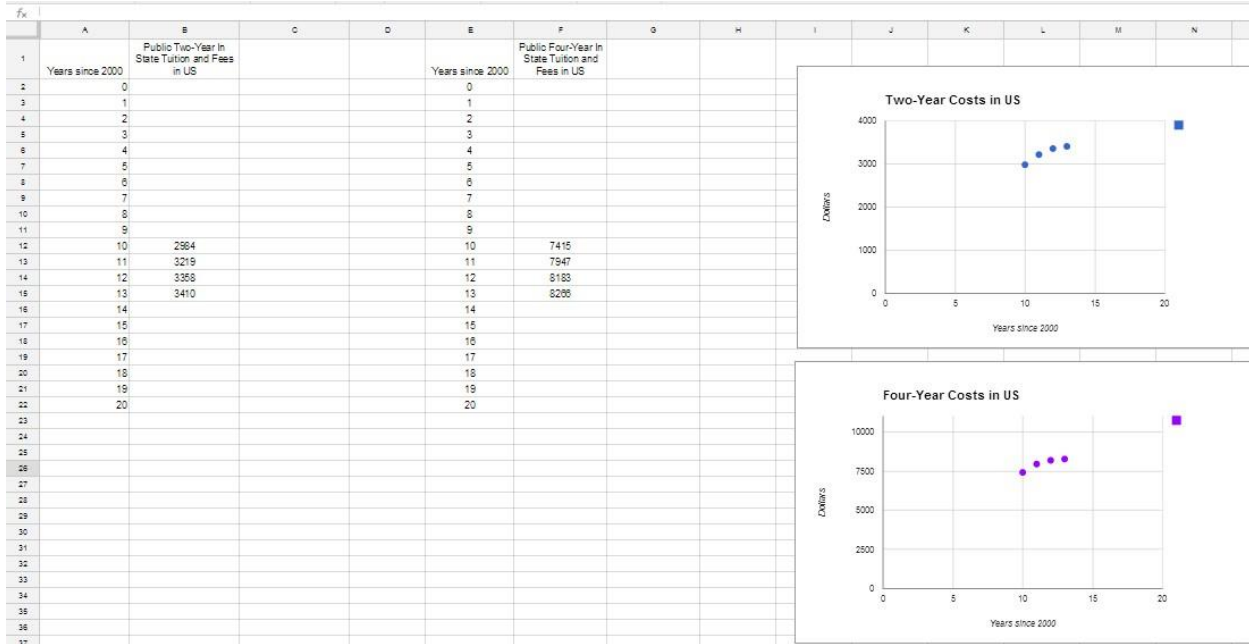


Tech Assignment: Find a Linear Function for College Costs

In this technology assignment, you will find a linear function that passes through two of the points on each of the scatter plots you created in the last technology assignment. You will need the file you created in the last technology assignment. The file should contain a worksheet called t1_yourname that looks like the one below.



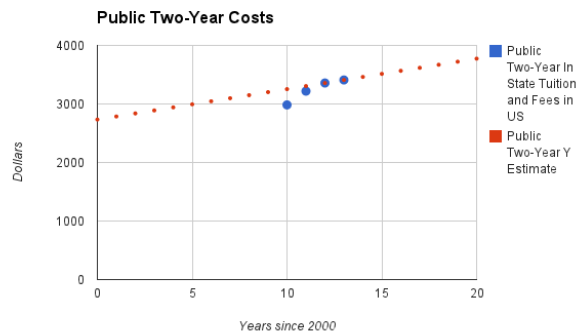
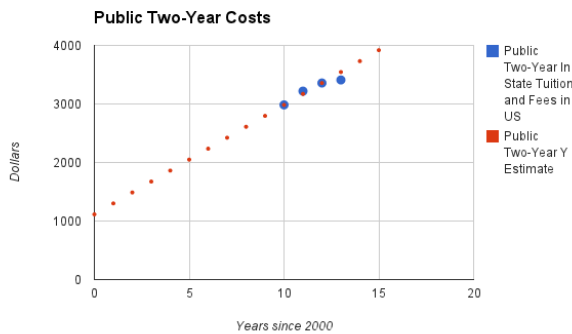
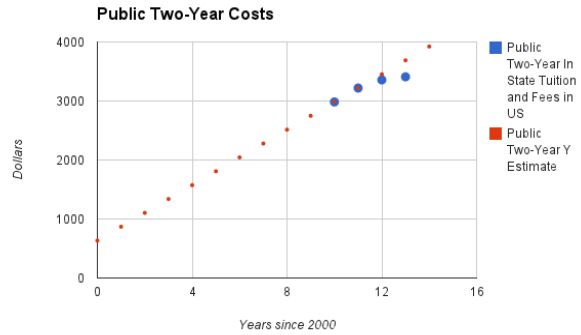
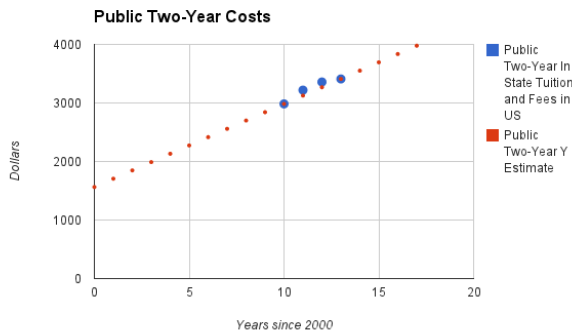
Your worksheet will differ from this one since yours uses the data you have been assigned in the project.

Before we can put the linear function that passes through two points on the scatter plot, we need to find the function by doing some mathematics. I'll show you how to do this math using the data for the US tuition and fees at two-year colleges. You should complete the same process for both sets of data for the state you are assigned.

Select the Points You'll Use

For this project, we'll find a linear function that passes close to the data for tuition and fees at two-year colleges by making the line pass through two of the data points. There are six possibilities we could choose. We could pass through the first two points, the first and third, the second and fourth, the last two, ect. Some of these possibilities are pictured below.

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Of these four possibilities, the graph on the upper left seems to pass as close to the points as possible. We can see this by looking at the location of the points on the same vertical window of $[0, 4000]$.

If you are doing the project collaboratively, assign each member of your group a pair of points that they will use to find the equation of the mathematical model. If you are doing the project individually, pick a pair of points that seems to represent the overall trend of the data best. Later on will quantify how close the line passes to the points so that you can pick the best mathematical model.

Find the Equation of the Line

We will demonstrate how to find a line through a pair of points using the ordered pairs $(10, 2984)$ and $(13, 3410)$. With these ordered pairs, the x values represent the number of years since 2000 and the y values represent the tuition and fees at US two-year colleges.

The slope between these points is calculated using the formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

where (x_1, y_1) and (x_2, y_2) are the ordered pairs we want the line to pass through. For the two points above,

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$$m = \frac{3410 - 2984}{13 - 10} = \frac{426}{3} = 142$$

Luckily, the value for the slope is exactly 142 and not some nasty decimal. If the slope had turned out to be a rounded decimal, we would use the fraction as the slope. This ensures that the line passes through the points exactly and not just very close.

Now let's put this slope into the slope-intercept form of a line, $y = mx + b$. We can use different variables for x and y . For simplicity, we'll stick with x and y . Using the slope, we get

$$y = 142x + b$$

To find the value of the y intercept, substitute one of the ordered pairs on the line for x and y . Solve the resulting equation for b . We will do this using the ordered pair (10, 2984):

$$2984 = 142(10) + b$$

Put in the ordered pair for x and y

$$2984 - 142(10) = b$$

Isolate b

$$1564 = b$$

Simplify the expression on the left side

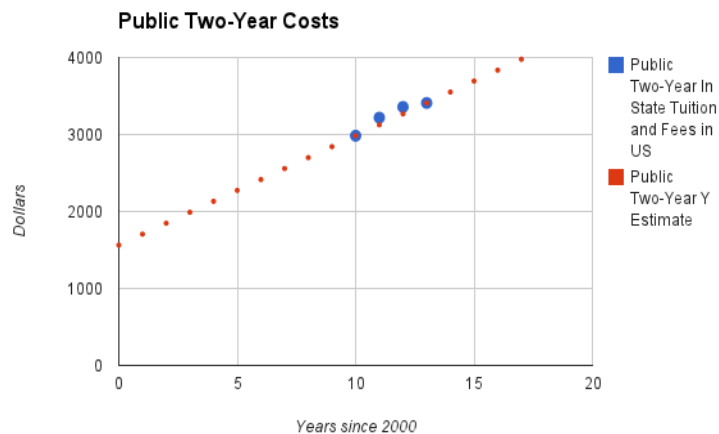
This means the equation of the line passing through the two points is

$$y = 142x + 1564$$

With this equation in hand, we can use Excel to graph the equation on the scatter plot of the tuition and fees at two-year colleges.

Graph a Line on a Scatter Plot

Our goal is to use Excel to create a graph like the one below.

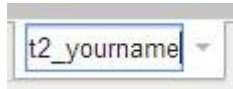


Once you have completed the process for your first scatter plot, you will need to find another line corresponding to the scatter plot for four-year colleges.

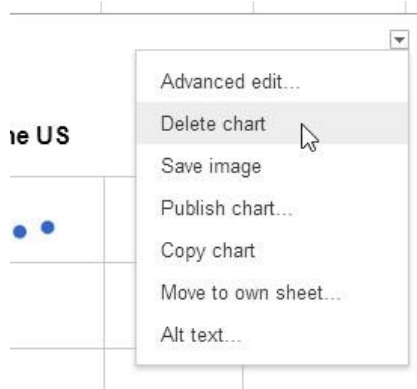
Put the Linear Model on the Scatter Plot

Before we add the linear model to your graph, let's duplicate the worksheet you made in the previous technology assignment.

1. Open your Sheets file. Right click on the tab for your previous technology assignment. Select Duplicate from the menu that appears. A duplicate worksheet will be created.
2. Double click on the duplicate tab. This will allow you to rename the worksheet to something like t2_yourname.



3. You will make new graphs in this worksheet. Before you do this, we need to delete the two scatter plots made in a previous assignment. Click on the top graph. In the upper right hand corner is a small triangle. Left click on this triangle to open a menu. Select Delete chart.



Repeat this step to delete the second scatter plot.

4. You will put y values from your linear function for two-year colleges in column C of your worksheet. Let's label this column in cell C1. Type in a label like Public Two-Year Y Estimate.

	A	B	C
1	Years since 2000	Public Two-Year In State Tuition and Fees in US	Public Two-Year Y Estimate
2	0		

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You may need to format the cell a bit to look like the one above. You can do this using the Format menu at the top of the sheet.

- Now you need to fill the rest of the column with values from the cost function for two-year colleges. In this case, the formula is $y = 142x + 1564$. In cell C2, type `=142*A2+1564`. The `=` sign indicates that the value for this cell is a calculation.

fx =142*A2+1564			
	A	B	C
1	Years since 2000	Public Two-Year In State Tuition and Fees in US	Public Two-Year Y Estimate
2	0		=142*A2+1564

Instead of typing A2, you could also click on the cell A2.

- Press Enter to have the value calculate in the cell.

fx			
	A	B	C
1	Years since 2000	Public Two-Year In State Tuition and Fees in US	Public Two-Year Y Estimate
2	0		1564
3	1		

- Click in cell C2 again. Use the cursor to graph the fill box in the lower right corner of the cell. While holding the left mouse button down, drag the mouse to cell C22 and release the button.

The y values for the function will fill cells C2 through C22.

Note the y values in cells C12 and C15. These values match the values in cells B12 and B15. This indicates that the model passes through the two points as it should.

Now you need to graph the data and the model together to help show how close the model falls with respect to the data.

- To graph the data and the corresponding model together, we need to select the numbers in the first three columns. Click on cell A1. While holding the left mouse button down, drag the cursor to cell C22. The numbers in the cells should be highlighted as shown below.

	A	B	C
1	Years since 2000	Public Two-Year In State Tuition and Fees in US	Public Two-Year Y Estimate
2	0		1564
3	1		1706
4	2		1848
5	3		1990
6	4		2132
7	5		2274
8	6		2416
9	7		2558
10	8		2700
11	9		2842
12	10	2984	2984
13	11	3219	3126
14	12	3358	3268
15	13	3410	3410
16	14		3552
17	15		3694
18	16		3836
19	17		3978
20	18		4120
21	19		4262
22	20		4404

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fx	Years since 2000		
	A	B	C
1	Years since 2000	Public Two-Year In State Tuition and Fees in US	Public Two-Year Y Estimate
2			1564
3			1706
4			1848
5			1990
6			2132
7			2274
8			2416
9			2558
10			2700
11			2842
12		2984	2984
13		3219	3126
14		3358	3268
15		3410	3410
16			3552
17			3694
18			3836
19			3978
20			4120
21			4262
22			4404
23			

9. Now let's take the data and create a scatter plot with it. From the menu bar select the Insert

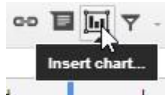
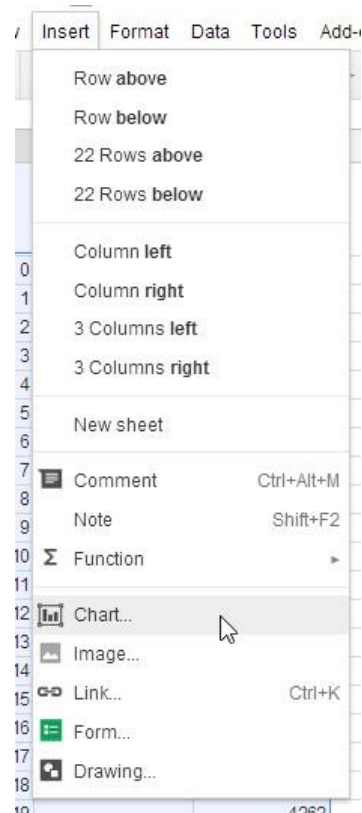


Chart button or choose the Insert menu and then Chart.



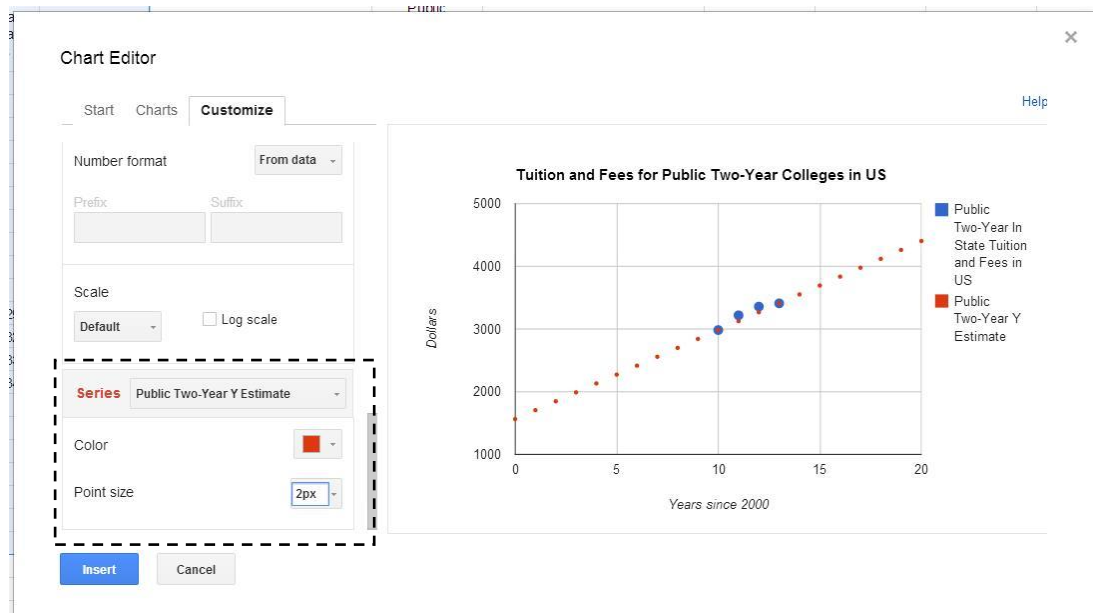
10. The recommended charts do not include a scatter plot. To see this choice, select More next to Recommended charts. Next choose Scatter and then the first chart option.

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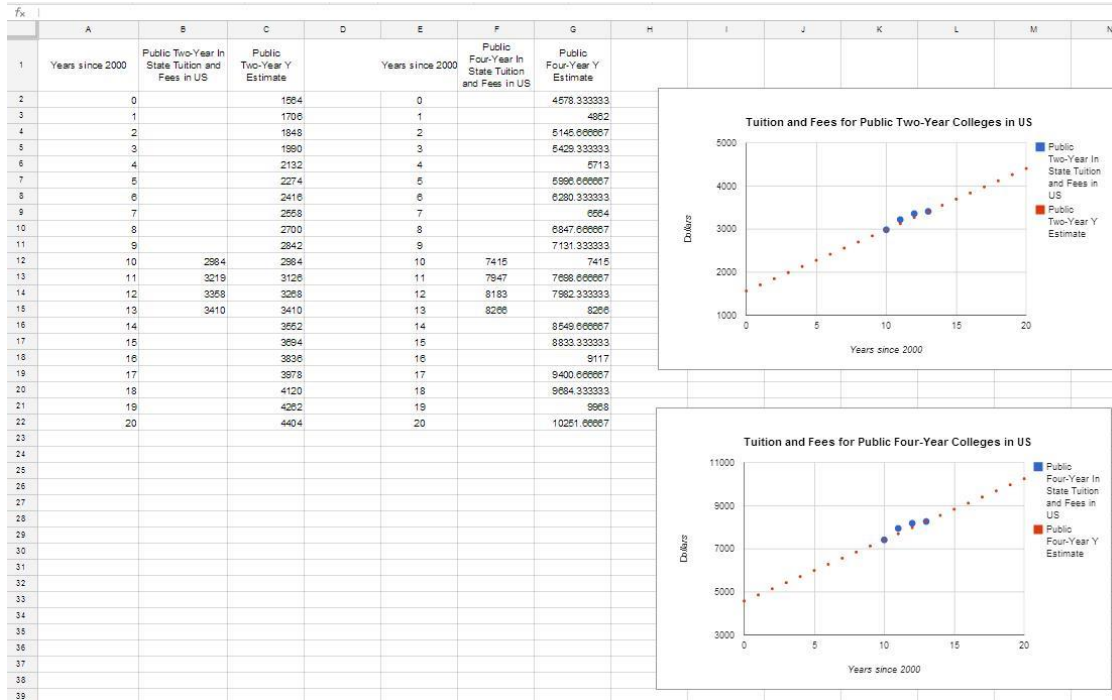
11. Before selecting Insert, let's customize the chart a bit. Choose the Customize tab near the top of the Chart Editor. As in previous assignments, add a title and labels to your graph. Make sure you use terms that are appropriate to your data.

Scroll to the bottom of the Customize tab to where you see Series and Select Public Two-Year Y Estimate. If you like, you may adjust the color. To emphasize the data, reduce the Point size to 2px. This makes it easier to see the data points with respect to the linear model.



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12. Select Insert to put the graph in the worksheet. You might need to grab the graph and move it to the right to make everything visible.
13. You will also need to graph of your four-year data and model. Repeat steps 4 through 12 using the data in columns E and F as well as the model for four-year colleges in column G. When complete, your worksheet should look similar to the one below.



14. If you have done everything correctly, two of your estimates from the linear model in columns C and G should match the data in columns B and F. Make sure your points match as they should.