

# Box plots and comparing distributions

About 50 minutes Calculator allowed 38 marks



Hints online, answers free with an account:  
mathswariz.uk/worksheets/stats-box-plots-and-comparing-distributions/

Date \_\_\_\_\_

## A Do Now

The first question is what today's lesson needs. The others bring back earlier topics.

- |                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                      |
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| <p><b>A1</b> <span style="border: 1px solid black; padding: 2px;">Needed today</span> [2 marks]</p> <p>The ages of 7 people at a bus stop were 50, 52, 59, 37, 52, 15, 19. Work out the interquartile range.</p> | <p><b>A2</b> <span style="border: 1px solid black; padding: 2px;">From chapter 6</span> [2 marks]</p> <p>The masses, in grams, of 24 apples were grouped: 10 in <math>30 &lt; m \leq 50</math>, 2 in <math>50 &lt; m \leq 60</math>, 6 in <math>60 &lt; m \leq 70</math>, 6 in <math>70 &lt; m \leq 90</math>. Work out an estimate of the mean.</p> |
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Answer .....

Answer .....

- |                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>A3</b> <span style="border: 1px solid black; padding: 2px;">From chapter 2</span> [2 marks]</p> <p>In a capture-recapture survey, 36 minnows are marked and released. Then the second catch is taken straight away in the same spot. Will the estimate of the number of minnows be too high or too low? Explain why.</p> | <p><b>A4</b> <span style="border: 1px solid black; padding: 2px;">From chapter 5</span> [2 marks]</p> <p>In a grouped table of the lengths, in mm, of some leaves, 20 have <math>60 &lt; l \leq 70</math> and 50 have <math>70 &lt; l \leq 80</math>. Assuming the values are spread evenly through each class, estimate how many have a value between 64 and 78.</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

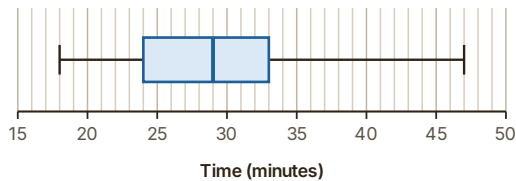
Answer .....

## B Example, then your turn

Your teacher works through each example with you. Then try the one beside it.

### EXAMPLE 1

The box plot shows the times, in minutes, of 80 bus journeys. Work out the interquartile range. Estimate how many of the journeys took longer than 24 minutes.



**Hint** A quarter of the values lie in each of the four sections of a box plot.

### EXAMPLE 2

For a set of waiting times the lower quartile is 22 minutes and the upper quartile is 38 minutes. The shortest wait was 5 minutes and the longest was 65 minutes.

An outlier is more than  $1.5 \times \text{IQR}$  below the lower quartile or above the upper quartile. Show that 65 is an outlier and 5 is not.

**Hint** Work out  $1.5 \times \text{IQR}$ , then the two limits.

### EXAMPLE 3

Here are the numbers of minutes that 15 trains were late, in order.

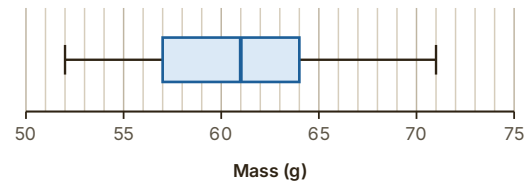
0, 1, 1, 2, 3, 3, 4, 5, 6, 6, 7, 8, 9, 10, 26

Find the values you need to draw a box plot, showing any outlier on its own.

**Hint** Find the quartiles first. A whisker stops at the largest value that is not an outlier.

### B1 The box plot shows the masses, in grams, of 120 eggs. [3 marks]

Work out the interquartile range. Estimate how many of the eggs have a mass of more than 61 g.



Answer IQR ..... g Eggs .....

### B2 In a sale, the prices of some lamps have a lower quartile of £14 and an upper quartile of £22. The cheapest lamp costs £1 and the dearest costs £33. [3 marks]

Using the  $1.5 \times \text{IQR}$  rule, is either £1 or £33 an outlier? Show your working.

Answer Outlier: .....

### B3 Here are the ages of the 11 members of a chess club, in order. [4 marks]

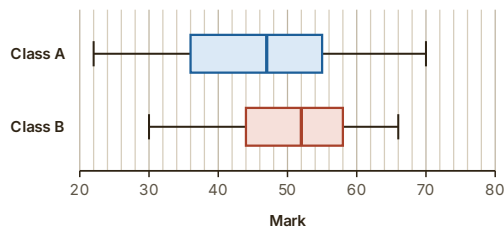
9, 12, 13, 14, 14, 15, 16, 17, 18, 19, 44

Find the values you need to draw a box plot. Say which value is plotted on its own as an outlier.

Answer Plot ....., ..., ..., ..., ..., outlier ...

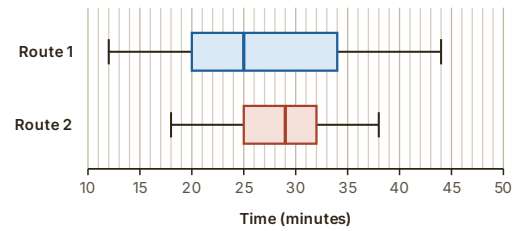
**EXAMPLE 4**

The box plots show the test marks of two classes. Compare the marks of the two classes.



**Hint** Compare one average and one measure of spread. Say what each means for the marks.

- B4** The box plots show the times, [2 marks]  
in minutes, taken by a driver  
on two routes to work.  
Compare the times on the two  
routes.




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### **c** Practice

- C1** A box plot shows the heights of [1 mark]  
some seedlings. Give one reason  
why you cannot find the mean  
height from the box plot.
- 
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- C2** The ages of the people at a [2 marks]  
concert have a lower quartile of  
31 years, an interquartile range  
of 18 years and a range of 50  
years. The youngest person is  
12. Find the upper quartile and  
the age of the oldest person.
- Answer UQ ..... Oldest .....
- C3** A box plot of the marks of 200 [2 marks]  
students has a lower quartile of  
34, a median of 47, an upper  
quartile of 58 and a highest  
mark of 79. Estimate how many  
students scored between 34  
and 79 marks.
- Answer .....
- C4** On a box plot of reaction times, [1 mark]  
the box goes from 0.28 seconds  
to 0.41 seconds. Explain what the  
box tells you about the reaction  
times.
- 
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## D Exam-style questions

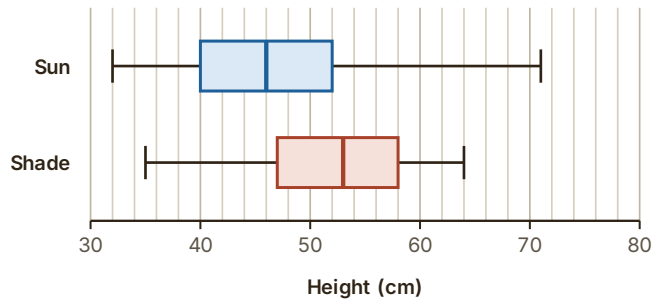
D1

The box plots show the heights, in cm, of tomato plants grown in the sun and in the shade.

[3 marks]

Jo says, "The plants in the sun grew taller, because the tallest plant grew in the sun."

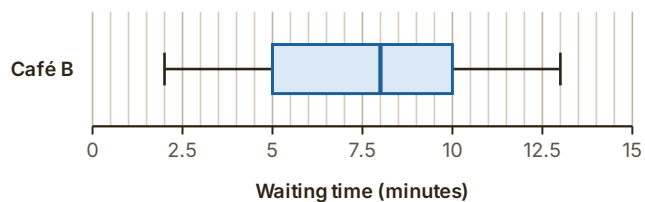
Is Jo right? Give a reason, using both box plots.



D2 Here are the waiting times, in minutes, of 15 customers at Café A, in order.

2, 3, 3, 4, 4, 5, 5, 6, 6, 7, 7, 8, 9, 10, 21

The box plot shows the waiting times at Café B.



(a) Show that 21 minutes is an outlier at Café A.

[3 marks]

Answer .....

(b) Compare the waiting times at the two cafés.

[2 marks]

Total for D2: 5 marks

## E Extension

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** Eleven whole numbers have a median of 20 and a range of 30. The largest number is 46, and it is an outlier: it is more than  $1.5 \times$  IQR above the upper quartile. [4 marks]

Work out the largest possible interquartile range.

Answer .....

### Extension hints

Cover these with paper. Uncover one at a time.

- E1** **Hint 1** Find the smallest number first. Then think about which quartiles make the interquartile range as big as possible.
- Hint 2** The smallest number is  $46 - 30 = 16$ , so the lower quartile is at least 16. To make the IQR large, take the lower quartile as 16.
- Hint 3** With lower quartile 16 and upper quartile  $u$ :  
 $u + 1.5(u - 16) < 46$ , so  $2.5u < 70$  and  $u < 28$ . The largest whole number is  $u = 27$ , so the largest IQR is  $27 - 16 = 11$ .

### How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can read a box plot and estimate how many values lie in each part of it. ☐ ☐ ☒

I can find outliers with the  $1.5 \times$  IQR rule and find the values to plot. ☐ ☐ ☒

I can compare two distributions with an average and a measure of spread, in context. ☐ ☐ ☒