Simple Linear Regression Formula: The regression line is represented as:

$$Y = a + bX$$

Where:

- Y is the dependent variable,
- X is the independent variable,
- a is the intercept,
- b is the slope.

How Do I Calculate the Regression Line?

1. First, calculate $\bar{y}$ and $\bar{x}$. Then, calculate $r = \dfrac{s_{xy}}{s_x s_y}$.
2. Find the slope, $b = r\left(\dfrac{s_y}{s_x}\right)$ and the y-intercept, $a = \bar{y} - b\bar{x}$.
3. Write the regression line by substituting the values for a and b into the equation: $y = a + bx$.

EXAMPLE

Find the best-fitting line relating y = starting hourly wage to x = number of years of work experience for the following data. Plot the line and the data points on the same graph.

x	2	3	4	5	6	7
y	$6.00	7.50	8.00	12.00	13.00	15.50

Solution Use the data entry method for your calculator to find these descriptive statistics for the bivariate data set:

$$\bar{x} = 4.5 \qquad \bar{y} = 10.333 \qquad s_x = 1.871 \qquad s_y = 3.710 \qquad r = .980$$

Then

$$b = r\left(\frac{s_y}{s_x}\right) = .980\left(\frac{3.710}{1.871}\right) = 1.9432389 \approx 1.943$$

and

$$a = \bar{y} - b\bar{x} = 10.333 - 1.943(4.5) = 1.590$$

Therefore, the best-fitting line is $y = 1.590 + 1.943x$. '

The best-fitting line can be used to estimate or predict the value of the variable y when the value of x is known. For example, if a person applying for a job has 3 years of work experience (x), what would you predict his starting hourly wage (y) to be? From the best-fitting line in Figure 3.14, the best estimate would be

$$y = a + bx = 1.590 + 1.943(3) = 7.419$$

Question 1: Write an equation for the best fit line for the following ordered pairs:

$$(2, 4), (3, 5), (5, 7), (7, 10), (9, 15)$$

Question 2: Consider the table below where the mass, y (grams), of a chemical is related to the time, x (seconds), for which the chemical reaction has been taking place according to the table:

Time , x (Seconds)	5	7	12	16	20
Mass, y (grams)	40	120	180	210	240

a) Find the equation of the regression line.

b) What is the mass of the chemical after ten seconds has passed?

Question3 : To see how students' reaction skills have improved over a year, eight students took a reactions test at the start of the year and at the end of the year. These are their scores:

Student	Liam	Felicity	Adian	Mel	Leroy	Vic	Lawrie	Louise
First Test, x	56	75	61	61	67	72	62	61
Second Test, y	21	39	34	21	32	24	29	24

Find the equation of the regression line given that:

$$\sum x = 515,\ \sum y = 224,\ \sum x^2 = 33441,\ \sum y^2 = 6576 \text{ and } \sum xy = 14590.$$