

The goal of this technology assignment is to graph several formulas in Excel. This assignment assumes that you are using Excel 2007. The formula you will graph is a rational function formed from two polynomials, $N(x)$ and $D(x)$. The form of this rational function is

$$y = \frac{N(x)}{D(x)}$$

where $N(x)$ is either a linear or quadratic model for the number of nurses in your state and $D(x)$ is either a linear or quadratic model for the number of doctors in your state.

In an earlier assignment you found the linear and quadratic models for the number of doctors in your state and linear and quadratic models for the number of nurses in your state. In earlier demonstrations, we looked at these models for the entire US.

Models for Nurses:	Linear Model	$N(x) = 30854.83x + 2234956.47$
	Quadratic Model	$N(x) = 1678.24x^2 + 15867.89x + 2249764.49$
Models for Doctors:	Linear Model	$D(x) = 14997.55x + 694701.65$
	Quadratic Model	$D(x) = -559.88x^2 + 19997.31x + 689761.57$

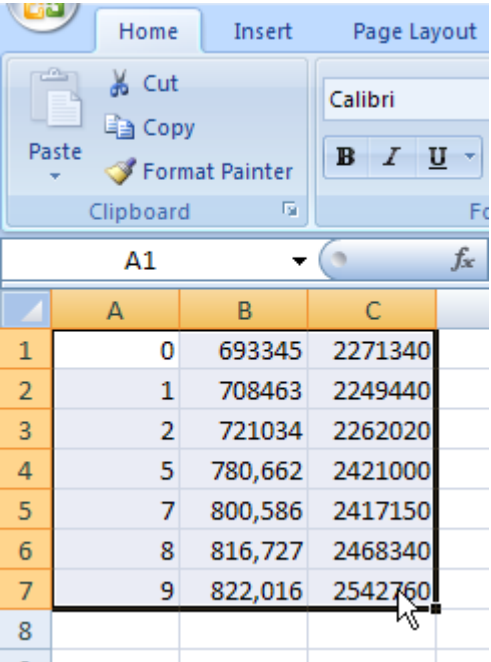
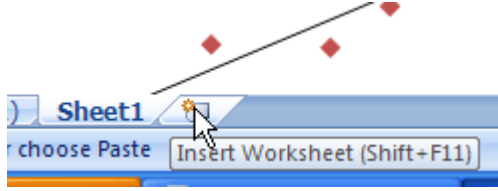

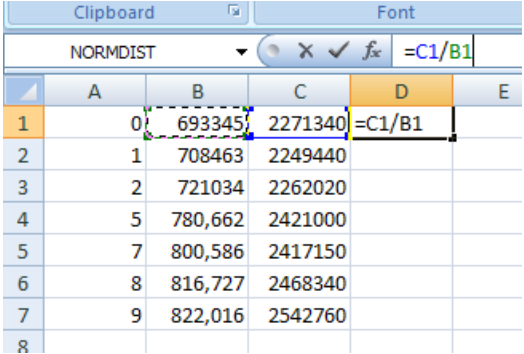
By picking one of the nurse models for $N(x)$ and one of the doctor models for $D(x)$, we can form four different rational functions that might be appropriate for modeling the nurse to doctor ratio in the United States. For instance, if we pick the linear model for nurses and the linear model for doctors, we get

$$y = \frac{N(x)}{D(x)} = \frac{30854.83x + 2234956.47}{14997.55x + 694701.65}$$

In this assignment, you'll compute the nurse to doctor ratio for your state in each year, make a scatter plot for the data, and then add the graph of the rational function like the one above for your state.

The document you submit should include a scatter plot with your nurse to doctor ratio data with a graph of the rational function that models the data, and the equation of the rational function below the graph.

Compute the Ratio Data in Excel 2007 or 2010

<ol style="list-style-type: none"> 1. Start Excel 2007. 2. Open the worksheet where the nurse and doctor data is located for your state. This is the same worksheet you have been using for earlier assignments. 3. Left click the cursor in cell A1. While holding the cursor button, drag the cursor to cell C7. This selects the data. 4. Copy the data by pressing the copy button under the Home tab. 	 <table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td><td>693345</td><td>2271340</td></tr> <tr><td>2</td><td>1</td><td>708463</td><td>2249440</td></tr> <tr><td>3</td><td>2</td><td>721034</td><td>2262020</td></tr> <tr><td>4</td><td>5</td><td>780,662</td><td>2421000</td></tr> <tr><td>5</td><td>7</td><td>800,586</td><td>2417150</td></tr> <tr><td>6</td><td>8</td><td>816,727</td><td>2468340</td></tr> <tr><td>7</td><td>9</td><td>822,016</td><td>2542760</td></tr> <tr><td>8</td><td></td><td></td><td></td></tr> </tbody> </table>		A	B	C	1	0	693345	2271340	2	1	708463	2249440	3	2	721034	2262020	4	5	780,662	2421000	5	7	800,586	2417150	6	8	816,727	2468340	7	9	822,016	2542760	8																					
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<ol style="list-style-type: none"> 5. At the bottom of the Excel window, click on a Insert Worksheet tab. This will open a new worksheet which you'll use for this assignment. 6. In the new worksheet, click in cell A1. Press the Paste button under the Home tab to paste your data into the new worksheet. 																																																							
<ol style="list-style-type: none"> 7. Now we'll compute the nurse to doctor ratio for each year and put these values in column D. Click the cursor in cell D1. 8. Move the cursor to the function bar labeled  and type =C1/B1. This tells Excel to divide the contents of cell C1 by the contents of cell B1. 	 <table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> </tr> </thead> <tbody> <tr><td>1</td><td>0</td><td>693345</td><td>2271340</td><td>=C1/B1</td><td></td></tr> <tr><td>2</td><td>1</td><td>708463</td><td>2249440</td><td></td><td></td></tr> <tr><td>3</td><td>2</td><td>721034</td><td>2262020</td><td></td><td></td></tr> <tr><td>4</td><td>5</td><td>780,662</td><td>2421000</td><td></td><td></td></tr> <tr><td>5</td><td>7</td><td>800,586</td><td>2417150</td><td></td><td></td></tr> <tr><td>6</td><td>8</td><td>816,727</td><td>2468340</td><td></td><td></td></tr> <tr><td>7</td><td>9</td><td>822,016</td><td>2542760</td><td></td><td></td></tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>		A	B	C	D	E	1	0	693345	2271340	=C1/B1		2	1	708463	2249440			3	2	721034	2262020			4	5	780,662	2421000			5	7	800,586	2417150			6	8	816,727	2468340			7	9	822,016	2542760			8					
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9. Press Enter to compute the ratio of the two cells. The value computed in cell D1, 3.275916, tells us that in 1999 there was an average of 3.275916 nurses for every 1 doctor in the United States.

	B	C	D
0	693345	2271340	3.275916
1	708463	2249440	
2	721034	2262020	
5	780,662	2421000	
7	800,586	2417150	
8	816,727	2468340	
9	822,016	2542760	

10. We would like to compute the ratio of nurses to doctors in each year to fill out cells D2 through D7. This is easily done utilizing the Fill handle. Click on cell D1 again. The small black box in the lower right corner of the cell is the fill handle.

	B	C	D
0	693345	2271340	3.275916
1	708463	2249440	
2	721034	2262020	
5	780,662	2421000	
		2417150	
		2468340	
9	822,016	2542760	

11. Move the cursor over the fill handle. Grab the handle by left clicking and holding the mouse button. Drag the cursor to cell D7.

	D
0	3.275916
1	
2	
5	
7	
8	
9	

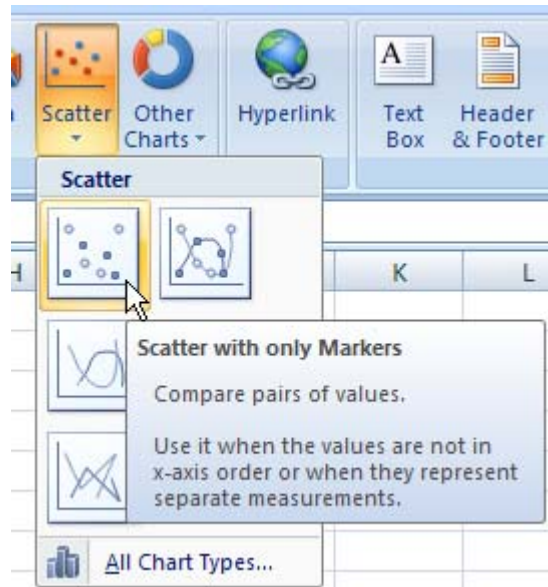
12. Release the mouse button. Cells D2 through D7 will be filled with numbers. Using the pattern of dividing the nurse value by the doctor value in each year, all of the ratios are quickly computed.

fx =C1/B1	
D	
40	3.275916
40	3.175099
20	3.137189
30	3.101214
50	3.019226
40	3.022234
50	3.093322

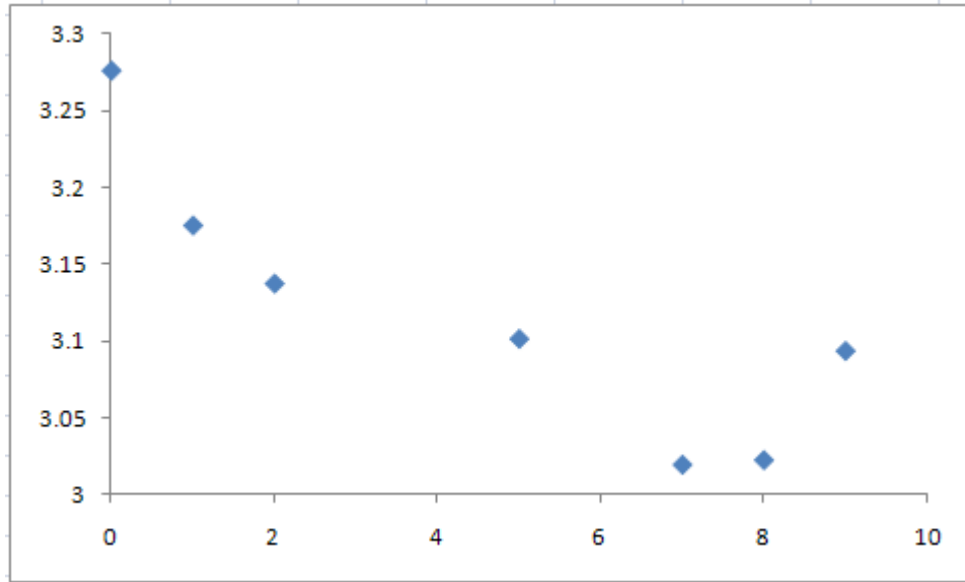
13. Use your cursor to select the data in column A.
14. Hold down the Ctrl key on your keyboard and use the cursor to select the data in column D. The data in column A and D will be highlighted in blue to indicate they have been selected.

D1		fx =C1/B1			
	A	B	C	D	
1	0	693345	2271340	3.275916	
2	1	708463	2249440	3.175099	
3	2	721034	2262020	3.137189	
4	5	780,662	2421000	3.101214	
5	7	800,586	2417150	3.019226	
6	8	816,727	2468340	3.022234	
7	9	822,016	2542760	3.093322	
8					

15. Left mouse click on the Insert tab located towards the top of Excel.
16. From the Chart panel, select Scatter.
17. From the drop down box, select Scatter with only Markers to make the scatter plot.



18. The scatter plot will appear in your Excel worksheet in an appropriate window.
19. Select the legend on the right of the graph and press Delete on your keyboard.
20. Select any grid lines on the scatter plot and press Delete on your keyboard. Your graph should be similar to the one below and not contain a legend or any gridlines.

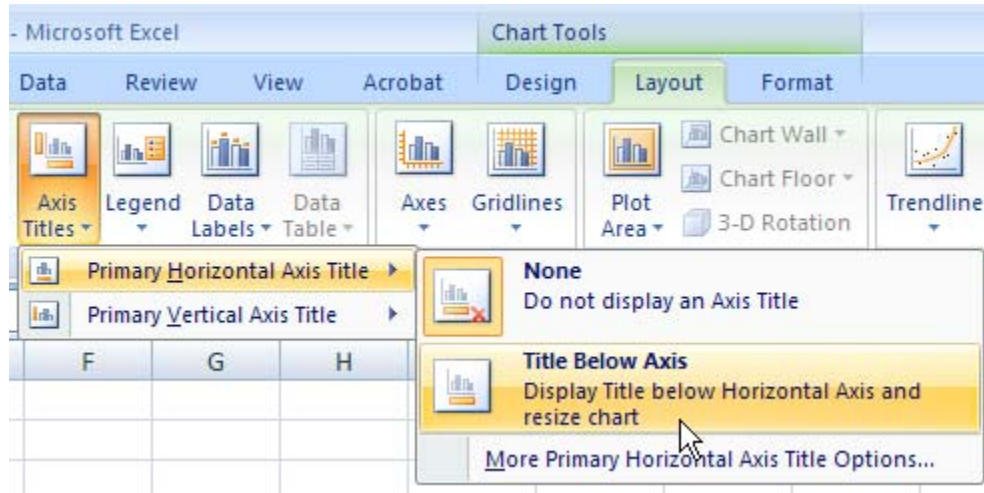


For this data, the overall trend is for the nurse to doctor ratio to decrease.

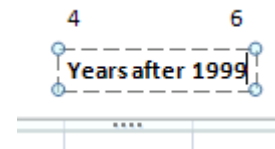
21. Use the mouse to left click on one of the data points in your graph. You'll notice that the points are selected and a tab called Chart Tools appears along the top of Excel.
22. Under the Design tab, try selecting different colors for the data points like the red points shown to the right. Many colors and sizes are available using the scroll bar on the Chart Styles panels. Make sure you use different colors on each set of data.



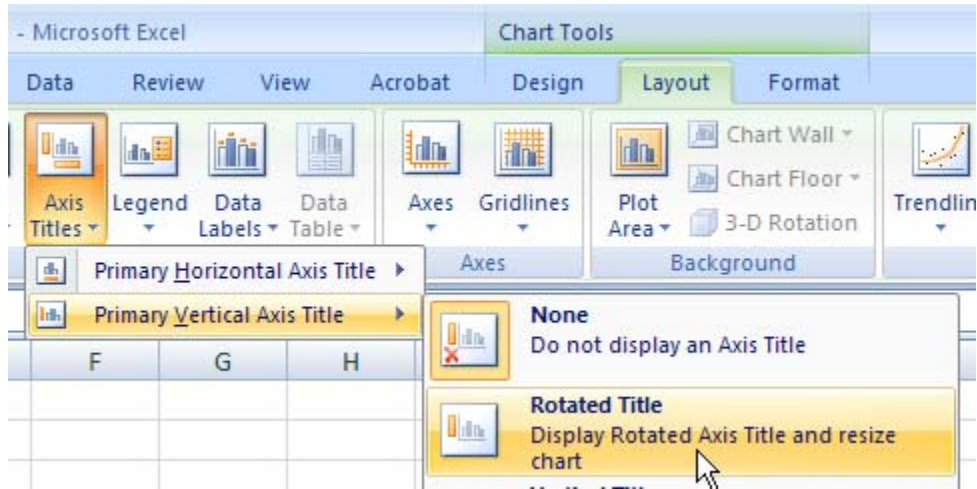
23. Click on the edge of your graph to select it. From Chart Tools, click on the Layout tab.
24. Under the Labels panel, select Axes Titles.
25. From the menu that appears, select Primary Horizontal Axis Title and finally left mouse click on Title Below Axis.



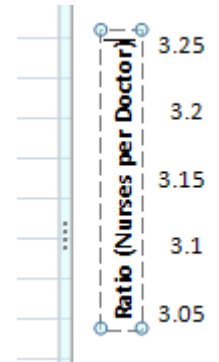
26. An axis title will appear below the horizontal axis. Double left mouse click on the axis title to select it and change it to an appropriate title for your graph.



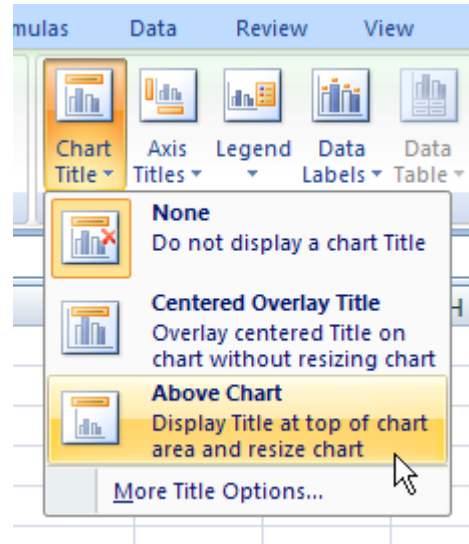
27. Click on the edge of your graph to select it. From Chart Tools, click on the Layout tab.
28. Under the Labels panel, select Axes Titles.
29. From the menu that appears, select Primary Vertical Axis Title and finally left mouse click on Rotated Title.



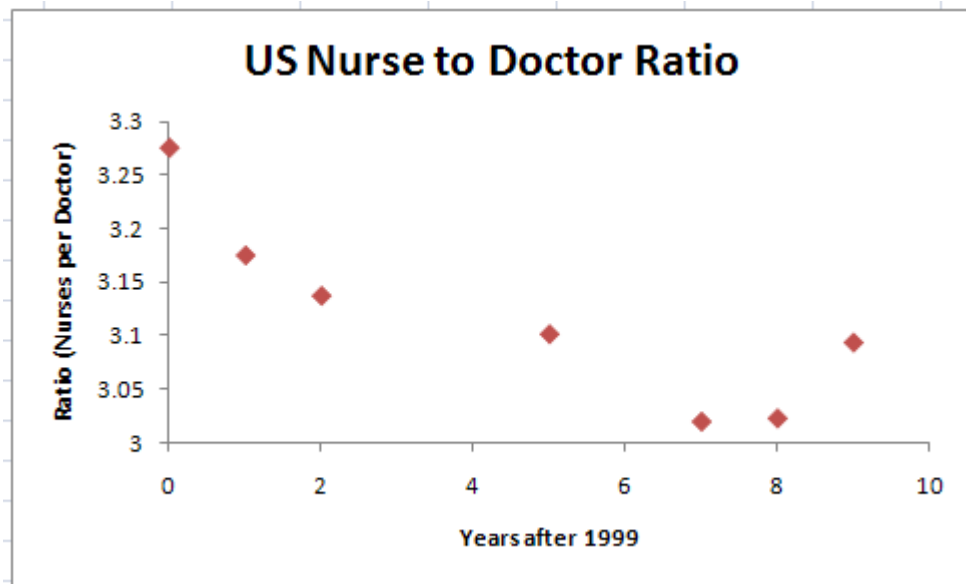
30. An axis title will appear to the left of the vertical axis. Double left mouse click on the axis title to select it and change it to an appropriate title for your graph.



31. The final addition to the graph you will make is a chart title. Click on the edge of your graph to select it. From Chart Tools, click on the Layout tab.
32. Under the Labels panel, select Chart Titles.
33. From the menu that appears, select Above Chart.



34. A chart title will appear above the scatter plot. Double left mouse click on the chart title to select it and change it to an appropriate title for your graph.



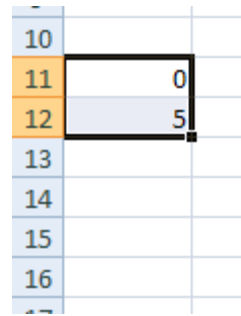
Add the Rational Model to the Scatter Plot

Now that we have graphed the ratio data, we want to make a copy of the scatter plot and add the rational model,

$$y = \frac{30854.83x + 2234956.47}{14997.55x + 694701.65}$$

to the scatter plot.

1. To make a copy of the graph, click on the graph to select it. From the Home tab, press the Copy button.
2. Click your mouse in a cell on the far right hand side of the worksheet. Press Paste from the Home tab. A copy of the scatter plot will appear. Click on the edge of the origin graph. Drag the graph to the right side of the worksheet below the copied scatter plot. This gives you plenty of room to work below your columns of data.
3. In cell A11 type 0 and in cell A12 type 5.
4. Click your mouse in cell A11. While holding the left mouse button down, drag your mouse to cell A12. You should see a black box around cells A11 and A12 like the one to the right.



10	
11	0
12	5
13	
14	
15	
16	
17	

5. In the lower right hand corner of this black box is the fill handle. Place your mouse over the fill handle. The cursor should change to a black cross.
6. Hold the left mouse button down and drag the cursor down. The box will expand as you drag the mouse like shown to the right. As you drag, numbers will appear like the 25 shown indicating what numbers will be placed into the corresponding cell. Since the pattern established by the first two numbers indicates that the numbers should increase by 5 in each cell, the cells will contain 0, 5, 10, 15, ...

9		
10		
11	0	
12	5	
13		
14		
15		
16		
17		25
18		

10		
11	0	
12	5	
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		50
23		

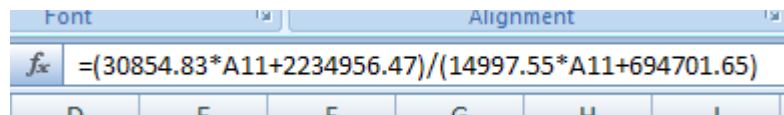
7. Drag the mouse to cell A21. This will fill the cells A11 through A21 with the numbers 0, 5, 10, 15, ..., 50. These numbers will be the x-values in the graph we will create.

10	
11	0
12	5
13	10
14	15
15	20
16	25
17	30
18	35
19	40
20	45
21	50
22	
23	

8. Now we'll type in the formula. In cell B11, type

$$=(30854.83*A11+2234956.47)/(14997.55*A11+694701.65)$$

You can click on cell A11 instead of typing A11 if you want. It is very important to start with an = so that Excel knows you want it to do a calculation. It is also important to type the * for multiplication. Make sure you modify the values to reflect the formula you are graphing.



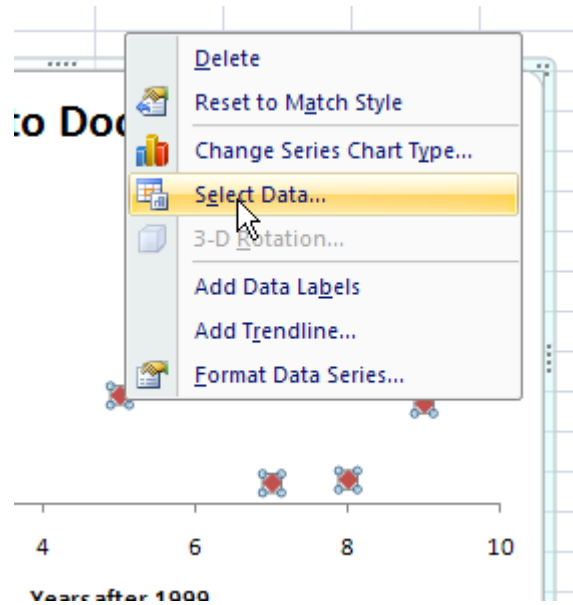
9. Press Enter on the keyboard. This will cause Excel to take the value in cell A11 and calculate the y-value based on the formula for the rational function. In this case we get 3.217146. You may get a different number depending on your formula.

10		
11	0	3.217146
12	5	
13	10	
14	15	
15	20	

10. Click your mouse in cell B11 again.
11. Grab the fill handle and drag it to cell B21.
12. Release the mouse button. The cells will be filled with y-values from your formula where the x-values come from the corresponding cells in the A column. This is the table we will use to create the graph of the formula.

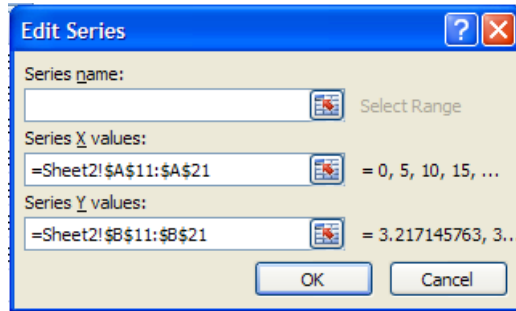
10		
11	0	3.217146
12	5	3.104149
13	10	3.011215
14	15	2.933437
15	20	2.867386
16	25	2.810596
17	30	2.761247
18	35	2.717967
19	40	2.6797
20	45	2.645624
21	50	2.615085
22		
23		

13. Right mouse click on one of the data points in the scatter plot you want to add the rational function graph to.
14. Choose Select Data,

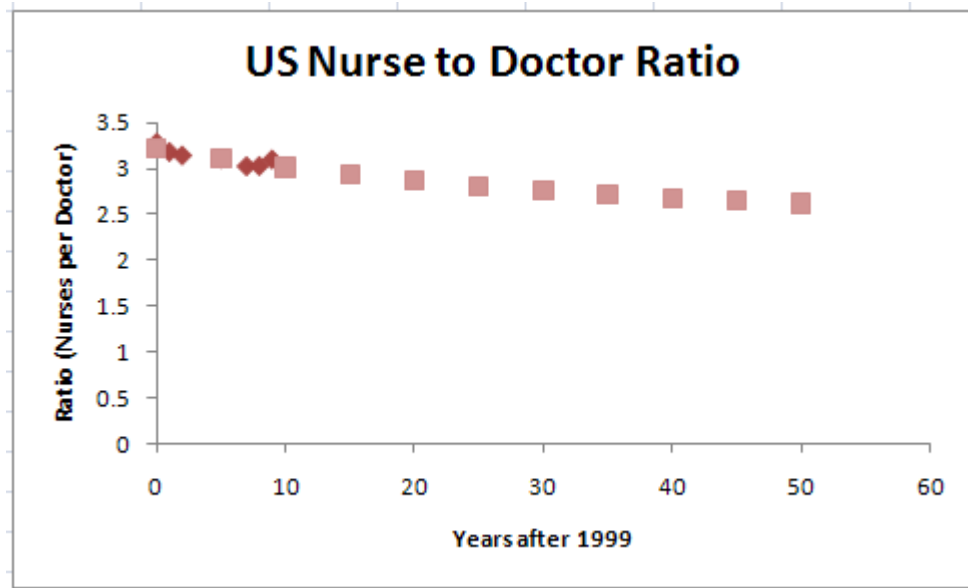


15. The Select Data Source box will appear. Choose Add to add new data to the graph.

16. Place your cursor on the line labeled Series X values. Now click on cell A11. While holding the left mouse button down, drag the cursor to cell A21. The cells in A11 through A21 will be selected.
17. Place your cursor on the line labeled Series y values. Delete any entries on that line. Now click on cell B11. While holding the left mouse button down, drag the cursor to cell B21. The cells in B11 through B21 will be selected.
18. Click on the OK button in this window and the next that appear.

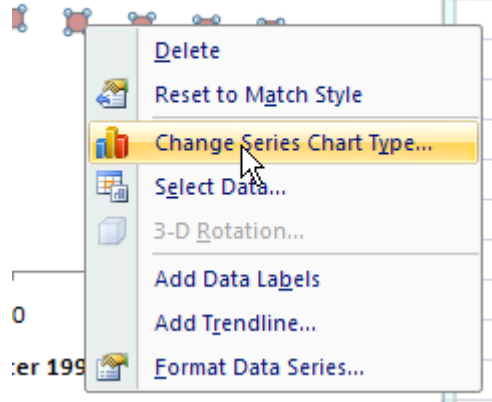


19. A new set of data points are added to the scatter plot. However, we want these points to be graphed as a curve.

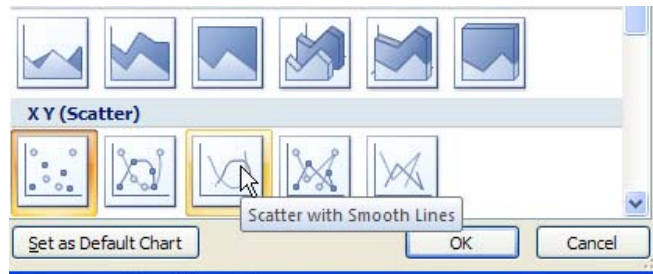


20. Right mouse click on one of the data points you just added to the scatter plot.

21. Select Change Series Chart Type.

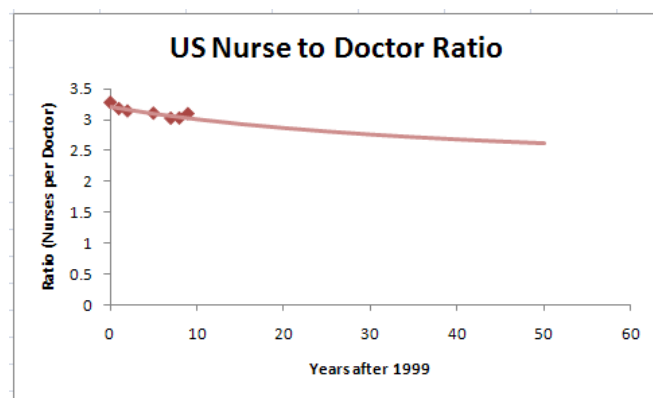


22. Under XY (Scatter), choose the third graph (Scatter with Smooth Lines).



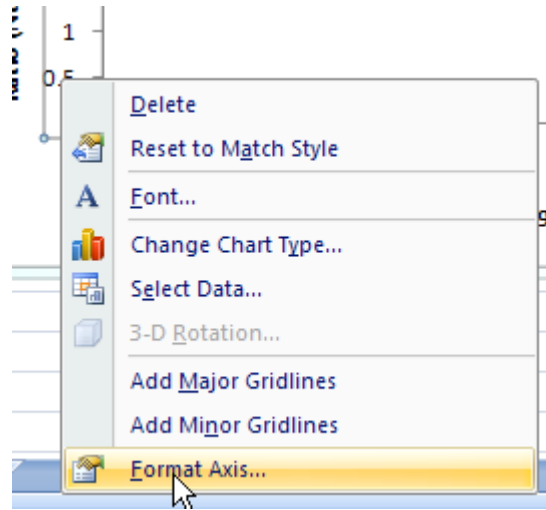
23. Click OK to update the scatter plot.

24. The graph should now look similar to the one below.



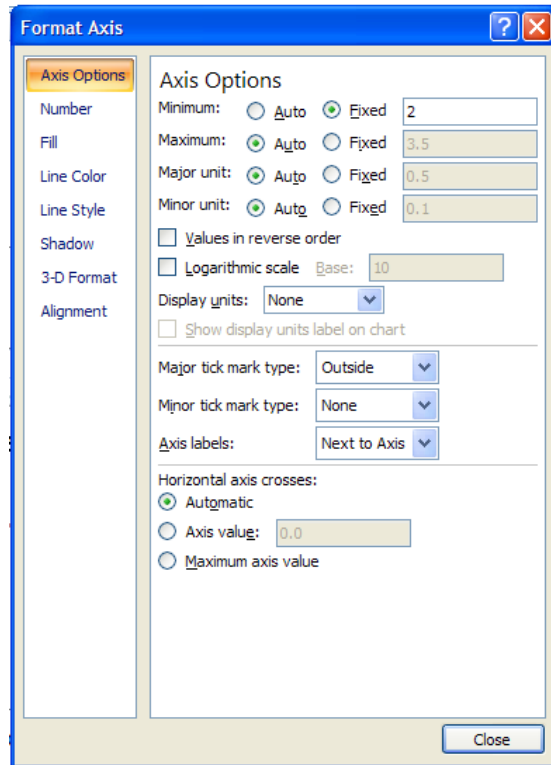
25. Since the scatter plot is not utilizing the entire window, let's modify the vertical scale. Right mouse click on one of the numbers on along the vertical axis. Your scatter plot may not need to be adjusted. If not, skip to step 29.

26. Select Format Axis...

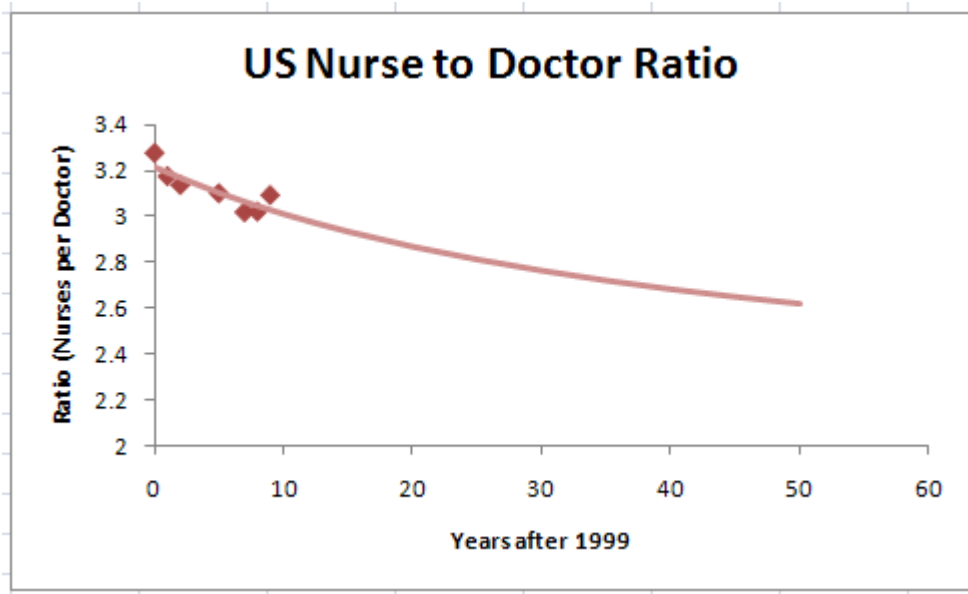


27. Excel will automatically set up a window for you. Click in the Fixed circle under the Minimum line. Adjust the numbers to reflect those on the right. This will start the bottom of the window at $y = 2$. We could also change the top of the viewing window by changing the entries on the Maximum line.

28. Click on the Close button to update the graph.



29. Your graph should now look similar to the one below.



30. To finish this tech assignment, you need to copy your graph from Excel to word processing document in Word (or a similar program). Click on the edge of your graph to select it.

31. On the Home tab, left click on the Copy button to copy the graph to the clipboard.



32. Open Word (or another word processing program).

33. At the top of the document, type your name, class, and the date followed by a carriage return (Enter).

34. In Word, left click on the Home tab.

35. Select Paste to paste the graph into your Word document. Your document should look similar to the one shown to the right.



36. Finally, you need to save this document to a convenient location. In the upper left hand corner of Word, left click on the disk icon.

37. Give the document and appropriate name and location and select Save.

38. You can also select the Office button to the left of the disk icon. This is useful to save the document with a new file name. In this case you would select Save As... and then give an appropriate name. If you are working on a document over several days, it is advisable to save the document with a slightly different name on each day based on the date. This allows you to recover earlier version of a document in case you need to refer to earlier work.

39. In Excel, save you Excel worksheet.



To finish this assignment, we need to use Mathtype or the equation editor in Word 2007 or 2010 to create the equation of the rational function in Word. If you are using Word 2003, you must use Mathtype to create the equation. If you are using Word 2007, you can use Mathtype or the equation editor in Word 2007. For those of you using Word 2010, stick with the equation editor built into Word 2010. Instructions for using Mathtype or the equation editor are shown below. You may choose what technique you want to use to create the rational function's formula beneath the graph you just created.

Create the Rational Model with Mathtype

1. If Mathtype is installed on your computer (if not check the Orientation button in CourseCompass), you should see the tab on the right in Word.

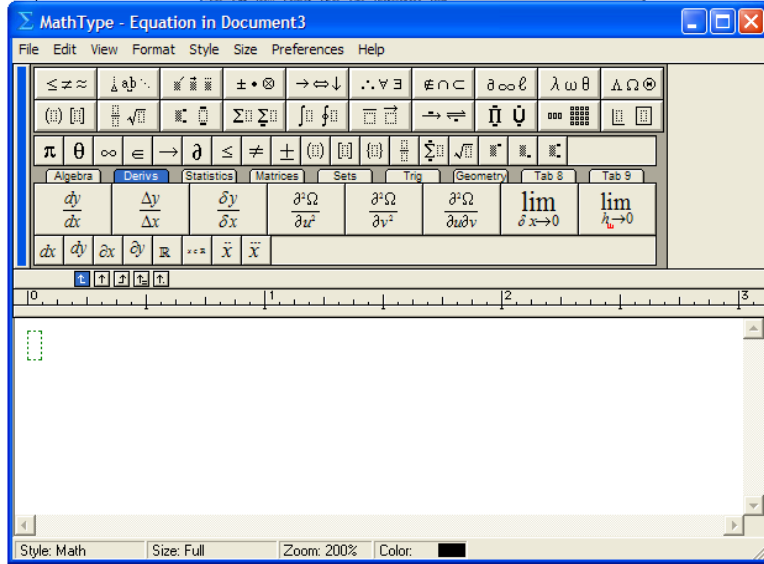


This panel contains all of the commands to start Mathtype or insert basic symbols. On the right side is the Insert Equations part of the panel. You can insert an equation within a sentence by left clicking on Inline. You can insert an equation on a line by itself by left clicking Display. You can even insert equations labeled with numbers on the right by left clicking on Right-numbered.


The Symbols part of the panel allows you to type Greek letters like α , β or mathematical symbols like \approx , ∞ , or \pm .

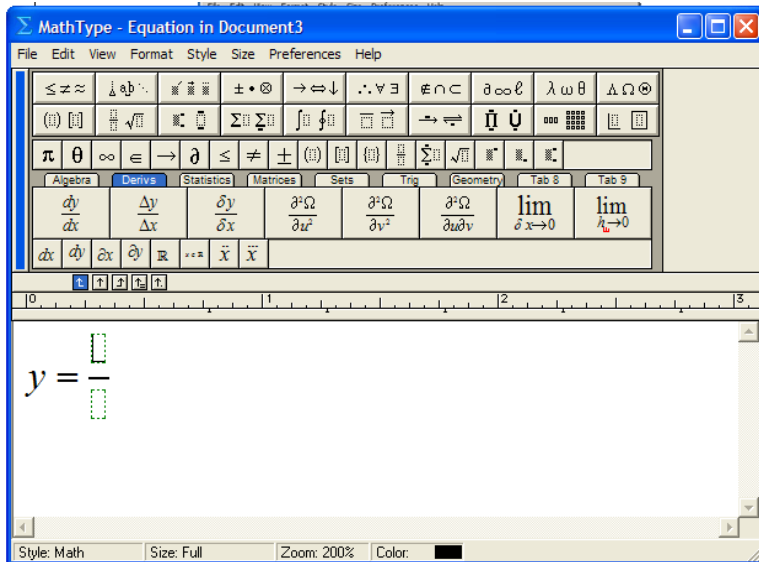
Make sure the cursor is located in the Word document under the scatter plot. This is where we'll put the function's formula.

2. There are two types of equations you can create with Mathtype. An inline equation is one that you put in the middle of a sentence. A display equation is an equation that is placed by itself on a line. For our purposes, we'll put the rational function on its own line. Press Display under the Mathtype tab. Mathtype will open in its own window.

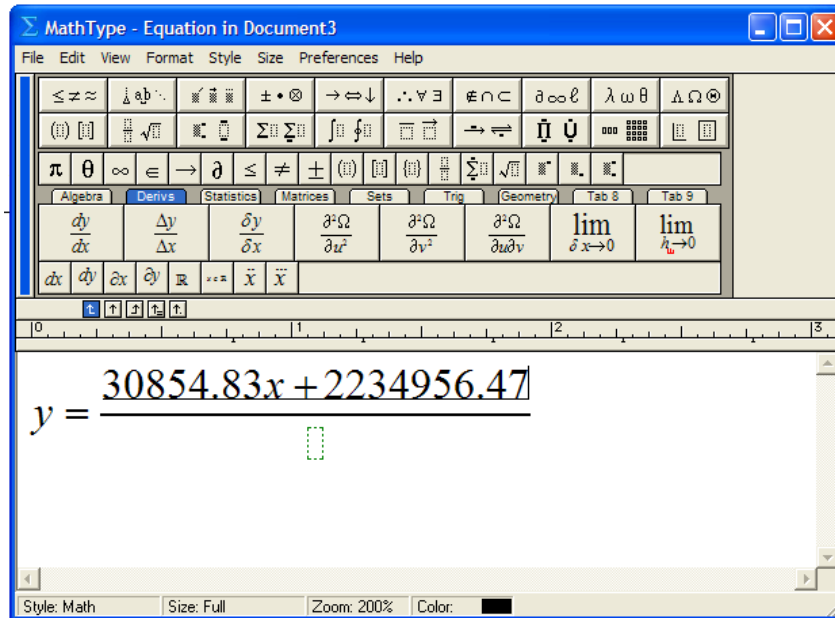


3. A Mathtype window like the one above will appear. This is the window we'll use to create equations, fractions and other mathematical creations. The buttons along the top contain all of the mathematics you'll need to document in this course.

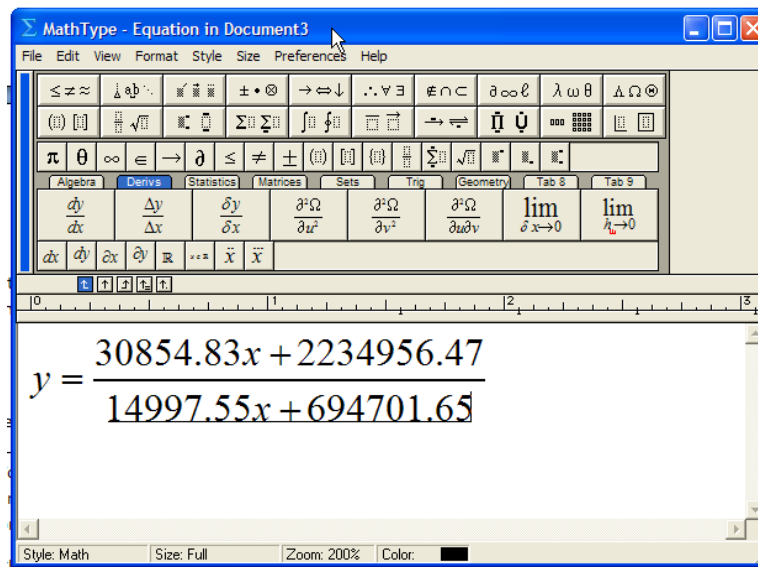
4. Start the equation by typing $y =$ using your keyboard. Then press the fraction button  to begin the fraction for the rational function.

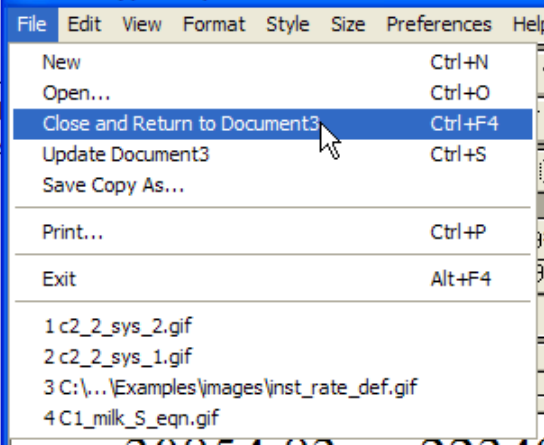


5. Place the cursor in the numerator of the fraction and then type the linear function $30854.23x+2234956.47$ using the keyboard.

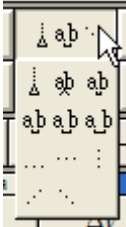






6. Place the cursor in the denominator of the fraction and then type the linear function $14997.55x+694701.65$ using the keyboard.

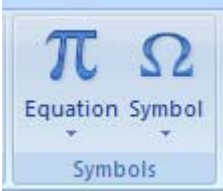
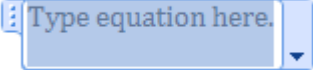
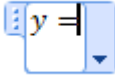
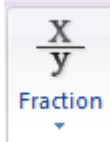

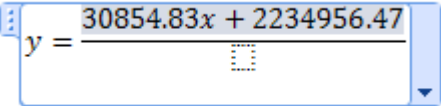
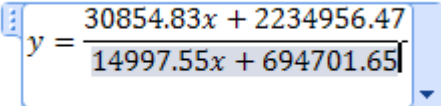


<p>7. Now that the function is complete, we need to return to the Word document. From the File menu at the top of the Mathtype window, select Close and Return to Document. This will paste the equation below your scatter plot.</p> <p>8. Save the Word document. Your document should contain your name, class, the date, a scatter plot of the data with the rational model, and the equation of the rational model. This is what you will turn in.</p>	
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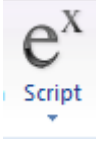

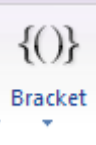
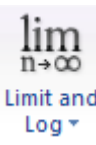
There are several other buttons within Mathtype that may come in handy:

	<p>This menu give you access to buttons that allows you to add extra spacing to your equations.</p>
	<p>This button allows you to put powers in your expressions. This will be especially useful when typing formulas for quadratic functions.</p>
	<p>This button gives you the ability to make square roots.</p>
	<p>These buttons are some of the various grouping symbols you can use. You can also use grouping symbols from the keyboard.</p>
	<p>This button places an infinity sign at the cursor location.</p>

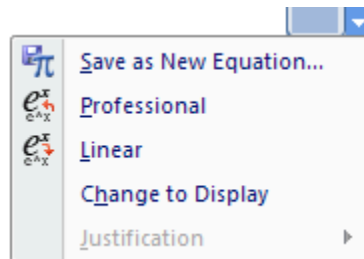
Create the Rational Model with the Equation Editor in Word 2007 or 2010

<ol style="list-style-type: none"> 1. Open Word 2007 or 2010. 2. Place the insertion point where you want the equation to go. 3. Select the Insert tab from the tabs along the top of the Word window. 	 <p>The image shows the 'Equation Symbol' button in the Microsoft Word ribbon. It features the Greek letters pi (π) and omega (Ω) at the top, the text 'Equation Symbol' in the middle, and a 'Symbols' dropdown arrow at the bottom.</p>
<ol style="list-style-type: none"> 4. Press the Equation button. This will place an equation region in your document. 	 <p>The image shows a blue equation region placeholder box with the text 'Type equation here.' and a small dropdown arrow on the right side.</p>
<ol style="list-style-type: none"> 5. Use the keyboard to type y =. 	 <p>The image shows the equation region with the text 'y =' entered. A small dropdown arrow is visible on the right side of the region.</p>
<ol style="list-style-type: none"> 6. Select the Fraction button . 	 <p>The image shows the 'Fraction' button in the Microsoft Word ribbon. It features a fraction symbol $\frac{x}{y}$ at the top and the text 'Fraction' with a dropdown arrow below it.</p>
<ol style="list-style-type: none"> 7. From the submenu that appears, select a basic vertical fraction like the one shown to the right. 	 <p>The image shows a vertical submenu for the fraction button. It contains a single option for a basic vertical fraction, represented by a fraction symbol $\frac{\square}{\square}$ with dashed boxes for the numerator and denominator.</p>
<ol style="list-style-type: none"> 8. Click on the numerator in the fraction to select it and type the formula of the numerator. 	 <p>The image shows the equation region with the numerator of the fraction selected and containing the formula '30854.83x + 2234956.47'. A dashed box is visible in the denominator position.</p>
<ol style="list-style-type: none"> 9. Click on the denominator in the fraction to select it and type the formula of the denominator. 10. The equation is now complete. 	 <p>The image shows the final completed rational equation in the equation region: $y = \frac{30854.83x + 2234956.47}{14997.55x + 694701.65}$.</p>

There are several other buttons within the equation editor in Word 2007 and 2010 that may come in handy:

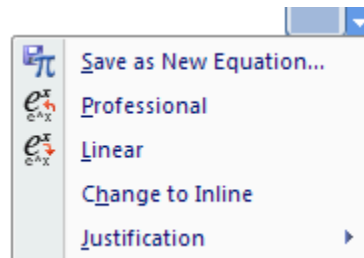
	<p>This button allows you to put powers in your expressions. This will be especially useful when typing formulas for quadratic functions.</p>
	<p>This button gives you the ability to make roots.</p>
	<p>This group of buttons buttons are some of the various grouping symbols you can use. You can also use grouping symbols from the keyboard.</p>
	<p>This group of buttons allows you to type logarithms and limits.</p>
<div> </div> <p>Along the top left side of the equation editor are basic math symbols including the ∞ symbol.</p>	

Equations may appear in two different formats when using the equation editor. An equation that appears within a sentence (like the infinity symbol above) is called an inline equation. An equation that appears on a line by itself is called a display equation. Display equations are useful when we want to emphasize the equation. If you put the insertion point within a sentence and create the equation, you will be creating an inline equation. You can change this equation to a display equation by clicking the small triangle in the lower right hand corner of the equation region. This brings up a menu like the one below:



By selecting Change to Display, we can force the equation to a line of its own.

If the equation is already a display equation, clicking on the triangle gives the menu



We can select Change to Inline to change the display equation to an inline equation.