

Box Plots

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

Here are the test marks of 11 students.

35 42 48 51 55 58 62 66 71 78 90

Draw a box plot for this information.

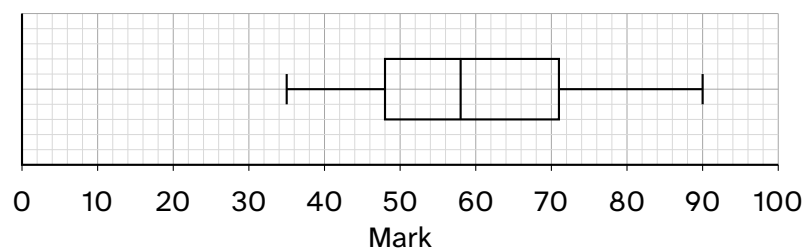
There are 11 marks, already in order.

Median: the $(11 + 1) \div 2 = 6$ th value = 58

Lower quartile: the $\frac{1}{4}(11 + 1) = 3$ rd value = 48

Upper quartile: the $\frac{3}{4}(11 + 1) = 9$ th value = 71

Lowest mark = 35, highest mark = 90



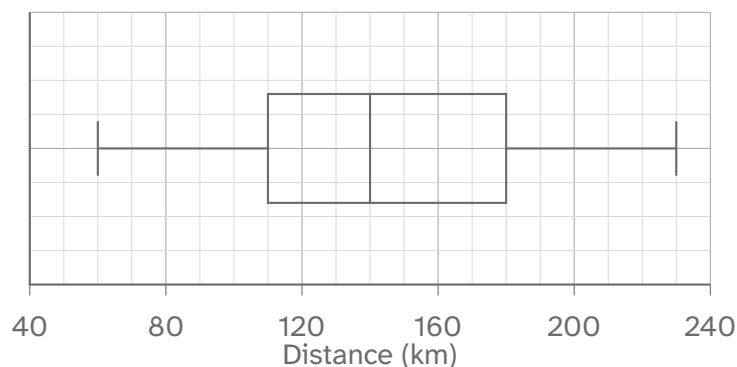
Answer: 35, 48, 58, 71, 90

Tip: Quartiles are less well done than the median. Cross off values from each end to find them, and check which value you plot for the lower quartile.

Marks: 1 mark for both quartiles (48 and 71). 1 mark for the median (58). 1 mark for a fully correct box plot.

2 (3 marks)

The box plot shows information about the distances, in km, that some delivery drivers drove on one day.



- (a) Work out the interquartile range of the distances.

Read the quartiles from the ends of the box:

Lower quartile = 110 km

Upper quartile = 180 km

$IQR = 180 - 110 = 70$ km

Answer: 70 km

Tip: Each small square on this scale is 10 km. Read the ends of the box carefully.

Marks: 1 mark for reading both quartiles. 1 mark for 70.

- (b) Tom says,
“About a quarter of the drivers drove more than 180 km.”

Is Tom correct?

Give a reason for your answer.

180 km is the upper quartile.

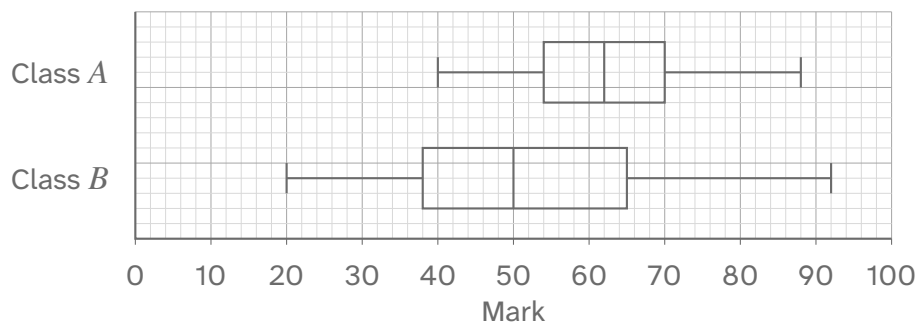
About 75% of the data is below the upper quartile and about 25% is above it.

So about a quarter of the drivers drove more than 180 km. Tom is correct.

Answer: Yes, 180 km is the upper quartile, so about 25% drove further

3 (3 marks)

The box plots show the marks of two classes in a test.



- (a) Compare the distributions of the marks for the two classes.

Median: class *A* 62, class *B* 50.

Class *A* has the higher median, so class *A* did better on average.

IQR: class *A* $70 - 54 = 16$, class *B* $65 - 38 = 27$.

Class *A* has the smaller IQR, so class *A*'s marks are more consistent.

Answer: A better on average and more consistent

Tip: Name the statistics you are comparing (the median and the interquartile range), give their values, and say which class is higher and what that means in context.

Marks: 1 mark for comparing the medians in context. 1 mark for comparing the IQRs (or ranges) in context.

- (b) Jess says, "The box plots show that class *B* had more students than class *A*."
Explain why Jess is wrong.

A box plot only shows five values: the lowest, LQ, median, UQ and highest.

It does not show how many students there are.

A longer box or whisker does not mean more students.

Answer: Box plots don't show frequency

4 (3 marks)

The ages of people at a meeting are summarised below.

The youngest person was 18 and the oldest was 64

The lower quartile was 25, the median was 34 and the interquartile range was 17

Draw a box plot for this information.

$$\text{IQR} = \text{UQ} - \text{LQ}, \text{ so } \text{UQ} = \text{LQ} + \text{IQR}.$$

$$\text{UQ} = 25 + 17 = 42$$

Draw the box from 25 to 42 with the median line at 34.

Draw whiskers to 18 and 64.



Answer: 18, 25, 34, 42, 64

Marks: 1 mark for the upper quartile (42). 1 mark for a correct box with the median. 1 mark for whiskers to 18 and 64.

5 (5 marks)

The table gives some information about the lengths, in minutes, of 60 phone calls.

Shortest call	2 minutes
Lower quartile	5 minutes
Median	9 minutes
Interquartile range	9 minutes
Range	29 minutes

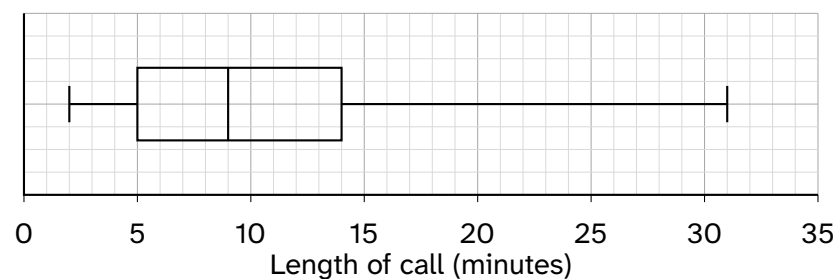
- (a) Draw a box plot to represent this information.

Upper quartile = lower quartile + IQR = $5 + 9 = 14$ minutes

Longest call = shortest + range = $2 + 29 = 31$ minutes

Draw the box from 5 to 14 with the median line at 9.

Draw whiskers to 2 and 31.



Answer: 2, 5, 9, 14, 31

Tip: The IQR and the range are not values to plot. Add them on: $UQ = LQ + IQR$ and $longest = shortest + range$.

Marks: 1 mark for the upper quartile (14) or the longest call (31). 1 mark for a correct box with the median. 1 mark for whiskers to 2 and 31.

- (b) Work out an estimate for the number of these calls that lasted more than 5 minutes.

5 minutes is the lower quartile, so about 25% of the calls lasted 5 minutes or less.

So about 75% of the calls lasted more than 5 minutes.

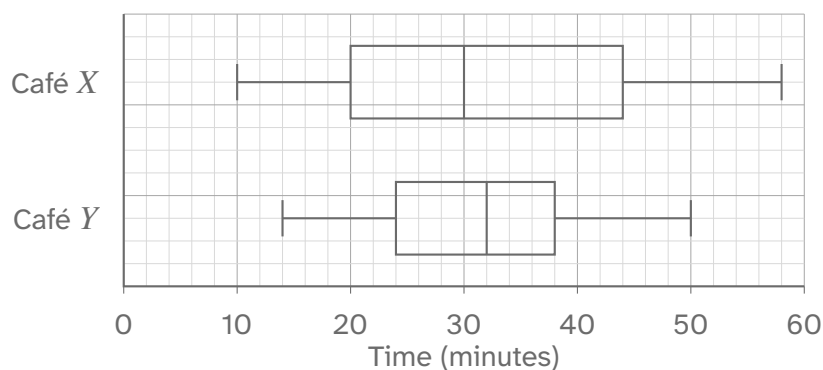
$$75\% \text{ of } 60 = 0.75 \times 60 = 45$$

Answer: 45

Marks: 1 mark for 75% or $\frac{3}{4}$. 1 mark for 45.

6 (4 marks)

The box plots show information about the lengths of time customers spent in two cafés, X and Y , one Saturday.



(a) Nia says,

“Half of the customers at Café X spent more than 44 minutes there.”

Is Nia correct?

Give a reason for your answer.

For Café X , 44 minutes is the upper quartile, not the median.

Only about a quarter of the customers spent more than 44 minutes.

Half of the customers spent more than the median, 30 minutes. So Nia is not correct.

Answer: No, 44 is the upper quartile, so only about a quarter spent more than 44 minutes

- (b) Owen says,
“About a quarter of the customers at Café *Y* spent less than 24 minutes there.”
Is Owen correct?
Give a reason for your answer.

For Café *Y*, 24 minutes is the lower quartile.

About 25% of the data is below the lower quartile.

So Owen is correct.

Answer: Yes, 24 is the lower quartile

Tip: Each of the four parts of a box plot (whisker, half-box, half-box, whisker) holds about 25% of the data.

- (c) Compare the distribution of the times at Café *X* with the distribution of the times at Café *Y*.

Median: Café *Y*'s median (32 minutes) is higher than Café *X*'s (30 minutes).

So on average, customers spent longer at Café *Y*.

IQR: Café *X*'s is $44 - 20 = 24$ minutes and Café *Y*'s is $38 - 24 = 14$ minutes.

Café *Y*'s IQR is smaller, so its times are more consistent.

Answer: Y longer on average (median $32 > 30$); Y more consistent (IQR $14 < 24$)

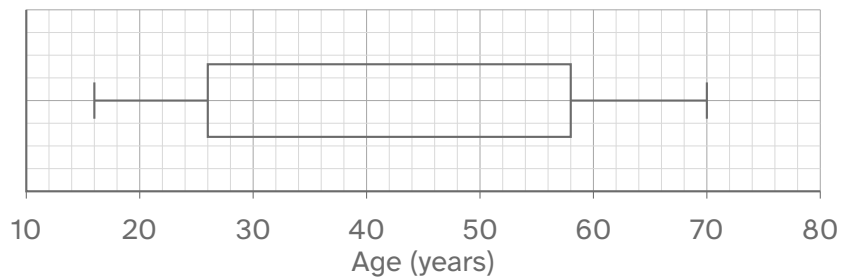
Marks: 1 mark for comparing the medians in context. 1 mark for comparing the IQRs (or ranges) in context.

7 (2 marks)

The table gives information about the ages of the members of a choir.

Youngest age	16 years
Lower quartile	32 years
Median	44 years
Interquartile range	26 years
Range	54 years

Zak used the information in the table to draw this box plot.
He made two mistakes.



Describe **each** mistake.

Check each value. The youngest (16) and oldest ($16 + 54 = 70$) are correct. The upper quartile = $32 + 26 = 58$ is correct.

1. The box starts at 26, which is the interquartile range. The lower quartile is 32, so the box should start at 32.
2. There is no median line. There should be a line across the box at 44.

The correct box plot is:



Answer: Lower quartile should be 32 (not 26); median line missing at 44

Tip: Say exactly what is wrong **and** what it should be. “The box is wrong” on its own is too vague.

Marks: 1 mark for each mistake correctly described.

8 (5 marks)

The stem and leaf diagram shows the times, in minutes, that 19 students took to complete a task.

1	2 5 8
2	0 3 4 6 9
3	1 1 4 7 8
4	2 5 6
5	0 3 7

Key: 1 | 2 represents 12 minutes

The box plot shows information about the times that some adults took to complete the same task.

(a) On the grid, draw a box plot for the students' times.

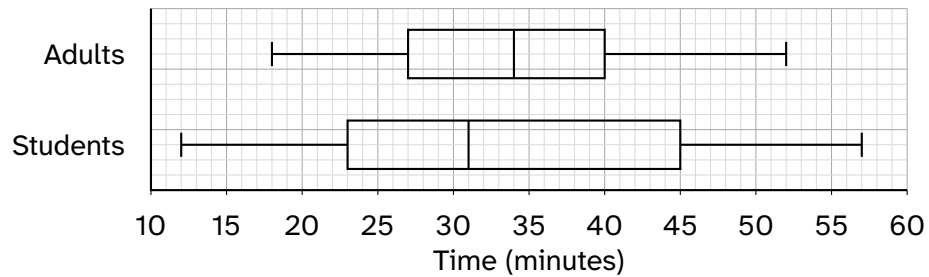
There are 19 times, already in order in the diagram.

Median: the $(19 + 1) \div 2 = 10$ th value = 31

Lower quartile: the 5th value = 23

Upper quartile: the 15th value = 45

Shortest = 12, longest = 57



Answer: 12, 23, 31, 45, 57

Tip: Count the leaves carefully: there are 19 values. Use the key to read each value, e.g. 3 | 4 is 34 minutes.

Marks: 1 mark for the median 31. 1 mark for both quartiles, 23 and 45. 1 mark for a fully correct box plot.

- (b) Compare the distribution of the students' times with the distribution of the adults' times.

Median: students 31 minutes, adults 34 minutes.

So on average, the students completed the task more quickly.

IQR: students $45 - 23 = 22$ minutes, adults $40 - 27 = 13$ minutes.

The adults' IQR is smaller, so the adults' times were more consistent.

Answer: Students quicker on average (median $31 < 34$); adults more consistent (IQR $13 < 22$)

Tip: Give the values you are comparing, and say what they mean in context (quicker on average, more consistent).

Marks: 1 mark for comparing the medians in context. 1 mark for comparing the IQRs (or ranges) in context.