**My name is Simon Njeru Mugoh.**

**Welcome to CEMASTEA Mathematics Tutorial Session, in this session we will explain ‘Standard Deviation as a Measure of Dispersion’.**

What are the measures of dispersion? Examples include: - range, mean absolute value, variance and standard deviation.

Why do we need to study measures of dispersion? (Let’s take about 20 sec to think about it)

Check the example below where marks of two students **Mary** and **Tom** in 8 subjects are shown in the table.

The mean of the two students is equal to 56. What is the significance of this mean?

* Mary’s marks are 5 points away from the mean, while Tom’s marks are about 8 points away from the mean.

This means that Tom’s marks are much more spread out than those of Mary.

How can we benefit from such information?

* This information can be used by teachers to determine the best method of responding to individual needs of each learner
* It will also help teachers to know areas of weaknesses and strengths of their learners in a particular subject
* Measures of dispersion are very important during decision making

**What is Standard Deviation?**

Standard deviation is a statistical measure that shows the spread of values in a particular set of data. It is the square root of sum of squared deviations from the mean divided by the number of observations. Thus, standard deviation is the square root of mean of the square of deviations from the mean. This will be clear when we do examples.

**What is Variance?**

Variance is the mean of the square of deviations from the mean.

Therefore, standard deviation is equal to the square root of variance.

Calculate the mean, variance & standard deviation of the following scores; - 10, 8, 10, 8, 8, & 4

* To calculate **mean**, add all the numbers and divide the result by the number of items. That is Mean = (10 + 8 + 10 + 8 + 8 + 4) over 6 = 48 ÷ 6 = 8
* To calculate **variance,** add all the square of deviations from mean divided by the number of items

Variance = [(10-8)2 + (8-8)2 + (10-8)2 + (8-8)2 + (8-8)2 + (4-8)2] over 6 = 24 ÷ 6 = 4

* To calculate **standard deviation**, find the square root of variance.

Standard deviation = Square root of 4 = 2.

**NB: - Standard deviation purely depends on Variance.**

**Example 1:**

The age of some Grade 1 pupils were recorded by their teacher as follows: - 5, 6, 6, 7, 7, 8, 8, 9

**Part a)** Calculate the mean age of the pupils (Take 1 min to calculate their mean. You are expected to pause the video for 1 min)

To calculate the mean, add all the numbers and divide the result by the number of items

In this case the mean equals (5+6+6+7+7+8+8+9) over 8 = 56 ÷ 8 = 7

**Part b)** To calculate variance let’s fill in the table below where x represents the grade for each student, d (deviation from mean) represents the (grade – mean) and d squared is the square of d (Take 2 min to complete the table. You are expected to pause the video for 2 min)

To calculate variance apply the formula **summation of d squared** over **n** where n is the number of items

So Variance = (4+1+1+0+0+1+1+4) over 8 = 12 ÷ 8 = 1.5

Therefore, variance is equal to 1.5.

**Part c)** To calculate standard deviation, we now find the square root of variance which you can try by yourself. (Take 30 seconds to find the standard deviation).

We know that standard deviation equals the square root of variance.

Therefore, the standard deviation is equal to the square root of 1.5 which is equal to 1.225.

**Example 2:**In an Agricultural Research Centre, the length of a sample of 50 maize cobs were measured and recorded as shown in the frequency distribution table below.

**Part a) Calculate the mean**

In this example the table is shown as a frequency distribution table where the length of each sample is given and its frequency

Check the table below where x represents the length and f (frequency) represents the number of Cobs and fx represent f times x.

Apply the formula of finding the mean, i.e. summation of fx over f, i.e. fx ÷ f, where fx is the sum of all data and summation of f represents the total number of items.

Now calculate fx and find the mean – (Take 2 min for this activity – You are expected to pause the video for 2 min)

You will find that the mean is 843 over 50, i.e. 843 ÷ 50 which is equal to **16.86**.

**Part b)**, **Calculate variance and standard deviation** by completing the table below where x represents length of sample, d is length of sample minus mean, d squared is the square of deviations & f is frequency (number of cobs) and fd squared is frequency multiplied by d squared.

Now, take 4 min to complete the table – you are expected to pause your video for 4 minutes.

Apply the formula for variance which is equal to summation of fd squared over summation of f

Then variance equals 862.02 ÷ 50 which equals 17.2404.

Now try to calculate the Standard Deviation – (take 30 seconds to calculate the standard deviation).

Answer: Standard deviation is equal to square root of variance

The square root of 17.2404 is equal to 4.152 to 4 sf.

Therefore, standard deviation equals 4.152 to 4sf.

In this section we will solve Example 2 again using CASIO fx-82EX a non-programmable Calculator in order to reduce time while calculating.

1st click Menu then press 2. To log in to Statistics press 1 to activate 1 - Variable,

On the screen will appear one column that represents x. To activate frequency press shift then Menu, scroll down and select Statistics & press 1 to turn on frequency table.

Now input the data from the table into the calculator in the x column, input 9 followed by equal sign then press 12 followed by equal sign, input all data in x column in the same way till length (x) 24.

To input the frequency data click on the right arrow and move up by pressing the arrow up.

Input the data frequency by pressing 4 followed by equal sign then press 7 followed by equal sign, input all data in f column in the same way till number of Cobs (f) 5.

When done press AC, then press Option, then press 2: 1- Variable Calculate, and all answers will appear in one screen and if you need to have more results scroll down.

In this section you will practice by yourself what we have covered in this session

**Assignment 1**: - Explain how measures of dispersion (standard of deviation) can be applied in the real life examples/situation.

**Assignment 2**: - The marks obtained by 10 pupils in an English test were 15, 14, 12, 13, p, 16, 11, 13, 12 and 17. The sum of the squares of the marks $(\sum\_{}^{}x^{2}$) is 1794.

Calculate the
(i) Value of p.

(ii) Standard deviation.

**Thank you very much!**