EXPLORATIONS

CHAPTER 12

When using the TI-83 Plus or TI-84 Plus calculators you access ***Finance*** by pressing the APPS key.

Breakeven Analysis

Breakeven analysis is concerned with the relationship between the cost and revenue of an enterprise. Implicit in such analysis is an examination of the relationship between fixed and variable costs, profits, and pricing policy and the volume of output (quantity produced).

Such analysis of prices, costs, and profits is good for the short term (usually twelve months). The analysis is only as good as the model that is built; the more flexible the pricing policy, the more difficult the model.

The following quantities are important in the breakeven analysis:

F	Fixed cost
V	Variable cost per unit
P	Unit price
X	Number of units
T	Pre-tax profit

Revenue R(X) and costs C(X) are both functions of X, the number of units.

$$\text{Revenue} = R(X) = P * X$$

$$\text{Cost} = C(X) = F + V * X$$

$$\text{Profit} = T(X) = R(X) - C(X) = P * X - (F + V * X)$$

If $R(X)$ and $C(X)$ are each linear relationships, with $R(X) = P * X$ and $C(X) = F + V * X$, then

$$\text{Profit} = P * X - F - V * X = (P - V)X - F$$

The above model is linear based on the quantity X. Breakeven analysis determines the quantity X for which the pre-tax profit is zero. Hence, the problem becomes

$$\text{Pre-tax profit} = (P - V)X - F = 0$$

where we must solve for X, given values for P (price per unit), V (variable cost per unit), and F (fixed cost).

On the TI-83 Calculator, the breakeven problem can be solved for the number of units X in several ways:

- numerically with the Solver command from the [MATH] key *(4A)*†
- graphically
- numerically with tables and inspection.

Example:
Rugged Can Company sells trash cans for \$20 each.. Each unit has a variable cost of \$15 and the fixed costs are \$4,000. How many cans must be sold to break even?

Method 1: Solver

Use 0 = (P - V) X - F with P = 20

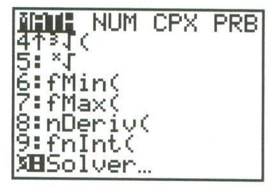
V = 15

F = 4000

1. From the Home Screen, press the [MATH] key *(4A)* and choose **0:Solver** from the MATH menu. (Figure 1)

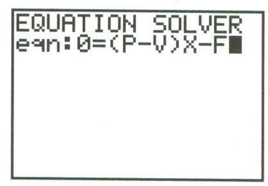
   If necessary, clear the Solver by pressing the up arrow followed by the [CLEAR] key *(4E)*.

(Figure 1)



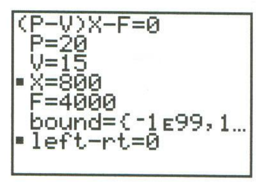
2. Enter the formula **(P-V)X-F** on the right of the equal sign. (Figure 2)
3. Press [ENTER]. Notice that the variables may contain values from a previous calculation.
4. Enter the values for this problem, place the cursor on **X**, and press [ALPHA] [SOLVE] *(10E)*.

(Figure 2)



Breakeven occurs if 800 units are produced and sold. (Figure 3)

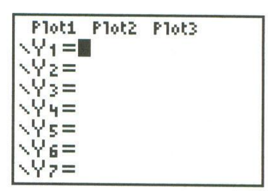
(Figure 3)



Method 2: Graphing

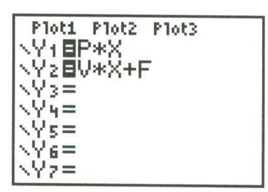
1. Press the [Y=] key *(1A)*.
2. Press the [CLEAR] key *(4E)* to remove any functions left there from an earlier problem. (Figure 4)

(Figure 4)



3. Input the functions, either by using the actual numbers, for example, Y_1 = 20*X and Y_2 = 15*X+ 4000, or in general, such as Y_1 = P*X and Y_2 = V*X+F. Either approach will work in this case since values have been entered already for P, F and V. Otherwise, values for P, F and V must be entered on the Home Screen using the [STO▸] key *(9A)*. (Figure 5)

(Figure 5)



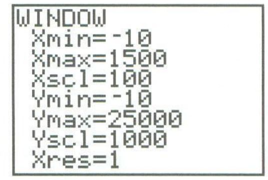
† **Refer to the section on Key Arrangement in Chapter 1 for an explanation of the key locator codes used in this manual.**

4. Choose an appropriate viewing window for these values.

   Press the [WINDOW] key *(1B)*. The values need to be changed to [-10,1500] by [-10,25000].

   Choose -10 for Xmin and Ymin so the axis shows. (Figure 6)

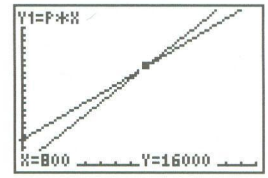
(Figure 6)



5. Press [GRAPH] *(1E)* to plot the equations.
6. Press the [TRACE] key *(1D)* to see the values of X and the function evaluated at X. The left and right arrows move the "spider-like" cursor along the functions. The up and down arrows cycle you through the functions.

   Notice that the function is listed at the top of the screen on the left. (Figure 7)

(Figure 7)

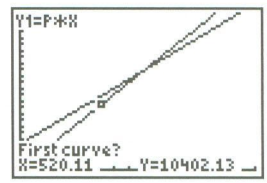


7. To find the point of intersection, press [2nd] [CALC] *(1D)*. From the CALCULATE menu, choose **5:intersect**. (Figure 8)

(Figure 8)

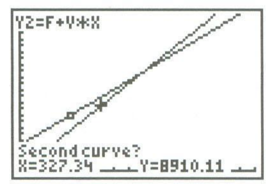
8. When the calculator asks "First curve?" move the cursor to Y_1 and press [ENTER]. (Figure 9)

(Figure 9)



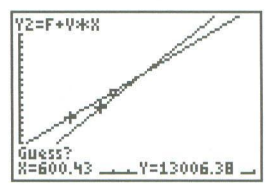
9. For the question "Second curve?" make sure the cursor is on the other curve and press [ENTER]. (Figure 10)

(Figure 10)



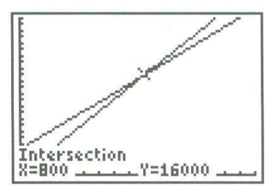
10. At the question "Guess?", move the cursor close to the point of intersection. (Figure 11)
11. Press [ENTER]. The cursor will move to the point of intersection.

(Figure 11)



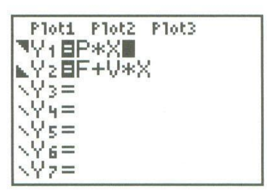
The breakeven point and the coordinates are printed on the bottom of the screen, X = 800 and Y = 16000. (Figure 12)

(Figure 12)



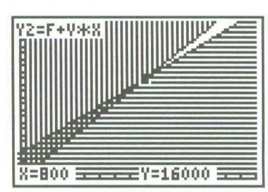
12. To graphically show the loss, press the [Y=] key *(1A)*.
13. Press the left arrow until the cursor is to the left of Y_1, and then press [ENTER] repeatedly to cycle through different styles of lines.
14. Choose the "shade above" icon for Y_1; repeat for Y_2 but choose "shade below" icon. (Figure 13)

(Figure 13)



15. Press [GRAPH]. Notice that the first function (Revenue) was shaded with vertical lines, while the second function (Cost) was shaded with horizontal lines, and the area with both vertical and horizontal lines represents loss (negative profit), while the area with no shading at all represents the profit area. (Figure 14)

(Figure 14)

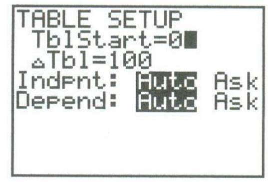


Method 3: Tables

Once Y_1 and Y_2 have been defined as Revenue and Cost, tables can give a numerical visualization of the problem.

1. Press [2nd] [TBLSET] *(1B)*.
2. Let TblStart be 0 and increment the table by 100. X, the number of items, can never be negative. The choice of 100 for the table increment, ΔTbl, is convenient for this problem. (Figure 15)

(Figure 15)



3. Press [2nd] [TABLE] *(1E)*. Notice that at 800, the values in Y_1 and Y_2 are both 16,000. Breakeven occurs when revenue equals cost. (Figure 16)

(Figure 16)

X	Y1	Y2
300.00	6000.0	8500.0
400.00	8000.0	10000
500.00	10000	11500
600.00	12000	13000
700.00	14000	14500
800.00	16000	16000
900.00	18000	17500

X=800

If either or both of the cost and revenue functions are non-linear, these same methods will apply.