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Lesson #9.4: Scatter Plots and Lines of Best Fit

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Learning Goal: We are learning to create a line of best fit from a scatter plot.

Remember watching Adam and Jamie gather data points on the length of time it took for a bullet to travel to a target? After they had three data points, Adam was able to draw a graph known as a scatter plot. He was extremely fortunate that the three data points sat perfectly in a line. Taking this one step farther, we could also determine the equation of this line, thus allowing us to calculate any time or distance.
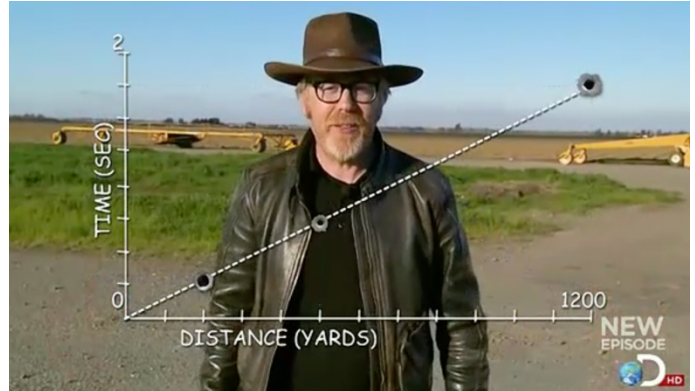
$b = -mx + y$

Today, we will take data from a table and plot it on a scatter plot. Then, we will determine the **line of best fit**. This is a line in $y = mx + b$ form. We will also utilize $y - y_1 = (x - x_1)$ to create that line. The line of best fit best describes the relationship between the data points. This, like standard deviation, is not difficult, but it is a long and tedious task. However, on small data sets, it is completely possible to do by hand.

This process is called _Statistical Modelling_ We are only looking at creating a line, but you can do this with curves and make models of the trajectory of a rocket launch, the growth of a virus, the housing market, the sales for your company, and so much more! This is IMMENSLEY useful.
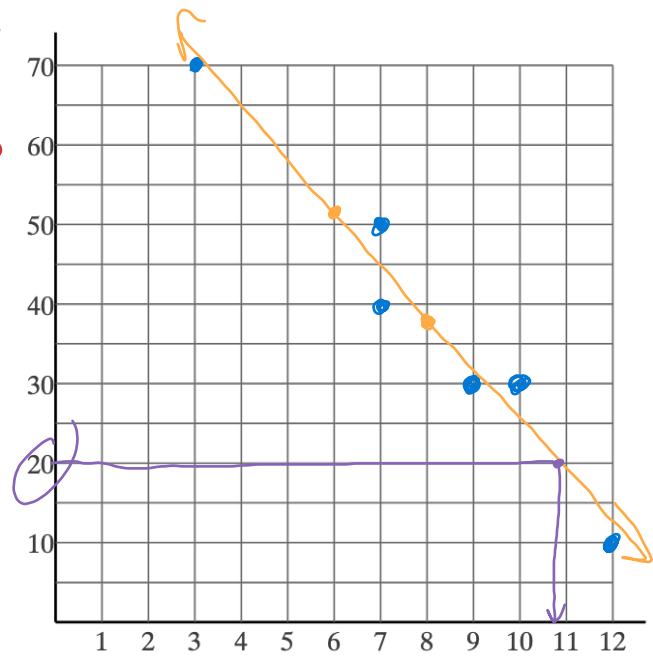
Example: Plot the points, calculate the line of best fit, then draw the line.

1. Plot the points.
2. Calculate the averages for the x and y coordinates.
3. Fill in the table (next page)
4. Calculate slope.
5. Determine $y = mx + b$.
6. Graph the line.
7. Answer any questions!

# of workers   hours to complete a job

X	Y
3	70
7	40
7	50
9	30
10	30
12	10

# of hours

$X_a = \frac{48}{6} = 8$

average

$Y_a = \frac{230}{6} = 38.3$

# of workers

(3)

x	y	$x - x_a$	$(x - x_a)^2$	$y - y_a$	$(x - x_a)(y - y_a)$
3	70	3-8= -5 → 25	25	31.7	(-5)(31.7)= -158.5
7	40	7-8= -1	1	1.7	-1.7
7	50	= -1	1	11.7	-11.7
9	30	9-8= 1	1	-8.3	-8.3
10	30	10-8= 2	4	-8.3	-16.6
12	10	12-8= 4	16	-28.3	-113.2

(top of table: 8 above $x - x_a$ column; 38.3 above $y - y_a$ column)

(4)

Slope

Run: Add

Rise: adding this

$$m = \frac{y's}{x's} = \frac{Rise}{Run} = \frac{-310}{48} = -6.45 \text{ (use 2 decimals)}$$

(5) need b, using X_a and Y_a

$$b = -mx_a + y_a$$
$$b = -(-6.45)(8) + 38.3$$
$$b = 90$$

∴ $y = -6.45x + 90$

(5) Graph.

use $x = 6$, $y = ?$
$$y = -6.45(6) + 90 \qquad (6, 51)$$
$$y = 51$$

use $x = 8$
$$y = -6.45(8) + 90 \qquad (8, 38)$$
$$y = 38$$

Now what? The best part is that we can now answer questions!

a) If we had one worker, how many hours would it take?

$x = 1$

$$y = -6.45(1) + 90$$
$$y = 83.55 \text{ hours.}$$

b) I need a job done in 20 hours, so how many workers should I hire?

y

$$20 = -6.45x + 9$$

$$x =$$

Success Criteria:
- I can plot points on a scatter plot
- I can calculate the line of best fit