

Teacher Notes



Revenue, Costs, and Maximizing Profit

Activity 1 Exploring Revenue and Costs

Activity at a Glance

- ◆ **Subject:** Social Studies
- ◆ **Subject Area:** Economics
- ◆ **Category:** Microeconomics
- ◆ **Topic:** Prices
- ◆ **Grade Level:** 9 - 12
- ◆ **Prerequisites:** Students should have covered the concept of demand and supply and their related schedules and graphs. In terms of production students should also be familiar with the concept of economies of scale and law of diminishing returns.
- ◆ **Total Teaching Time:** 90 minutes

Materials

- ◆ TI-83 Plus or TI-83 Plus Silver Edition
- ◆ CellSheet™ Application
- ◆ Student Work Sheets: **Exploring Revenue, Exploring Costs**

Activity Overview

First, divide the class into pairs. In each pair students will work through each part of the exploration (cost and revenue) together, discussing their answers with each other. Students will examine measures of revenue and cost and discuss how these measures give information about profit. The whole class should then discuss and share their conclusions.

Tip

It is important that the entire class have an opportunity to discuss their findings and avoid any misunderstandings.

Directions

Before the Activity Begins

Make sure each student has a TI-83 Plus loaded with the CellSheet™ Application.

The students will work in teams of two in this activity, so make enough copies of the student work sheets so that each student receives either a copy of the revenue work sheet or cost work sheet.

Warm-up Activity

The students should already have some acquaintance with the concepts of demand, supply, economies of scale, and law of diminishing returns. A review of these concepts may be worthwhile, depending on the class' depth of understanding of these terms.

The teacher should lead a discussion about revenue and cost. This should include defining terminology such as revenue, fixed costs, and variable costs. Possibly a section from a text or information from a web site may provide a resource for the students to define terms on their own. A suggested web site is the National Council on Economic Education, www.ncee.net.

During the Activity

Place students in pairs. Distribute handouts to the students. In each team, one student will work on the Revenue sheet and the other will work on the Cost sheet. Monitor student progress to ensure that students are completing the work. It may be necessary to provide additional structure for this activity. When students have finished their worksheets, ensure that each team reviews and discusses with their partners their individual results. After the teams have discussed their answers, bring the class together to discuss the issues raised during the activity.

After the Activity

Lead a class discussion that incorporates the questions from the work sheets. Summarize the key ideas of total revenue, marginal revenue, average cost and marginal cost.

If time permits, the students may explore "what if" scenarios with the data and the CellSheet™ application to determine where total revenue would increase and where it would decrease. Some scenarios that might be interesting to students include the production of different types of clothing or the production and sale of CDs. Teachers can make up numbers in terms of price, quantity and cost that fit different scenarios or the teacher can challenge the students to create their own. Another alternative would be to gather and use real data obtained from local businesses.

Selected Possible Answers

Exploring Revenue Work Sheet

1. As price increases, the quantity demanded decreases and vice versa.
2. Answers will vary. Some students may assume it is true but many may realize it will depend on the change in quantity demanded. Lower prices may increase quantity demanded enough to increase total revenue.
3. Revenue increased. This may be a surprise to some students.
4. Revenue decreased. Quantity demanded did not rise enough to offset the decrease in price. This question can be used to introduce and explore the concept of elasticity.

5. Negative marginal revenue indicates a loss in revenue when producing one more item.
6. Positive values are an indication to produce more since revenue is increasing. Negative values are an indication to produce less since revenue is decreasing.
7. The marginal revenue is at 0 when total revenue is at its highest point.
8. Not necessarily, costs need to be taken into account.
9. Answers will vary. Key factors may include changes in quantity demanded as prices change, marginal revenue, and costs of production.

Exploring Costs Work Sheet

1. Fixed costs are costs that remain the same at all levels of output, and are paid regardless of production. Variable costs change with the level of output.
2. Fixed cost does not change, variable cost increases.
4. Average cost decreases then increases. Initially, fixed costs are spread over a few items and the average cost remains high. As output increases, these costs are spread over more items. Eventually, costs increase at a larger rate because increased output requires additional equipment, buildings, overtime, and the like.
5. Marginal cost at first declines as the producer reaches its optimal production level. Eventually, marginal cost rises because costs such as overtime, additional fixed costs, and so forth, are incurred.
6. In terms of economies of scale, as output increases, efficiency can increase due to greater specialization, more efficient use of resources, and so forth. Because of these efficiencies, the marginal and average costs initially decrease as output increases. Firms may eventually become less efficient if they grow too large and the law of diminishing returns applies.
7. Most students will likely respond that the answer is the point at which the average or unit cost is minimized.
8. Revenue needs to be taken into account.

Student Work Sheet
Exploring Revenue

Name: _____

Date: _____

Calculating Revenue

In order to calculate how much revenue a company generates through the sale of a product, we multiply the price per item by the quantity sold. For example, if 100 items are sold at \$2 each, the company has \$200 in revenue. (Revenue = Price x Quantity = 2 x 100 = 200)

1. Based on your understanding of demand, what will happen to the quantity of items demanded if a company increases/decreases its price?

2. Do you think increasing the price will increase revenue and decreasing price will decrease revenue? Why or why not?

Using the CellSheet™ application

You will examine a demand schedule and calculate total revenue using the CellSheet™ application on the TI-83 Plus.

- A. To enter data, first press **[APPS]** and select the CellSheet application by moving the cursor beside it and pressing **[ENTER]**.

Follow the directions on the screen (press any key). You may wish to make note of the Help Menu that appears (also shown to the right). Press any key to continue.



B. A spreadsheet appears.

- ◆ Press **GRAPH** to access the **Menu**.

```
CELLSHEET MENU
1:File...
2:Edit...
3:Options...
4:Charts...
5:Help
6:Quit CellSheet
```

- ◆ Select **1:File** by pressing **1** or highlight the **1** and pressing **ENTER**.

```
SAVE AS...
Old:S01
New:
Enter
```

- ◆ If the spreadsheet shown was blank, select **2:Save As** and enter the file name. Use the title **REVENUE**.

REVE	A	B	C
1			
2			
3			
4			
5			
6			
A1:			Menu

- ◆ If a previously loaded spreadsheet was shown, select **3:New** and enter the file name. Use the title **REVENUE**.

```
NEW...
Old:S01
New:
Enter
```

C. Move the cursor to cell A1 and enter the heading for the column. To enter text, type " first (above the + key). Since you will be entering a large amount of text, it will be helpful to turn on the alpha-lock by pressing **2nd ALPHA**. Enter the title **PRICE**. In cell B1, enter the heading **QD** (for quantity demanded). In cell C1, enter the heading **TR** (for Total Revenue).

D. In column A enter the following prices.

- A2: 19
- A3: 17
- A4: 15
- A5: 13
- A6: 11
- A7: 9
- A8: 7
- A9: 5
- A10: 3
- A11: 1

In column B enter the following quantity demanded.

- B2: 0
- B3: 1
- B4: 2
- B5: 3
- B6: 4
- B7: 5
- B8: 6
- B9: 7
- B10: 8
- B11: 9

E. Calculate the revenues by entering the formula in cell C2. Move the cursor to C2 and press **[STO▶]** to begin a formula. Revenue is calculated by multiplying Price by Quantity. Enter the formula **A2*B2**.

F. To copy the formula, press **[ZOOM]**. Highlight the range where the formula is to be copied to by pressing **[Y=]** and moving the cursor down to highlight the range from C2 to C11. Press **[TRACE]** to paste the formula to the cells highlighted.

REVE	A	B	C
1	PRICE	QD	TR
2	19	0	0
3	17	1	17
4	15	2	30
5	13	3	39
6	11	4	44
C2: =A2*B2			[Menu]

- 3.** What do you notice about the total revenue as price decreases from \$19 to \$9? Is this surprising?

- 4.** What do you notice about the total revenue as price decreases from \$9 to \$1? Why is this different from your answer to the question above?

One other measurement that is also helpful when examining revenue is Marginal Revenue. Marginal Revenue is the extra amount of Total Revenue generated due to the selling of one more item. In other words it is the change in Total Revenue as the quantity demanded increases by one.

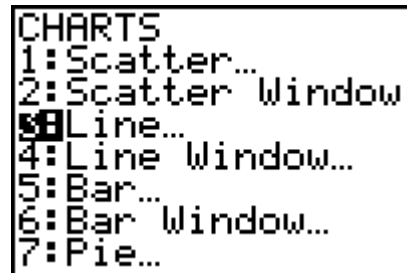
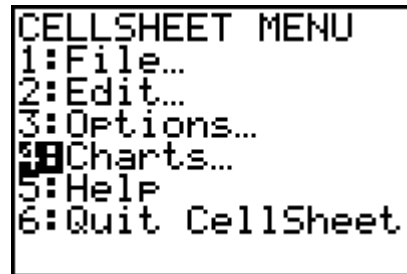
To calculate the Marginal Revenue, you need to determine the change in successive values of Total Revenue. Return to your TI-83 Plus.

- G. Type **MR** as the heading for column D in cell D1.
- H. In cell D2, enter the formula by pressing $\boxed{\text{STO}}\blacktriangleright$ and then enter C2-C1. (C1 contains the heading for the column and has a numeric value of 0.)
- I. Copy the formula into the other cells by pressing $\boxed{\text{ZOOM}}\blacktriangleright$. Press $\boxed{\text{Y=}}$ and move the cursor down to highlight all the cells in the column where the formula is to be copied (D2 to D11). Press $\boxed{\text{TRACE}}$ to paste the formula into the selected cells.
- 5.** Review the column entitled Marginal Revenue. What does a negative value for Marginal Revenue indicate?

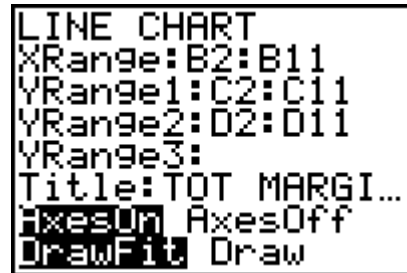
6. Would a company produce more items if the Marginal Revenue is positive or negative? Explain your response.

Return to the TI-83 Plus device and construct graphs of the Total Revenue and Marginal Revenue data and compare them.

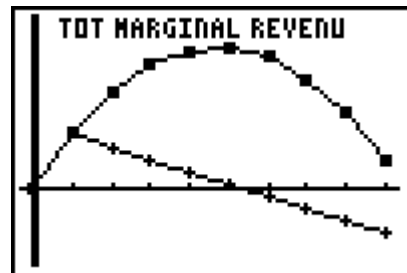
- J. To construct a Line graph, press **GRAPH** to access the **MENU**. Select **4:Charts** and then **3:Line**.



- K. Enter cells B2:B11 for the XRange (this is the quantity). For YRange1, enter **C2:C11** which is the Total Revenue. For YRange2, enter **D2:D11** which is Marginal Revenue. Enter an appropriate title such as **TOT MARGINAL REVENUE**.



- L. Move the cursor to DrawFit and press **ENTER** to see the Line graphs. Press the **TRACE** key to identify key values using the arrow keys.



7. Sketch a copy of the graphs. On this sketch, indicate the location on the Total Revenue Line graph that defines the quantity that should be produced to maximize revenue. What happens to that quantity in terms of the Marginal Revenue Line graph?

8. Will this quantity result in maximum profits? Explain your response.

9. Discuss your results with your partner and suggest what factors should be taken into account in determining how much to produce in order to maximize profits.

Student Work Sheet

Exploring Costs

Name: _____

Date: _____

Calculating Total Costs

A business incurs a variety of costs in order to produce and market its products. We will classify these in terms of fixed costs and variable costs.

1. Define what is meant by the terms *fixed costs* and *variable costs*.

2. As the number of items produced increases, what happens to the amount paid for fixed costs and for variable costs?

You will examine the costs of production by calculating various measures of cost using the CellSheet™ application on the TI-83 Plus device.

- A. To enter data, first press **[APPS]** and select the CellSheet™ application by moving the cursor beside it and pressing **[ENTER]**.

Follow the directions on the screen (press any key). You may wish to make note of the Help Menu that appears (also shown to the right). Press any key to continue.

```
CellSheet V1.10 Help
= ..... STO->
% ..... RCL
Select Range ..... F1
Cut/Copy ..... F2/F3
Paste ..... F4
Menu ..... F5
Grab Cell Ref..... APPS
Use " in front of text
Press Any Key
```

- B. A spreadsheet appears.
- ◆ Press **[GRAPH]** (the key under the word **Menu**).

```
CELLSHEET MENU
1:File...
2:Edit...
3:Options...
4:Charts...
5:Help
6:Quit CellSheet
```

- ◆ Select **1:File** by pressing **1** or highlight the **1** and pressing **[ENTER]**.

```
SAVE AS...
Old: S01
New: 
Enter
```

- ◆ If the sheet displayed was blank, select **2:Save As** and enter the file name. Use the title **COST**.

COST	A	B	C
1			
2			
3			
4			
5			
6			
A1:	[Menu]		

- ◆ If a previously loaded spreadsheet was displayed, select **3:New** and enter the file name. We will use **COST**.

```
NEW...
Old: S01
New:
Enter
```

- C. Move your cursor to cell A1 and enter the heading for the column. To enter text, type " first (above the + key). Since you will be entering a large amount of text, it will be helpful to turn on the alpha-lock by pressing **[2nd] [ALPHA]**. Enter the title: **QS** (for Quantity Supplied). In cell B1, enter the heading **FC** (for Fixed Costs). In cell C1, enter the heading **VC** (for Variable Costs). In cell D1, enter the heading **TC** (for Total Costs).

D. In column A, enter the following prices.

A2: 0

A3: 1

A4: 2

A5: 3

A6: 4

A7: 5

A8: 6

A9: 7

A10: 8

A11: 9

In column B, enter the fixed cost of 5 in cells B2 to B11.

In column C, enter the following variable costs.

C2: 0

C3: 4

C4: 6

C5: 7

C6: 9

C7: 13

C8: 18

C9: 25

C10: 33

C11: 43

E. Calculate the Total Cost by entering the formula in cell D2. Move the cursor to D2 and press **[STO]** to begin a formula. Total Cost is calculated by adding Fixed Cost and Variable Cost. Enter the formula $B2+C2$.

F. To copy the formula, press **[ZOOM]**. Highlight the range where the formula is to be copied to by pressing **[Y=]** and moving the cursor down to highlight the range from D2 to D11. Press **[TRACE]** to paste the formula to the selected cells.

COST	B	C	D
1	FC	VC	TC
2	5	0	5
3	5	4	9
4	5	6	11
5	5	7	12
6	5	9	14
D2: =B2+C2			[Menu]

As expected, total costs rise as the number of items produced increases. Companies therefore may look at other measures to determine the optimal level of production. One such calculation is the Average Cost. This is also referred to as the unit cost. It is the cost of producing each item.

To calculate the average cost, return to the TI-83 Plus device.

- G. Calculate the Average Cost in column E. To do this, move the cursor to cell E1 and enter the heading **AC** (for Average Cost).
- H. Move to cell E2 and press **[STO▶]** to begin a formula. Average Cost is calculated by taking Total Cost divided by Quantity Supplied. Enter the formula $D2/A2$.

Note: You will get a “divide by 0” error but this is expected for the first cell since the quantity is 0. This error will not occur when you copy the formula.

- I. Copy the formula into the other cells by press **[ZOOM]**. Press **[Y=]** and move the cursor down to highlight all the cells in the column where the formula is to be copied (E2 to E11). Press **[TRACE]** to paste the formula to the cells highlighted.

COST	C	D	E
1	VC	TC	AC
2		0	5 ERROR
3		4	9
4		6	11 5.5
5		7	12 4
6		9	14 3.5
E2: =D2/A2			[Menu]

One other measurement that is also helpful when examining costs is Marginal Cost. Marginal Cost is the extra cost due to the production of one more item. In other words, it is the change in Total Cost as the quantity supplied increases by one. Return to the TI-83 Plus device.

- J. To calculate the Marginal Cost, first determine the change in successive values of Total Cost. Enter **MC** in cell F1 as the heading of column F.
- K. In cell F2, enter the formula by pressing **[STO▶]**, and type $D2-D1$. (D1 contains the heading for the column and has a numeric value of 0.)
- L. Copy the formula into the other cells by press **[ZOOM]**. Press **[Y=]** and move the cursor down to highlight all the cells in the column where the formula is to be copied (F2 to F11). Press **[TRACE]** to paste the formula into the selected cells.

M. Examine the graphs of the Average Cost and Marginal Cost. To construct a Line graph, press **GRAPH** to access the **MENU**. Select **4:Charts** and then **3:Line**.

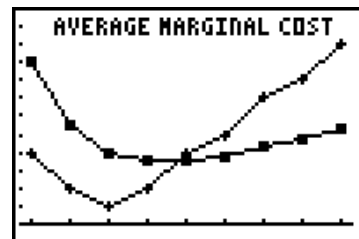
```
CELLSHEET MENU
1:File...
2:Edit...
3:Options...
4:Charts...
5:Help
6:Quit CellSheet
```

```
CHARTS
1:Scatter...
2:Scatter Window
3:Line...
4:Line Window...
5:Bar...
6:Bar Window...
7:Pie...
```

Enter cells A3:A11 for the XRange (this is the quantity). Note: Start the graphing at row 3 since row 2 is undefined for Average Cost. For YRange1, enter E3:E11 which is the Average Cost. For YRange2, enter F3:F11 which is the Marginal Cost. Enter an appropriate title such as **AVERAGE MARGINAL COST**.

```
LINE CHART
XRange:A3:A11
YRange1:E3:E11
YRange2:F3:F11
YRange3:
Title:AVERAGE M...
AxesOn AxesOff
DrawFit Draw
```

Move the cursor to DrawFit and press **ENTER** to see the Line graphs. Press the **TRACE** key to identify key values using the arrow keys on the device.



3. Sketch a copy of the graphs and indicate the location on the Average Cost Line graph that defines the quantity that should be produced to minimize average or unit cost.

4. What do you notice about the average cost as the number of items produced increases? Explain why you think this happens.

5. Describe what happens to the Marginal Cost as the quantity supplied changes. Explain why you think this happens.

6. Explain how the graph(s) may be related to the concepts of Economies of Scale and Law of Diminishing Returns.

7. What quantity would you suggest this business produce in order to maximum profits? Explain your response.

8. Discuss the results with your partner and suggest what factors should be taken into account in determining how much to produce in order to maximize profits.