Chapter Five: Cost—volume—profit analysis

Cost-volume-profit (CVP) analysis is concerned with the relationships between costs, the levels of activity performance, sales or service performance and profit. CVP analysis can be useful to help answer queries such as:

- How many units need to be sold or services performed to break even (e.g. earn zero profit)?
- What is in the impact on profit of a change in the mix between fixed and variable costs?
- How many units need to be sold or services performed to achieve a particular level of profit?
- What is the impact on profit of a certain percent increase in sales prices?
- Which products or services are contributing best to the entity's profit performance?

Fixed and variable costs

The nature of fixed and variable costs relates to whether such costs are likely to alter in total with changes in activity. Fixed costs are commonly identified as those that remain the same in total (within a given range of activity and time frame), irrespective of the level of activity. Typically, fixed costs include such costs as facility-sustaining costs like lease costs and depreciation charges. When levels of activity are thought of in terms of units of output, it is interesting to note that, while total fixed costs remain the same, the fixed costs per unit will decrease as the number of units produced increases.

Variable costs are commonly identified as those that change in total, as the level of activity changes. Typically, variable costs might include such costs as ingredients for a food manufacturer or fuel costs for a courier. Just as we did for fixed costs, we can consider variable costs on a total or unit basis.

Break Even point analysis:

Break even point is the level of sales at which profit is zero. According to this definition, at break even point sales are equal to <u>fixed cost</u> plus <u>variable cost</u>. This concept is further explained by the following equation:

[Break even sales = fixed cost + variable cost]

The break even point can be calculated using either the <u>equation method</u> or <u>contribution margin</u> method. These two methods are equivalent.

Equation Method:

The equation method centers on the contribution approach to the <u>income statement</u>. The format of this statement can be expressed in equation form as follows:

Profit = (Sales – Variable expenses) – Fixed expenses

Rearranging this equation slightly yields the following equation, which is widely used in cost volume profit (CVP) analysis:

Sales = Variable expenses + Fixed expenses + Profit

According to the definition of break even point, break even point is the level of sales where profits are zero. Therefore the break even point can be computed by finding that point where sales just equal the total of the variable expenses plus fixed expenses and profit is zero.

Example:

For example we can use the following data to calculate break even point.

$$\text{Sales price per unit} = \$250$$
$$\text{variable cost per unit} = \$150$$
$$\text{Total fixed expenses} = \$35,000$$

Required: Calculate break even point

Calculation:

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profit}$$
$$\$250Q^* = \$150Q^* + \$35,000 + \$0^{**}$$
$$\$100Q = \$35000$$
$$Q = \$35,000 / \$100$$
$$Q = 350 \text{ Units}$$

$Q^* = $ Number (Quantity) of units sold.

**The break even point can be computed by finding that point where profit is zero

The break even point in sales dollars can be computed by multiplying the break even level of unit sales by the selling price per unit.

$$350 \text{ Units} \times \$250 \text{ per unit} = \$87,500$$

Contribution Margin Method:

The contribution margin method is actually just a short cut conversion of the equation method already described. The approach centers on the idea discussed earlier that each unit sold provides a certain amount of contribution margin that goes toward covering fixed cost. That means contribution margin equals to the difference between sales price and variable costs [contribution margin = sales – variable cost]. To find out how many units must be sold to break even, divide the total fixed cost by the unit contribution margin.

$$\text{Break even point in units} = \frac{\text{Fixed expense}}{\text{Unit contribution margin}}$$
$$= \$35,000 / \$100^* \text{ per unit}$$
$$= 350 \text{ Units}$$

*$250 (Sales) – $150 (Variable exp.)

Target profit analysis:

Target profit is the amount of net operating income or profit that management desires to achieve at the end of a business period. Management needs to know the required level of business activities to get target profits. Cost volume profit (CVP) equations and formulas can be used to determine the sales

volume needed to achieve a target profit. The explanation of target profit analysis requires an example.

Example:

Sales price per unit = $250
Variable cost per unit = $150
Total fixed expenses = $35,000
Target Profit = $40,000
Q = Number (Quantity) of units sold

Required:
How many units will have to be sold to earn a profit of $40,000?

Solution:
The CVP Equation Method:
Under CVP equation approach, we can find the number of units to be sold to obtain target profit by solving the equation where profits are equal to target profit (that is $40,000).

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profit}$$
$$\$250Q = \$150 + \$35,000 + \$40,000$$
$$\$100Q = \$75,000$$
$$Q = \$75,000 / \$100 \text{ per unit}$$
$$Q = 750 \text{ Units}$$

Thus the target profit can be achieved by selling 750 units per month, which represents $187,500 in total sales ($250 × 750 units).

The Contribution Margin Approach:
A second approach involves expanding the <u>contribution margin</u> formula to include the target profit.
[Unit sales to attain target profit = (Fixed expenses + Target Profit) ÷ Unit contribution margin]
This approach gives the same answer as the equation method since it is simply a short cut version of the equation method. Similarly the dollar sales needed to attain the target profit can be computed as follows:

$$\text{Dollar sales to attain the target profit} = [(\text{Fixed expenses} + \text{Target profit}) \div \text{CM ratio}]$$
$$= (\$35,000 + \$40,000) \div 0.40$$
$$= \$187,500$$
$$\text{No. of units to be sold} = \$187,500 / \$250$$
$$= 750 \text{ units}$$

Review Problem:

Voltar Company manufactures and sells a telephone answering machine. The Company's contribution margin format income statement for the most recent year is given below:

	Total	Per Unit	Percent of Sales
Sales (20,000 units)	$1,200,000	$60	100%
Less: variable expenses	(900,000)	45	?%
Contribution margin	300,000	$15	?%
Less: fixed expenses	240,000	======	======
Net operating income	$60,000		

Management is anxious to improve the company's profit performance. Assume that next year management wants the company to earn a minimum profit of $90,000. How many units will have to be sold to meet the target profit figure?

Solution:

Equation Method:

$$\text{Sales} = \text{Variable expenses} + \text{Fixed expenses} + \text{Profits}$$
$$\$60Q = \$45Q + \$240,000 + \$90,000$$
$$\$15Q = \$3330,000$$
$$Q = \$3330,000 / \$15 \text{ Per unit}$$
$$Q = 22,000 \text{ Units}$$

Contribution Margin Method:

$$[(\text{Fixed expenses} + \text{Target profit}) / \text{Contribution margin per unit}]$$
$$[(\$240,000 + \$90,000) / \$15 \text{ Per unit}]$$
$$22,000 \text{ Units}$$

Problem:

ModClean sells a special purpose cleaning cloth. The product is generally sold through trade, home and exhibition shows. The following data is available, relating to the most recent year of operation.

Selling price	$25 per unit
Purchase price	$14 per unit
Fixed exhibition and trade show	$28,000 per year
Variable demonstration costs	$1 per unit
Fixed transport costs	$10,600 per year
Administration fixed costs	$6,400 per year

Management wants to earn a minimum profit of $50,000.

Required:

i. Calculate break even point of unit sales and total dollar sales using Equation method.

ii. Calculate the number of unit required to be sold to earn expected profit using Contribution Margin method.

iii. Calculate the required amount of sales dollar to earn expected profit using equation method.