

# Calculating the correlation coefficient

Tuesday, 26 February 2019 5:56 PM

★ By the end of the lesson I would hope that you have an understanding and be able to apply to questions the following concepts:

- Know how to calculate Pearson's correlation coefficient by hand
- Know how to use a CAS to calculate the correlation coefficient
- Know how to interpret the results

## RECAP:

In a previous lesson we were introduced to the idea of Pearson's correlation coefficient. This is basically a numerical value to give a measure of the linearity of a series of points on a scatter plot.

The values of  $r$ , Pearson's correlation coefficient, fall between  $-1$  and  $1$ .  
The value of  $r$  can only be used to describe linear relationships.

There was a table which we can use to convert between the value of  $r$  and a worded description.

Strong positive association: $r$ between 0.75 and 0.99
Moderate positive association: $r$ between 0.5 and 0.74
Weak positive association: $r$ between 0.25 and 0.49
No association: $r$ between $-0.24$ and $+0.24$
Weak negative association: $r$ between $-0.25$ and $-0.49$
Moderate negative association: $r$ between $-0.5$ and $-0.74$
Strong negative association: $r$ between $-0.75$ and $-0.99$



In this lesson we're going to use a formula to help us calculate the value of  $r$  and our CAS.

## Finding $r$ by hand

Here is the formula you are going to need to use.  
It looks pretty disgusting yes?!

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{(n - 1)s_x s_y}$$

$x$ :  $x$  data item  
 $y$ :  $y$  data item  
 $\bar{x}$ : Mean (or average) of the  $x$  data  
 $\bar{y}$ : Mean (or average) of the  $y$  data  
 $s_x$ : Standard Deviation of the  $x$  data  
 $s_y$ : Standard Deviation of the  $y$  data

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{(n - 1)s_x s_y}$$

Here is an example of how to use it.

Find the value of  $r$  for the following data items

$x$	1	3	5	4	7
$y$	2	5	7	2	9

$$r = \frac{\sum(x - \bar{x})(y - \bar{y})}{(n - 1)s_x s_y}$$

We can use the CAS to help us find the values of  $\bar{x}$ ,  $\bar{y}$ ,  $s_x$  and  $s_y$  but that comes in a different lesson.  
For now, know the following:

$$(n-1) s_x s_y$$

We can use the CAS to help us find the values of  $\bar{x}$ ,  $\bar{y}$ ,  $s_x$  and  $s_y$  but that comes in a different lesson.  
For now, know the following:

$\bar{x}$ : 4  
 $\bar{y}$ : 5  
 $s_x$ : 2.236  
 $s_y$ : 3.082

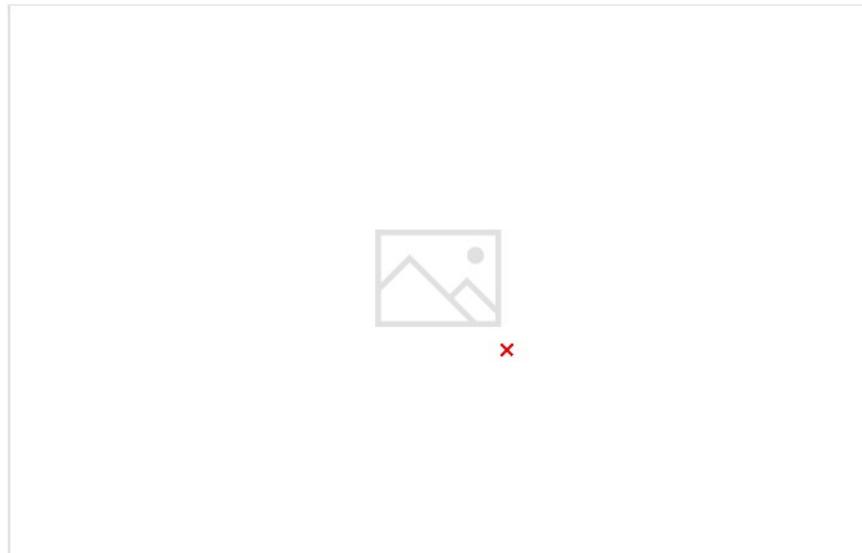
$x$	$y$	$x - \bar{x}$	$y - \bar{y}$	$r$
1	2	-3	-3	9
3	5	-1	0	0
5	7	1	2	2
4	2	0	-3	0
7	9	3	4	12
				<u>23</u>

$$r = \frac{23}{\sqrt{4 \times 2.236 \times 3.082}} = \underline{\underline{0.834}}$$

Using the CAS to find the value of  $r$



Using a calculator





VCAA Exam Question on this concept  
2016 Paper 1

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