Hints online, answers free with an account:
mathswariz.uk/worksheets/a-level-statistics-year-1-chapter-3-a-star/

Representations of data: A* questions

72 marks

Date

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X A* exam questions

A to A*

Extended Edexcel-style questions. Show every step. The hints are at the end of the sheet. Use one at a time.

X1 Nine values, in order, are 3, 8, x, 14, 16, 19, $2x$, 30, 41. An outlier is a value more than $1.5 \times \mathrm{IQR}$ below Q_1 or above Q_3.

(a) Explain why $9.5 \leqslant x \leqslant 14$. [2 marks]

(b) Find the set of values of x for which 41 is an outlier, and show that 3 is never an outlier. [4 marks]

(c) Given that $x = 11$, find the mean and the median, and say which is the better average for these values. [3 marks]

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(d) With $x = 11$, the value 41 is removed. Find the quartiles and the median of the remaining eight values. [3 marks]

Total for X1: 12 marks

X2 Two groups of 40 students each did a task. The table summarises their times, in minutes. In each group exactly a quarter of the times are less than Q_1, half are less than the median and three quarters are less than Q_3. The two longest times in group B are 55 and 61 minutes. An outlier is a value more than $1.5 \times \mathrm{IQR}$ below Q_1 or above Q_3.

	Shortest	Q_1	**Median**	Q_3	**Longest**
Group A	8	20	26	31	45
Group B	15	28	33	40	61

(a) Show that group B has exactly one outlier. [3 marks]

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(b) The 80 times are put together. Show that the median of all 80 times lies between 26 and 33 minutes. [4 marks]

(c) Compare the times of the two groups. State the values of any statistics you use. [3 marks]

Total for X2: 10 marks

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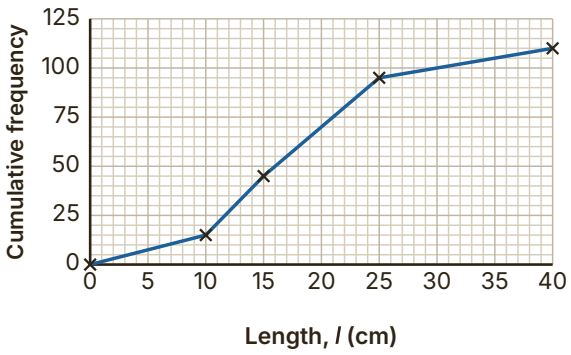
X3 The table shows the times, t seconds, of 160 runners in a race. An outlier is a value more than $1.5 \times \text{IQR}$ below Q_1 or above Q_3. Use linear interpolation to estimate the quartiles, and hence estimate the number of runners whose times are outliers. [9 marks]

Time, t (s)	Frequency
$40 < t \leq 50$	8
$50 < t \leq 55$	32
$55 < t \leq 60$	56
$60 < t \leq 70$	40
$70 < t \leq 90$	16
$90 < t \leq 120$	8

Answer .....

X4 The cumulative frequency polygon shows the lengths, l cm, of 110 leaves. The points are joined with straight lines.

(a) Find the frequency density of each class. [3 marks]



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(b) Explain why the class whose segment is steepest has the tallest bar on a histogram. [2 marks]

(c) Estimate the number of leaves with lengths between 12 cm and 30 cm. [3 marks]

(d) A student joins the same points with a smooth curve and says that the answer to (c) will not change. Comment on this. [2 marks]

Total for X4: 10 marks

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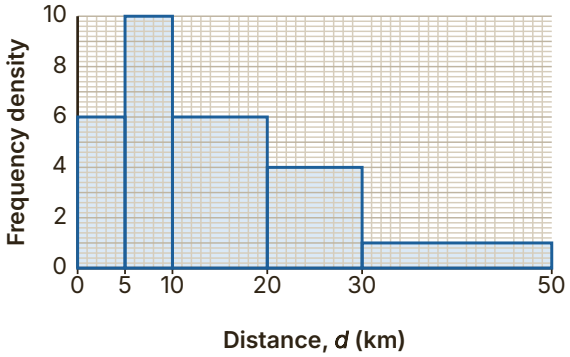
X5 A histogram shows the times, t minutes, that visitors spent on a website. The frequency polygon drawn on it joins the points $(5, 1.2)$, $(12.5, 4.4)$, $(20, 3)$ and $(35, 0.8)$, where the second coordinate is the frequency density. The first class starts at $t = 0$ and there are no gaps between the classes. Find the classes and their frequencies, estimate the median time, and estimate the probability that a visitor chosen at random spent more than 30 minutes. [9 marks]

Answer .....

X6 The histogram shows the distances, d km, that 200 people travel to work.

(a) Estimate the number of people who travel more than 18 km. [2 marks]



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(b) One of the people who travel more than 10 km is chosen at random. Estimate the probability that this person travels more than 18 km. [3 marks]

(c) The company says that 85% of these people travel less than 25 km. Use linear interpolation to test this claim. [3 marks]

(d) State the assumption used in (a) and (c), and explain why it may give a poor estimate for the class $30 < d \leqslant 50$. [2 marks]

Total for X6: 10 marks

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X7 The table shows the times, t minutes, that 500 customers spent in a shop. A histogram is drawn for these data. A model for the histogram is the curve with equation $y = kt(10 - t)$ for $0 \leqslant t \leqslant 10$, where y is the frequency density.

Time, t (minutes)	Frequency
$0 < t \leq 2$	52
$2 < t \leq 4$	124
$4 < t \leq 6$	148
$6 < t \leq 8$	124
$8 < t \leq 10$	52

(a) Show that $k = 3$. [3 marks]

(b) Use the table, with the values in each class spread evenly, to estimate the number of customers who spent between 1 and 3 minutes in the shop. [2 marks]

(c) Use the model to estimate the same number. [3 marks]

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(d) Explain why the two estimates are different, and say which is likely to be better. [2 marks]

(e) Without integrating again, write down the median time given by the model. Give a reason. [2 marks]

Total for X7: 12 marks

F How did it go?

Colour one circle on each line.

	Not yet	Nearly	Yes
I can find quartiles and outlier boundaries when the data hold an unknown, and estimate how many values are outliers from grouped data.	○	○	○
I can reason from box plots, including about two groups put together, and compare data using the right statistics.	○	○	○
I can move between histograms, frequency polygons and cumulative frequency polygons.	○	○	○
I can use a curve fitted to a histogram, where the area under the curve is the total frequency.	○	○	○

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Hints

Use one hint at a time. Cover the ones below it with a sheet of paper.

X1	**Hint 1**	For 9 values, Q_1 is the 3rd value and Q_3 is the 7th, so both quartiles are in terms of x.
	Hint 2	The upper boundary is $2x + 1.5x$. Solve $41 > 3.5x$ and combine with the order of the values.
	Hint 3	For eight values, $\frac{n}{4} = 2$ is whole, so take the mean of the 2nd and 3rd values.
X2	**Hint 1**	The median of 80 values is the mean of the 40th and 41st values.
	Hint 2	Count how many times can be below 26: half of A, and at most a quarter of B, since B's Q_1 is 28.
	Hint 3	Do the same for times above 33; if at most 30 are on each side, the middle two values are between 26 and 33.
X3	**Hint 1**	Q_1 is the 40th value and Q_3 the 120th. Look at the cumulative frequencies.
	Hint 2	Find the boundaries $Q_1 - 1.5 \times \text{IQR}$ and $Q_3 + 1.5 \times \text{IQR}$, and check whether any class lies beyond each one.
	Hint 3	The upper boundary cuts a class. Take the fraction of that class beyond it, assuming the times are spread evenly.
X4	**Hint 1**	Each class frequency is the rise in cumulative frequency across that class.
	Hint 2	Frequency density is frequency $\div$ class width, and the gradient of a segment is rise $\div$ run.
	Hint 3	Read the cumulative frequency at 12 and at 30 by interpolating along the segments that contain them.
X5	**Hint 1**	Each point of a frequency polygon is at the midpoint of its class, and the first class starts at 0.
	Hint 2	A class ends as far above its midpoint as it starts below it; that end is where the next class starts.
	Hint 3	Frequency $=$ frequency density $\times$ class width. Then interpolate for the median, and divide by the total for the probability.
X6	**Hint 1**	Read each frequency density from the scale and multiply by the class width.
	Hint 2	"Given more than 10 km" means the people who travel more than 10 km are the whole group you choose from.
	Hint 3	85% of 200 is 170. Find the 170th value by interpolation.

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X7

Hint 1 On a histogram, area represents frequency. The total area under the curve should be 500.

Hint 2 For (b), the values between 1 and 3 are half of the first class and half of the second.

Hint 3 The curve $y = t(10 - t)$ has a line of symmetry. Where is it?

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