6. Maths - Statistics – PART – 6

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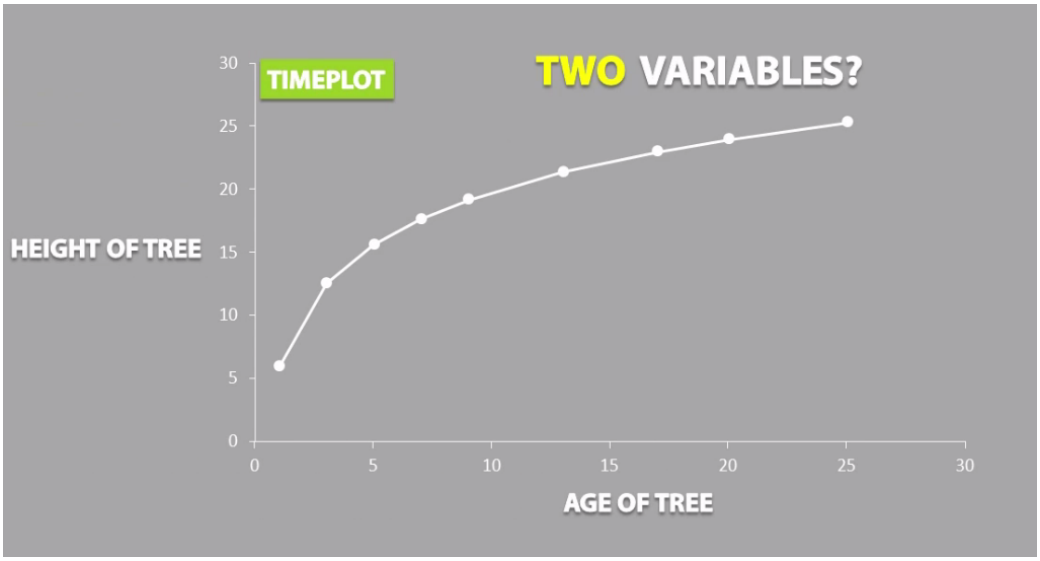
6. Maths - Statistics – PART – 6

✓ This concept explains about how two variables are related each other

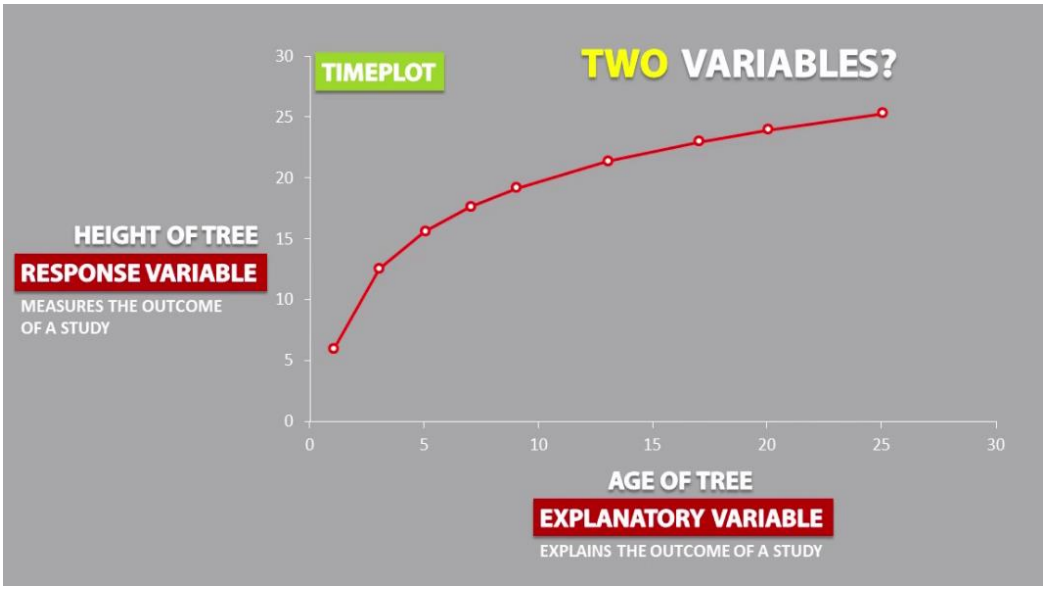


1. Explanatory variable

- ✓ This variables explains the outcome of the study
- ✓ Example is Age:
  - As we are reaching older then the taller will be increase till to certain level
  - **Age** is explains about **height**
- ✓ It is also called as Independent variable

2. Response variable

- ✓ This variables measures the outcome of the study
- ✓ It is also called as Dependent variable

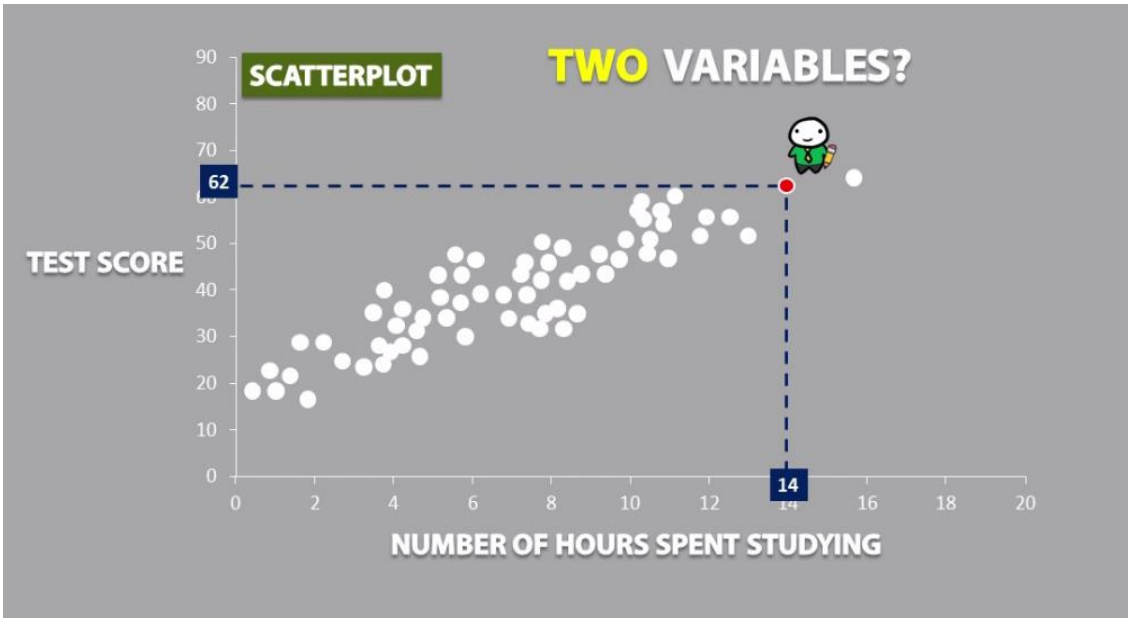


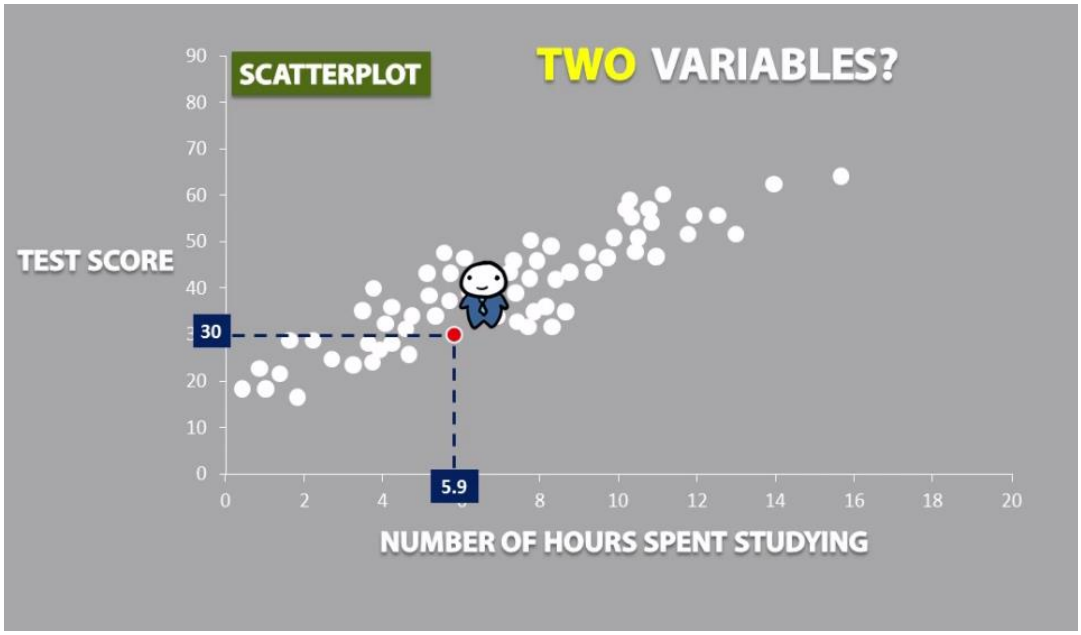
3. Scatter plot

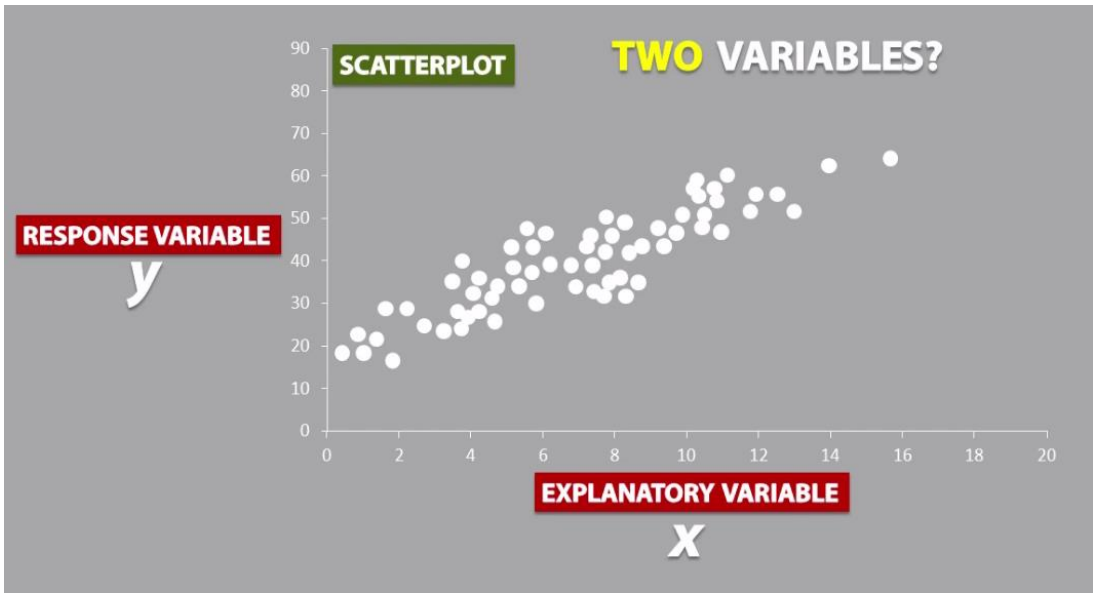
- ✓ Scatter plot is the good example which explains about one variable growth/down based on other variable

4. Example

- ✓ Scatter plot is the good example which explains about one variable growth/down based on other variable



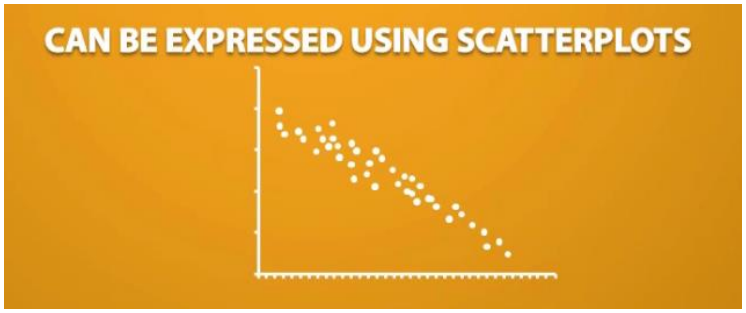

SCATTERPLOT
TWO VARIABLES?
TEST SCORE
NUMBER OF HOURS SPENT STUDYING
30
5.9
0
10
20
30
40
50
60
70
80
90
0
2
4
6
8
10
12
14
16
18
20


SCATTERPLOT
TWO VARIABLES?
RESPONSE VARIABLE
y
EXPLANATORY VARIABLE
x
0
10
20
30
40
50
60
70
80
90
0
2
4
6
8
10
12
14
16
18
20

5. Correlation

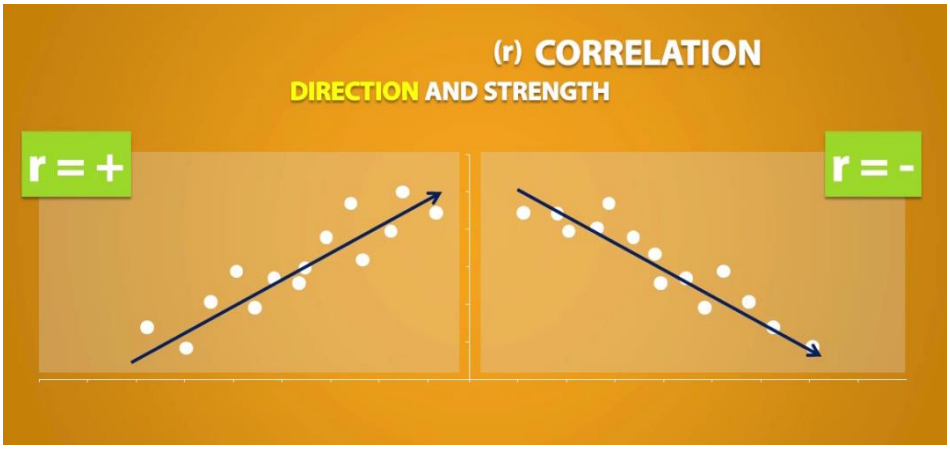
- ✓ It explains about the direction and strength of the linear relationship shared between two quantitative variables
- ✓ It is denoted as **r**

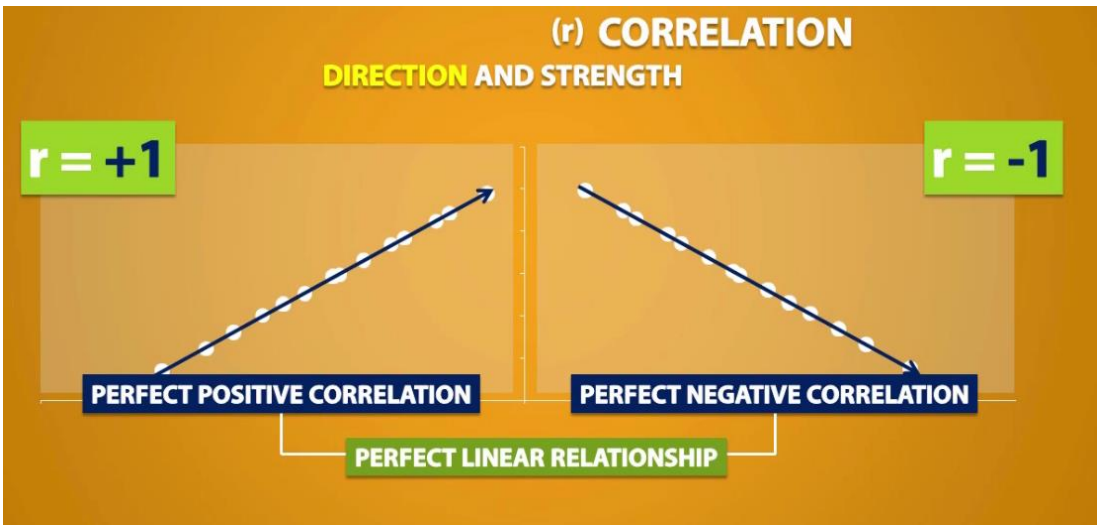
- ✓ Correlation can be expressed using scatter plots



6. Correlation – Direction & Strength

- ✓ Correlation speaks about the direction or slop of set of data points
- ✓ It explains about the direction can be upwards or downwards
  - If upwards then correlation is positive
  - If downwards then correlation is negative

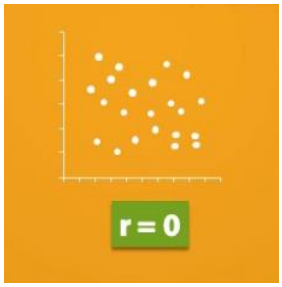




- ✓ Correlation measures the strength of the linear relationship
- ✓ So, correlation values can be in between **+1** and negative **-1**
- ✓ The strength of the linear relationship increased as r got close to positive **+1** or **-1**

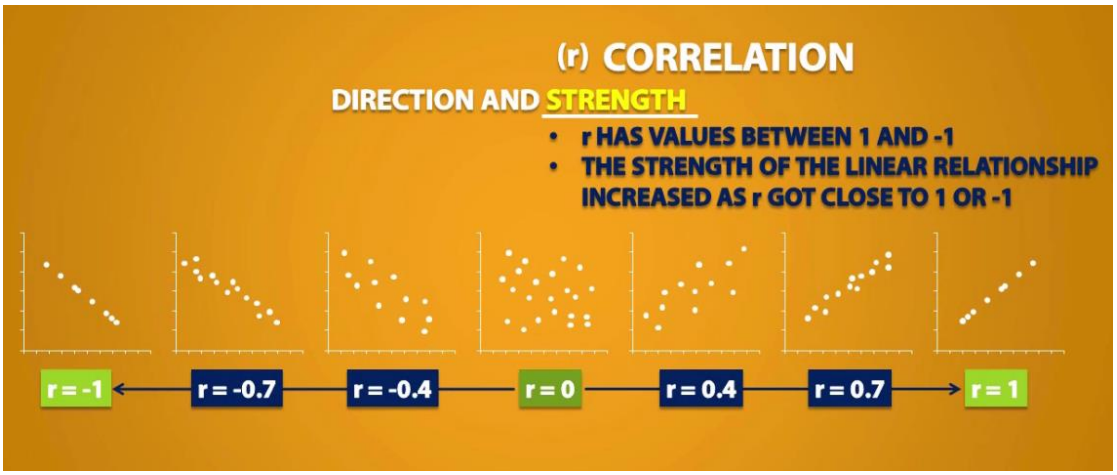
6.1. r = 0

- ✓ There is no correlation
- ✓ There is no linear relationship in between



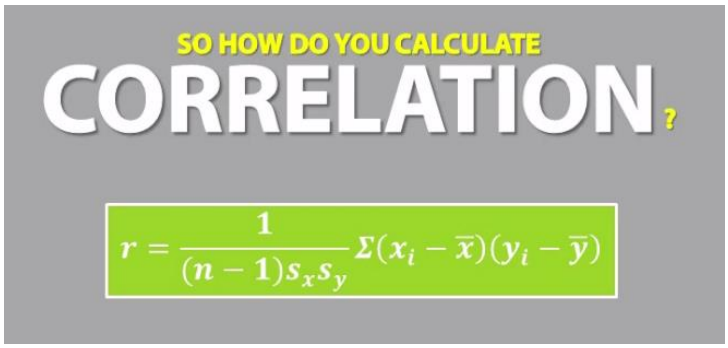
6.2. If r value is towards to +1 or -1

- ✓ In this case the linear relationship get stronger
- ✓ If r value gets close to +1 or -1 then the relationship is very stronger

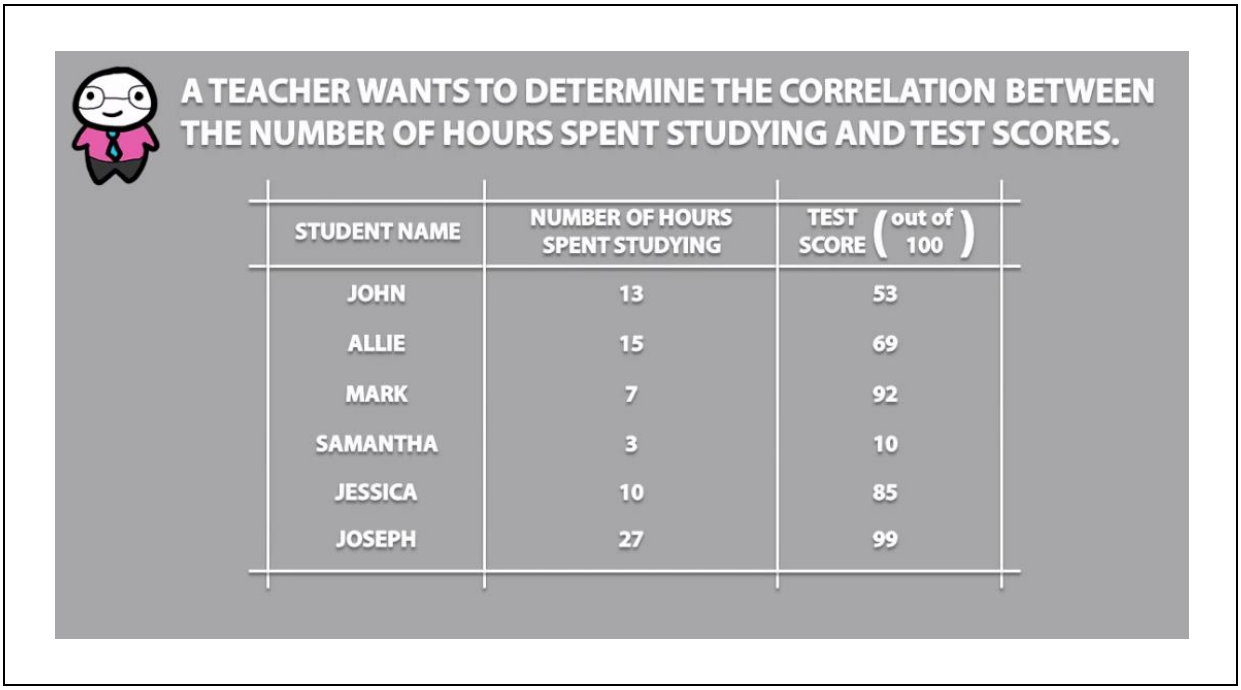


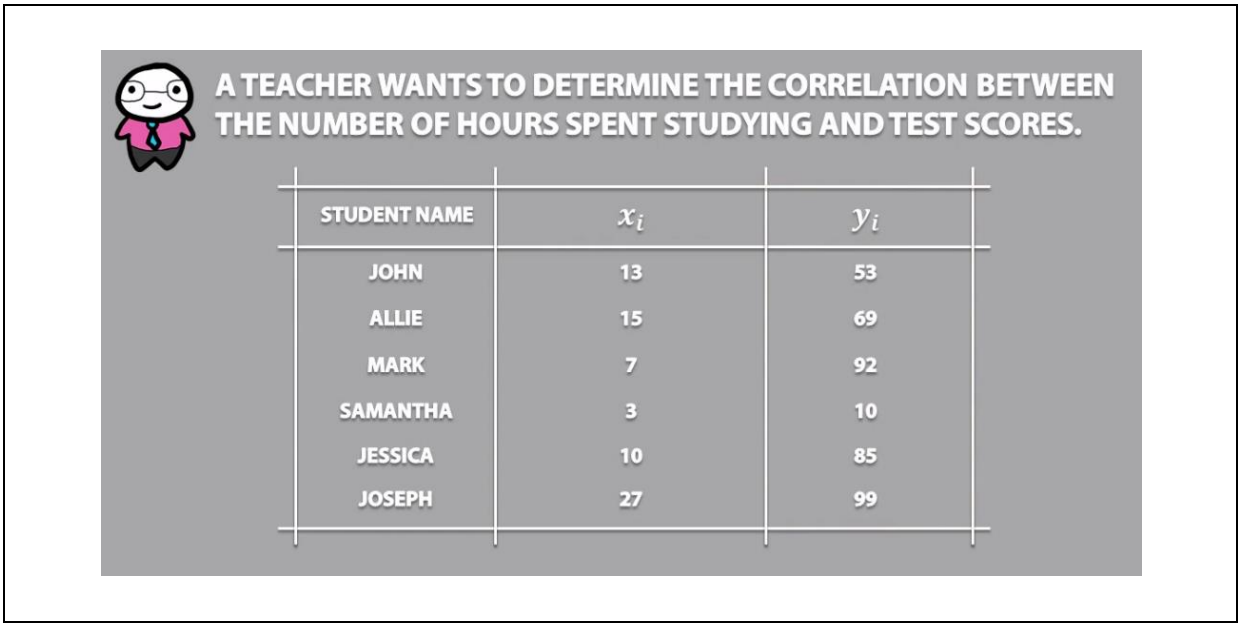
7. Calculate correlation

- ✓ We can calculate correlation by using formula



Example


A TEACHER WANTS TO DETERMINE THE CORRELATION BETWEEN THE NUMBER OF HOURS SPENT STUDYING AND TEST SCORES.
STUDENT NAME
NUMBER OF HOURS SPENT STUDYING
TEST SCORE (out of 100)
JOHN 13 53
ALLIE 15 69
MARK 7 92
SAMANTHA 3 10
JESSICA 10 85
JOSEPH 27 99


A TEACHER WANTS TO DETERMINE THE CORRELATION BETWEEN THE NUMBER OF HOURS SPENT STUDYING AND TEST SCORES.
STUDENT NAME
x_i
y_i
JOHN 13 53
ALLIE 15 69
MARK 7 92
SAMANTHA 3 10
JESSICA 10 85
JOSEPH 27 99

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53			
15	69			
7	92			
3	10			
10	85			
27	99			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53			
15	69			
7	92			
3	10			
10	85			
27	99			
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	13 − 12.5		
15	69			
7	92			
3	10			
10	85			
27	99			
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5		
15	69	15 − 12.5		
7	92			
3	10			
10	85			
27	99			
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5		
15	69	2.5		
7	92	-5.5		
3	10	-9.5		
10	85	-2.5		
27	99	14.5		
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	53 – 68	
15	69	2.5		
7	92	-5.5		
3	10	-9.5		
10	85	-2.5		
27	99	14.5		
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	
15	69	2.5	1	
7	92	– 5.5	24	
3	10	– 9.5	– 58	
10	85	– 2.5	17	
27	99	14.5	31	
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	(0.5)(– 15)
15	69	2.5	1	
7	92	– 5.5	24	
3	10	– 9.5	– 58	
10	85	– 2.5	17	
27	99	14.5	31	
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	(0.5)(– 15)
15	69	2.5	1	(2.5)(1)
7	92	– 5.5	24	
3	10	– 9.5	– 58	
10	85	– 2.5	17	
27	99	14.5	31	
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			

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

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821

$$r = \frac{1}{(n-1)s_x s_y} \left[\quad 821 \quad \right]$$

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821

$$r = \frac{1}{(6-1)s_x s_y}\left[\ 821\ \right]$$

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821

$$r = \frac{1}{(6-1)s_x s_y}\left[\ 821\ \right]$$

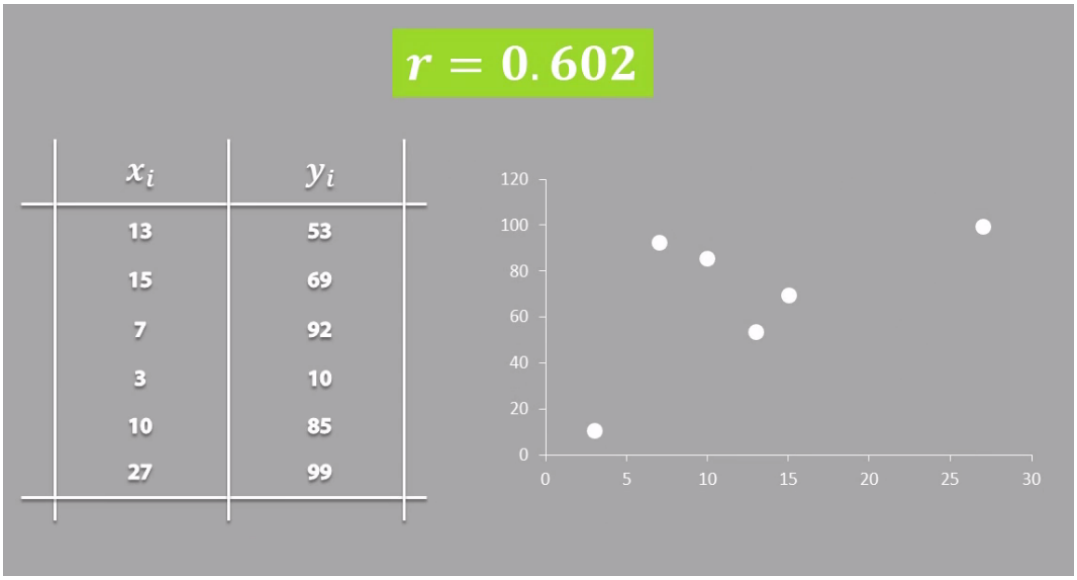
x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821
$s_x = 8.28$	$s_y = 32.91$			

$$r = \frac{1}{(6-1)(8.28)(32.91)}\left[821\right]$$

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821
$s_x = 8.28$	$s_y = 32.91$			

$$r = 0.602$$

x_i	y_i	$(x_i - \bar{x})$	$(y_i - \bar{y})$	$(x_i - \bar{x})(y_i - \bar{y})$
13	53	0.5	– 15	– 7.5
15	69	2.5	1	2.5
7	92	– 5.5	24	– 132
3	10	– 9.5	– 58	551
10	85	– 2.5	17	– 42.5
27	99	14.5	31	449.5
$\bar{x} = 12.5$	$\bar{y} = 68$			SUM = 821
$s_x = 8.28$	$s_y = 32.91$			



✓ So, here its explains the correlation is +0.6, its upwards direction