

Statistics practice

HeLovesMath • Original questions • KS3 / GCSE Mathematics

Name: _____ Date: _____

Show your working. Include units. Keep exact values until the final line. Questions 7-9 are Higher extensions under AQA GCSE Maths.

1. Mean, median, modes and range

Eight scores are 6, 8, 3, 6, 10, 3, 9 and 7.

Find the mean, median, all modes and range.

2. An unusually long journey

Six journey times, in minutes, are 12, 13, 14, 14, 15 and 16.

(a) Find their mean and median. (b) Replace 16 with 76 and find the new mean and median. (c) Which average better describes the centre of the revised list, and why?

3. A discrete frequency table

Twenty-four players earned the following numbers of stars.

Stars, x	0	1	2	3	4
Frequency, f	3	6	8	5	2

Find the mean, median, mode and range of the numbers of stars.

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4. Combining groups of unequal size

Group A has 12 players with a mean score of 18 points. Group B has 18 players with a mean score of 23 points. Each player belongs to exactly one group.

Find the mean score for all 30 players. Explain why $(18 + 23) / 2$ is not the correct method here.

5. Estimating a mean from grouped data

Twenty delivery times are summarised below.

Time, t (minutes)	Frequency
$0 \leq t < 10$	4
$10 \leq t < 20$	8
$20 \leq t < 40$	6
$40 \leq t < 60$	2

Use class midpoints to estimate the mean delivery time. Explain why this is an estimate.

6. Pie-chart sectors

Of 72 club members, 18 cycle to the club, 24 take the bus and 30 walk. Each member selects exactly one of these travel methods.

Calculate the angle of each sector in a pie chart, and check that the angles total 360° .

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7. Quartiles and interquartile range - Higher extension

The nine values are 13, 2, 9, 6, 20, 11, 8, 4 and 15.

For this question, order the values, exclude the overall median from both halves when there is an odd number of values, and take the median of each half as Q1 and Q3. This is the stated median-of-halves convention; other conventions can give different results.

Find the median, lower quartile Q1, upper quartile Q3 and interquartile range.

8. Cumulative-frequency estimates - Higher extension

Forty waiting times have this cumulative-frequency table. The cumulative frequency gives the number of times at most the upper boundary.

Upper boundary, t (minutes)	0	10	20	30	40	50
Cumulative frequency	0	4	12	24	36	40

Plot these points with time on the horizontal axis and cumulative frequency on the vertical axis. For this question, join consecutive points with straight lines.

(a) Estimate Q1, the median and Q3. (b) Estimate the IQR. (c) Estimate the number of people who waited more than 35 minutes. Give the median to 1 decimal place. Use $N/4$, $N/2$ and $3N/4$ on the cumulative-frequency axis. All readings are estimates of the original ungrouped data.

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9. Histogram with unequal class widths - Higher extension

The table describes a frequency-density histogram of completion times.

Time, t (minutes)	Frequency	Frequency density
$0 \leq t < 5$	20	?
$5 \leq t < 15$	30	?
$15 \leq t < 35$	40	?
$35 \leq t < 45$	?	1.5

(a) Complete the table. (b) Find the total frequency. (c) Identify the tallest bar and the class with the greatest frequency. Explain why they differ. (d) Assuming an even spread of times within each class, estimate how many times satisfy $10 \leq t < 25$.

10. Correlation, causation and prediction

A scatter graph of a park shop's daily ice-cream sales and daily sunhat sales shows that days with more ice creams sold tend to have more sunhats sold. The observed ice-cream sales range from 40 to 180 per day.

(a) Name the direction of correlation. (b) Is the claim "selling more ice creams causes more sunhats to be sold" justified by this graph alone? Explain. (c) Suggest a possible third variable. (d) Explain why using a line of best fit to predict sunhat sales on a day when 300 ice creams are sold would be uncertain.

Worked answers

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1. Mean, median, modes and range

Ordered scores: 3, 3, 6, 6, 7, 8, 9, 10.

- Sum = 52, so mean = $52 / 8 = 6.5$.
- There are eight scores. Median = $(4\text{th value} + 5\text{th value}) / 2 = (6 + 7) / 2 = 6.5$.
- Both 3 and 6 occur twice; every other value occurs once. The modes are 3 and 6 .
- Range = $10 - 3 = 7$.

2. An unusually long journey

Original total = $12 + 13 + 14 + 14 + 15 + 16 = 84$ minutes.

- Original mean = $84 / 6 = 14$ minutes .
- Original median = $(14 + 14) / 2 = 14$ minutes .
- Revised total = $84 - 16 + 76 = 144$ minutes, so new mean = $144 / 6 = 24$ minutes .
- The middle two values remain 14 and 14, so new median = 14 minutes .
- The median better represents the centre of these six revised times: five are between 12 and 15 minutes, while the unusually long journey pulls the mean upward. This does not prove that 76 is a recording error.

3. A discrete frequency table

x	f	fx	Cumulative frequency
0	3	0	3
1	6	6	9
2	8	16	17
3	5	15	22
4	2	8	24
Total	24	45	-

- Mean = $\text{sum}(fx) / \text{sum}(f) = 45 / 24 = 1.875$ stars .
- Median positions are 12 and 13. Positions 10 through 17 all contain 2 stars, so median = $(2 + 2) / 2 = 2$ stars .
- Highest frequency is 8, attached to $x = 2$, so mode = 2 stars , not 8.
- Range = $4 - 0 = 4$ stars .

Worked answers

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4. Combining groups of unequal size

Group A total = $12 \times 18 = 216$ points. Group B total = $18 \times 23 = 414$ points.

Combined mean = $(216 + 414) / (12 + 18) = 630 / 30 = 21$ points .

$(18 + 23) / 2 = 20.5$ gives the two groups equal weight, even though their sizes differ. Weight each mean by its group size.

5. Estimating a mean from grouped data

Time (minutes)	f	Midpoint, m	fm
$0 \leq t < 10$	4	5	20
$10 \leq t < 20$	8	15	120
$20 \leq t < 40$	6	30	180
$40 \leq t < 60$	2	50	100
Total	20	-	420

Estimated mean = $420 / 20 = 21$ minutes .

Only intervals are known; each midpoint represents the unknown times within its interval. Therefore 21 minutes is an estimate, not a mean recovered from the original observations.

6. Pie-chart sectors

Sector angle = category frequency / 72 $\times 360^\circ$.

- Cycle: $18 / 72 \times 360^\circ = 90^\circ$.
- Bus: $24 / 72 \times 360^\circ = 120^\circ$.
- Walk: $30 / 72 \times 360^\circ = 150^\circ$.
- Check: $90^\circ + 120^\circ + 150^\circ = 360^\circ$.

Worked answers

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7. Quartiles and interquartile range - Higher extension

Ordered values: 2, 4, 6, 8, 9, 11, 13, 15, 20.

- Median is the 5th value: 9 .
- Exclude 9. Lower half: 2, 4, 6, 8. $Q1 = (4 + 6) / 2 = 5$.
- Upper half: 11, 13, 15, 20. $Q3 = (13 + 15) / 2 = 14$.
- $IQR = Q3 - Q1 = 14 - 5 = 9$.

These are the answers under the stated convention. For example, some interpolation conventions give $Q1 = 6$ and $Q3 = 13$ for this same list; that does not invalidate the explicitly chosen method.

8. Cumulative-frequency estimates - Higher extension

$N = 40$, so read $Q1$ at cumulative frequency 10, the median at 20, and $Q3$ at 30. Plotting the supplied points and joining them linearly gives:

- $Q1$ is between (10, 4) and (20, 12). The required increase is $10 - 4 = 6$ out of a total rise of 8:
 $Q1 = 10 + (6 / 8) \times 10 = 17.5$ minutes .
- Median is between (20, 12) and (30, 24): median = $20 + ((20 - 12) / (24 - 12)) \times 10 = 20 + 20/3 = 80/3 \approx 26.7$ minutes .
- $Q3$ is between (30, 24) and (40, 36): $Q3 = 30 + ((30 - 24) / (36 - 24)) \times 10 = 35$ minutes .
- $IQR \approx 35 - 17.5 = 17.5$ minutes .
- At 35 minutes, estimated cumulative frequency = $24 + (5 / 10) \times 12 = 30$. Estimated number waiting more than 35 minutes = $40 - 30 = 10$ people .

All are estimates because individual waiting times inside each interval are unknown. A smooth curve instead of the specified straight segments could give slightly different readings.

Worked answers

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9. Histogram with unequal class widths - Higher extension

Class width = upper boundary - lower boundary. Density = frequency / class width.

Time (minutes)	Width	Frequency	Density
$0 \leq t < 5$	5	20	$20 / 5 = 4$
$5 \leq t < 15$	10	30	$30 / 10 = 3$
$15 \leq t < 35$	20	40	$40 / 20 = 2$
$35 \leq t < 45$	10	$10 \times 1.5 = 15$	1.5

- Total frequency = $20 + 30 + 40 + 15 = 105$.
- Tallest bar: $0 \leq t < 5$, with density 4.
- Greatest frequency: $15 \leq t < 35$, with 40 observations. It is wider, so its larger area can occur despite its smaller height.
- From 10 to 15 minutes: half of the second class, giving $(5 / 10) \times 30 = 15$.
- From 15 to 25 minutes: half of the third class, giving $(10 / 20) \times 40 = 20$.
- Estimated count for $10 \leq t < 25 = 15 + 20 = 35$.

The last calculation requires the stated even-spread assumption; the table alone does not determine the exact count.

10. Correlation, causation and prediction

- (a) Positive correlation . The wording does not supply enough detail to grade its strength.
- (b) No . An association between the sales totals does not establish that one causes the other.
- (c) Weather/temperature is a plausible third variable: hotter, sunnier days might increase demand for both. Park attendance is another reasonable answer. Neither explanation is proved by the graph.
- (d) 300 is outside the observed range of 40-180 , so this is extrapolation. The observed relationship may not continue that far, making the prediction less reliable.