Outliers

Grade 6 | Worked solutions

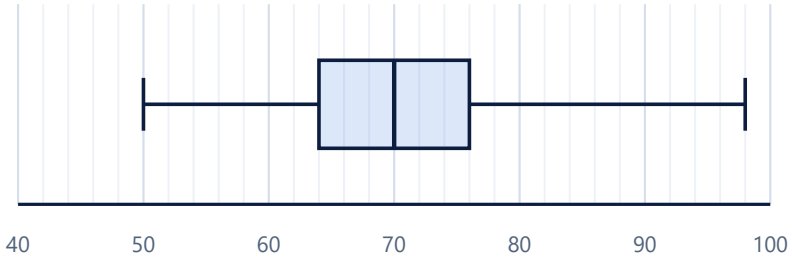
GCSE Statistics topic practice

1 A nurse records the resting pulse rates, in beats per minute, of a group of patients. The box plot shows her results.

An outlier is a value that is more than 1.5 × IQR below the lower quartile or more than 1.5 × IQR above the upper quartile.

a. Work out the interquartile range of the pulse rates. (1)

b. Show that the highest pulse rate, 98 beats per minute, is an outlier. (2)



Pulse rate (beats per minute)

(3 marks)

a)

Lower quartile = 64 and upper quartile = 76

IQR = 76 - 64

= 12

b)

1.5 × 12 = 18

Upper boundary = 76 + 18

= 94

98 > 94 so 98 is an outlier.

a) 12 b) 98 is above the boundary of 94

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2 A warehouse records the number of hours each employee worked in one week. The lower quartile is 32 hours and the upper quartile is 40 hours. The smallest value is 21 hours and the largest value is 55 hours.

An outlier is a value that is more than 1.5 × IQR below the lower quartile or more than 1.5 × IQR above the upper quartile.

a. Determine whether each of 21 hours and 55 hours is an outlier. You must show your working. (3)

b. The manager checks and finds that the value of 55 hours was recorded correctly. Should this value be removed from the data? Give a reason for your answer. (1)

(4 marks)

a)

$$\text{IQR} = 40 - 32$$
$$= 8$$
$$1.5 \times 8 = 12$$
$$\text{Lower boundary} = 32 - 12$$
$$= 20$$
$$\text{Upper boundary} = 40 + 12$$
$$= 52$$

21 > 20 so 21 hours is not an outlier

55 > 52 so 55 hours is an outlier

b)

No, it should not be removed.

It is a real value, not a mistake.

a) 21 is not an outlier, 55 is an outlier b) no, keep it

3 Here are the times, in seconds, that 11 students took to solve a puzzle. The times are in order.

23 27 28 31 33 35 36 38 41 44 62

An outlier is a value that is more than 1.5 × IQR below the lower quartile or more than 1.5 × IQR above the upper quartile.

a. Find the lower quartile and the upper quartile of the times. (2)

b. Determine whether the time of 62 seconds is an outlier. You must show your working. (2)

(4 marks)

a)

There are 11 values

$(11 + 1) \div 4 = 3$

Lower quartile = 3rd value = 28

$3 \times 3 = 9$

Upper quartile = 9th value = 41

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b)

$$\begin{aligned} IQR &= 41 - 28 \\ &= 13 \\ 1.5 \times 13 &= 19.5 \\ \text{Upper boundary} &= 41 + 19.5 \\ &= 60.5 \end{aligned}$$

62 > 60.5 so 62 seconds is an outlier.

a) 28 and 41 b) yes, 62 is an outlier

4 A machine fills bags of flour. The masses of the bags have a mean of 1005 g and a standard deviation of 4 g.

For these bags, an outlier is a mass that is more than 3 standard deviations away from the mean.

a. Work out the smallest mass and the largest mass that are not outliers. (2)

b. One bag is recorded as having a mass of 990 g. Is this mass an outlier? Give a reason for your answer. (1)

c. This bag is weighed again and its mass is found to be 999 g. What should be done with the recorded value of 990 g? Give a reason for your answer. (1)

(4 marks)

a)

$$\begin{aligned} 3 \times 4 &= 12 \\ \text{Smallest} &= 1005 - 12 \\ &= 993 \\ \text{Largest} &= 1005 + 12 \\ &= 1017 \end{aligned}$$

b)

990 < 993 so yes, it is an outlier.

c)

The value of 990 g was a mistake.

It should be replaced with 999 g,

or removed from the data.

a) 993 g and 1017 g b) yes, 990 < 993 c) correct it

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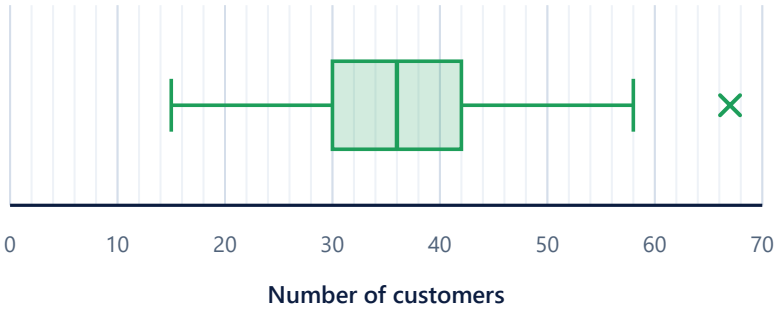
5 A cafe records the number of customers it has each day for 31 days. Here is some information about the results.

Lowest value	Lower quartile	Median	Upper quartile	Two highest values
15	30	36	42	58 and 67

An outlier is a value that is more than 1.5 × IQR below the lower quartile or more than 1.5 × IQR above the upper quartile.

a. Show that 67 is an outlier. (2)

b. On the grid, draw a box plot for this information. Show the outlier with a cross. (3)



(5 marks)

a)

$$\text{IQR} = 42 - 30$$
$$= 12$$
$$1.5 \times 12 = 18$$
$$\text{Upper boundary} = 42 + 18$$
$$= 60$$

67 > 60 so 67 is an outlier.

b)

$$\text{Lower boundary} = 30 - 18$$
$$= 12$$

15 > 12 so 15 is not an outlier.

Draw the box from 30 to 42.

Draw the median line at 36.

Draw the whiskers to 15 and to 58.

58 is the highest value that is not an outlier.

Mark the outlier with a cross at 67.

a) 67 > 60 b) box 30 to 42, whiskers to 15 and 58

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