

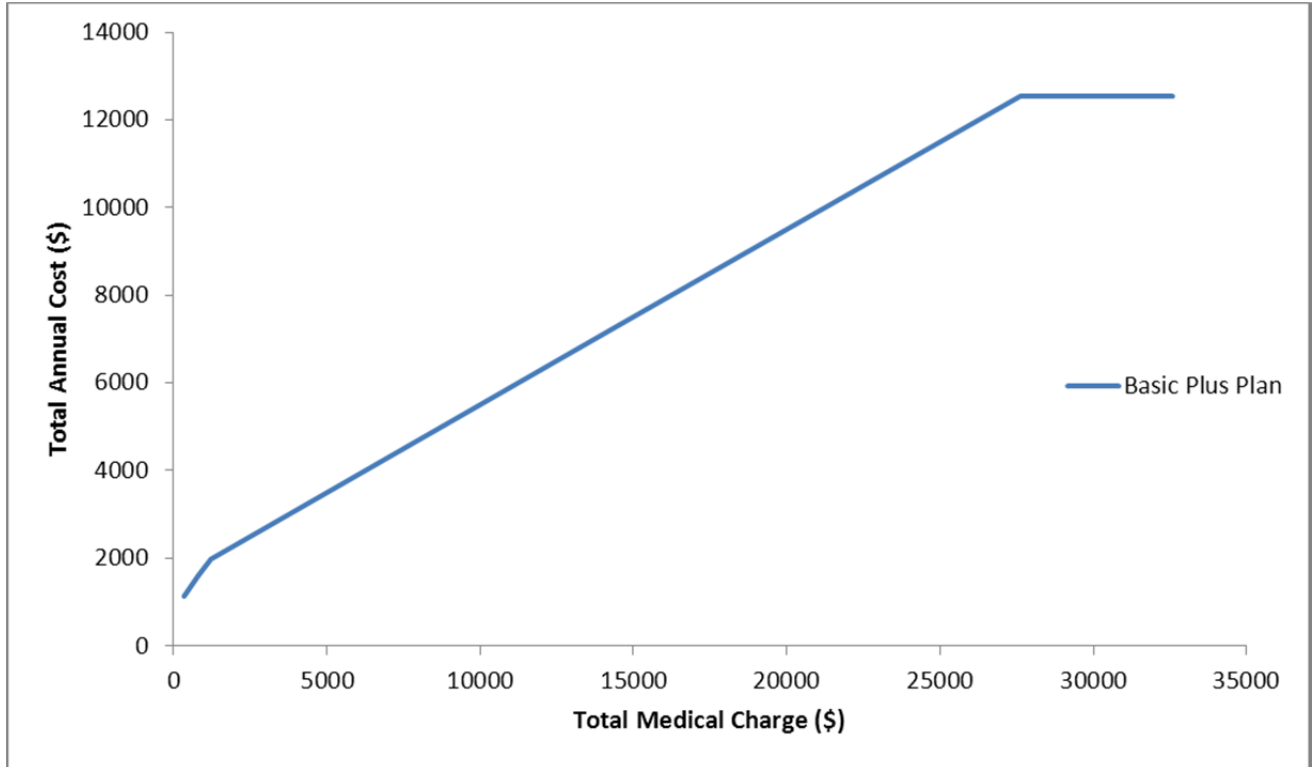
Tech Assignment – Calculate Cost

In the previous technology assignment, you entered data into an Excel spreadsheet for one or two health insurance plans. You should have an Excel file with one or two worksheets like the one below.

| | A | B | C | D |
|----|--------------------------------------|------------------------|-------------------------------------|------|
| 1 | | Basic Plus Plan | | Name |
| 2 | Plan Type | PPO | | Date |
| 3 | Primary Care Physician Visits | 40% | | |
| 4 | Other Physician Office Visits | 40% | | |
| 5 | In Network Coinsurance | 40% | | |
| 6 | Prescription Drugs | | | |
| 7 | Generic | \$10 | no deductible | |
| 8 | Preferred Brand | 20% | max of \$100 per fill | |
| 9 | Non-Preferred Brand | 50% | \$20 min to a max of \$150 per fill | |
| 10 | Out of Pocket Maximum | | | |
| 11 | Individual | \$6,000 | | |
| 12 | Family | \$12,000 | | |
| 13 | Annual Deductible | | | |
| 14 | Individual | \$600 | | |
| 15 | Family | \$1,200 | | |
| 16 | Lifetime Maximum | \$2,000,000 | | |
| 17 | Cost | \$46 | per month | |
| 18 | | | | |

This plan does not have copays for office or specialist visits. Your plan may have copays. We'll also cover how to deal with a plan with copays using a plan called the Premier Plan. For both plans, we'll find costs for family coverage. Your project may require different coverage. Check the project letter for the type of coverage you must use and make appropriate changes in the steps below. these steps below illustrate the process, but you will need to make changes for your plans.

The goal of this assignment is to create a graph of the total annual cost of health insurance as a function of the amount of charges incurred. This means that we will create one or two graphs like the one below.



To do this, you need to locate three points on this curve. Depending on whether your plan(s) has copays or not, follow the instruction below or on page 9 to find the points.

Calculate Costs for a Plan without Copays

Let's look at the graph above to learn about what is going on.

The horizontal axis is labeled "Total Medical Charges (\$)". Medical Charges are what are charged by the medical provider to the insurance company. This graph shows total medical charges in dollars from slightly higher than zero to over 30,000.

The vertical axis is labeled "Total Annual Cost (\$)". The total annual cost is the amount the insured party pays for insurance coverage in 1 year.

Tech Assignment – Calculate Cost

This graph shows the relationship between the amount of charges incurred and the corresponding total annual cost. For example, one point on this graph is (6200,3872).

This means that if you had incurred \$6200 in charges by visiting doctors, emergency rooms, urgent care, ect. over 1 year, it would cost you \$3872. Because of the health plan, you are saving a little over \$2000 than if you were uninsured.

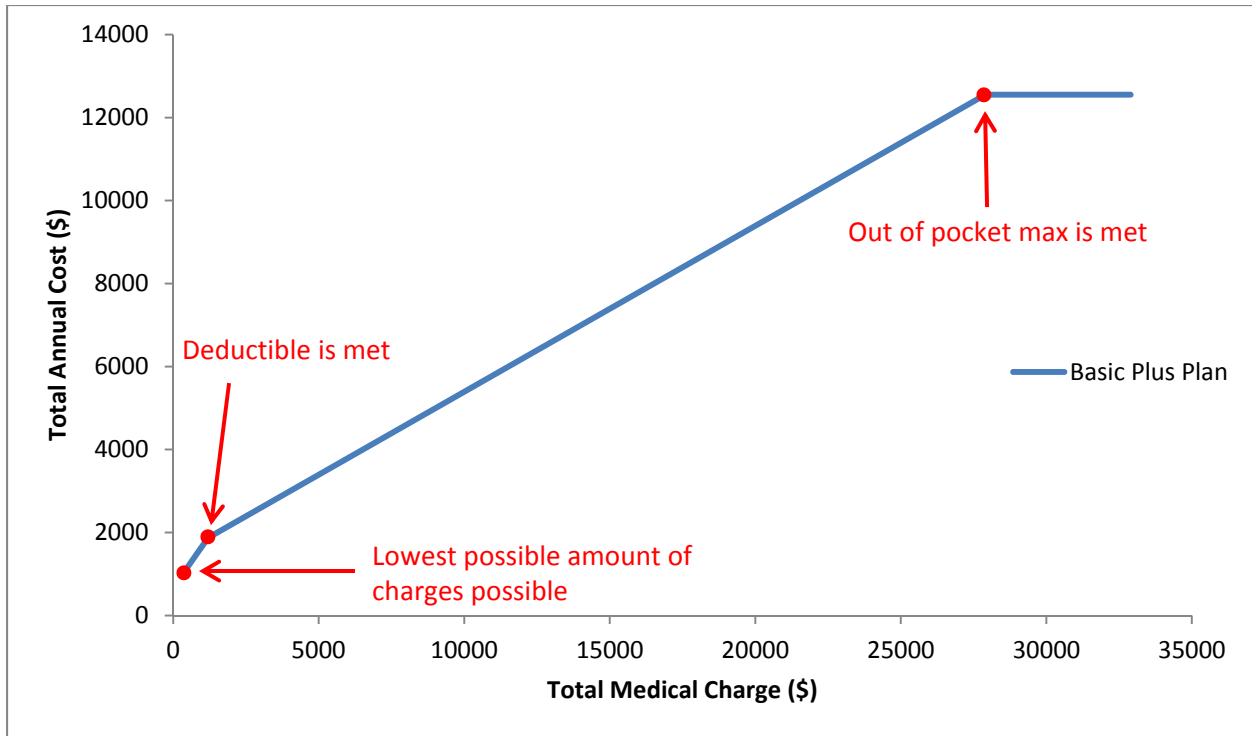
Other points on this graph indicate how much you would pay annually for other charge levels. A key concept is the relationship between the charge and the cost. The charge is amount that the medical provider sends to the insurance company. The cost is what you pay the insurance company for this service.

Other costs must be included to calculate the total annual cost. The insured party must also pay for prescriptions according to the plan benefits. The sum of the medical cost and the prescription cost is called the out of pocket cost. To be a part of the health insurance plan, the insured party must also pay premiums. The total annual cost is the sum of the out of pocket costs and the premiums,

$$\text{Total Annual Cost} = \underbrace{\text{Total Annual Out of Pocket}}_{\text{Total Medical Cost} + \text{Total Prescription Cost}} + \text{Total Annual Premiums}$$

Most of these costs are easily calculated. The prescriptions for the Basic Plus Plan (yours may be different) are \$10 per month for a total annual prescription cost of \$120. The monthly premiums are \$46 per month for an annual total of $12 \cdot \$46$ or \$552.

In examining the graph, you have probably noticed that it consists of three line segments.



Total medical cost is calculated differently depending on which of these segments the charges correspond to. These three segments relate to how charges are passed on to the insured party by the health plan. If we can find the charges and individual costs for each of the endpoints on the segments, we can easily calculate the total annual cost. With those charges and costs, we can draw the graph you see above.

First Segment – Meeting the Deductible

The first segment extends from the lowest possible charge to the point where the deductible is met. For these charges, the insured party pays all of the charges that are incurred.

At the endpoint on the left side of the segment, the insured party incurs the smallest amount of charges under the assumptions in the project. For this project, we assume the insured party will make two visits to their primary care physician (PCP) and one visit to a specialist. The charge for these visits is different for each student and is given in the project letter. For demonstration purposes, I will assume the PCP visits are charged at \$100 per visit and the specialist visits are charged at \$150 per visit. Thus the minimum charge under these assumptions (yours will be different) is \$350. Since the

deductible has not been met, the insured party must pay all of this charge. In other words, the minimum charge of \$350 costs the insured party \$350. This means the total annual cost for this charge is

$$\text{Total Annual Cost for \$350 charge} = \underbrace{350}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{552}_{\text{Premiums}} = 1022$$

Points on the graph have the form (Total medical charge, Total annual cost). This means the left endpoint of the first segment is (350,1022).

At the right endpoint of the first segment, the deductible for the health plan is met. With a family deductible of \$1200, the insured party pays all charges up until the cost is \$1200. This means the deductible is met at a charge of \$1200. At this charge, the total annual cost is

$$\text{Total Annual Cost for \$1200 charge} = \underbrace{1200}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{552}_{\text{Premiums}} = 1872$$

This charge and corresponding cost give the ordered pair (1200,1872).

Second Segment – Coinsurance Kicks In

The second segment is less steep than the first segment since the insured party is only paying a portion of additional charges. This portion is determined by the coinsurance. For the Basic Plus Plan, the coinsurance is 40%. This means that the insured party pays 40% of all charges beyond where the deductible is met.

Let's look at an example of a charge on this segment. Suppose the insured party incurs \$6200 in charges. This amount is \$5000 more than where the deductible was met. The total annual cost at this charge the sum of the deductible, the portion paid in coinsurance, the prescription cost, and the annual premium:

$$\text{Total Annual Cost for \$6200 charge} = \underbrace{1200 + 0.4(5000)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{552}_{\text{Premiums}} = 3872$$

Tech Assignment – Calculate Cost

The medical and prescription cost are the portion paid out of pocket. In this case, the total out of pocket is \$3320. The ordered pair matching this information, $(6200, 3872)$, is not the right endpoint of the segment since the out of pocket maximum has not been met. For the Basic Plus Plan, this occurs when the out of pocket cost is equal to \$12,000.

Let's try another charge of \$11,200. The total annual cost for this charge is

$$\text{Total Annual Cost for } \$11,200 \text{ charge} = \underbrace{1200 + 0.4(10000)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{552}_{\text{Premiums}} = 5872$$


The out of pocket cost for this charge is \$5320. This amount is still less than the out of pocket maximum so the right endpoint has not been reached. Let's make a table of the values and several others to find a pattern.

| Medical Charge | Medical Cost | Prescription Cost | Out of Pocket |
|----------------|---------------------|-------------------|---------------|
| 1200 | 1200 | 120 | 1320 |
| 6200 | $1200 + 0.4(5000)$ | 120 | 3320 |
| 11200 | $1200 + 0.4(10000)$ | 120 | 5320 |
| 16200 | $1200 + 0.4(15000)$ | 120 | 7320 |
| 21200 | $1200 + 0.4(20000)$ | 120 | 9320 |

As charges are increased in increments of \$5000, the out of pocket amount increases by \$2000. To find the charge that leads to an out of pocket maximum of \$12,000, let's add one more row to the table. Let's label the charge in that row as x .

Tech Assignment – Calculate Cost

| Medical Charge | Medical Cost | Prescription Cost | Out of Pocket |
|----------------|------------------------|-------------------|------------------------------|
| 1200 | 1200 | 120 | 1320 |
| 6200 | $1200 + 0.4(5000)$ | 120 | 3320 |
| 11200 | $1200 + 0.4(10000)$ | 120 | 5320 |
| 16200 | $1200 + 0.4(15000)$ | 120 | 7320 |
| 21200 | $1200 + 0.4(20000)$ | 120 | 9320 |
| x | $1200 + 0.4(x - 1200)$ | 120 | $1200 + 0.4(x - 1200) + 120$ |



The number in parentheses is 1200 less than the charge

Looking at the first two columns, notice that the number in parentheses is always \$1200 less than the charge in the first column. This is due to the fact that the coinsurance is paid on all charges above the deductible.

To find when the total out of pocket maximum of \$12,000 is reached, set the expression for the out of pocket amount in the last row equal to 12,000:

$$1200 + 0.4(x - 1200) + 120 = 12000$$

Remove the parentheses from the left side and isolate x to solve this equation:

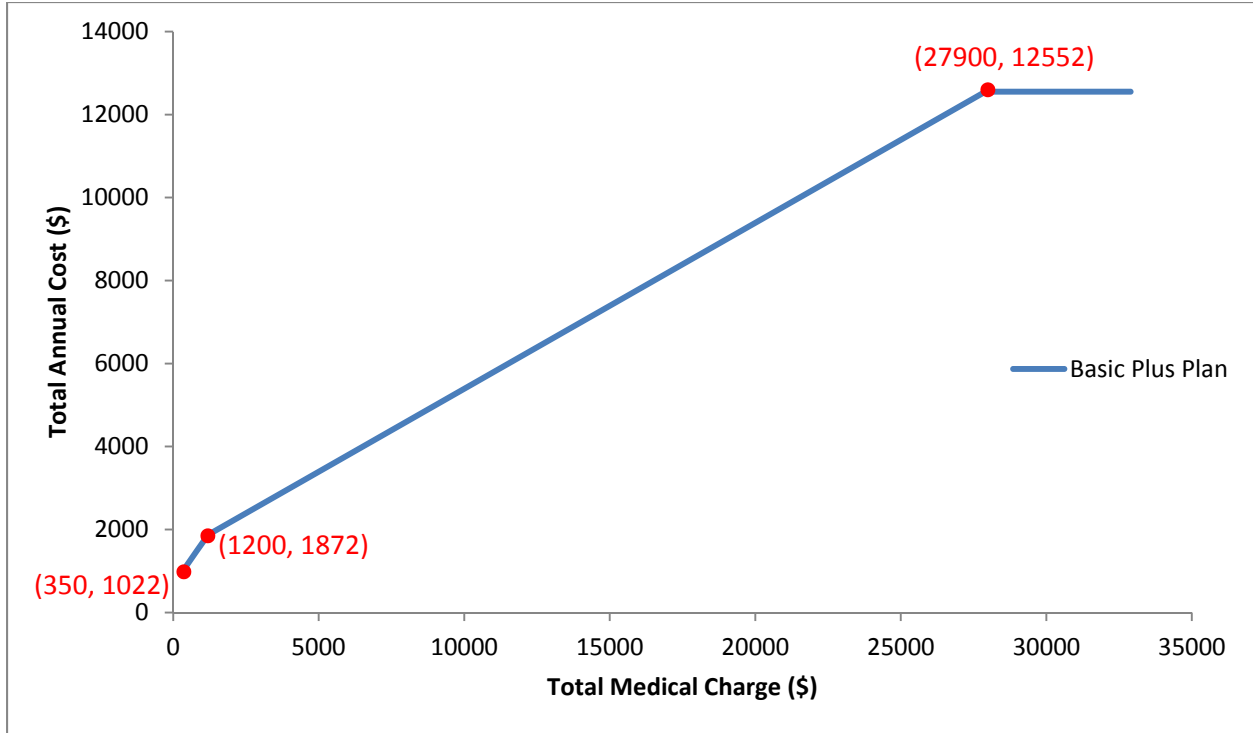
$$\begin{aligned}
 1200 + 0.4x - 480 + 120 &= 12000 && \text{Remove the parentheses} \\
 0.4x + 840 &= 12000 && \text{Collect like terms on the left side} \\
 0.4x &= 11160 && \text{Subtract 840 from both sides} \\
 x &= 27900 && \text{Divide both sides by 0.4}
 \end{aligned}$$

At this amount of charges, the total annual cost is

$$\text{Total Annual Cost for } \$27,900 \text{ charge} = \underbrace{1200 + 0.4(26700)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{552}_{\text{Premiums}} = 12552$$

With this final point, we can label all of the important points on the graph.

Tech Assignment – Calculate Cost



These points can be used to graph the functions and find the piecewise linear function that models the plan.

If your plan does not include copays, you will need to use steps like those above to find the three points on the graph. Carry out those steps before attempting to make a graph using Excel.

Calculate Costs for a Plan with Copays

You may have chosen a plan with copays. In these types of plans, certain services like doctor’s visits cost a set amount and are not subject to the deductible. An example of a plan like this is the Premier Plan.

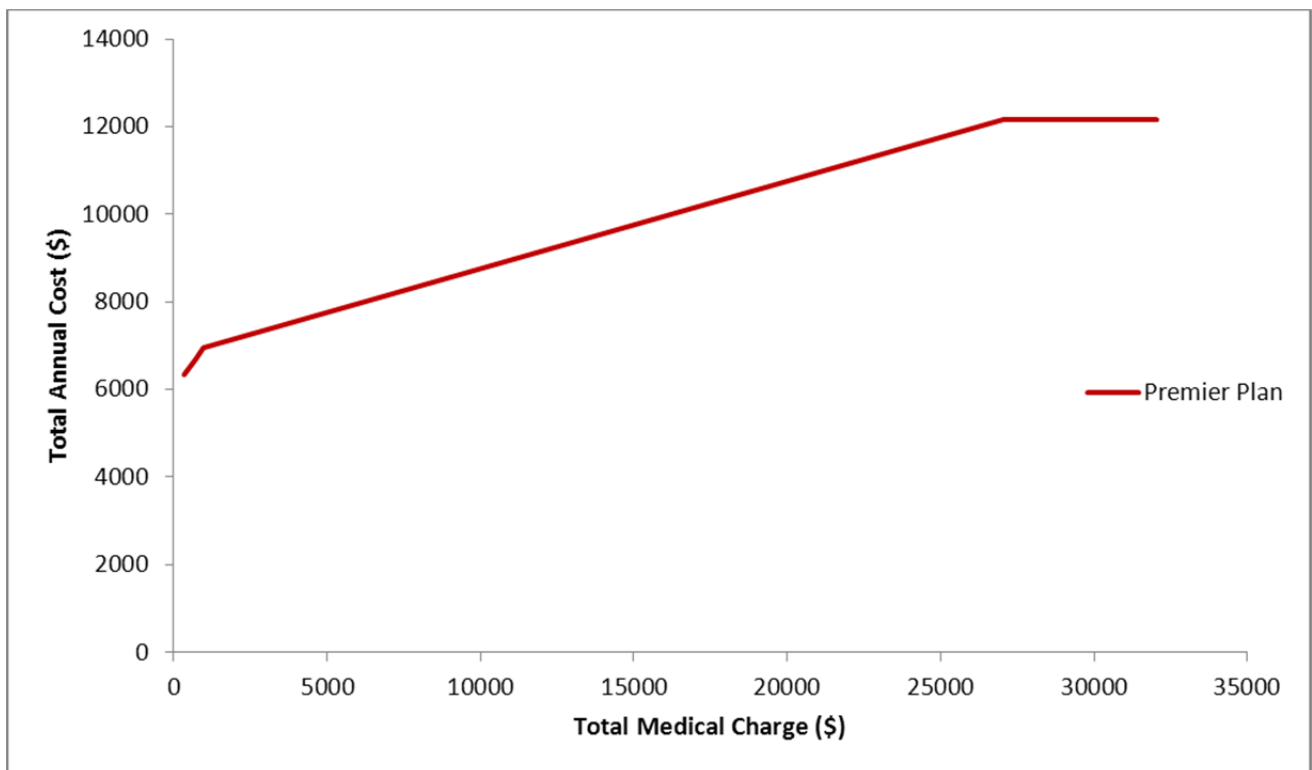
| | A | B | C |
|----|--------------------------------------|---------------------|-------------------------------------|
| 1 | | Premier Plan | |
| 2 | Plan Type | PPO | |
| 3 | Primary Care Physician Visits | \$20 | no deductible |
| 4 | Other Physician Office Visits | \$20 | |
| 5 | In Network Coinsurance | 20% | |
| 6 | Prescription Drugs | | |
| 7 | Generic | \$10 | no deductible |
| 8 | Preferred Brand | 20% | max of \$100 per fill |
| 9 | Non-Preferred Brand | 50% | \$20 min to a max of \$150 per fill |
| 10 | Out of Pocket Maximum | | |
| 11 | Individual | \$3,000 | |
| 12 | Family | \$6,000 | |
| 13 | Annual Deductible | | |
| 14 | Individual | \$300 | |
| 15 | Family | \$600 | |
| 16 | Lifetime Maximum | \$2,000,000 | |
| 17 | Cost | \$514 | per month |

The copays are shown in the rows for Primary Care Physician Visits and Other Physician Office Visits. For this plan, those visits cost the insured party \$20 per visit. There is no deductible for these visits and charges for these visits as well as the copays

Tech Assignment – Calculate Cost

themselves do not count toward the deductible. If we assume two Primary Care Physician visits at \$100 per visit and one specialist visit charged at \$150 per visit, the insurance company will be charged \$350. These visits will cost the insured party $3(\$20)$ or \$60. Since these charges do not count toward the deductible, there will need to be an additional \$600 (family coverage) before the deductible is met. This means that the deductible is actually met when \$950 in charges is incurred since the \$350 for the visits do not count toward the deductible.

The graph of the Premier Plan is shown below.



For all charge levels under this plan, the prescription cost is $12(\$10)$ or \$120. The annual premium is $12(\$514)$ or \$6168. The medical cost is determined by which section of the graph the charge matches up with.

First Segment – Meeting the Deductible

The first segment extends from a charge of \$350 to a charge of \$950. This is slightly above the deductible since the office visits don't count toward the deductible. We can calculate the total annual cost at each of these charges,

$$\begin{aligned}
 \text{Total Annual Cost for \$350 charge} &= \underbrace{60}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{6168}_{\text{Premiums}} = 6348 \\
 \text{Total Annual Cost for \$950 charge} &= \underbrace{60 + 600}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{6168}_{\text{Premiums}} = 6948
 \end{aligned}$$

Copsys
↙ ↘
↙ ↘
Deductible

This information corresponds to the points (350, 6348) and (950, 6948) on the graph.

Second Segment – Coinsurance Kicks In

For amounts above where the deductible is met and before the out of pocket max is reached, the insurance company splits the charge with the insured party according to the coinsurance. In the case of the Premium Plan, the insured party pays 20% of all charges above \$950. For instance, if there were \$5950 in charges (\$5000 above where the deductible is met),

$$\text{Total Annual Cost for \$5950 charge} = \underbrace{60 + 600 + 0.2(5000)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{6168}_{\text{Premiums}} = 7948$$

In this case the total out of pocket is

$$\text{Out of Pocket for \$5950 in charges} = \underbrace{60 + 600 + 0.2(5000)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} = 1240$$

As we did with the Basic Plus Plan, we can construct a table of values for the out of pocket to establish a pattern.

Tech Assignment – Calculate Cost

| Medical Charge | Medical Cost | Prescription Cost | Out of Pocket |
|----------------|---------------------------|-------------------|---------------------------------|
| 950 | $60 + 600$ | 120 | 780 |
| 5950 | $60 + 600 + 0.2(5000)$ | 120 | 1780 |
| 10950 | $60 + 600 + 0.2(10000)$ | 120 | 2780 |
| 15950 | $60 + 600 + 0.2(15000)$ | 120 | 3780 |
| x | $60 + 600 + 0.2(x - 950)$ | 120 | $60 + 600 + 0.2(x - 950) + 120$ |

The out of pocket maximum of \$6000 is reached when

$$60 + 600 + 0.2(x - 950) + 120 = 6000$$

We can solve this equation for x to find the appropriate charge:

$$60 + 600 + 0.2x - 190 + 120 = 6000 \quad \text{Remove parentheses}$$

$$0.2x + 590 = 6000 \quad \text{Combine like terms}$$

$$0.2x = 5410 \quad \text{Subtract 590 from both side}$$

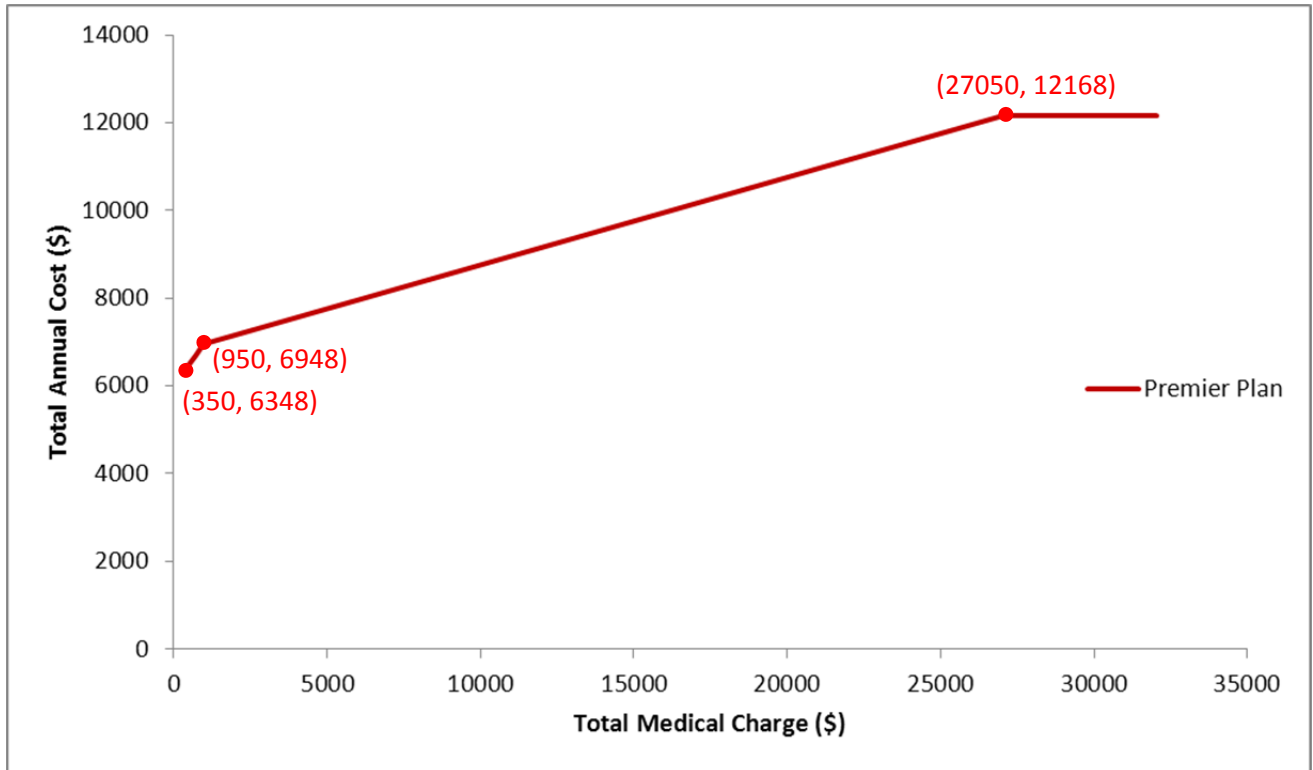
$$x = 27050 \quad \text{Remove parentheses}$$

At this charge, the out of pocket maximum is met. The total annual cost at this charge is

$$\text{Out of Pocket for } \$27050 \text{ in charges} = \underbrace{60 + 600 + 0.2(26100)}_{\text{Medical Costs}} + \underbrace{120}_{\text{Prescription Cost}} + \underbrace{6168}_{\text{Premiums}} = 12168$$

This information corresponds to the point $(27050, 12168)$ on the graph. Let's label the points we have found.

Tech Assignment – Calculate Cost





If your plan includes copays, you will need to use steps like those above to find the three points on the graph. Carry out those steps before attempting to make a graph using Excel.

Use Excel to Graph the Plan Using Points

You should now have three points on the graph of your plan. It is a good idea to write these values down since you will need them to graph your plan. For the Basic Plus Plan, the values are shown below.

| Total Medical Charge | Total Annual Cost |
|----------------------|-------------------|
| 350 | 1022 |
| 1200 | 1872 |
| 27900 | 12552 |

Tech Assignment – Calculate Cost

| | |
|---|---|
| <ol style="list-style-type: none">1. Open the Excel workbook you created in the previous technology assignment. It should include the initial information for your insurance plan(s). If you have more than one plan, you should have a different sheet for each set of initial information.2. You should see other sheet in this workbook. You can access these worksheets using the tabs along the bottom of the Excel window. We want to rename one of the empty worksheets. You should see one named “Sheet2” or “Sheet3”. |  A screenshot of an Excel worksheet tab. The tab is labeled "Sheet2" in a bold, black font. To the right of the text is a small icon of a sun and a mountain range. The tab has a light blue background and a thin border. |
| <ol style="list-style-type: none">3. Double click in the name of the worksheet so that it becomes highlighted. Type in a new name for the worksheet like “Graph”. If you have more than one plan you are analyzing, you will want to add to this title so each worksheet that contains a graph has a different name. |  A screenshot of an Excel worksheet tab. The tab is labeled "Graph" in a bold, black font. To the right of the text is a small icon of a sun and a mountain range. The tab has a light blue background and a thin border. |

Tech Assignment – Calculate Cost

4. Before we enter the numbers from the table above, let's add some labels to the worksheet. Modify the worksheet so that it looks like the one shown below.

| | A | B | C |
|---|---------------------------|-----------------------|-------------------|
| 1 | | Total Medical Charges | Total Annual Cost |
| 2 | Minimum Charge | | |
| 3 | Deductible Met | | |
| 4 | Reached Out of Pocket Max | | |

5. Add the three different medical charges you found in cells B2 through B4.
6. In cell B5, put another charge that is greater the charge at which the out of pocket max i reached. We will use this charge as the right ending point of the graph. In the example below, the graph will extend horizontally from 350 to 30,000. The numbers for your plan will probably be different.

| | A | B | C |
|---|---------------------------|-----------------------|-------------------|
| 1 | | Total Medical Charges | Total Annual Cost |
| 2 | Minimum Charge | 350 | |
| 3 | Deductible Met | 1200 | |
| 4 | Reached Out of Pocket Max | 27900 | |
| 5 | | 30000 | |
| 6 | | | |

Tech Assignment – Calculate Cost

7. In cells C2 through C5, enter the corresponding total annual costs. The cost for the charge in cell B5 should be the same as the cost in cell B4. Remember, at this point the out of pocket max has been reached so the graph levels off.

| | A | B | C |
|---|---------------------------|-----------------------|-------------------|
| 1 | | Total Medical Charges | Total Annual Cost |
| 2 | Minimum Charge | 350 | 1022 |
| 3 | Deductible Met | 1200 | 1872 |
| 4 | Reached Out of Pocket Max | 27900 | 12552 |
| 5 | | 30000 | 12552 |
| 6 | | | |

8. Click in cell B2. While holding the left mouse button down, drag the mouse to cell C5. You should see the cells below highlighted indicating that you have selected them.

| | A | B | C |
|---|---------------------------|-----------------------|-------------------|
| 1 | | Total Medical Charges | Total Annual Cost |
| 2 | Minimum Charge | 350 | 1022 |
| 3 | Deductible Met | 1200 | 1872 |
| 4 | Reached Out of Pocket Max | 27900 | 12552 |
| 5 | | 30000 | 12552 |
| 6 | | | |

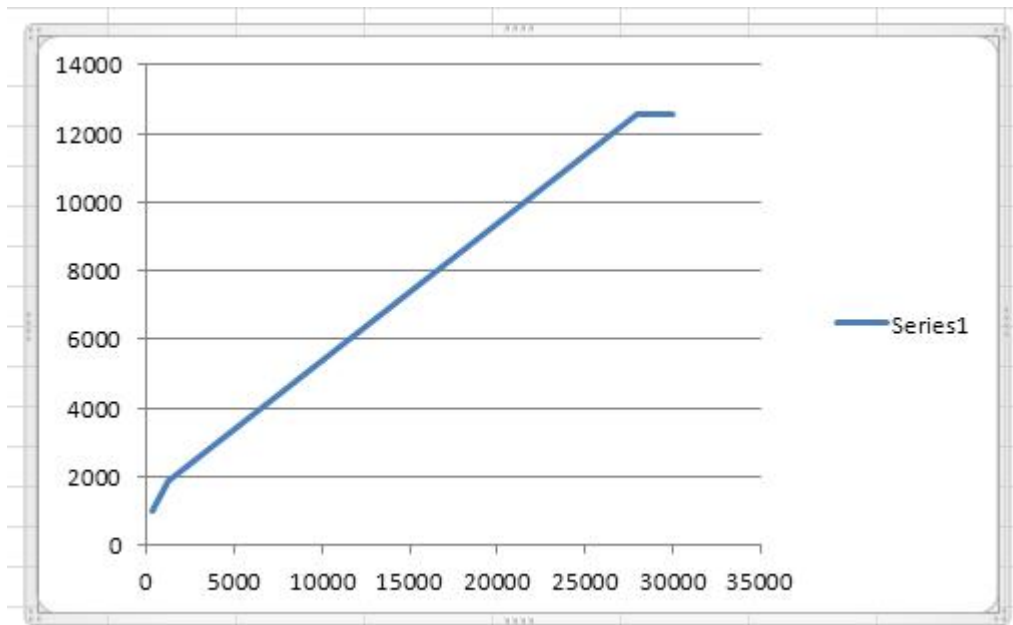
9. From the menu along the top of the Excel window, click on the Insert tab.
10. From the Charts panel, choose Scatter.
11. From the drop down menu that appears, select Scatter with Straight lines. This option is the graph at the bottom of the menu as shown below.

Tech Assignment – Calculate Cost

The screenshot shows the Excel interface with the 'Charts' ribbon selected. The 'Scatter' dropdown menu is open, and the 'Scatter with Straight Lines' option is highlighted. A tooltip for this option is displayed, stating: 'Scatter with Straight Lines. Compare pairs of values. Use it when there are many data points in x-axis order and the data represents separate samples.'

| C | D | E | H | I |
|-------------------|---|---|---|---|
| Total Annual Cost | | | | |
| 1022 | | | | |
| 1872 | | | | |
| 12552 | | | | |
| 12552 | | | | |

12. The ordered pairs in your table will be shown in a graph like the one below. In the steps that follow, we'll format this graph further.



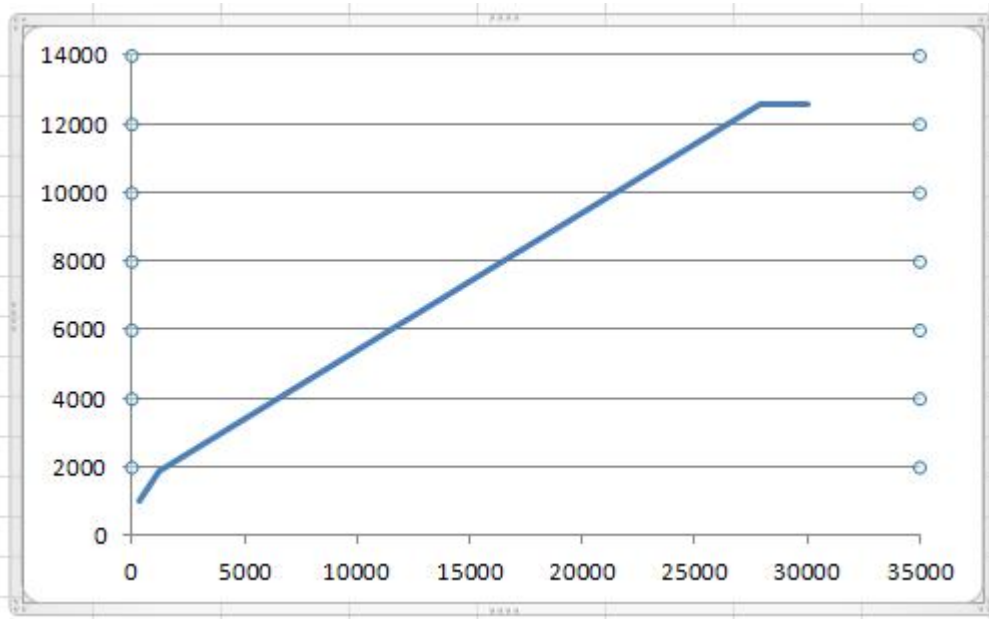
13. Since there is only one graph, let's remove the legend on the right. If you are going to put two graphs together, you might want to leave the legend on the graph. To remove the legend, click on the legend to highlight it.



14. Press the Delete button on your keyboard.

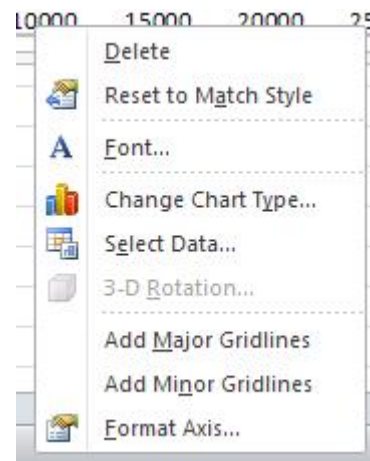
15. Next, let's remove the gridlines. Click on one of the gridlines to select them. You will see little circles appear on the gridlines to let you know that you have selected them successfully.

16. Press the Delete button on the keyboard.

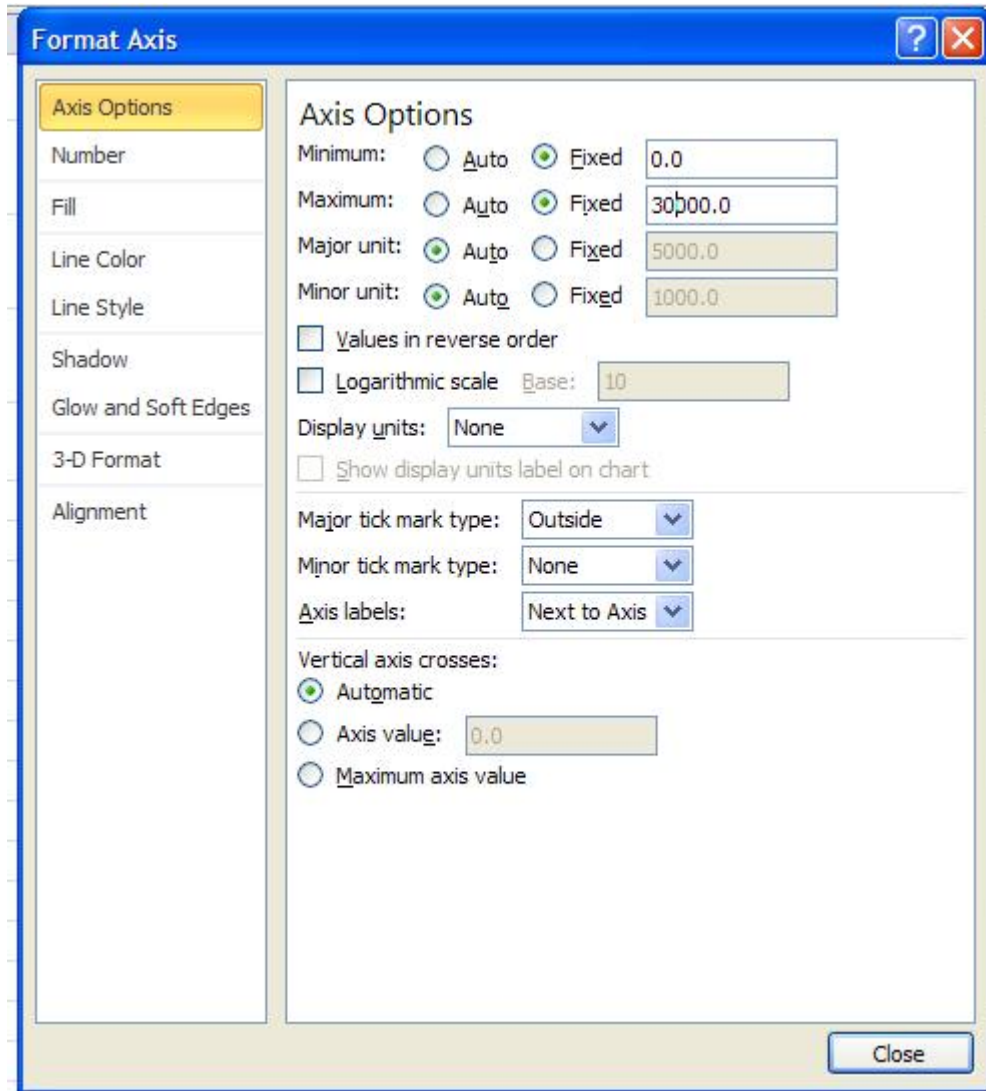


17. We can also format the scales on each axis. For instance, right mouse click on the horizontal axis to reveal the menu on the right.

18. Select Format Axis.

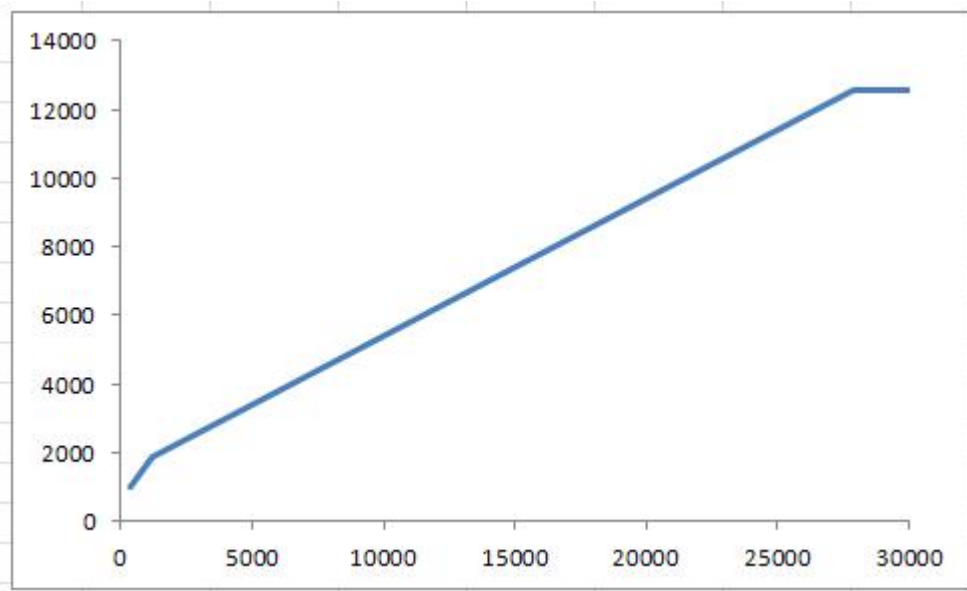


- Under Axis Option, click on Fixed next to the Minimum and Maximum. These values define the horizontal window on the graph.
- Remember that the charges in my table extend from 350 to 30,000. To include these values I'll set the Minimum to 0 and the Maximum to 30,000 as shown below.



You can use the other options in this box to change how often the axis is labeled (Major Unit) and how the axis appears in the graph (Line Color, Line Style).

21. Select Close to update the graph. Your graph should now be formatted similar to the one below.

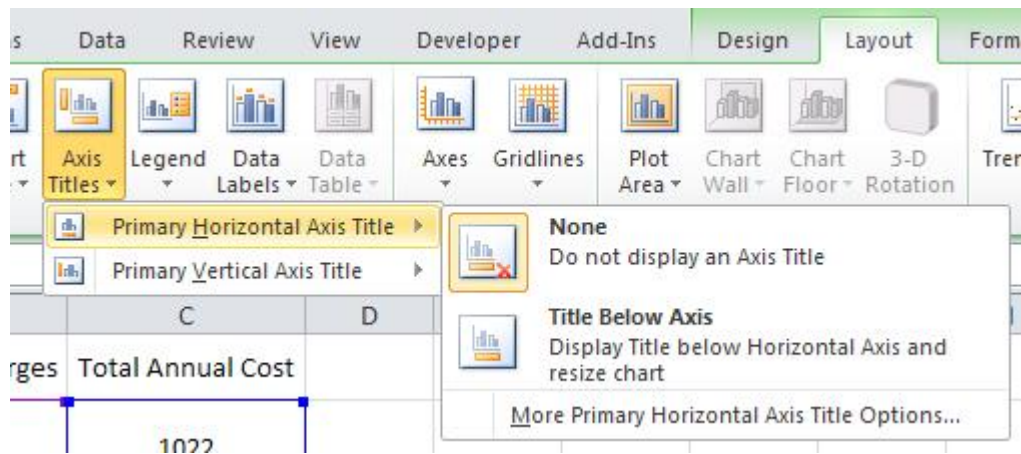


22. Axes labels help to clarify what is being graphed. Let's add them to the horizontal and vertical axes. Start by clicking on the graph to select it.

23. Once the graph is selected, you'll see a number of new tabs labeled Chart Tools. Click on the Layout Tab.

24. On the Labels panel, choose Axes Titles.

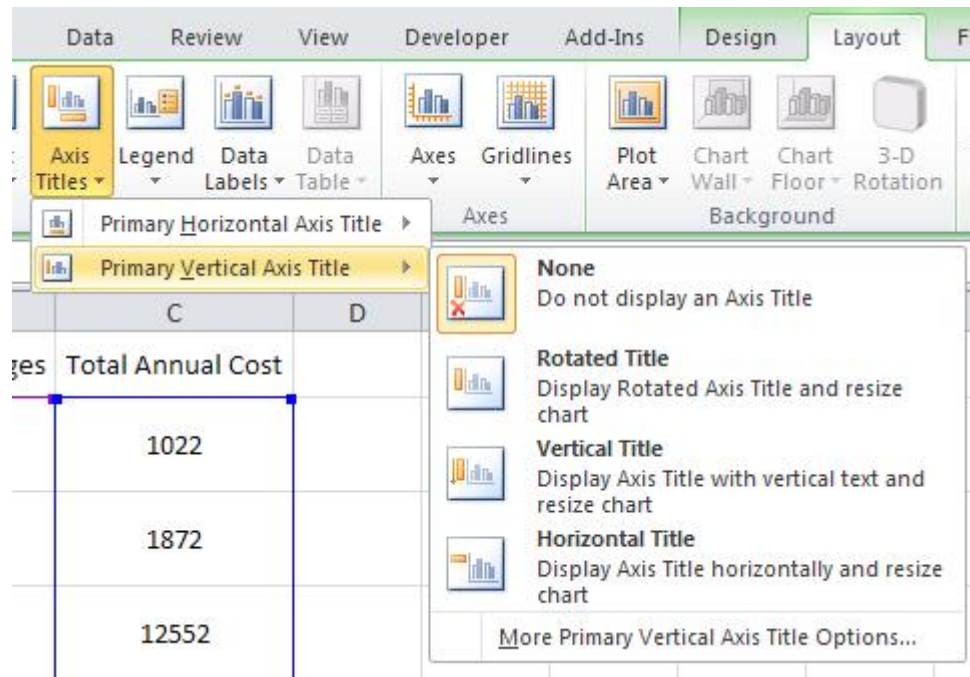
25. Now choose Primary Horizontal Axis Title and then Title Below Axis.



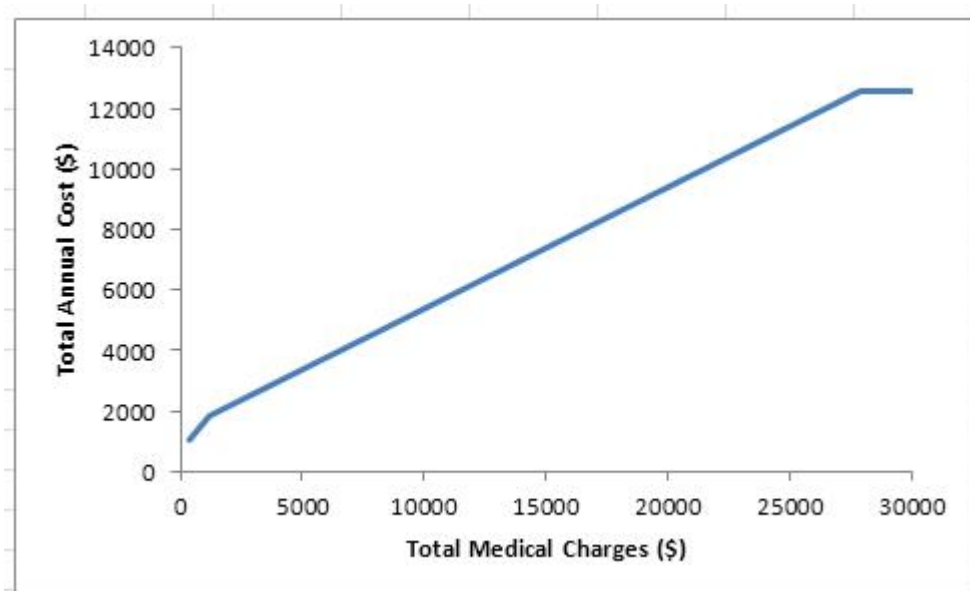
You should now see a label on the horizontal axis.

26. Let's repeat some of these steps to put a label on the vertical axis. This time when you select Axes Titles, choose the Primary Vertical Axis Title option.

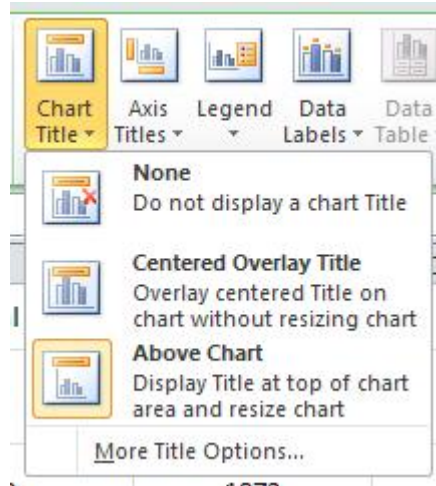
27. Choose a Rotated Title.



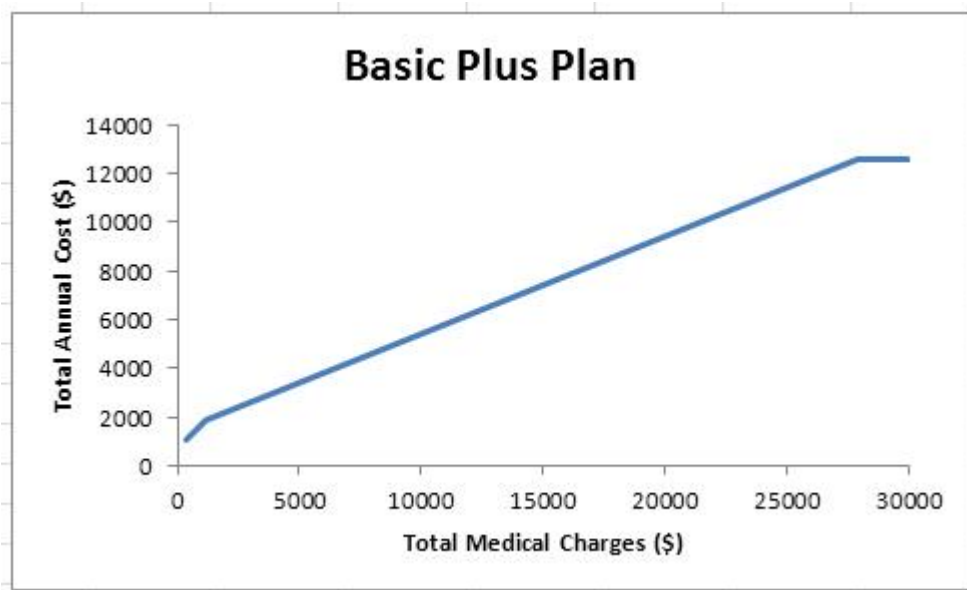
28. Click on each label and edit them so that they appear similar to the labels below. Make sure each label includes a description as well as the units on the quantity.



- 29. Finally, let's add a title to the chart. Click on the graph to elect it.
- 30. Click on the Layout tab and select the Chart Title button.
- 31. Click on Above Chart as shown to the right.



- 32. Edit the title to reflect the name of your health insurance plan.



- 33. Save your Excel workbook. If you are only modeling a single health plan, you can now submit the Excel file you have created for your plan. This file should contain two worksheets. One should contain your initial information and the other your charge/cost table and corresponding graph.
- 34. If you are comparing two plans, repeat these steps for your other plan. Submit the Excel file with four worksheets. Two should contain the information for each plan and the other two the corresponding charge/cost tables and graphs.