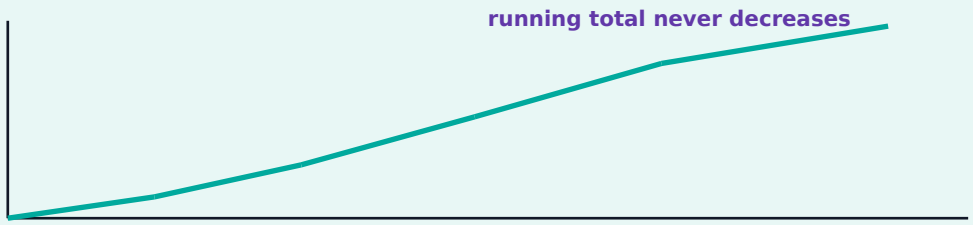
Pearson Edexcel content references S3, S4, S5. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

Grouped data do not reveal positions within each class. Linear interpolation assumes observations are evenly spread across a class. To estimate a percentile, identify the class containing the target cumulative position, find how far through that class the position lies, then apply the same fraction to the class width. This is a model-based estimate, not an exact recovered value.

KEY VOCABULARY

interpolation • target position • cumulative before • class frequency • class width • assumption



Why the method works

- Fraction through class=(target position-cumulative before)/class frequency.
- Estimated value=lower boundary+fraction×class width.
- The method assumes uniform spread inside the class.
- Interpolation is more defensible than selecting the midpoint for every percentile.

CHECK BEFORE MOVING ON

Answer mentally: 1) Class10-20,freq12,cum before8,target14:value. 2) Class30-50,freq10,cum before20,target25. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 17 • S3-S5 • METHODS

S3, S4, S5

Grouped-data interpolation and advanced estimates — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Calculate the target cumulative position.
- Locate its class and cumulative total before that class.
- Find the fractional progress through the class.
- Apply it to the class width and label the result estimated.

WORKED EXAMPLE 1

Class20-30 has frequency16; cumulative before is24. Estimate value at cumulative position32.

1. Progress=(32-24)/16=1/2.
2. Value=20+1/2×10.

ANSWER: 25

WORKED EXAMPLE 2

Class50-70 has frequency20;cumulative before40. Estimate position55.

1. Progress=15/20=.75.
2. Value=50+.75×20.

ANSWER: 65

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Write fraction-through formula. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 17 • S3-S5 • APPLICATION

S3, S4, S5

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Percentile thresholds in grouped performance data rely on a within-class model. Exact raw observations would be preferable when available.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Check estimate location. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 17 • S3-S5 • PRACTICE

S3, S4, S5

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Class10-20,freq12,cum before8,target14:value.**

2. **Class30-50,freq10,cum before20,target25.**

3. **Write fraction-through formula.**

4. **Why lower boundary used?**

5. **State uniformity assumption.**

6. **Is result exact?**

7. **When target equals cumulative before?**

8. **Check estimate location.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

CHAPTER 18 • S1-S6

S1-S6 synthesis

Higher statistical investigation and critical conclusions

Connect question, sample, representation, calculation and inference.

SPECIFICATION FOCUS

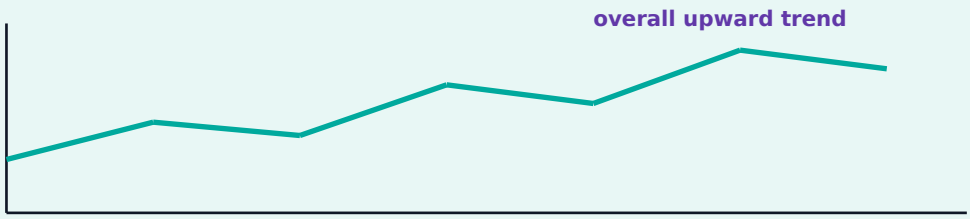
Pearson Edexcel content references S1-S6 synthesis. This lesson develops representation, accurate calculation and interpretation within Higher Tier problem solving.

Understand the idea

A statistical investigation is a chain of decisions. Define a measurable question, select a representative sample, classify the variable, choose an honest display, calculate suitable summaries and make a conclusion no stronger than the evidence. Higher questions may ask whether a graph, average, model or inference is valid. Method evaluation is part of the mathematics, not an optional comment.

KEY VOCABULARY

investigation • hypothesis • sample • representation • summary • inference • limitation



Why the method works

- The research question determines what data are needed.
- Variable type determines valid grouping and display.
- Centre and spread should be interpreted together.
- Causation and population claims require evidence beyond a convenient sample or correlation.

CHECK BEFORE MOVING ON

Answer mentally: 1) Name bias in convenience sample. 2) Choose display for unequal grouped intervals. 3) State one definition or rule from this page in your own words.

EXPLAIN IT

Complete this sentence: “The method works because …” Use the key vocabulary above and refer to the representation in the diagram.

CHAPTER 18 • S1-S6 • METHODS

S1-S6 synthesis

Higher statistical investigation and critical conclusions — method and examples

Follow the reasoning; do not copy steps mechanically.

Reliable method

- Define population, variable and sampling frame.
- Plan collection and anticipate bias.
- Choose display and summaries suited to the data.
- Conclude with evidence, uncertainty and limitations.

WORKED EXAMPLE 1

A volunteer web poll finds80% support. Can it represent all residents?

1. Participants self-select and internet access may exclude groups.

ANSWER: No reliable population inference

WORKED EXAMPLE 2

Two groups have medians52,57 and IQRs9,16. Compare.

1. Second has higher typical value.
2. First is more consistent.

ANSWER: Group2 higher;Group1 less spread

SELF-CHECK QUESTION

Which step carries the mathematical reason, and which step carries only arithmetic? Being able to distinguish them makes it easier to repair errors.

GUIDED TRY

Choose summary resistant to outliers. First predict the form or approximate size of the answer; then show a complete method.

CHAPTER 18 • S1-S6 • APPLICATION

S1-S6 synthesis

Apply and reason

Connect the method to a context and communicate the conclusion.

Real-world model

CONTEXT

Public policy and business decisions depend on statistical evidence. Transparent limitations make a conclusion more credible, not weaker.

Common mistakes and how to repair them

MISTAKE 1

Reading a graph before checking its scale and units. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 2

Giving a calculation without interpreting it in context. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

MISTAKE 3

Treating a sample result as certain for the whole population. Repair: return to the definition, write one complete mathematical line, then check the size or sign of the result.

Exam communication

- Write the operation or equation before the answer.
- Preserve exact values unless the question asks for rounding.
- Attach units and interpret the final value in the context.

REASONING PROMPT

Give two investigation limitations. Write one sentence explaining why your calculation or conclusion is valid.

CHAPTER 18 • S1-S6 • PRACTICE

S1-S6 synthesis

Independent practice

Complete without notes, then use the answer section to diagnose errors.

1. **Name bias in convenience sample.**

2. **Choose display for unequal grouped intervals.**

3. **Choose summary resistant to outliers.**

4. **Correlation strong:prove causation?**

5. **Explain extrapolation risk.**

6. **State histogram area meaning.**

7. **Write comparison from median40/44,IQR7/12.**

8. **Give two investigation limitations.**

REFLECTION

Circle one: secure / almost / reteach. Write the question number of your most useful error and the rule that repairs it.

PRACTICE ANSWERS

CHAPTER 01

Answers, method guidance and repair notes

Populations, samples and reliable data collection

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. State population for survey of Year 11 travel. **ANSWER: all Year 11 pupils**

Method guidance: Define the target population and the variable to measure. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Name study of every population member. **ANSWER: census**

Method guidance: Choose a sampling frame covering that population. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Find 20th item after random start 7, step 13. **ANSWER: 254**

Method guidance: Select a random, systematic or stratified method and justify it. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Stratify 120 of 600 from subgroup 150. **ANSWER: 30**

Method guidance: Identify practical limitations and avoid leading questions. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Give one benefit of random sampling. **ANSWER: reduces selection bias**

Method guidance: Define the target population and the variable to measure. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Identify bias in online voluntary poll. **ANSWER: self-selection bias**

Method guidance: Choose a sampling frame covering that population. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Rewrite “Don’t you agree lessons are too long?” neutrally. **ANSWER: What do you think of lesson length?**

Method guidance: Select a random, systematic or stratified method and justify it. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain why sample size alone cannot remove bias. **ANSWER: method may systematically exclude groups**

Method guidance: Identify practical limitations and avoid leading questions. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 02

Answers, method guidance and repair notes

Frequency tables, tally charts and two-way tables

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Sum frequencies 6,11,8,5. **ANSWER: 30**

Method guidance: Choose non-overlapping categories covering every possible response. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Mode category frequencies A4,B9,C7. **ANSWER: B**

Method guidance: Tally each raw value once. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Total 50,male 23: female. **ANSWER: 27**

Method guidance: Add frequencies and verify against the data count. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Total 80,yes 46,male yes 21: female yes. **ANSWER: 25**

Method guidance: For a two-way table, complete inner cells before marginal totals. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Female total 44,female yes 25: female no. **ANSWER: 19**

Method guidance: Choose non-overlapping categories covering every possible response. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Row entries 12,x,total 31: x. **ANSWER: 19**

Method guidance: Tally each raw value once. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why must categories not overlap? **ANSWER: each observation counted once**

Method guidance: Add frequencies and verify against the data count. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. State one check on two-way table. **ANSWER: row and column totals give same grand total**

Method guidance: For a two-way table, complete inner cells before marginal totals. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 03

Answers, method guidance and repair notes

Pictograms, bar charts and comparative charts

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Key icon=6; 4 icons. **ANSWER: 24**

Method guidance: Read the title, axes, units and pictogram key. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Key icon=10; 2.5 icons. **ANSWER: 25**

Method guidance: Determine the value of one small grid interval. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Bars 18,25,21: total. **ANSWER: 64**

Method guidance: Read bar height from the numbered scale, not by appearance. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Difference between 46 and 29. **ANSWER: 17**

Method guidance: Calculate differences or totals only after extracting exact values. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Increase 30 to 39: percentage. **ANSWER: 30%**

Method guidance: Read the title, axes, units and pictogram key. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Why gaps between categorical bars? **ANSWER: categories are separate**

Method guidance: Determine the value of one small grid interval. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Name chart for two groups across same categories. **ANSWER: comparative bar chart**

Method guidance: Read bar height from the numbered scale, not by appearance. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain danger of vertical axis starting 95 for values 98 and 100. **ANSWER: exaggerates small difference**

Method guidance: Calculate differences or totals only after extracting exact values. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 04

Answers, method guidance and repair notes

Pie charts and proportional representation

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Frequency 25 of 100: angle. **ANSWER: 90°**

Method guidance: Find the total frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Frequency 14 of 60: angle. **ANSWER: 84°**

Method guidance: Calculate angle per item as 360÷total when convenient. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. 90° sector: percentage. **ANSWER: 25%**

Method guidance: Multiply by category frequency and check sector angles total 360°. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. 144° sector of total 250: frequency. **ANSWER: 100**

Method guidance: Use a protractor from a common centre and label sectors clearly. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Angles 80°,120°,x: find x. **ANSWER: 160°**

Method guidance: Find the total frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Total 72: angle per person. **ANSWER: 5°**

Method guidance: Calculate angle per item as 360÷total when convenient. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Can two equal pie sectors prove equal frequencies across different charts? **ANSWER: no, totals may differ**

Method guidance: Multiply by category frequency and check sector angles total 360°. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain why sector angles total 360°. **ANSWER: complete circle**

Method guidance: Use a protractor from a common centre and label sectors clearly. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 05

Answers, method guidance and repair notes

Mean, median, mode and range

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Mean of 4,7,9,10. **ANSWER: 7.5**

Method guidance: Order the data before finding median, mode or range. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Median of 2,5,8,11,14. **ANSWER: 8**

Method guidance: Count observations carefully. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Median of 3,6,9,12. **ANSWER: 7.5**

Method guidance: For mean, calculate the total then divide by count. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Mode of 1,2,2,3,3. **ANSWER: 2 and 3**

Method guidance: Interpret average and spread together in the original units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Range of −4,3,11. **ANSWER: 15**

Method guidance: Order the data before finding median, mode or range. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Six values mean 8: total. **ANSWER: 48**

Method guidance: Count observations carefully. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Mean 10 for 5 values; four sum 37: missing. **ANSWER: 13**

Method guidance: For mean, calculate the total then divide by count. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain outlier effect on mean. **ANSWER: pulls mean toward extreme**

Method guidance: Interpret average and spread together in the original units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 06

Answers, method guidance and repair notes

Frequency distributions and weighted means

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. x 1,2,3; f 4,3,3: mean. **ANSWER: 1.9**

Method guidance: Create columns for x, f and fx. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. x 2,4,6; f 1,5,4: Σfx. **ANSWER: 46**

Method guidance: Add Σf and Σfx independently. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Previous table: mean. **ANSWER: 4.6**

Method guidance: Divide Σfx by Σf for the mean. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Frequencies 2,7,5: modal position. **ANSWER: second category**

Method guidance: Use cumulative frequency to locate middle observation(s). Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Total frequency 25: median observation position. **ANSWER: 13th**

Method guidance: Create columns for x, f and fx. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Eight values mean 6.5: Σfx. **ANSWER: 52**

Method guidance: Add Σf and Σfx independently. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why not divide Σfx by number of rows? **ANSWER: rows are not observations**

Method guidance: Divide Σfx by Σf for the mean. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. State check for calculated mean. **ANSWER: between minimum and maximum**

Method guidance: Use cumulative frequency to locate middle observation(s). Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 07

Answers, method guidance and repair notes

Grouped data and estimated averages

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Midpoint of $20<x\leq30$. **ANSWER: 25**

Method guidance: List each class midpoint. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Midpoint of $1.5\leq x<2.5$. **ANSWER: 2**

Method guidance: Multiply midpoint by class frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Class frequencies 3,8,6: modal position. **ANSWER: second class**

Method guidance: Add estimated totals and divide by total frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Midpoints 5,15; frequencies 4,6: estimated mean. **ANSWER: 11**

Method guidance: Write “estimated mean” and appropriate units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Midpoints 10,30,50; f 2,5,3: Σfm. **ANSWER: 320**

Method guidance: List each class midpoint. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Previous: estimated mean. **ANSWER: 32**

Method guidance: Multiply midpoint by class frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why is grouped mean estimated? **ANSWER: exact values unknown**

Method guidance: Add estimated totals and divide by total frequency. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Give one requirement for class intervals. **ANSWER: no overlap and full coverage**

Method guidance: Write “estimated mean” and appropriate units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 08

Answers, method guidance and repair notes

Stem-and-leaf diagrams and comparing distributions

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Read 3|7 if key 3|7=37. **ANSWER: 37**

Method guidance: Write a key before entering data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Leaves 1,4,4,9: frequency. **ANSWER: 4**

Method guidance: Place each value on its correct stem. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Data 8,11,13: range. **ANSWER: 5**

Method guidance: Order leaves and count against the original data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Ordered 12,15,17,20,22: median. **ANSWER: 17**

Method guidance: Calculate and compare a typical value and spread. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. A median 50,B 46: typical comparison. **ANSWER: A higher**

Method guidance: Write a key before entering data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. A range 9,B 15: consistency. **ANSWER: A more consistent**

Method guidance: Place each value on its correct stem. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why include a key? **ANSWER: defines place value**

Method guidance: Order leaves and count against the original data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Write a complete comparison sentence using median and range. **ANSWER: context-dependent: compare centre and spread**

Method guidance: Calculate and compare a typical value and spread. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 09

Answers, method guidance and repair notes

Scatter graphs, correlation and lines of best fit

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Name correlation for points rising left to right. **ANSWER: positive**

Method guidance: Label both axes with variable and units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Name correlation falling left to right. **ANSWER: negative**

Method guidance: Plot every coordinate accurately. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. What is an outlier? **ANSWER: point away from pattern**

Method guidance: Describe direction and strength and mention outliers. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Prediction inside data range is called? **ANSWER: interpolation**

Method guidance: Use the best-fit line only across a sensible data range. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Prediction outside range is called? **ANSWER: extrapolation**

Method guidance: Label both axes with variable and units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Why not join every scatter point? **ANSWER: points are not a sequence**

Method guidance: Plot every coordinate accurately. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Gradient from (1,6),(5,18). **ANSWER: 3**

Method guidance: Describe direction and strength and mention outliers. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain why correlation does not prove causation. **ANSWER: third variables/chance possible**

Method guidance: Use the best-fit line only across a sensible data range. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 10

Answers, method guidance and repair notes

Time series, misleading graphs and statistical conclusions

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Values 80 to 92: absolute increase. **ANSWER: 12**

Method guidance: Read title, source, axes, units and interval. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Same values: percentage increase. **ANSWER: 15%**

Method guidance: Describe overall trend, repeated pattern and unusual points separately. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Name overall long-term direction. **ANSWER: trend**

Method guidance: Calculate absolute or percentage change when comparison is required. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Name repeating annual pattern. **ANSWER: seasonal pattern**

Method guidance: Evaluate sampling, display choices and whether the conclusion overreaches. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Why equal time spacing? **ANSWER: distance represents equal intervals**

Method guidance: Read title, source, axes, units and interval. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. State issue with 3D pictogram doubled in height and width. **ANSWER: area quadruples, exaggerating**

Method guidance: Describe overall trend, repeated pattern and unusual points separately. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Give one question about data source. **ANSWER: who collected/how sampled**

Method guidance: Calculate absolute or percentage change when comparison is required. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Write cautious conclusion for sample mean higher than another. **ANSWER: sample suggests, not proves, higher population value**

Method guidance: Evaluate sampling, display choices and whether the conclusion overreaches. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 11

Answers, method guidance and repair notes

Data types, chart choice and vertical line charts

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Classify eye colour. **ANSWER: categorical**

Method guidance: Identify the variable and its data type. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Classify number of pets. **ANSWER: discrete numerical**

Method guidance: Choose categories, separate numerical values or intervals. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Classify exact mass. **ANSWER: continuous numerical**

Method guidance: Label axes with variable, frequency and units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Best display for ungrouped discrete frequencies. **ANSWER: vertical line chart**

Method guidance: Check that spacing and total frequency are accurate. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. At x=4 frequency 9: line height. **ANSWER: 9**

Method guidance: Identify the variable and its data type. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Should bars touch for categorical data? **ANSWER: no**

Method guidance: Choose categories, separate numerical values or intervals. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why is measured time continuous? **ANSWER: any value in an interval is possible**

Method guidance: Label axes with variable, frequency and units. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. State one essential axis label. **ANSWER: variable/frequency/units**

Method guidance: Check that spacing and total frequency are accurate. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 12

Answers, method guidance and repair notes

Histograms and frequency density

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Width5,frequency30:density. **ANSWER: 6**

Method guidance: Write exact class boundaries and widths. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Width12,density2.5:frequency. **ANSWER: 30**

Method guidance: Calculate density for every class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Class20-35:width. **ANSWER: 15**

Method guidance: Use a numerical horizontal scale and density vertical scale. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Densities4 and3,widths5 and8:larger frequency. **ANSWER: second:24 vs20**

Method guidance: Recover missing frequencies from bar areas. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Why bars touch? **ANSWER: continuous scale**

Method guidance: Write exact class boundaries and widths. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Why not compare heights only? **ANSWER: widths may differ**

Method guidance: Calculate density for every class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. State vertical-axis label. **ANSWER: frequency density**

Method guidance: Use a numerical horizontal scale and density vertical scale. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Explain area meaning. **ANSWER: bar area represents frequency**

Method guidance: Recover missing frequencies from bar areas. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 13

Answers, method guidance and repair notes

Cumulative frequency curves and percentile estimates

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Frequencies3,8,6,3:cumulative totals. **ANSWER: 3,11,17,20**

Method guidance: Build a running-total column. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Total120:median position. **ANSWER: 60**

Method guidance: Plot lowest boundary at zero and each upper boundary at its cumulative total. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Total120:Q1 position. **ANSWER: 30**

Method guidance: Read horizontally from the required cumulative position to the curve. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Total120:Q3 position. **ANSWER: 90**

Method guidance: Drop vertically to estimate the data value. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Why plot upper boundary? **ANSWER: class completed there**

Method guidance: Build a running-total column. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Can curve decrease? **ANSWER: no**

Method guidance: Plot lowest boundary at zero and each upper boundary at its cumulative total. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Meaning of 90th percentile. **ANSWER: 90% at or below value**

Method guidance: Read horizontally from the required cumulative position to the curve. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Why quartiles are estimates. **ANSWER: raw values within classes unknown**

Method guidance: Drop vertically to estimate the data value. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 14

Answers, method guidance and repair notes

Box plots, quartiles and interquartile range

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Q1=18,Q3=31:IQR. **ANSWER: 13**

Method guidance: Mark all five values on one accurate scale. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Min7,max46:range. **ANSWER: 39**

Method guidance: Draw box from Q1 toQ3 and median line inside. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Box from12 to28: middle percentage. **ANSWER: 50%**

Method guidance: Extend whiskers to minimum and maximum. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Which line marks typical middle? **ANSWER: median**

Method guidance: Compare typical value and spread using data context. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. A IQR6,B IQR11:more consistent. **ANSWER: A**

Method guidance: Mark all five values on one accurate scale. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. A median54,B61:higher typical. **ANSWER: B**

Method guidance: Draw box from Q1 toQ3 and median line inside. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why IQR resists extremes. **ANSWER: uses middle half**

Method guidance: Extend whiskers to minimum and maximum. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. State two-part comparison. **ANSWER: compare median and spread in context**

Method guidance: Compare typical value and spread using data context. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 15

Answers, method guidance and repair notes

Comparing distributions and evaluating summaries

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Medians18,23:which higher. **ANSWER: second**

Method guidance: Identify comparable centre measures. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. IQRs9,5:which more consistent. **ANSWER: second**

Method guidance: Identify comparable spread measures. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Why no claim every B value higher? **ANSWER: distributions overlap**

Method guidance: Write one contextual sentence for each. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Which measures resist outliers? **ANSWER: median and IQR**

Method guidance: Add a limitation based on sample design or display. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Mean below median suggests which skew direction? **ANSWER: negative/left skew**

Method guidance: Identify comparable centre measures. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. State sample limitation. **ANSWER: may not represent population**

Method guidance: Identify comparable spread measures. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why compare like measures? **ANSWER: different statistics answer different questions**

Method guidance: Write one contextual sentence for each. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Write cautious population inference. **ANSWER: sample suggests, not proves**

Method guidance: Add a limitation based on sample design or display. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 16

Answers, method guidance and repair notes

Capture-recapture and population estimation

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. M30,C50,R10:estimate. **ANSWER: 150**

Method guidance: Record M,C,R clearly. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. M45,C72,R9. **ANSWER: 360**

Method guidance: Form M/N=R/C. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Why release and mix? **ANSWER: restore representative mixing**

Method guidance: Rearrange and calculate N. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. State closed-population assumption. **ANSWER: no births/deaths/migration**

Method guidance: Round sensibly and evaluate assumptions. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Effect if marks fall off. **ANSWER: R too small,estimate too high**

Method guidance: Record M,C,R clearly. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Effect if marked animals avoid traps. **ANSWER: R too small,estimate too high**

Method guidance: Form M/N=R/C. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Why small R unstable? **ANSWER: small count has large relative variation**

Method guidance: Rearrange and calculate N. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. State proportional equation. **ANSWER: M/N=R/C**

Method guidance: Round sensibly and evaluate assumptions. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 17

Answers, method guidance and repair notes

Grouped-data interpolation and advanced estimates

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Class10-20,freq12,cum before8,target14:value. **ANSWER: 15**

Method guidance: Calculate the target cumulative position. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Class30-50,freq10,cum before20,target25. **ANSWER: 40**

Method guidance: Locate its class and cumulative total before that class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Write fraction-through formula. **ANSWER: (target-cumulative before)/class frequency**

Method guidance: Find the fractional progress through the class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Why lower boundary used? **ANSWER: measure progress into class**

Method guidance: Apply it to the class width and label the result estimated. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. State uniformity assumption. **ANSWER: even spread within class**

Method guidance: Calculate the target cumulative position. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. Is result exact? **ANSWER: no**

Method guidance: Locate its class and cumulative total before that class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. When target equals cumulative before? **ANSWER: lower boundary**

Method guidance: Find the fractional progress through the class. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Check estimate location. **ANSWER: must lie inside class**

Method guidance: Apply it to the class width and label the result estimated. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

PRACTICE ANSWERS

CHAPTER 18

Answers, method guidance and repair notes

Higher statistical investigation and critical conclusions

Attempt every question first. The answer confirms the outcome; the method guidance identifies the governing process. Rework an error from a blank line and show every algebraic or numerical stage.

1. Name bias in convenience sample.

ANSWER: selection bias

Method guidance: Define population, variable and sampling frame. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

2. Choose display for unequal grouped intervals.

ANSWER: histogram

Method guidance: Plan collection and anticipate bias. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

3. Choose summary resistant to outliers.

ANSWER: median and IQR

Method guidance: Choose display and summaries suited to the data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

4. Correlation strong:prove causation?

ANSWER: no

Method guidance: Conclude with evidence, uncertainty and limitations. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

5. Explain extrapolation risk.

ANSWER: outside observed evidence

Method guidance: Define population, variable and sampling frame. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

6. State histogram area meaning.

ANSWER: frequency

Method guidance: Plan collection and anticipate bias. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

7. Write comparison from median40/44,IQR7/12.

ANSWER: second higher,first more consistent

Method guidance: Choose display and summaries suited to the data. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

8. Give two investigation limitations.

ANSWER: sample bias/measurement error/small size

Method guidance: Conclude with evidence, uncertainty and limitations. Apply the rule to the stated values, record each transformation, then verify sign, size, restrictions, accuracy and units.

EDITORIAL SIGN-OFF

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AUTHORSHIP

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