Statistics

Guidance for tutors

Outcome	S9	Student can consistently:	Find and interpret the variance and standard deviation.
How the topic is examined			• This topic is not currently examined at GCSE but certain aspects are on GCSE Statistics, AS/A2 mathematics and additional maths qualifications. • It is likely that students would have a calculator to solve problems as the calculations can easily become quite complex. • Students should understand that the standard deviation gives you an idea of a measure of spread of the distribution. In order to calculate standard deviation students often first calculate the variance. • In addition they should be able to calculate the standard deviation of a set of data.

Prior knowledge			• Students should be confident:
			     ○ Using a calculator.
			     ○ Finding the mean of a set of data.(S2)

Suggested tuition approaches

- The standard deviation is a measure of how spread out data is. It is usually denoted by the Greek letter σ (sigma) or s (sample standard deviation). .
- The following website gives a simplistic overview of what variance is for the population and also the difference for a sample. http://www.mathsisfun.com/data/standard-deviation.html
- To find the standard deviation of a set of data you would use one of the following formulas.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \overline{x})^2}$$ Where $\overline{x}$ is the mean of the data.	$$s = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$$ Σ means the sum of.
	In this formula you only need to know the x values and everything else is worked out for you.

Guidance for tutors

This formula requires you to work out the mean of the data first.	
Find the standard deviation of the following data. 1, 5, 6, 7, 7, 10 Find the mean of the data first $$\overline{x} = 6$$ Subtract the mean from each value and then square it $$(1-6)^2 = 25$$ $$(5-6)^2 = 1$$ $$(6-6)^2 = 0$$ $$(7-6)^2 = 1$$ $$(7-6)^2 = 1$$ $$(10-6)^2 = 16$$ Add together these answers 25 + 1 + 0 + 1 + 1 + 16 = 44 $n = 6$ as there are 6 numbers Now substitute these numbers into the formula	If we use the above formula to find the standard deviation of the same data. 1, 5, 6, 7, 7, 10 $$\sum x = 1 + 5 + 6 + 7 + 7 + 10 = 36$$ $$\sum x^2 = 1^2 + 5^2 + 6^2 + 7^2 + 7^2 + 10^2 = 260$$ $$n = 6$$ $$s = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$$ $$s = \sqrt{\frac{260 - \frac{(36)^2}{6}}{5}}$$ $$s = \sqrt{\frac{260 - 216}{5}}$$

Guidance for tutors

$$s = \sqrt{\frac{1}{6-1} \times (44)} = \sqrt{\frac{44}{5}} = 2.9$$

$$s = \sqrt{\frac{44}{5}} = 2.97$$

As expected we get the same answer using either method.

- Students may be asked to work out the standard deviation of data in a table. If this is the case the following alternative formula can be used.

$$s = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} f(x_i - \overline{x})^2}$$

Where $\overline{x}$ is the mean of the data.

Where $n = \sum f$

$$s = \sqrt{\frac{\sum fx^2 - \frac{(\sum fx)^2}{n}}{n-1}}$$

Σ means the sum of.

Where $n = \sum f$

- Note that there are many variations of the standard deviation formulae (just arrangements of the same thing). You should use the one you feel happiest with.
- Most modern calculators (including basic ones) now allow you to calculate the standard deviation on them. The following page provides detailed information http://mrroche.pbworks.com/w/file/fetch/46462762/casio%20stats.pdf and the video too shows a worked example https://www.youtube.com/watch?v=UTJZzX8tOy4
- Some formulae divide by n as opposed to $n-1$. There is much discussion around which one to use and most exams allow both answers to be given. There is marginal difference between the two values.

Guidance for tutors

Common errors and misconceptions	- These calculations can be quite long winded and mistakes can easily be made therefore encourage students to organise their calculations and present in the form of a table. - The calculator is the best method to find the standard deviation, however it is easy to make a data entry error, but hard to spot if you do. It is important to double check any calculations that are entered. - Standard deviation cannot be negative and so if a negative value is obtained, students should go back and check their work.
Suggested resources	- Questions - http://www.cimt.org.uk/projects/mepres/allgcse/bkb9.pdf (pp175-183) - http://www.bbc.co.uk/bitesize/quiz/q58903948 - Past GCSE Questions - https://www.examsolutions.net/tutorials/exam-questions-discrete-data-mean/ - Video tutorial - https://www.examsolutions.net/tutorials/standard-deviation/