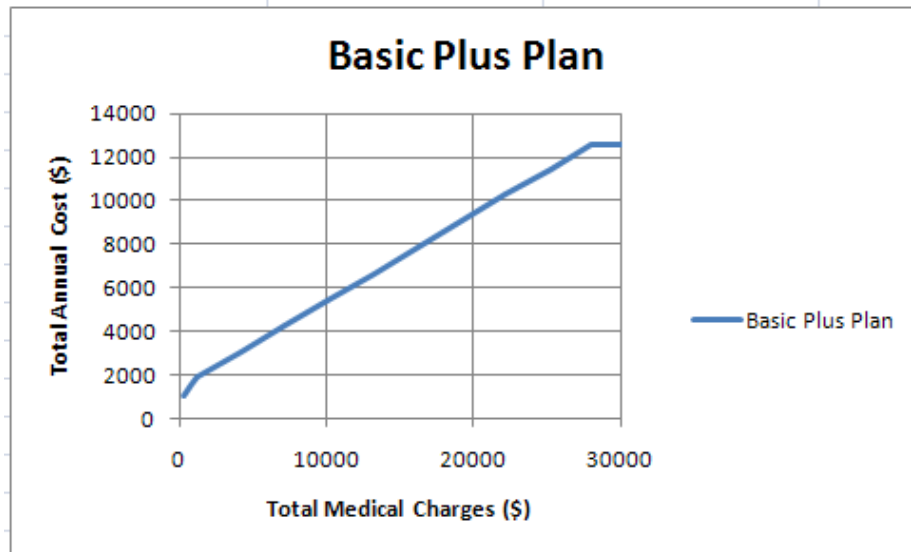At the conclusion of the technology assignment on calculating and graphing the total annual cost, you had a graph of the of health insurance plan you are examining.


In this technology assignment, you'll learn how to find the function that models the plan. Once you have found the formula, you'll paste your graph into a Word document and add the formula using the Equation Editor included with Word 2007 or 2010.

Find a Model for the Health Insurance Plan

The graph consists of a series of line segments. Each of these segments can be modeled by a line of the form $y = mx + b$. When we put these segments together in a single function, we get a piecewise linear function. The word piecewise indicates that the graph consists of several pieces. Each of the pieces has a different formula. Our goal is to find an equation for each line segment, and to put them together in a formula for a piecewise linear function.

Let's find the formula for the first segment on the Basic Plus Plan. The graph for this plan shows three different line segments.
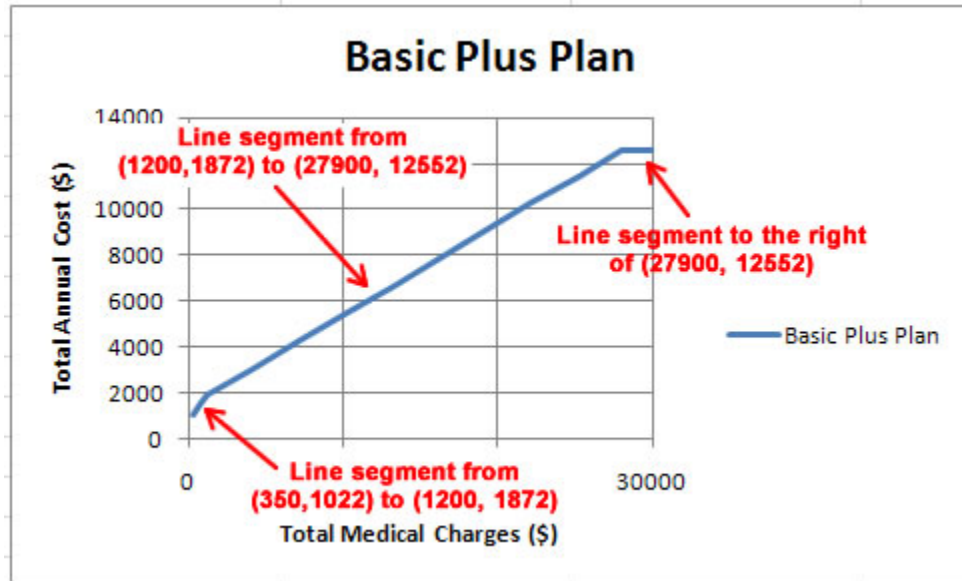
To write out the function describing these line segments, let x represent the total medical charges in dollars and let y represent the total annual cost in dollars. In the sections below, we'll find the equation of each line segment for the Basic Plus Plan. You will carry out the same process for your health insurance plan. Keep in mind that you will be working with different numbers so that you process may have some slight differences.

Total Annual Cost for $350 \le x \le 1200$

We can find the equation of this line using the slope-intercept form of a line, $y = mx + b$. The slope of the line segment, m, is found by calculating the slope between the points $(350, 1022)$ and $(1200, 1872)$:

$$m = \frac{1872 - 1022}{1200 - 350} = \frac{850}{850} = 1$$

This gives us $y = 1x + b$. To find the y-intercept b, substitute one of the points in this equation and solve for b. If we substitute $(350, 1022)$ in place of (x, y), we get

$$1022 = 1 \cdot 350 + b$$

$$1022 = 350 + b$$

$$672 = b$$

This means the equation of the first segment for $350 \le x \le 1200$ is $y = x + 672$.

Total Annual Cost for $1200 \le x \le 27900$

For the second line segment, the line passes though many points in the table. We could choose any pair of points on the line to find its equation. If we use the points (1200, 1872) and (27900, 12552), the slope of the line is calculated

$$m = \frac{12552 - 1872}{27900 - 1200} = \frac{10680}{26700} = 0.4$$

If we substitute this value into the slope-intercept form of a line, we get $y = 0.4x + b$. To find the y-intercept, set $(x, y) = (1200, 1872)$ and solve for b to yield

$$1872 = 0.4(1200) + b$$
$$1872 = 480 + b$$
$$1392 = b$$

The equation of the line for $1200 \le x \le 27900$ is $y = 0.4x + 1392$.

Total Annual Cost for $x \ge 27900$

Once the total medical charges for the Basic Plus Plan have reached $27,900, the maximum out of pocket has been reached. Beyond this point, the insured will always pay $12,552 as long as the lifetime maximum benefit has not been reached. Assuming the lifetime benefit has not been reached, the total annual cost for any amount of medical charges above $27,900 is a constant $12,552. Therefore, the equation of the line segment for $x \ge 27900$ is $y = 12552$.

Define the Piecewise Function

We have three line segments,

For $350 \le x \le 1200$, $y = x + 672$.

For $1200 \le x \le 27900$, $y = 0.4x + 1392$.

For $x \ge 27900$, $y = 12552$.

We will combine these together in a piecewise function called $BP(x)$, for total annual cost in dollars for the Basic Plus Plan. A piecewise function is written with the function's formulas on the right side of the function definition and a large bracket. To the right of each formula is an inequality that indicates the values of the independent variable over which the formula is used. For the Basic Plus Plan, the function would be defined

$$BP(x) = \begin{cases} x + 672 & \text{for } 350 \le x < 1200 \\ 0.4x + 1392 & \text{for } 1200 \le x < 27900 \\ 12552 & \text{for } x \ge 27900 \end{cases}$$

In the inequalities, the equal sign has been left out since we do not want to define the function twice for some inputs. This is not a problem since this function is graphed as a continuous curve with no gaps or jumps. To find the value of a function like this, we must figure out which of the three formulas the input must be put into and then calculate the output based on that formula.

For instance, the value $B(500)$, is calculated from the first formula since 500 lies in the interval defined by $350 \le x \le 1200$. Putting this value into the first formula yields

$$BP(500) = 500 + 672 = 1172$$

This means that if there are $500 in total medical charges, the total annual cost is $1172.

To find the value $BP(30000)$, we need to use the third formula since 30000 is greater than 27900. On the surface this might look confusing since there is no variable in the formula. However, this simply means that the output is 12552 for any input greater than or equal to 27900. Therefore,
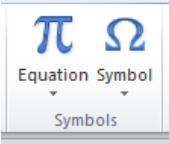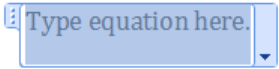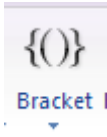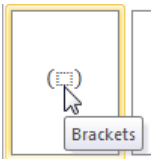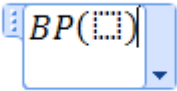
$$BP(30000) = 12552$$
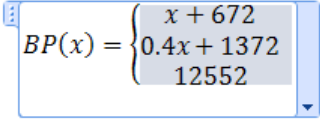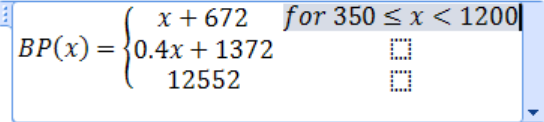
This means that if there are $30000 in total medical charges, the total annual cost is $12552.

Not all inputs have a corresponding output. If you examine the inequalities in the piecewise function, you'll note that only inputs greater than 350 make sense and are in the domain. So a value $BP(100)$ is not defined. This is due to the fact that the assumptions we established ensured there would be at least $350 in medical charges each year.

For your health insurance plan, find the piecewise function that models the total annual costs as a function of the total medical charges. Once you have found these formulas, you can use the instructions below to put the formulas in a Word document.

Put a Formula into Word 2007 or 2010 with the Equation Editor

1. Under the Insert tab, locate the Symbols panel. The two buttons here allow you to put mathematical symbols and equations into your document. Using these two buttons you can put Greek letters like α or π and equations like $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ into your document. 2. To put an equation, like your piecewise function, click on the equation button.	π Ω Equation Symbol Symbols
3. This should create a small equation region in your document like the one shown to the right.	Type equation here.
4. Type the name of your function. For the Basic Plus plan we are using to demonstrate the process with, this is BP.	BP
5. On the Design tab of Equation Tools, click on the Bracket button.	{()} Bracket
6. To insert the parentheses in the function notation, click on the parentheses in the upper left corner of the menu that appears. Word calls the parentheses brackets so don't be alarmed at this name.	(☐) Brackets
7. Once the parentheses have been inserted, click in the space inside the parentheses. Type the variable name or x in this case.	$BP(\square)$
8. Use the right arrow key or the mouse to move the insertion point to the right of the parentheses. Use the keyboard to type an equal sign. At this point you should have $(x) =$. 9. Click on the Bracket button again and locate the left	{☐

bracket button. Use the mouse to select the left bracket. 10. Once the bracket is in the function, click in the outlined space after thee bracket to highlight it.	
11. To give us three spaces to put the three pieces of the formula into, we'll use a type of table called a matrix. Locate and select the Matrix button.	$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ Matrix
12. From the submenu that appears, select a matrix consisting of three rows and one column. If you function only contains two pieces, you should select a matrix with two rows and one column.	
13. Place the insertion point in the first row and type the first part of the piecewise function. In the case of this function, x + 672. 14. Move the insertion point to the other rows and type the formulas for the other pieces. 15. Use the right arrow key to move the insertion point to the right of this table. Press the space bar two to three times to add some spacing between the formula and the corresponding inequalities.	$BP(x) = \begin{cases} x + 672 \\ 0.4x + 1372 \\ 12552 \end{cases}$

16. Add another matrix with three rows and one column (or two rows and one column if it is appropriate) as in steps 10 and 11.

17. Place the insertion point in the first row of this new matrix and type the inequality for the first piece. You'll need the ≤ and < button from the Design menu.

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1372 & \square \\ 12552 & \square \end{cases}$$

18. Move the insertion point to the other rows and type in their inequalities. Once you have finished the inequalities, you should have something similar to the picture below.

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1392 & for\ 1200 \leq x < 27900 \\ 12552 & for\ x \geq 27900 \end{cases}$$

Notice how each part of the formula and inequalities are center justified. To make the function more palatable, let's left justify each part.

19. Click anywhere in the table for the inequalities. Right mouse click to reveal a new menu.

20. From this menu, select Column Alignment and then Left.
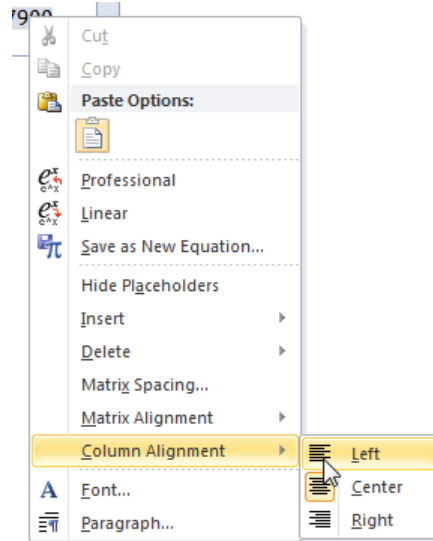
21. All of the inequalities should now be left justified as shown below.

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1392 & for\ 1200 \leq x < 27900 \\ 12552 & for\ x \geq 27900 \end{cases}$$

22. Repeat steps 19 and 20, but start by clicking anywhere in the table with the formulas. Once you have carried out these steps again, the formula part of the function should be left justified.

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1392 & for\ 1200 \leq x < 27900 \\ 12552 & for\ x \geq 27900 \end{cases}$$

The equation is now complete and we may click outside of the equation region to type any other text that is needed. This equation is an example of a Display equation. This means that the equation is displayed on a line by itself. We can change this to an equation displayed within a sentence called an Inline equation. This is done by clicking on the small down arrow in the lower right corner of the equation region.

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1392 & for\ 1200 \leq x < 27900 \\ 12552 & for\ x > 27900 \end{cases}$$

- 🔢 Save as New Equation...
- e^x Professional
- e^x Linear
- Change to Inline
- Justification ▸

Choose Change to Inline to make this equation display within a sentence. We could carry out the same process to change an inline equation to a display equation. In this case, we would select Change to Display.

23. Your Word document should look similar to the one below. Of course, your formulas will be different from the ones shown here.

Von Aron

College Algebra (MAT 152)

September 1, 2011

$$BP(x) = \begin{cases} x + 672 & for\ 350 \leq x < 1200 \\ 0.4x + 1392 & for\ 1200 \leq x < 27900 \\ 12552 & for\ x \geq 27900 \end{cases}$$

24. Press Enter to add a few vertical spaces below these two functions. Then Save your document. On subsequent pages, we'll paste the graph for these formulas into this Word document from Excel.

Paste a Graph from Excel into Word

1. Make sure you can see the Excel window with your file for modeling the medical insurance plan open.

2. Click on the edge of the graph you created in an earlier technology assignment to select it. From the Home tab, select Copy.

3. Switch to Word. From the Home tab, select Paste. Your graph should be inserted below the two piecewise formulas you put into your document earlier.
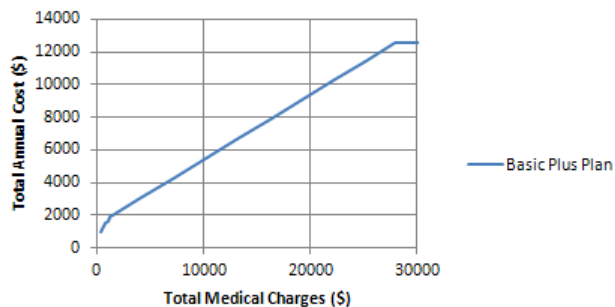
Von Aron

College Algebra (MAT 152)

September 1, 2011

$$BP(x) = \begin{cases} x + 672 & \text{for } 350 \le x < 1200 \\ 0.4x + 1392 & \text{for } 1200 \le x < 27900 \\ 12552 & \text{for } x \ge 27900 \end{cases}$$

Basic Plus Plan

4. Save the Word document. Submit the Word file for this technology assignment.