*

Connecting the Dots

- or -

Using Plotly for Straight Line and Broken Line Plots

ISC1057

Janet Peterson and John Burkardt

Computational Thinking

Fall Semester 2016

Example 1: Stretching a Spring

A rubber band is useful because it has a property known as elasticity.

We know a few things about a rubber band:

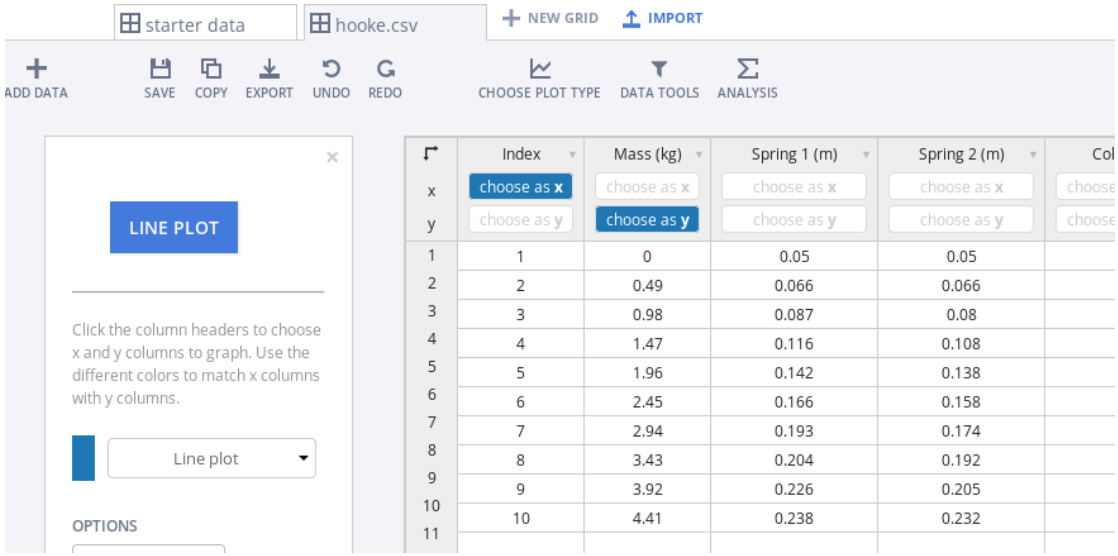
- it has a natural length of one or two inches;
- as we pull on it harder and harder, it stretches to six or seven inches;
- if we let go, it snaps back;
- if we pull too hard, it breaks.

Robert Hooke searched for a pattern to describe the stretching of a spring.

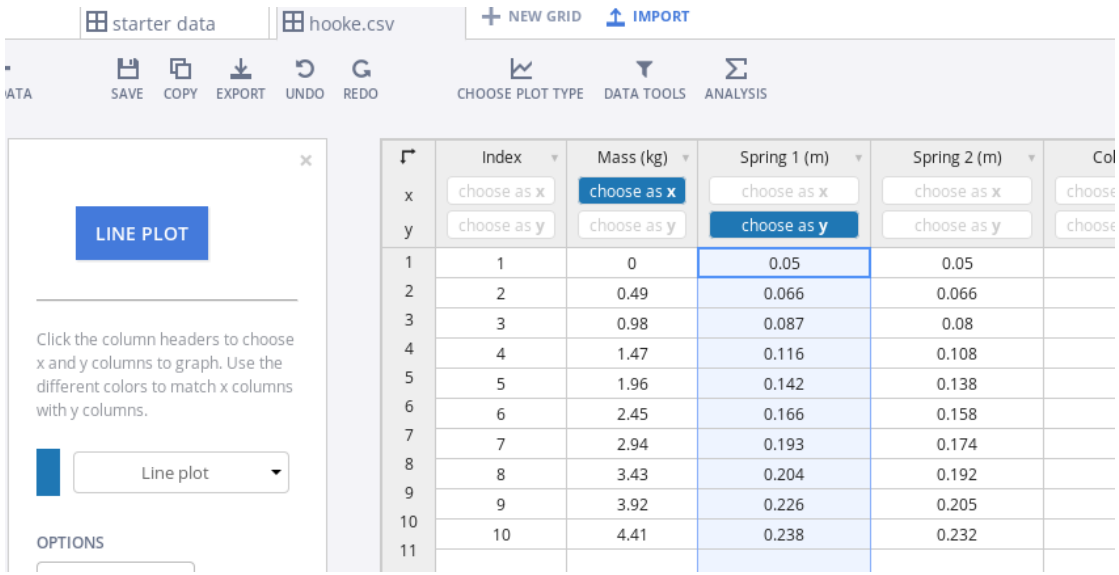
Here is sample data stored in the file $hooke.csv$, in which two springs were stretched by adding one more mass at a time to the end of the spring and measuring the position of the end of the spring.

"Index",	"Mass (kg)",	"Spring 1 (m)",	"Spring 2 (m)"
1,	0.00,	0.050,	0.050
2,	0.49,	0.066,	0.066
3,	0.98,	0.087,	0.080
—	$more\ data$	—	—
8,	3.43,	0.204,	0.192
9,	3.92,	0.226,	0.205
10,	4.41,	0.238,	0.232

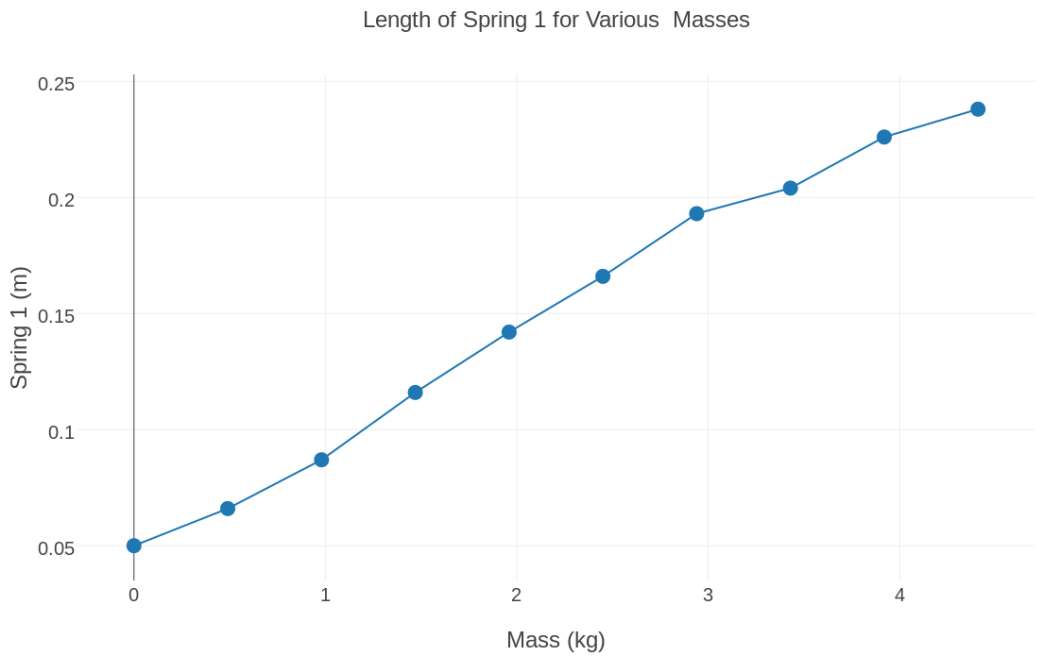
To examine this data, we can log into Plotly, then use the "import" menu to browse for the file $hooke.csv$ and bring it into the Plotly grid, so that we see something like this:



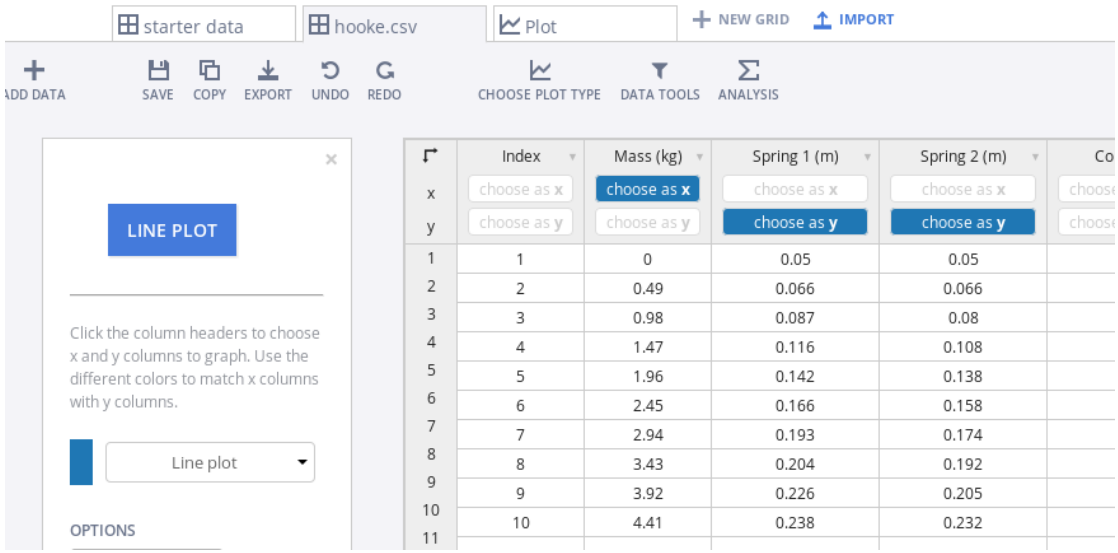
We need to change “Choose as x” and “Choose as y” so that we plot Mass versus Spring 1 Length,



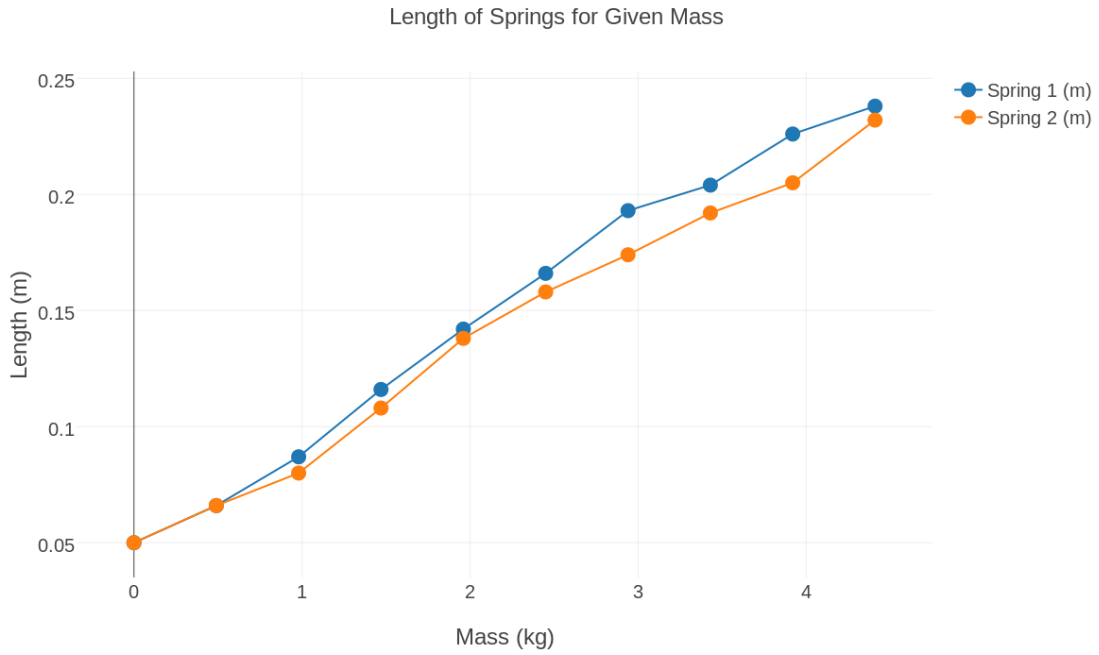
Now we have a "broken line" plot of the data for spring 1.



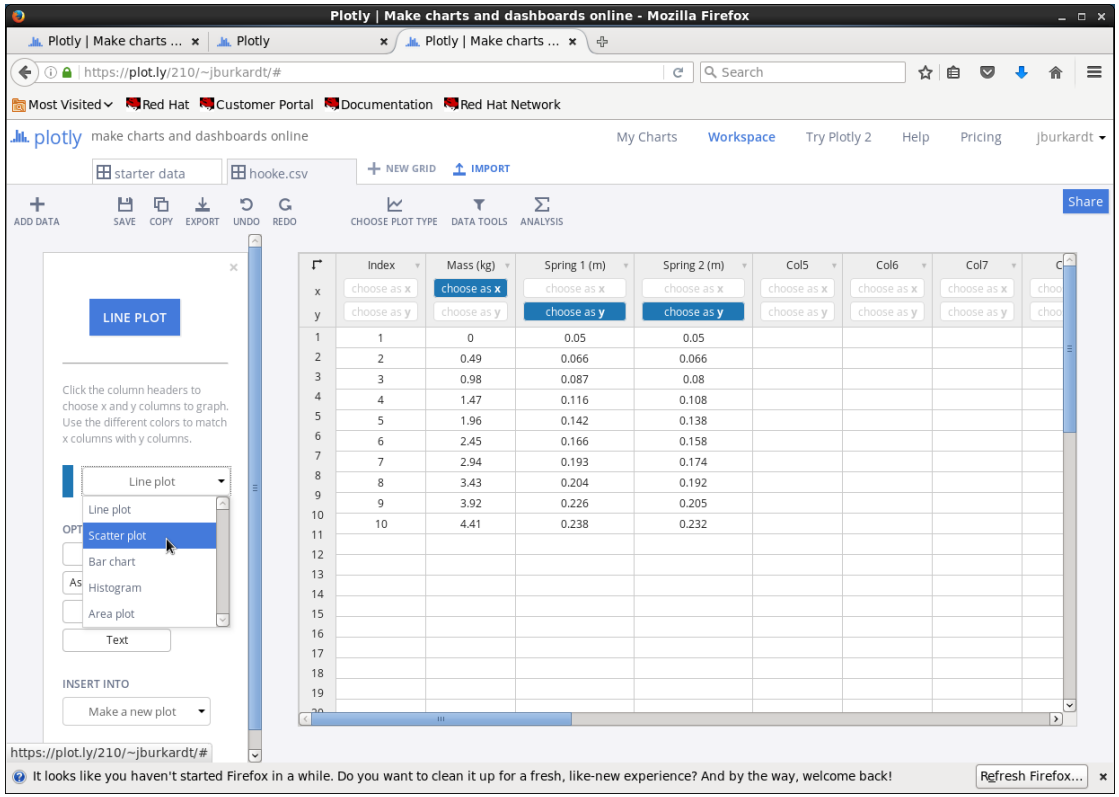
We can go back to the data grid and add the Spring 2 data using "choose as y"



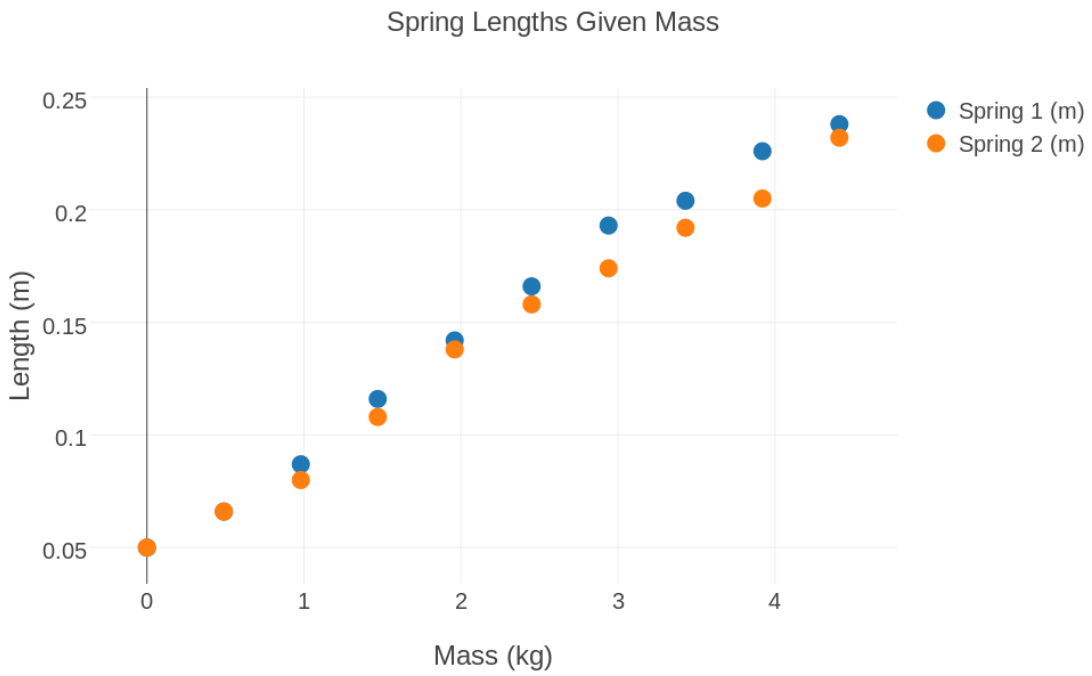
The blue and orange lines are for springs 1 and 2.



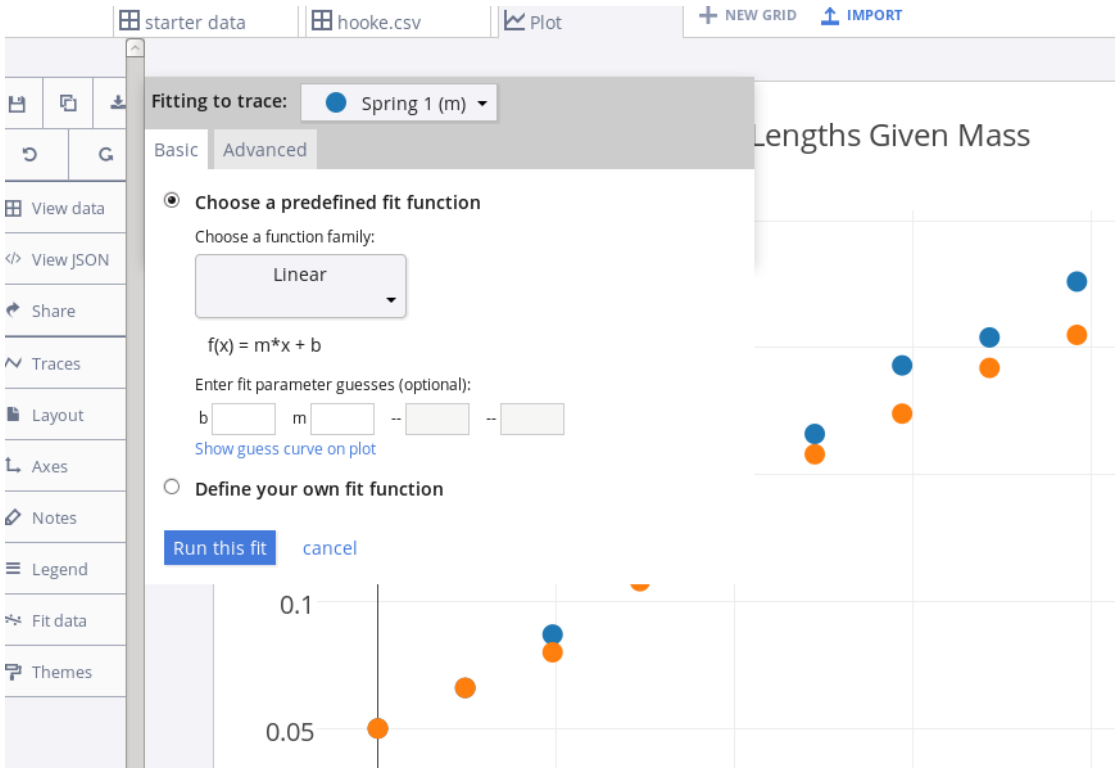
Our data doesn't lie on straight lines. Let's redraw the points as scatterplots.



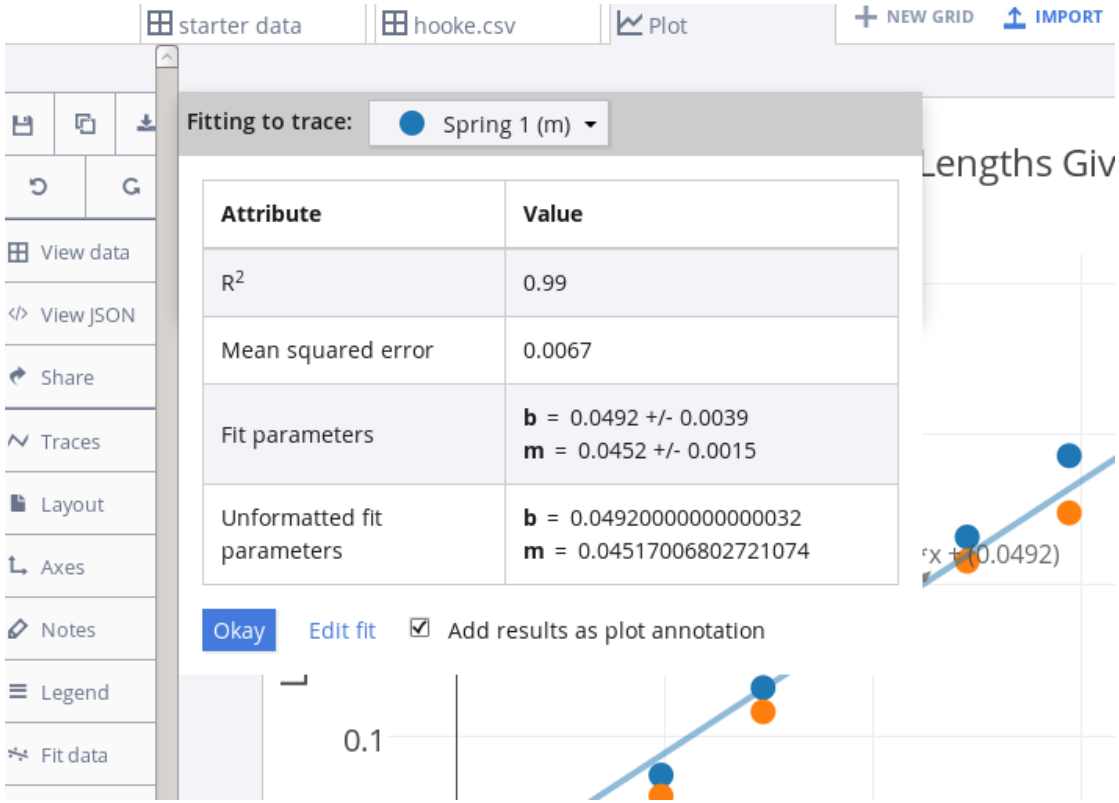
Here is just the data.



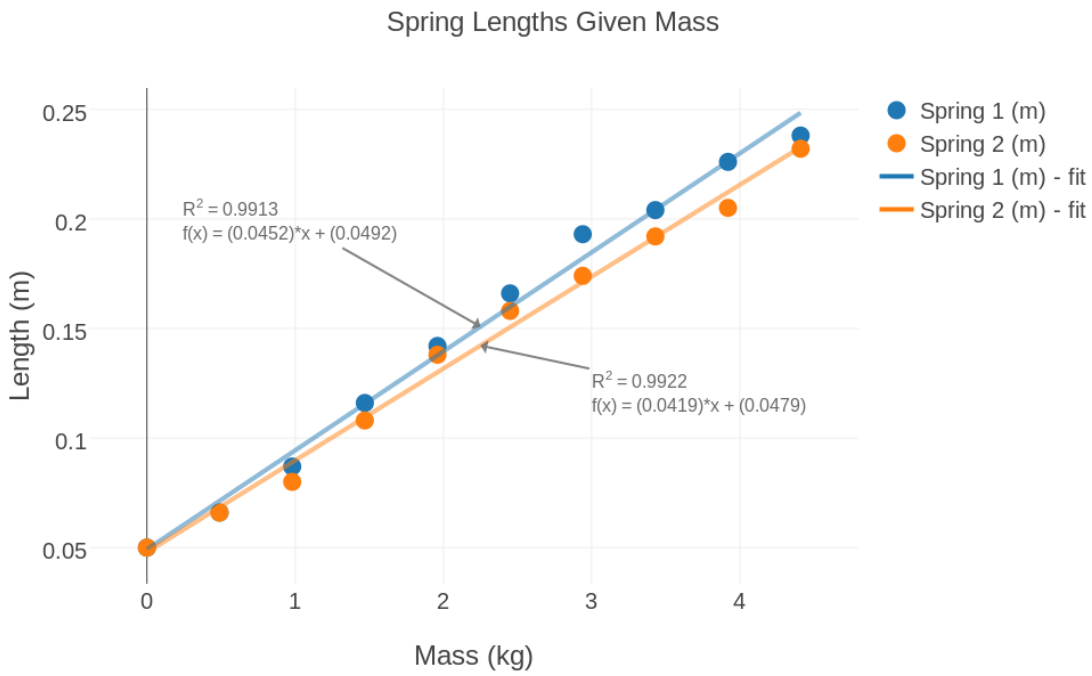
By using the Fit data menu, we can request a line like the (blue) data.



Plotly finds a formula $y = 0.0452x + 0.0492$ that best fits the blue data.



We can also get a fitting line for the orange data.



Example 2: Housing Data from Zillow

A realtor considers many factors when suggesting a listing price for a house:

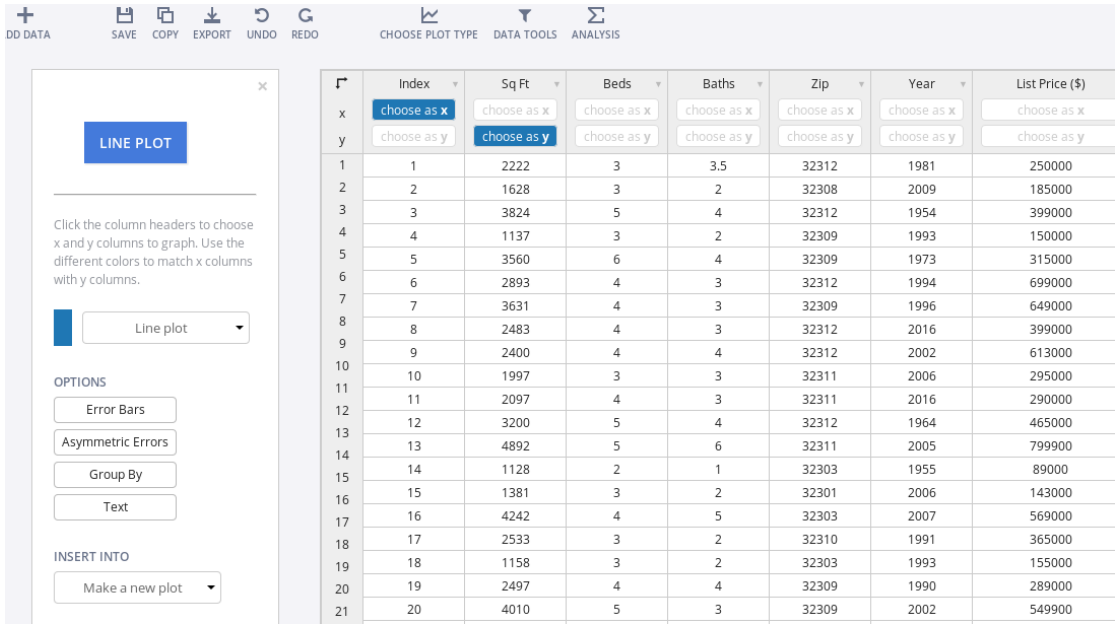
- the square footage;
- number of bedrooms and bathrooms;
- the zip code;
- the year the house was built.

Experience suggests that the square footage is one of the most important.

Here is sample data stored in the file *zillow.csv*

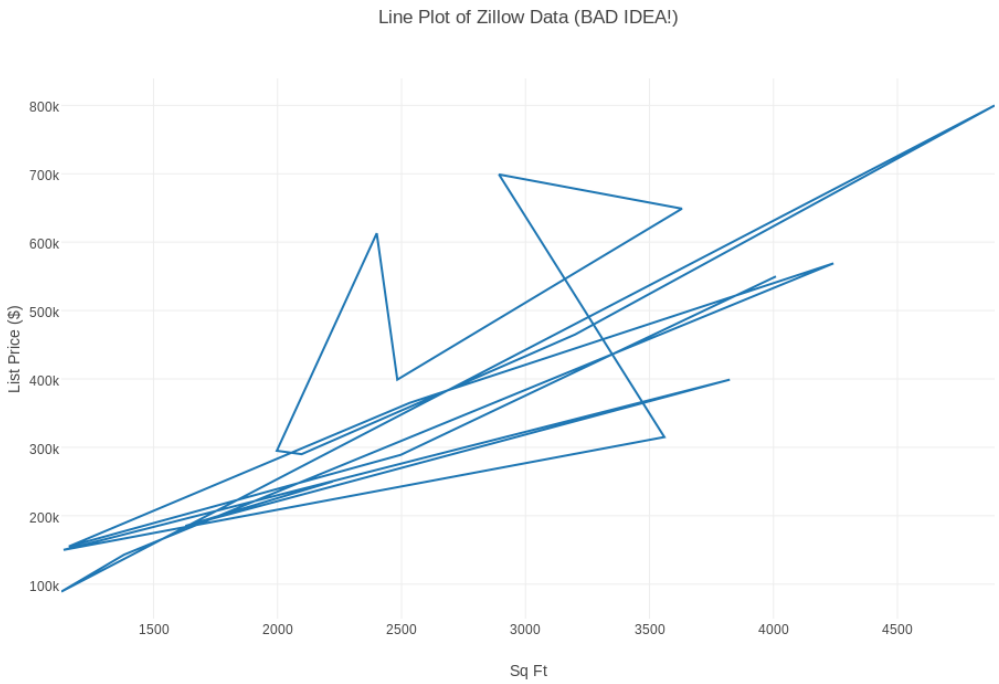
"Index",	"(Sq Ft)",	"Beds",	"Baths",	"Zip",	"Year",	"List Price ($)"
1,	2222,	3,	3.5,	32312,	1981,	250000
2,	1628,	3,	2,	32308,	2009,	185000
3,	3824,	5,	4,	32312,	1954,	399000
—	—	*more data*	—	—	—	—
18,	1158,	3,	2,	32303,	1993,	155000
19,	2497,	4,	4,	32309,	1990,	289000
20,	4010,	5,	3,	32309,	2002,	549900

To examine this data, we can log into Plotly, then use the "import" menu to browse for the file $zillow.csv$ and bring it into the Plotly grid, so that we see something like this:

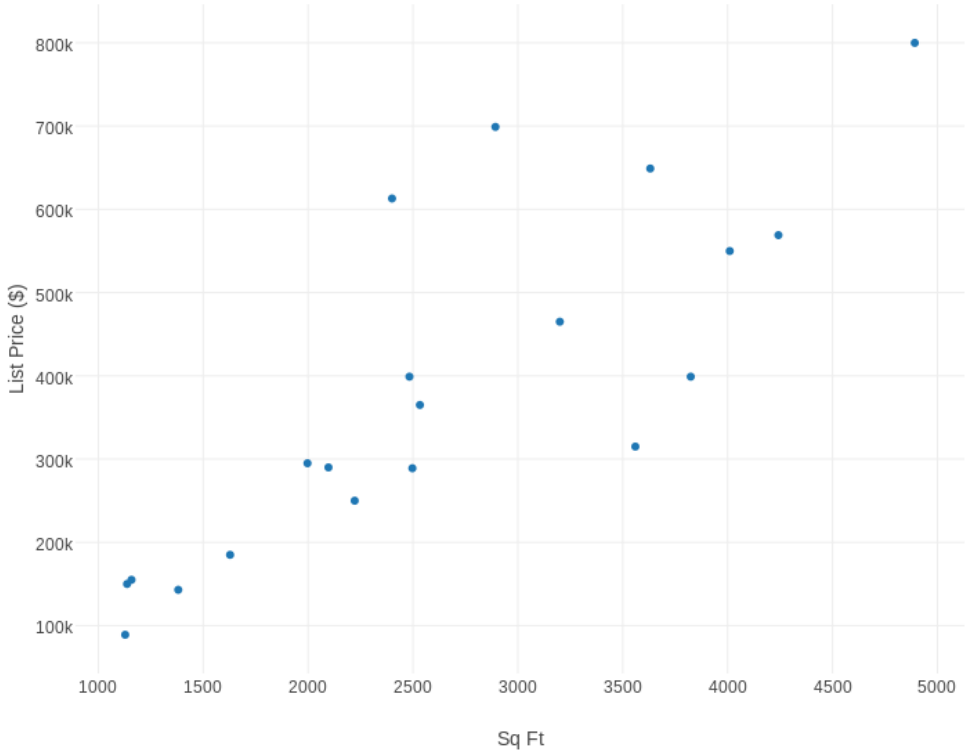


	Index	Sq Ft	Beds	Baths	Zip	Year	List Price ($)
x	choose as x	choose as x	choose as x	choose as x	choose as x	choose as x	choose as x
y	choose as y	choose as y	choose as y	choose as y	choose as y	choose as y	choose as y
1	1	2222	3	3.5	32312	1981	250000
2	2	1628	3	2	32308	2009	185000
3	3	3824	5	4	32312	1954	399000
4	4	1137	3	2	32309	1993	150000
5	5	3560	6	4	32309	1973	315000
6	6	2893	4	3	32312	1994	699000
7	7	3631	4	3	32309	1996	649000
8	8	2483	4	3	32312	2016	399000
9	9	2400	4	4	32312	2002	613000
10	10	1997	3	3	32311	2006	295000
11	11	2097	4	3	32311	2016	290000
12	12	3200	5	4	32312	1964	465000
13	13	4892	5	6	32311	2005	799900
14	14	1128	2	1	32303	1955	89000
15	15	1381	3	2	32301	2006	143000
16	16	4242	4	5	32303	2007	569000
17	17	2533	3	2	32310	1991	365000
18	18	1158	3	2	32303	1993	155000
19	19	2497	4	4	32309	1990	289000
20	20	4010	5	3	32309	2002	549900

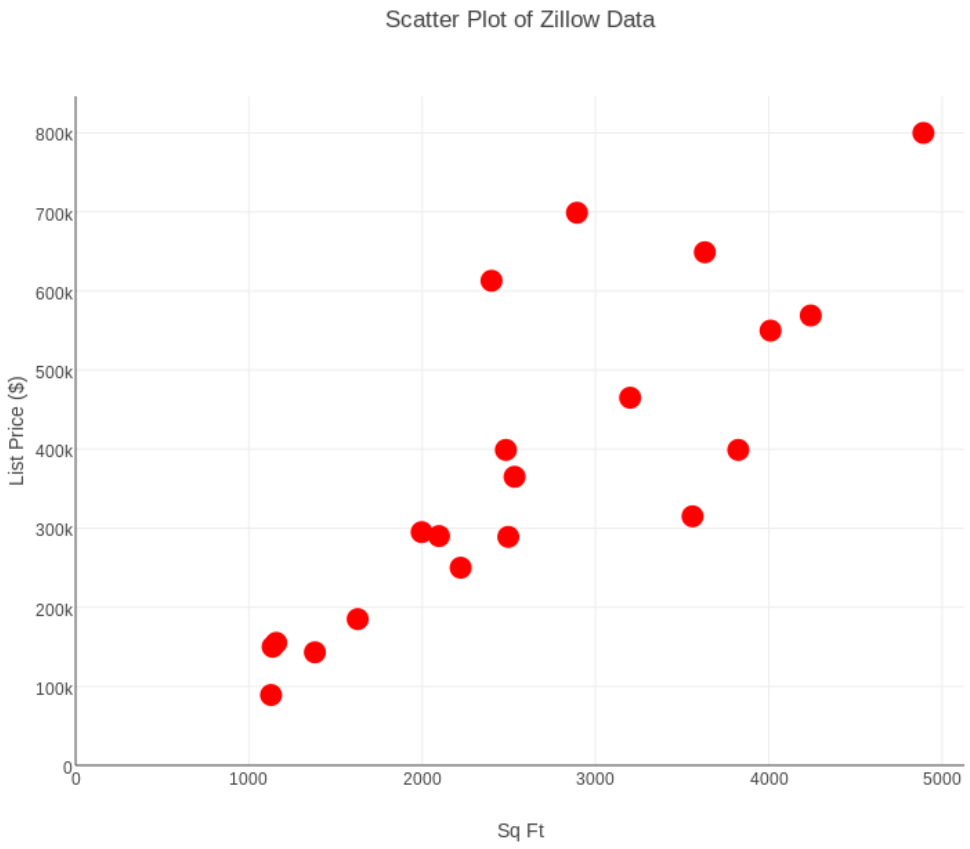
We can **choose as x** square footage, and **choose as y** the price and hit Line Plot, but here's what we get:



Our data is not suitable for line plots; we can make a scatter plot.



The **Traces** menu changes the size and color of dots. The **Axes** menu shifts the graph so we see the zero values for Footage and Price.



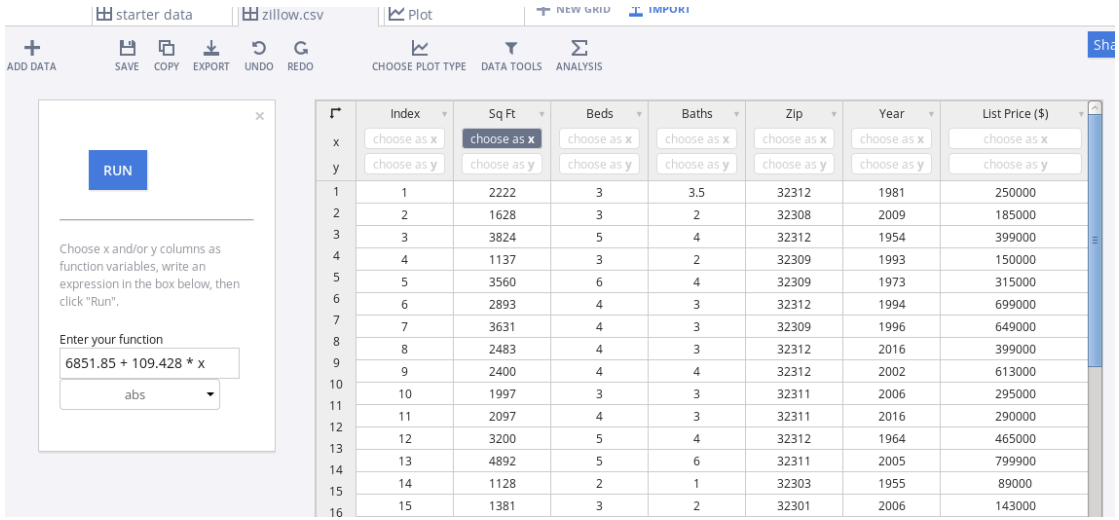
Now it seems like there is a general trend of the data, that the list price increases with the square footage.

If we think about it carefully, we can even find a formula that exact predicts the relationship between footage and price, if we just consider the first two pairs of data:

```
footage x = 2,222, price y = $250,000
footage x = 1,628, price y = $185,000
```

The formula is $y = 6851.85 + 109.428x$. We'd like to compare this formula to all 20 of our data points.

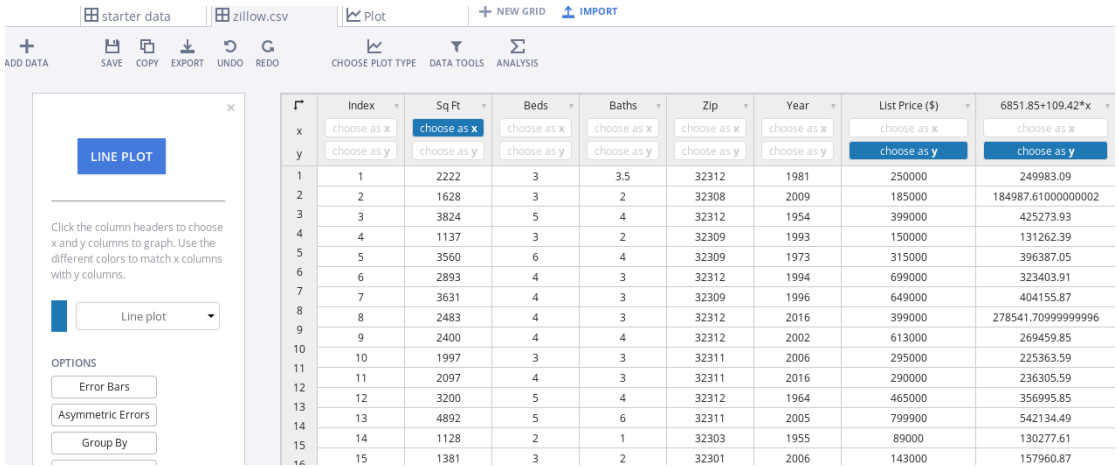
If we select the Data Tools item, and then formula f(x), we see a box to enter our formula:



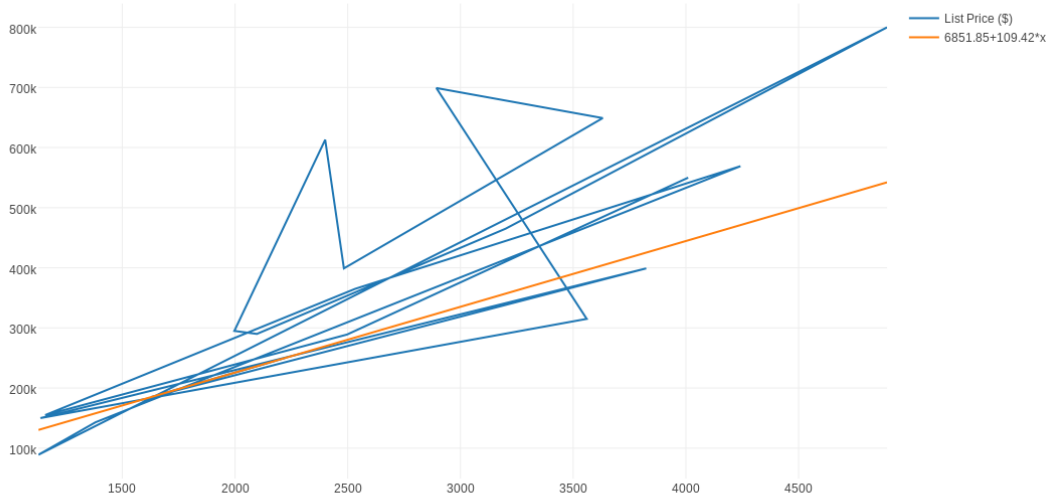
Using square footage as x, Plotly creates a new column of formula values.

	Index	Sq Ft	Beds	Baths	Zip	Year	List Price ($)	6851.85+109.42*x
x	choose as x	choose as x	choose as x	choose as x	choose as x	choose as x	choose as x	choose as x
y	choose as y	choose as y	choose as y	choose as y	choose as y	choose as y	choose as y	choose as y
1	1	2222	3	3.5	32312	1981	250000	249983.09
2	2	1628	3	2	32308	2009	185000	184987.61000000002
3	3	3824	5	4	32312	1954	399000	425273.93
4	4	1137	3	2	32309	1993	150000	131262.39
5	5	3560	6	4	32309	1973	315000	396387.05
6	6	2893	4	3	32312	1994	699000	323403.91
7	7	3631	4	3	32309	1996	649000	404155.87
8	8	2483	4	3	32312	2016	399000	278541.70999999996
9	9	2400	4	4	32312	2002	613000	269459.85
10	10	1997	3	3	32311	2006	295000	225363.59
11	11	2097	4	3	32311	2016	290000	236305.59
12	12	3200	5	4	32312	1964	465000	356995.85
13	13	4892	5	6	32311	2005	799900	542134.49
14	14	1128	2	1	32303	1955	89000	130277.61
15	15	1381	3	2	32301	2006	143000	157960.87
16	16	4242	4	5	32303	2007	569000	471011.49

Now we can plan to plot square footage against our data **and** our formula values.

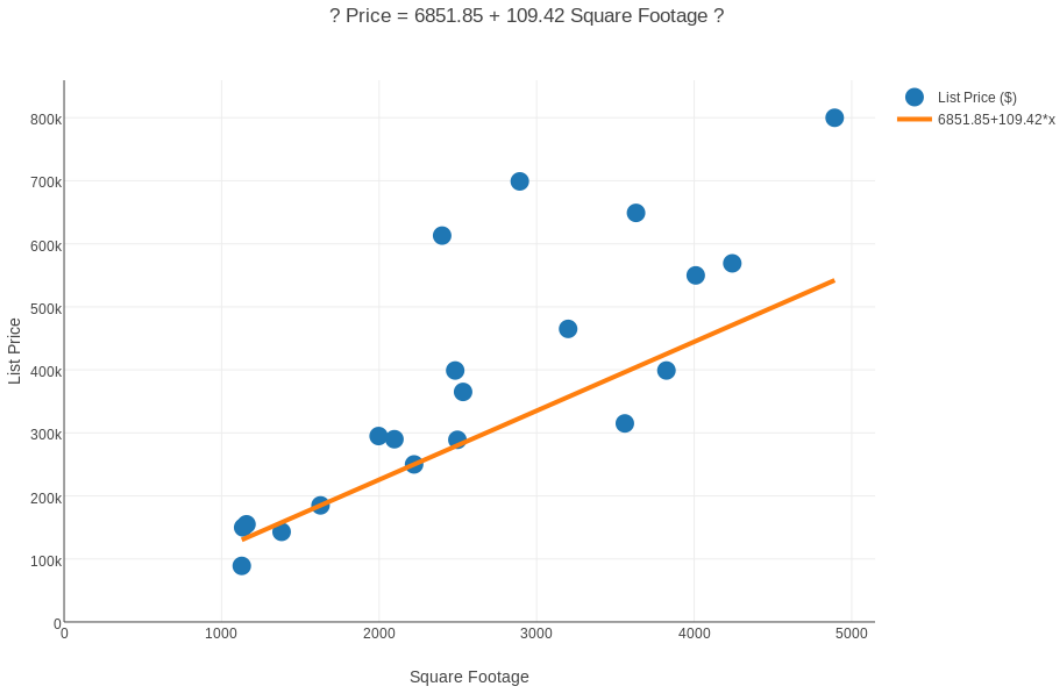


Choosing **Line Plot**, Plotly will make a mess of our data, but the line shows up just fine.



We can clean things up.

- Use **Traces/Mode/Lines/Markers** to change tha marker for the list price data from a line to a dot;
- Use **Traces/Style** to change the size of dots from 6 to 16;
- Use **Axes** to shift the x-axis and y-axis to start at 0;


? Price = 6851.85 + 109.42 Square Footage ?
List Price ($)
6851.85+109.42*x
List Price
800k
700k
600k
500k
400k
300k
200k
100k
0
0
1000
2000
3000
4000
5000
Square Footage