

## Cost-Volume-Profit Analysis

### Cost-volume-profit relationships

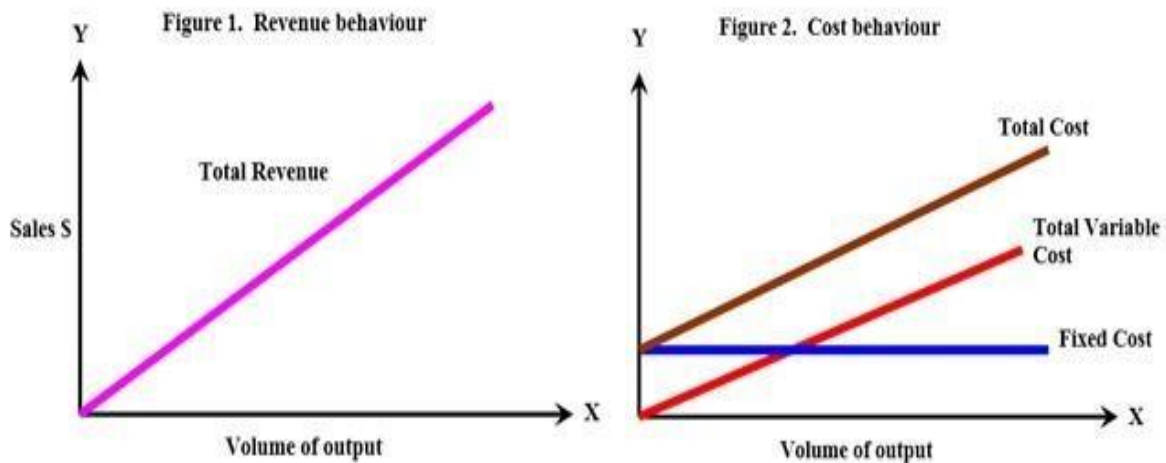
A primary function of accounting is the collection of cost and revenue data which may then be used to examine the existing relationships between cost behaviour and revenue behaviour.

Any analysis, whether graphical or algebraic, makes certain assumptions about the behaviour of costs and revenue. In its simplest form, cost-volume-profit analysis makes the following assumptions:

1. Revenue per unit of output is constant. Thus total revenue varies directly with volume [TR = P\*Q, Total Revenue is Price of each unit \* the unit Q sold].
2. Costs can be classified to be either fixed or variable [FC, VC].
3. Fixed costs are those costs which remain constant over the time period considered for all levels of out-put. Examples of costs in this category are: depreciation, rent, property taxes, supervision and management salaries. Since fixed costs are constant in total, they vary per unit of output. They decrease per unit of output as volume increases and increase per unit of output as volume decreases.
4. Variable costs are costs that are constant per unit of output regardless of volume and thus fluctuate in total amount as volume fluctuates. Examples of costs in this category are direct material costs, direct labour costs and sales commissions.

The above assumptions present a simplified view of the real world. Fixed costs are not constant across all levels of output but tend to change in a step-like manner. Per unit variable costs are not always constant but are influenced by economies of scale. There is no black and white classification of costs into fixed costs and variable costs; rather many costs are semi-variable, that is, they contain a fixed component as well as a variable component. However, for purposes of an uncomplicated introductory analysis, the assumptions made serve a useful purpose.

Using these simplifying assumptions, the behaviour of revenue and the behaviour of costs may be represented graphically by straight-line diagrams as shown in Figures 1 and 2.



The following components are basic to cost-volume-profit relationships and mathematical notation

will be used for these components as indicated:

- X = Volume of output
- P = Selling price (revenue) per unit of output
- TR = Total revenue
- TC = Total cost
- FC = Fixed cost
- TVC = Total variable cost
- VC = Variable cost per unit of output □ NI = Net income (profit).

### **The Accounting Relationships (income statement equations)**

#### Formula 1

**TOTAL REVENUE = TOTAL COST + NET INCOME (TR = TC + NI)** is basic to cost-volume-profit analysis; the following relationships are also useful:

#### Formula 2

**TOTAL REVENUE = VOLUME x UNIT REVENUE ( TR = (X)(P) )**

#### Formula 3

**TOTAL COST = FIXED COST + TOTAL VARIABLE COST (TC = FC + TVC)**

Formula 4

**TOTAL VARIABLE COST = VOLUME x VARIABLE COST PER UNIT (  $TVC = (X)(VC)$  )**

Formula 5

**TOTAL REVENUE = FIXED COST + TOTAL VARIABLE COST + NET INCOME (  $TR = FC + TVC + NI$  )**

**Break-even Analysis**

The most popular approach to cost-volume-profit analysis is referred to as **break-even analysis**. The break-even approach focuses on the profitability of the business and is specifically concerned with identifying the level of output at which the business neither makes a profit nor sustains a loss, that is the level of output at which **NET INCOME = 0**.

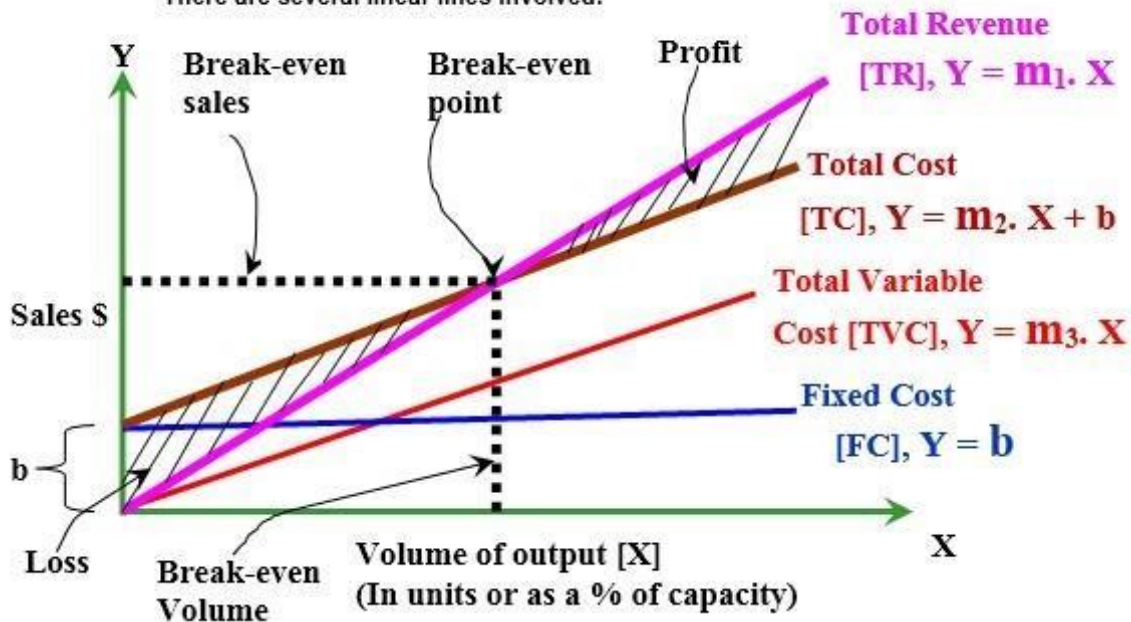
This level of output, at which  $NI = 0$ , is referred to as **the break-even point** and is obtainable from

Formula 1 (or Formula 5) above. Since  $NI = 0$  the break-even point is the level of output at which **TOTAL REVENUE = TOTAL COST**

The relationship between revenue and costs at different levels of output may be portrayed graphically by showing **revenue behaviour** (Figure 1, above) and **cost behaviour** (Figure 2, above) on the same graph. The resulting graph shows the break-even point and is known as a **break-even chart** (see Figure 3, below).

**Figure 3. Break-even Chart**

There are several linear lines involved:


**Notes to the charts**

1. The horizontal axis is used to represent volume of output either as a number of units or as a percent of capacity. The vertical axis represents dollar values (sales revenue). The origin is at zero-representing zero volume and zero dollars.
2. The total revenue line is drawn by plotting two or more total revenue points (one of which is always the origin) and joining them.
3. The fixed cost line is drawn parallel to the horizontal axis from a point on the vertical axis which represents total fixed cost dollars.
4. The total cost line is drawn by plotting two or more total cost points (one of which is always the point where the fixed cost line starts on the vertical axis) and joining them.
5. The point where the total revenue line and the total cost line intersect is the break-even point.
6. The point of intersection on the horizontal axis of the perpendicular drawn from the break-even point to the horizontal axis indicates the break-even volume in units or as a percent of capacity.
7. The point of intersection on the vertical axis of the perpendicular drawn from the break-even point to the vertical axis indicates the break-even volume in dollars (\$Sales).

8. The area between the horizontal axis and the fixed cost line represents the fixed cost in dollars.
9. The area between the fixed cost line and the total cost line represents the total variable cost in dollars for the various levels of operations.
10. The area between the total revenue line and the total cost line to the left of the break-even point represents the loss area where total revenue is less than total cost.
11. The area between the total cost line and the total revenue line to the right of the break-even point represents the profit area where total revenue is greater than total cost.

The graphical approach resulting in a break-even chart is complemented by an algebraic approach which utilizes Formulae 1 and 2. The cases are the two distinct situations which may be encountered depending on the accounting data that is available. For the first situation, the accounting information is in terms of units. For the second situation, the accounting information is in terms of total dollars.

The information on Excel Spread-Sheet programming techniques, mathematical built-in functions for common use, finance use, and for business use are described in Excel through the help feature.