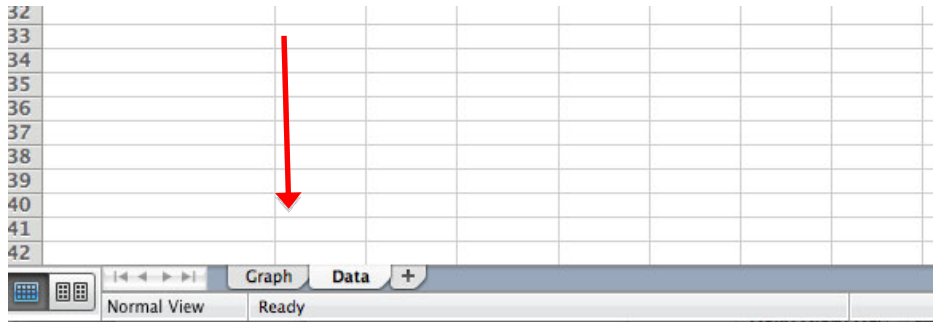


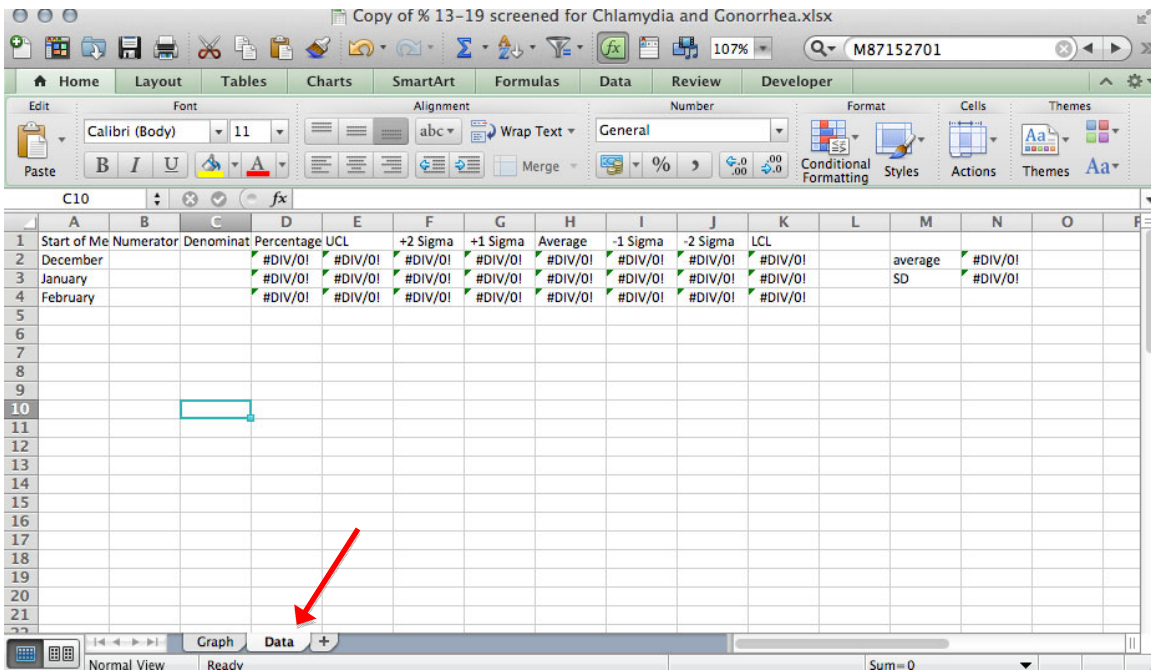


Guide to using Excel Control Charts

OVERVIEW: This guide provides instructions on how to use control charts in Excel. When you open your control chart you will notice that each Excel file has two tabs at the bottom of the data sheet, one for the *Graph* from your control chart and one for the *Data* that you will enter to populate your graph.

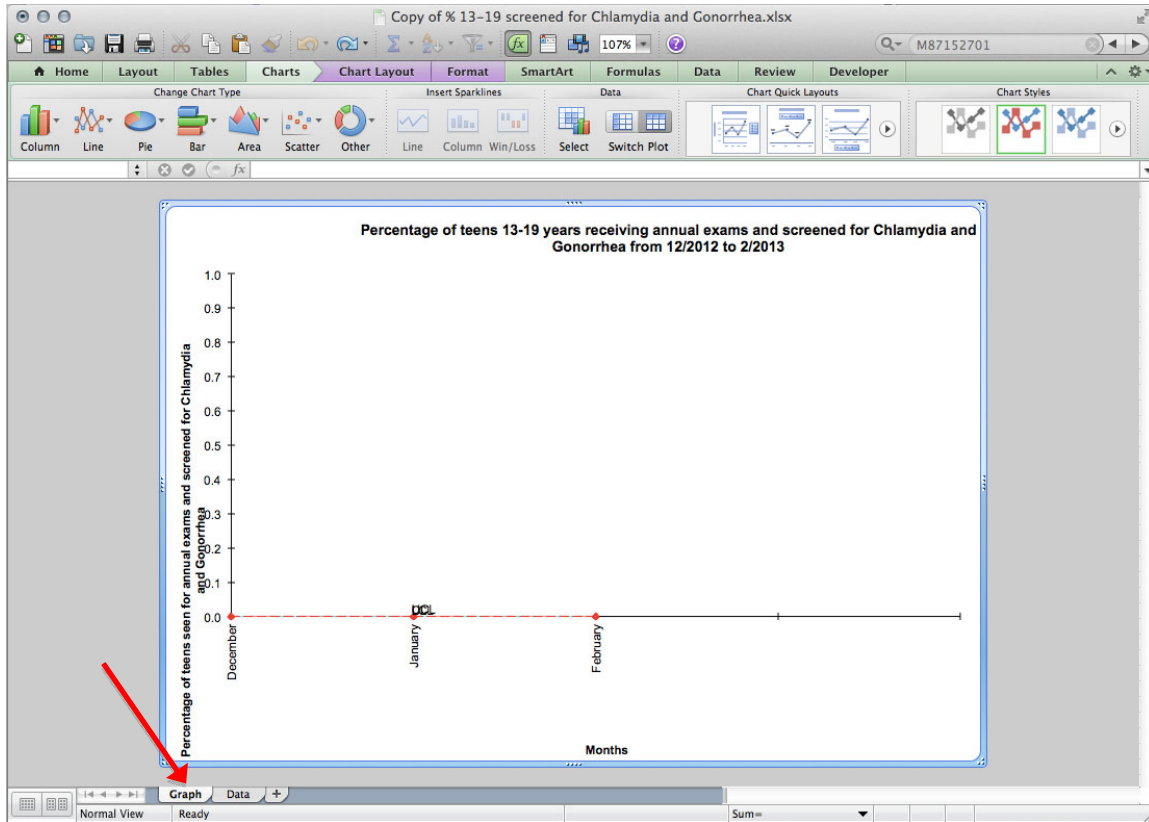


- The *Graph* tab takes the data that you have entered in the *Data* tab and uses it to populate the graph. It is important to remember that if you have not entered any data in your *Data* tab, then you will not have anything to graph and thus your graph will appear empty. When you first open your Excel file, this is what the *Data* tab of your spreadsheet will look like:





- When you first open your Excel file, this is what the *Graph* tab of your spreadsheet will look like:



CONTROL CHART LAYOUT: Below you will find a guide to the different parts of the *Data* tab within the control chart.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	Start of Measurement Period	Numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL			
1	December			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		average	#DIV/0!
2	January			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		SD	#DIV/0!
3	February			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!			
4														
5														

1. **Start of Measurement Period:** This column represents the months or time points that will be included within the control chart. Each row within the spreadsheet will be filled with data that was gathered for that particular month.
2. **Numerator:** The numerator column will be used to enter the new events that have occurred for each month that data is gathered. Please note that each numerator should only include the events that occurred in that particular month (i.e., there



- were 3 new cases of Chlamydia in December out of the 20 people that were tested).
- 3. Denominator:** The denominator column will include the total sample size that was used for that month. Adding to the example above, if there were 3 new cases of Chlamydia in December out of the 20 people that were tested the denominator would be 20.
 - 4. Percentage:** The percentage is calculated by taking the values in the numerator column and dividing them by the values in the denominator column. Excel has been formatted to present these values in a percent format.
 - 5. Upper Confidence Level:** The upper confidence level is found by taking the average of the row (row 8) and adding it to 3 times the standard deviation for all of the values. For instance, if the average is 14.5 and standard deviation is 12.9, than the upper confidence level is 54.2 or $(14.5 + (3 \times 12.9) = 54.2)$.
 - 6. +2 Sigma:** +2 Sigma is found by taking the average of the row and adding it to 1.96 times the standard deviation for all of the data values. For instance, if the average is 14.5 and standard deviation is 12.9, than the +2 Sigma is 40.3 or $(14.5 + (2 \times 12.9) = 40.3)$.
 - 7. +1 Sigma:** +1 Sigma is found by adding together the average of the row and the standard deviation for all of the data values. For instance, if the average is 14.5 and standard deviation is 12.9, than the +1 Sigma is 27.4 or $(14.5 + 12.9 = 27.4)$.
 - 8. Average:** The average value is the same as the average for all of the data values and thus this number should be the same for all of the rows of data. For instance if the data from three consecutive months were 29.4%, 6.3%, and 7.8 %, the average would be 14.5 or $((29.4 + 6.3 + 7.8) / 3 = 43.5 / 3 = 14.5)$.
 - 9. -1 Sigma:** -1 Sigma is found by subtracting the standard deviation for all of the data values from the average for the row. For instance, if the average is 14.5 and standard deviation is 12.9, than the -1 Sigma is 1.6 or $(14.5 - 12.9 = 1.6)$.
 - 10. -2 Sigma:** -2 Sigma is found by taking the average of the row and subtracting it from 1.96 times the standard deviation for all of the values. For instance, if the average is 14.5 and standard deviation is 12.9, than the -2 Sigma is -11.3 or $(14.5 - (2 \times 12.9) = -11.3)$.
 - 11. Lower Confidence Level:** The lower confidence level is found by taking the average of the row values and subtracting it from 3 times the standard deviation for all of the data values. For instance, if the average is 14.5 and standard deviation is 12.9, than the lower confidence level is -24.2 or $(14.5 - (3 \times 12.9) = -24.2)$.



- 12. **Average and SD:** This average is the average of the percentages in column D. The standard deviation is a measure of variation from the average across all column entries. It is found by using the standard deviation function in Excel.

EXCEL FUNCTION FUNDAMENTALS: Before attempting to understand what should be entered in the chart, you must first understand some basic Excel principles. Here are the Excel principles that are fundamental to understanding how to create a control chart:

- 1. Cell: a cell can be thought of as a box that makes up a small part of your *Data* tab. A cell is used to store a unit of data as well as can be used to calculate new values (i.e., sum, mean, standard deviation, etc...). This is what a cell looks like:

Start of Me	Numerator	Denominat	Percentage
December			#DIV/0!
January			#DIV/0!
February			#DIV/0!

- 2. Formula Bar: By clicking on a cell with a value that was created by an equation, you can see how that number was calculated in the formula bar. If you place your cursor in the equation within the formula bar, it will highlight the cell(s) that were used when forming the calculation. In the example below, the value in cell D3 was calculated by taking the value in cell B3 and dividing it by the value in cell C3. The percent symbol after C3 tells Excel to present the value in a percent format.

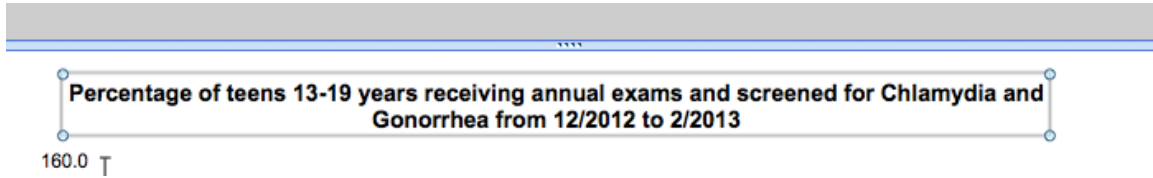
In this example, “#DIV/0!” is used by Excel when there are no values for equation to calculate. As you enter data, “#DIV/0!” will disappear, if it does not disappear, use the troubleshooting section below for tips on how to fix this problem.

	A	B	C	D	E	F
1	Start of Me	Numerator	Denominat	Percentage	UCL	+2 Sig
2	December			#DIV/0!	#DIV/0!	#DIV
3	January			#DIV/0!	#DIV/0!	#DIV
4	February			#DIV/0!	#DIV/0!	#DIV

- 3. Format Graph: There are a few things that are important to know when trying to create and format your graph. It is important to note that when in the *Graph* tab,

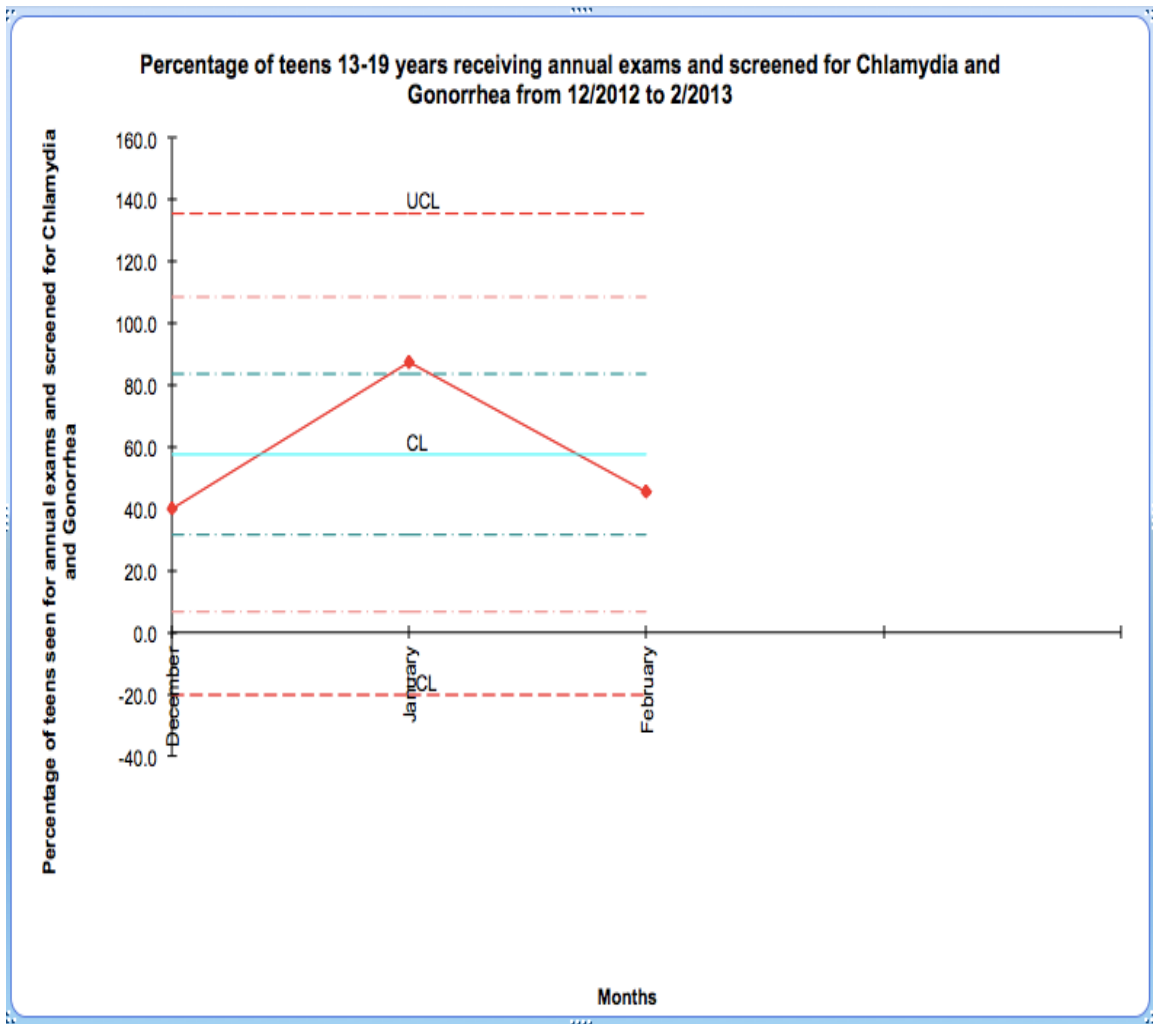


you can select any of the text boxes (i.e., main title or axis titles) by clicking on the text box around them. Once you have selected the text box you can adjust its location relative to the graph itself by moving your cursor around in the window. Sometimes when you update the data in your graph the titles get shifted and need corrections.

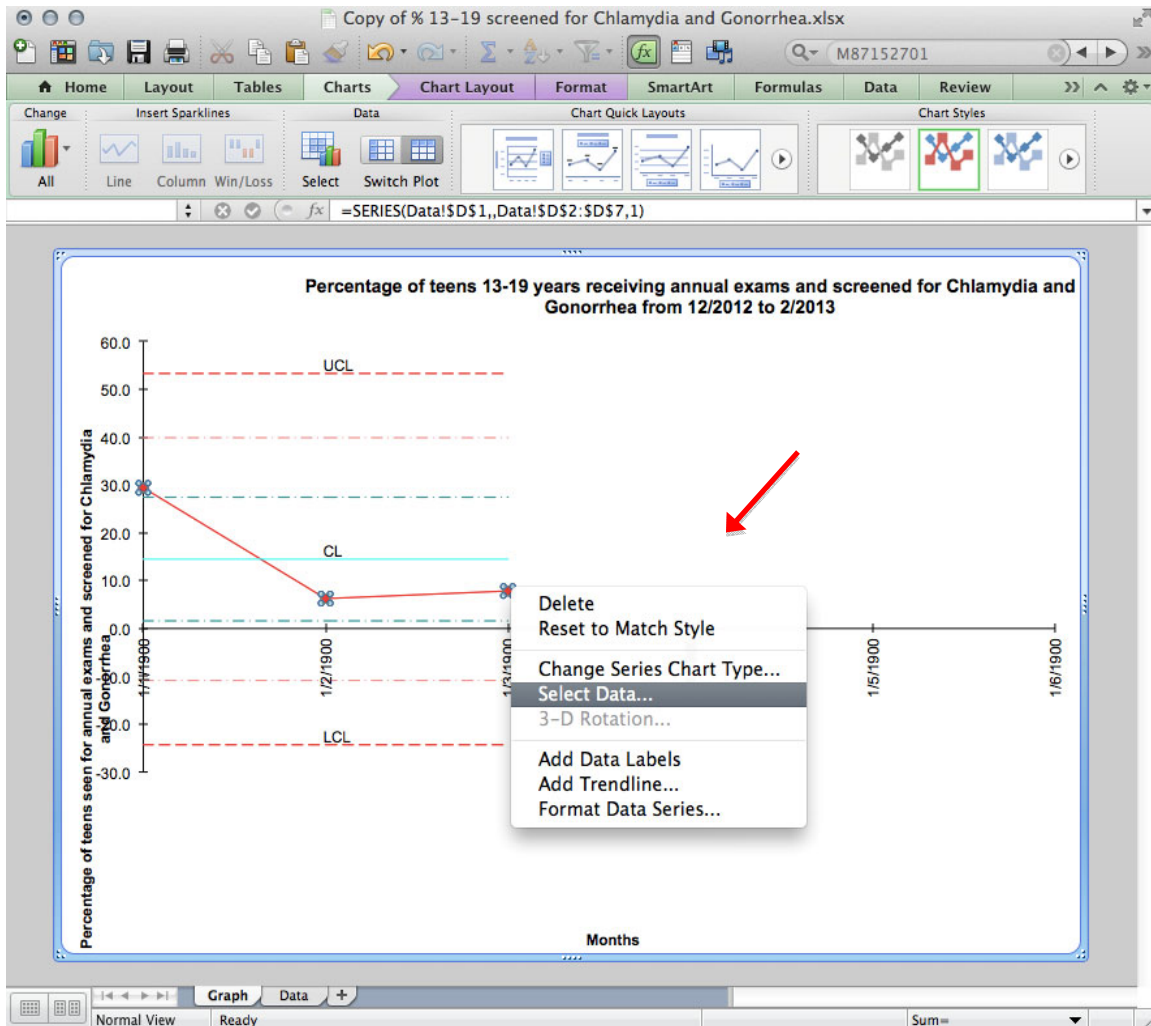


Further, if you right-click on the y-axis and select the numbers that run vertically down the side of your graph, you can update the scale values as well as the font and text style options.

To make sure that your graph actually represents the data in your *Data* tab, you will often need to update the data selected in your graph.



To access this, you need to go to your *Graph* tab, select one of the red data dots (Fictitious data has been provided to better illustrate the example) and right click on it. Once you have right-clicked on the graph, please select the “Select Data” option.



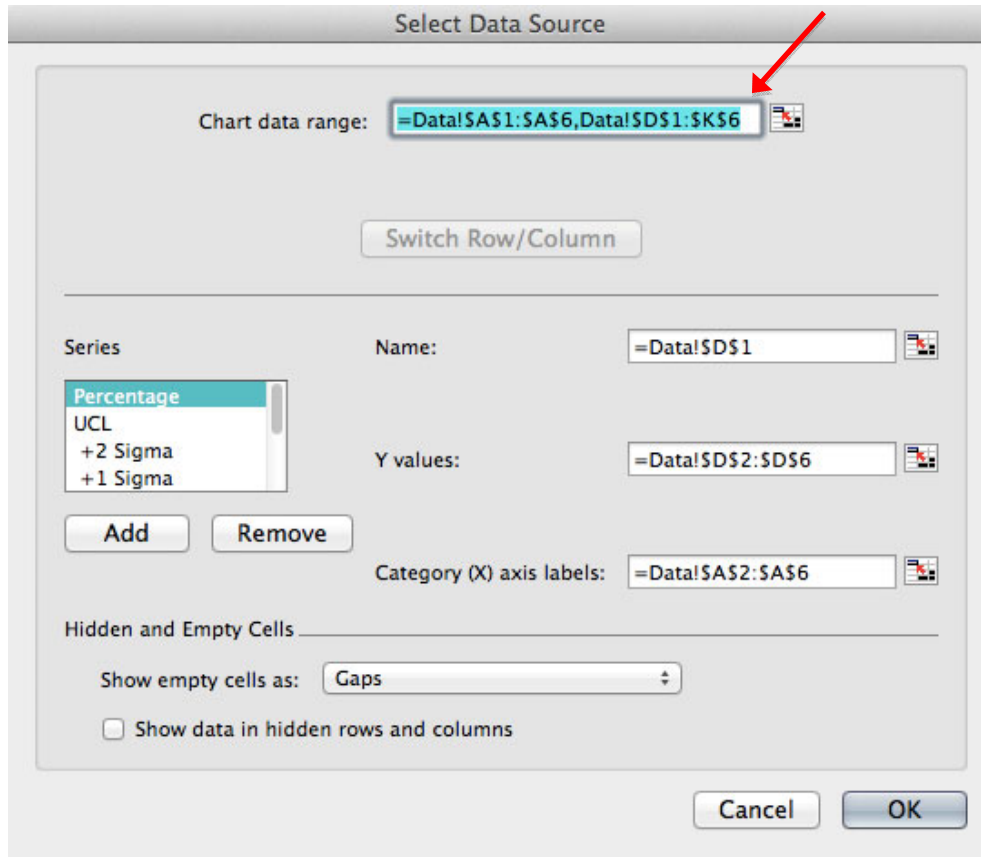
Once you have selected this option, a window will pop up and you will be automatically taken to the *Data* Tab. Notice that once you are taken to the *Data* tab, the data that is being used in your graph will appear with a dotted line around it.

Start of Measurement Period	Numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL
December	5	17	29.4	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3
January	2	32	6.3	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3
February	4	51	7.8	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3

Besides the data being outlined, there will also be a window that appears. Within this window you can tell Excel which cells should be used to populate the graph. It is important that only the cells with data values in them get included when



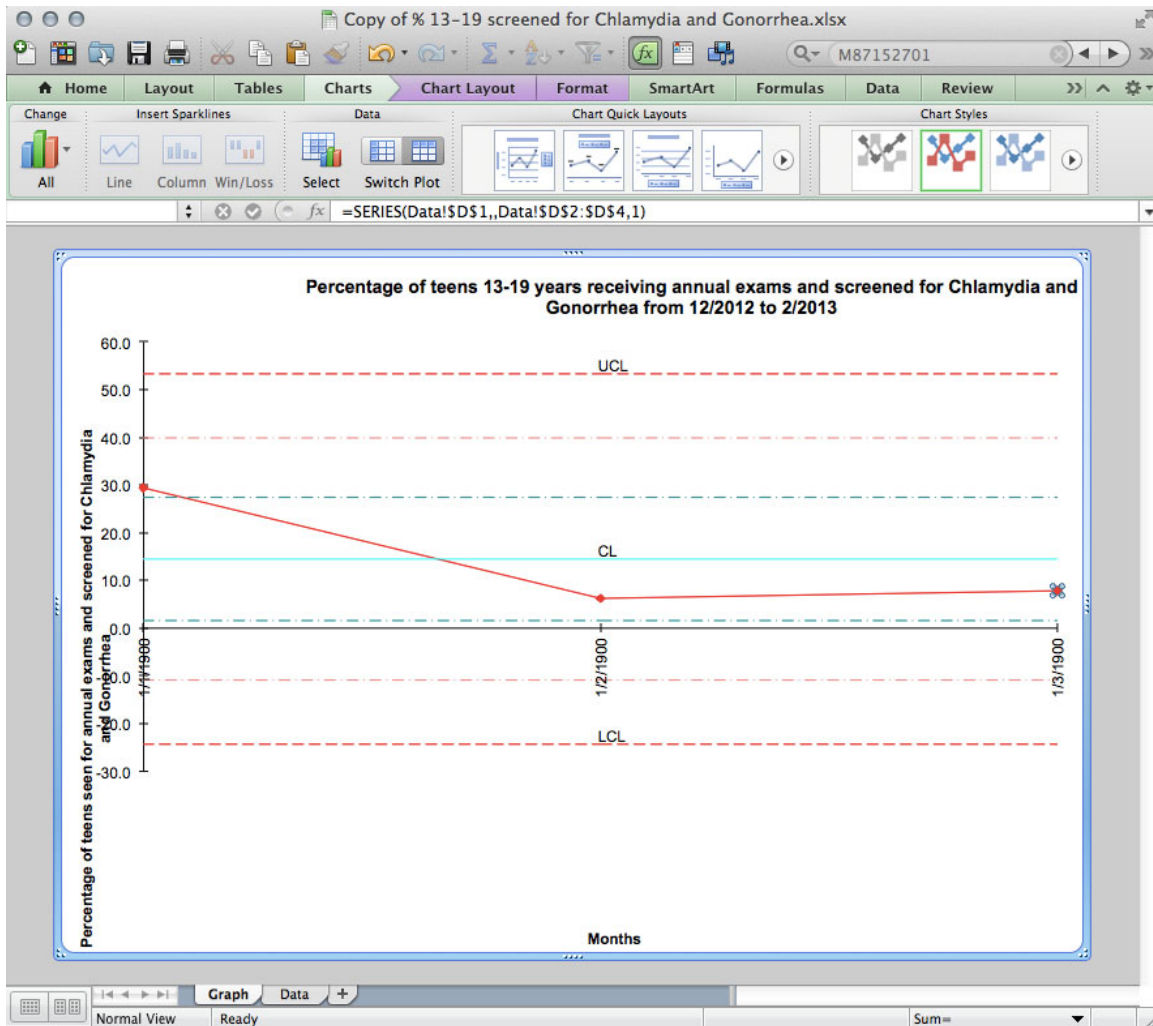
populating the graph. This will be very important to remember as you begin to acquire data; make sure you always check that your graph is populated by cells that actually contain data values (more on this below).



To update the data to be graphed, use the cursor within the *Data* tab and select all of the cells that should be included (i.e., make a box around the cells) and then click “OK.”

	A	B	C	D	E	F	G	H	I	J	K
Start of Measurement Period		Numerator	Denominat	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL
December		5	17	29.4	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3
January		2	32	6.3	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3
February		4	51	7.8	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3

Upon clicking “OK” the *Graph* tab will pop-up and the updated graph with the data from the correct cells will appear.

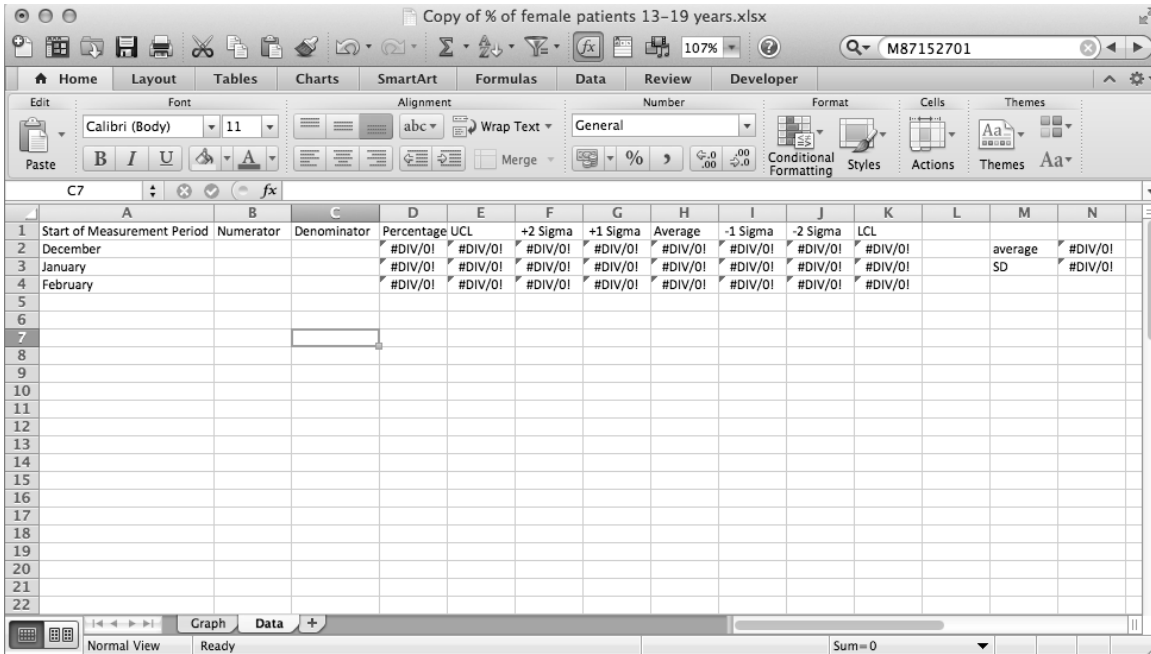


Those are the basic functions needed to understand how to successfully navigate utilizing a control chart. Getting comfortable with using these functions takes practice; errors are bound to happen while setting up a control chart. Below are some common errors that are encountered while using control charts.

CONTROL CHART TROUBLE SHOOTING

TROUBLE SHOOTING CONTROL CHARTS: The following examples are common errors that have encountered while trying to use control charts and some strategies that may be helpful should you encounter one of these errors. Errors will be noted with an “E” and solutions to the error will be noted will an “S.”

E: When opening the *Data* tab, the cells are full of values that read “#DIV/0!”

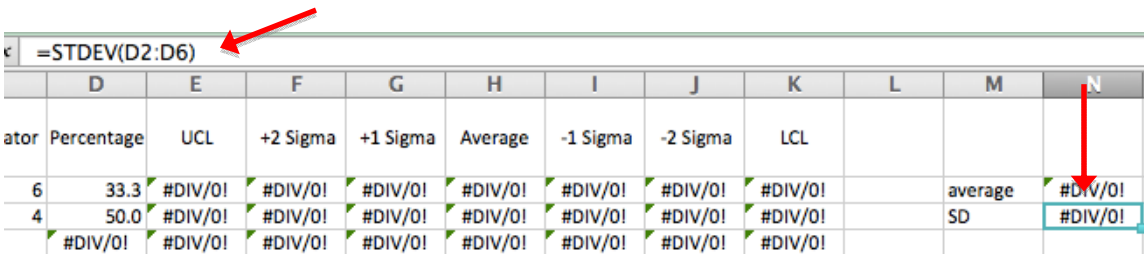


S: This is how your Data tab should look when first opening the Excel file. The “#DIV/0!” means that there are equations in those cells and that there are no numeric values for the equations to calculate. When numbers are entered into the cells that the equations are based off of, the “#DIV/0!” in the cell will disappear.

E: When typing numbers in the first two cells (numerator and denominator in this example), none of the other cells in those rows are changing.

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Start of Measurement Period	Numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL			
December	2	6	33.3	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		average	#DIV/0!
January	2	4	50.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		SD	#DIV/0!
February			#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!			

S: The best way to verify why the cells for specific rows are not changing is to take the cursor and click on those cells one at a time. After clicking on those cells, look in the formula bar to see how those cells are being calculated.





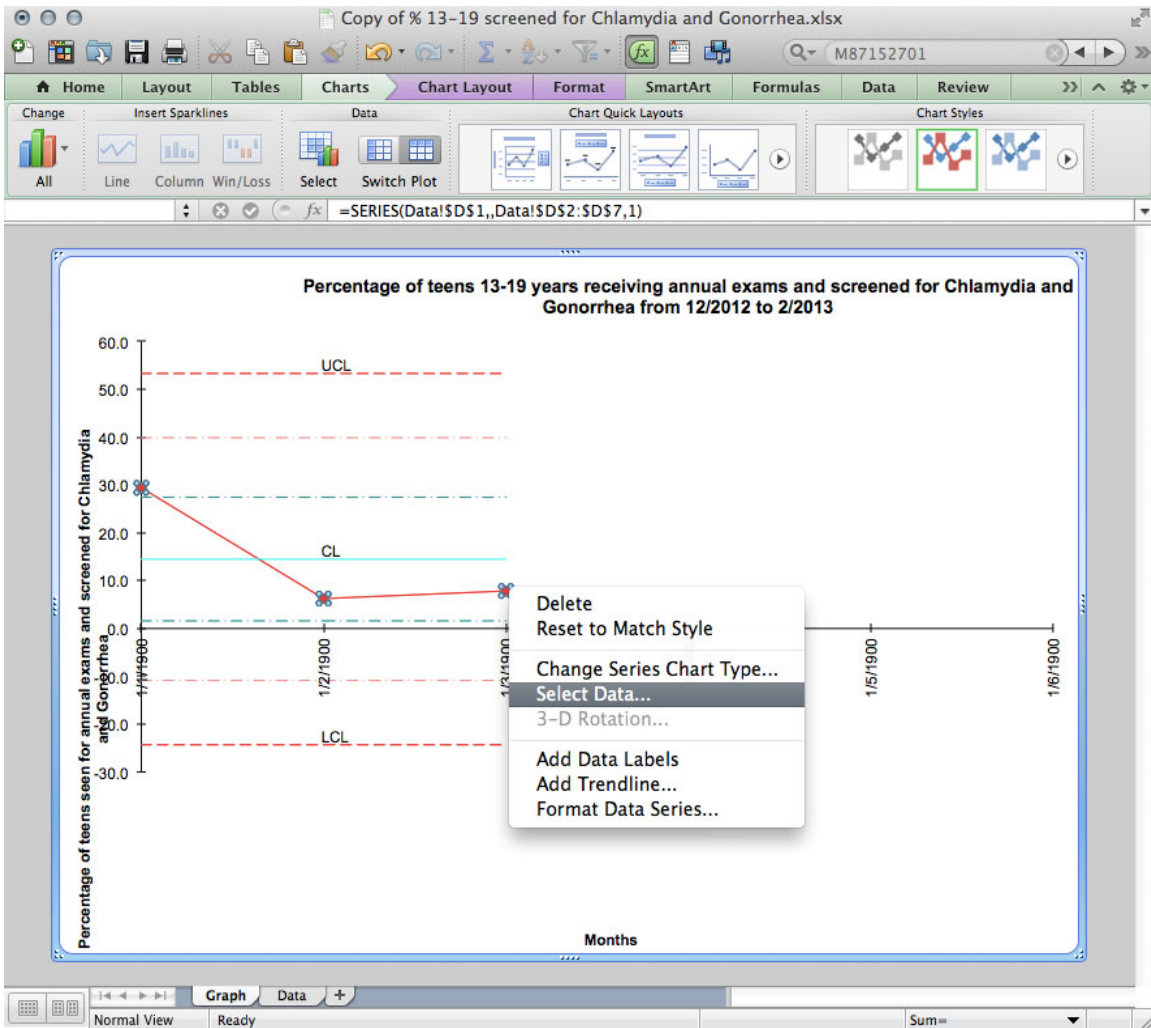
Chances are if the values in these cells are not updating, it is because incorrect cells are selected for them, verify this by looking in the formula bar. To correct this, make sure that only the values that have data are selected for each cell.

fx =STDEV(D2:D3)													
B	C	STDEV(number1, [number2], ...)				G	H	I	J	K	L	M	N
numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL				
2	6	33.3	77.0	64.8	53.5	41.7	29.9	18.6	6.3		average	41.7	
2	4	50.0	77.0	64.8	53.5	41.7	29.9	18.6	6.3		SD	D2:D3	
		#DIV/0!	77.0	64.8	53.5	41.7	29.9	18.6	6.3				

fx =STDEV(D2:D3)			
C	STDEV(number1, [number2], ...)		
Denominator	Percentage	UCL	+2 Sigma
6	33.3	77.0	64.8
4	50.0	77.0	64.8
	#DIV/0!	77.0	64.8

Verify that the correct data is highlighted in all the cells that need require calculations to ensure that your chart is accurate.

- E: When graphing the data, the graph does not look right, appears as if it graphing a point that lies on the x-axis.
- S: To fix this problem go to your *Graph* tab, select one of the red data dots (Fictitious data has been provided to better illustrate the example) and right click on it. Once you have right-clicked on the graph, please select the “Select Data” option. Once you have selected this option, a window will pop up and you will be automatically taken to the *Data* Tab.



Notice that once you are taken to the Data tab, the data that is being used in your graph will appear with a dotted line around it. Besides the data being outlined, there will also be a window that appears. Within this window you can tell Excel which cells should be used to make your graph. It is important that only the cells with data values in them get included for your graph.

D1	A	B	C	D	E	F	G	H	I	J	K	L
	Start of Measurement Period	Numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL	
	December	5	17	29.4	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	
	January	2	32	6.3	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	
	February	4	51	7.8	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	



Select Data Source

Chart data range:

Switch Row/Column

Series

Name:

Y values:

Category (X) axis labels:

Hidden and Empty Cells

Show empty cells as:

Show data in hidden rows and columns

Cancel OK

This will be very important to remember as you begin to acquire data; make sure you always check that your graph is populated by cells that actually contain data values (more on this below). To update the data to be graphed you can take your cursor onto the *Data* tab and select all of the cells you want included (i.e., make a box around the cells) and then click “OK.”

	A	B	C	D	E	F	G	H	I	J	K	
Start of Measurement Period		Numerator	Denominator	Percentage	UCL	+2 Sigma	+1 Sigma	Average	-1 Sigma	-2 Sigma	LCL	
December		5	17	29.4	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	
January		2	32	6.3	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	
February		4	51	7.8	53.3	39.9	27.4	14.5	1.6	-10.9	-24.3	

Upon clicking “OK” you will be taken back to the *Graph* tab and your graph updated for the correct cells will appear.

