Standard deviation

Grade 7 | Worked solutions

GCSE Statistics topic practice

1 The masses, x kg, of 10 parcels in a delivery van are recorded. The results are summarised below.

$\Sigma x = 150$ $\Sigma x^2 = 2290$

a. Work out the mean mass of the parcels. (1)

b. Calculate the standard deviation of the masses of the parcels. (2)

(3 marks)

a)

$$\text{mean} = \frac{\text{sum of } x}{n}$$

$$\text{mean} = \frac{150}{10}$$

$$\text{mean} = 15 \text{ kg}$$

b)

$$\text{sd} = \sqrt{\left(\frac{\text{sum of } x^2}{n} - \text{mean}^2\right)}$$

$$\text{sd} = \sqrt{\left(\frac{2290}{10} - 15^2\right)}$$

$$\text{sd} = \sqrt{(229 - 225)}$$

$$\text{sd} = \sqrt{4}$$

$$\text{sd} = 2 \text{ kg}$$

a) 15 kg b) 2 kg

2 The waiting times, in minutes, of six patients at Clinic A are shown below.

12 15 9 14 10 12

a. Calculate the standard deviation of these waiting times. Give your answer correct to 2 decimal places. (3)

b. At Clinic B the mean waiting time is 12 minutes and the standard deviation is 4.5 minutes. Compare the consistency of the waiting times at the two clinics. (1)

(4 marks)

a) Find the mean first

$$\text{sum of } x = 12 + 15 + 9 + 14 + 10 + 12$$

$$\text{sum of } x = 72$$

$$\text{mean} = 72 \div 6$$

$$\text{mean} = 12$$

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

Square each value and add

$\text{sum of } x^2 = 144 + 225 + 81 + 196 + 100 + 144$

$\text{sum of } x^2 = 890$

$$sd = \sqrt{\left(\frac{\text{sum of } x^2}{n} - \text{mean}^2\right)}$$

$$sd = \sqrt{\left(\frac{890}{6} - 12^2\right)}$$

$$sd = \sqrt{(148.333... - 144)}$$

$$sd = \sqrt{4.333...}$$

$sd = 2.08$ minutes

b)

2.08 is less than 4.5

Clinic A has the lower standard deviation

so its waiting times are more consistent

a) 2.08 minutes b) Clinic A more consistent

3 Dawit counts the number of customers in his cafe at midday on each of five days.

21 26 28 30 35

Number of customers, x	x – mean	$(x - \text{mean})^2$
21	−7	49
26		
28		
30		
35		

a. Show that the mean number of customers is 28. (1)

b. Complete the table. (1)

c. Calculate the standard deviation of the number of customers. Give your answer correct to 2 decimal places. (2)

(4 marks)

a)

$\text{sum of } x = 21 + 26 + 28 + 30 + 35$

$\text{sum of } x = 140$

$\text{mean} = 140 \div 5$

mean = 28

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

b) Subtract 28 from each value, then square

x - mean $-7, -2, 0, 2, 7$

squared $49, 4, 0, 4, 49$

c) Add the squares

$49 + 4 + 0 + 4 + 49 = 106$

$$sd = \sqrt{\left(\frac{\text{sum of squares}}{n}\right)}$$

$$sd = \sqrt{\left(\frac{106}{5}\right)}$$

$$sd = \sqrt{21.2}$$

$$sd = 4.60 \text{ (2 dp)}$$

a) $140 \div 5 = 28$ b) table c) 4.60

4 Farah times 8 journeys to work on bus Route A. The times, x minutes, are summarised below.

$\Sigma x = 280$ $\Sigma x^2 = 9928$

For 8 journeys on bus Route B, the mean time is 33 minutes and the standard deviation is 6.5 minutes.

a. Calculate the mean and the standard deviation of the times for Route A. (3)

b. Compare the journey times on Route A with the journey times on Route B. (2)

(5 marks)

a)

$$\text{mean} = \frac{280}{8}$$

mean = 35 minutes

$$sd = \sqrt{\left(\frac{\text{sum of } x^2}{n} - \text{mean}^2\right)}$$

$$sd = \sqrt{\left(\frac{9928}{8} - 35^2\right)}$$

$$sd = \sqrt{(1241 - 1225)}$$

$$sd = \sqrt{16}$$

sd = 4 minutes

b) Compare the means

33 is less than 35

Route B is quicker on average

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.

Compare the standard deviations

4 is less than 6.5

The times on Route A are more consistent

a) mean 35, sd 4 b) B quicker, A more consistent

5 The heights, x cm, of the 20 students in a Year 11 class have a mean of 160 cm and a standard deviation of 5 cm.

a. Work out the value of Σx^2 for these 20 students. (3)

b. A new student who is exactly 160 cm tall joins the class. Without doing any more calculations, state whether the standard deviation of the heights will go up, go down or stay the same. Give a reason for your answer. (2)

(5 marks)

a)

$$sd = \sqrt{\left(\frac{\text{sum of } x^2}{n} - \text{mean}^2\right)}$$

Square both sides

$$sd^2 = \frac{\text{sum of } x^2}{n} - \text{mean}^2$$

$$5^2 = \frac{\text{sum of } x^2}{20} - 160^2$$

$$25 = \frac{\text{sum of } x^2}{20} - 25600$$

$$25625 = \frac{\text{sum of } x^2}{20}$$

$$\text{sum of } x^2 = 25625 \times 20$$

$$\text{sum of } x^2 = 512500$$

b)

The standard deviation goes down

The new height is equal to the mean

so it adds 0 to the sum of the squared differences

That sum is now divided by 21, not 20

a) 512500 b) goes down

Free for classroom and home use: print, photocopy and share. Not for resale or re-hosting.