First Differences

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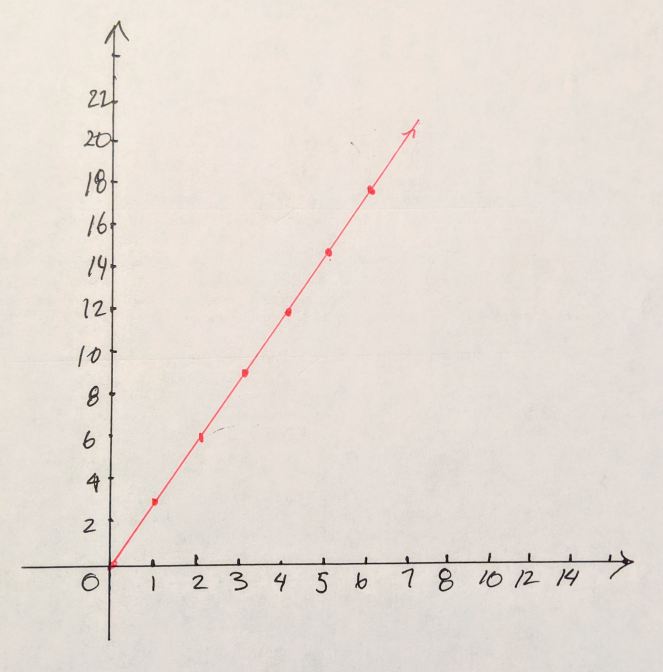
First differences

This is an interesting way of determing whether a relationship is linear. The first differences are the differences between the y-values in a table of values. For example,

x	y	1^{st} difference
0	0	
1	3	3 = 3-0
2	6	3 = 6-3
3	9	3 = 9-6
4	12	3 = 12 - 9
5	15	3 = 15-12
6	18	3 = 18-15

We have the table of values for the x and y values. The 1^{st} differences are equal. If we graph the points in the table of values, what do we get? Graphing the points we get a line. What is the slope and y-intercept of this line?



Slope: Let's us the points, $(x_0, y_0) = (0, 0), (x_1, y_1) = (1, 3)$,

$$\begin{aligned} m &= \frac{y_1 - y_0}{x_1 - x_0} = \frac{3 - 0}{1 - 0} = 3 \\ l : y &= 3x + b. \end{aligned}$$

Insert $(0, 0)$ in to the equation for l to give the y-intercept,

$$\begin{aligned} 0 &= 0 + b \\ 0 &= b \end{aligned}$$

Exercises

1. Using first differences, which tables of values represent a linear relation?

a)

x	-1	0	1	2	3	4
y	6	4	2	0	-2	-4

b)

x	-2	-1	0	1	2	3
y	4	1	0	1	4	9

c)

x	-2	-1	0	1	2	3
y	1	1	1	1	1	1

d)

x	-2	-1	0	1	2	3
y	2	1	0	-1	-2	-3

e)

x	-2	-1	0	1	2	3
y	-8	-1	0	1	8	27

2. For those relations in #1 that are linear what is the slope of the linear relation?

3. For those relations in #1 that are linear, find the y-intercept.

4. For those relations in #1 that are linear, graph the line and write the equation of the line.

