Foundations of Accounting & Finance

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Week - 07

Lecture – 31

Break-Even Analysis

What is the Break-Even Point?

Break-even point is the point where sales value just covers all the cost or the cost is exactly equal to sale value. The amount you spend is exactly equal to the amount that you receive and that is what you say breakeven; where you make no loss or no profit. We can express break-even in either unit sales or sales dollars.

Contribution analysis

One important aspect when discussing the breakeven point is what we refer to as contribution analysis. But what exactly is this contribution? Let me illustrate this concept with examples:

Now, let us use some basic numbers. Let us say the selling price per unit of a particular product is 100 rupees. Now, for the variable costs, including direct material, direct labour, and other direct expenses, let us consider them to be a total of 70 rupees per unit. As for the fixed costs, they remain constant regardless of the number of units manufactured. Let us assume the total fixed cost is one lakh rupees.

If I manufacture 100 units, my total revenue would be 100 multiplied by 100 rupees per unit. Similarly, my variable cost would be 100 units multiplied by 70 rupees per unit. If I increase the production to 1000 units, the total revenue and variable cost would scale accordingly. However, the fixed cost remains the same at one lakh rupees in both scenarios.

With each unit produced, there's a contribution toward covering the fixed cost. This contribution is essentially the difference between the selling price and the variable cost per unit. In this case, it's 30 rupees. So, for every unit sold, 30 rupees contributes to covering the fixed cost and generating profit. This is what we refer to as contribution analysis. It helps us understand how much each unit contributes towards covering fixed costs and generating profit.

Fixed cost and Profit/Loss

Why did we introduce the term profit here? In this scenario, the fixed cost remains constant at one lakh rupees. Each unit I manufacture and sell contributes 30 rupees towards covering this fixed cost. How many units do I need to sell to cover the total fixed cost of one lakh rupees? Simply, it

is one lakh divided by 30, which equals 3,333.333 units. Rounded up, it's 3,334 units. This is our breakeven point, where we neither make a profit nor incur a loss.

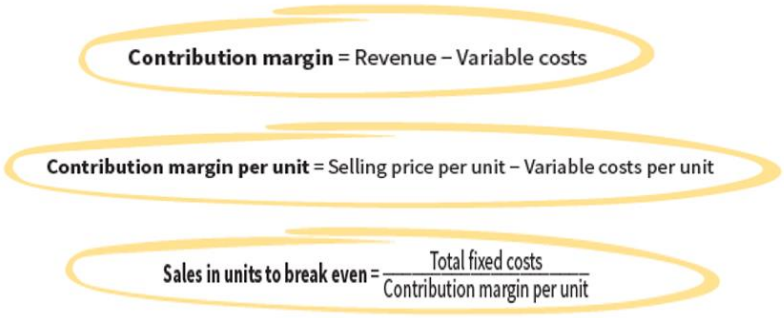
Let us verify this. If I sell 3,334 units at 100 rupees each, my total revenue would be 3,33,400 rupees. And if the variable cost per unit is 70 rupees, the total variable cost for 3,334 units would be 2,33,340 rupees. There might be a slight difference due to rounding, but overall, my contribution would cover the fixed cost precisely.

Now, if I manufacture and sell one extra unit, making it 3,335 units, that additional unit contributes 30 rupees, resulting in a profit of 20 rupees over the fixed cost. Similarly, each additional unit beyond the breakeven point yields a contribution, which is essentially profit. This is the essence of contribution analysis—understanding how each unit contributes towards covering fixed costs and generating profit.

What is contribution margin?

Contribution margin is a crucial concept in cost accounting, representing the difference between revenue and variable costs per unit. It is essentially the selling price per unit minus the variable cost per unit. This margin helps determine how much each unit contributes towards covering fixed costs and generating profit.

To calculate the contribution margin per unit, you divide the total fixed cost by the contribution margin per unit. This gives you the breakeven point—the point where total revenue equals total costs, resulting in neither profit nor loss.



Example: Break-Even Units

- Variable cost per unit is $3.65 per box:
    - $1.35 DM + $2.10 DL + $0.20 = $3.65
- Fixed costs are $850 a month.
- The selling price is $6.25 per box.

How many boxes do you need to sell to break even?

What is contribution? Let us break down the example:

To find the breakeven point, we calculate the contribution per unit: Contribution = Selling price per unit - Variable cost per unit Contribution = $6.25 - $3.65 = $2.60 per unit

Now, we determine the number of boxes needed to break even: Breakeven units = Fixed costs / Contribution per unit Breakeven units = $850 / $2.60 ≈ 326.923

Since you can't sell a fraction of a box, you would need to sell at least 327 boxes to break even.

You can also express the breakeven point in terms of dollars, which would mean you need to generate $850 in contribution margin to cover your fixed costs.

$$\text{Sales in units to break even} = \frac{\text{Total fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Sales in units to break even} = \frac{\$\ 850}{(\$\ 6.25 - \$\ 3.65)}$$

$$\text{Sales in units to break even} = \frac{\$\ 850}{2.60}$$

Sales in units to break even = $326.923, or 327 **boxes**

Contribution margin ratio or PV ratio

Let us understand the contribution margin ratio, also known as the Profit Volume (PV) ratio.

$$\textbf{Sales in dollars to break even} = \frac{\text{Total fixed costs}}{\text{Contribution margin ratio}}$$

$$\textbf{Contribution margin ratio} = \frac{\text{Contribution margin per unit}}{\text{Selling price per unit}}$$

$$\textbf{Contribution margin ratio} = \frac{\text{Total contribution margin}}{\text{Total sales}}$$

The contribution margin ratio is calculated by dividing the contribution per unit by the selling price per unit. This ratio helps in understanding the proportion of each sales dollar that contributes to covering fixed costs and generating profit.

For instance, if the contribution per unit is $30 and the selling price per unit is $100, then the contribution margin ratio would be:

Contribution Margin Ratio=Contribution per unit / Selling price per unit×100

Contribution Margin Ratio=30100×100=30%

This means that 30% of each sales dollar contributes to covering fixed costs and generating profit.

For example, if total sales are $500,000, then 70% of this amount (representing the variable costs) covers the cost of goods sold, while the remaining 30% (the contribution margin) is available to cover fixed costs and generate profit.

Sales to earn a desired profit

To achieve a desired profit of 20,000 rupees, considering a fixed cost of one lakh and a contribution of 30 rupees per unit, we can calculate the number of units needed:

Total required contribution=Fixed costs + Desired profit

=1,00,000+20,000=1,20,000

Number of units needed=Total required contribution / Contribution per unit

=1,20,000/ 30=4000 units

So, manufacturing and selling 4000 units will yield a profit of 20,000 rupees. This calculation ensures that the fixed costs are covered and the desired profit is achieved.

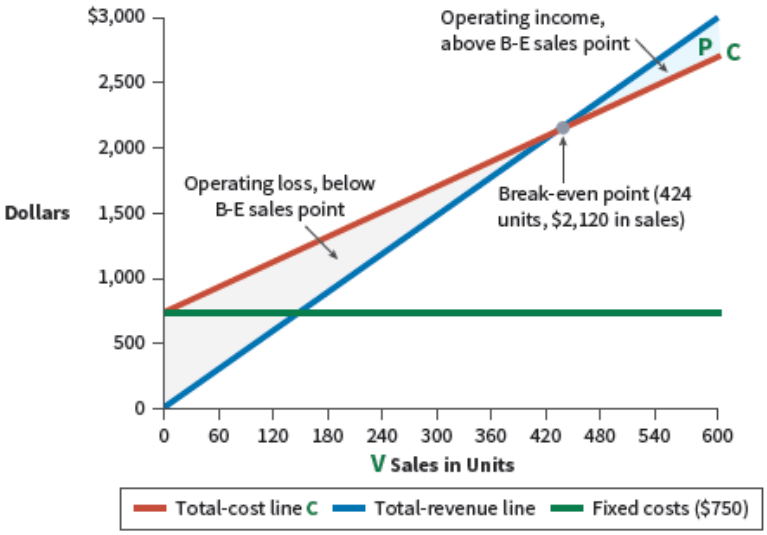
$$\text{Sales in units to achieve target profit} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin per unit}}$$

$$\text{Sales in dollars to achieve target profit} = \frac{\text{Total fixed costs} + \text{Target profit}}{\text{Contribution margin ratio}}$$

Cost-Volume-Profit Analysis

Cost-volume-profit (CVP) analysis is the relationship between a company's revenues, costs, volume of sales, and, consequently, profit. CVP allows managers to see how their decisions will affect company profit.

CVP Relationships



This is the Cost-Volume-Profit (CVP) graph. The key aspect to note is the green line denoting fixed costs, which remain constant regardless of sales volume. On the other hand, variable costs increase with the number of units sold, as depicted along the x-axis representing sales volume.

The y-axis represents sales revenue, calculated by multiplying the number of units sold by the unit price. At the minimum, the graph indicates the flat, straight line of fixed costs.

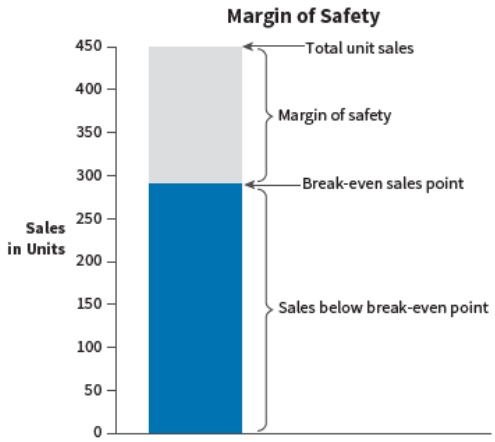
The red line illustrates total costs, which include both fixed and variable costs. For instance, at 0 units produced, only fixed costs are incurred. However, as production increases, total costs rise, reflecting the cumulative effect of fixed and variable costs.

Moving on, the profit line showcases revenue generated from sales. As sales volume increases, total revenue follows suit. Eventually, there's a point where the revenue line intersects with the total cost line, known as the breakeven point. At this juncture, total revenue equals total costs, resulting in neither profit nor loss.

Margin of Safety

The margin of safety is the difference between total unit sales (or sales in dollars) and the break-even point in units (or sales dollars). It represents the difference between current sales and the breakeven point, indicating the cushion or buffer the company has in covering its costs.

Visualizing the margin of safety can be facilitated through a graph, where the breakeven point is depicted as the threshold between profit and loss. Sales falling below this point signify a loss, while sales surpassing it contribute to profitability.



Essentially, any sales volume or revenue exceeding the breakeven point constitutes the margin of safety. This surplus signifies the portion of sales that contributes to profit generation, safeguarding the company against unexpected downturns or challenges.

The margin of safety can be expressed in various forms, whether as a percentage of sales, a dollar amount, or the number of units sold.

Margin of safety in units = Total units sold – Break-even point in units
Margin of safety in sales dollars = Total sales in dollars – Break-even point in sales dollars

Break-even with Taxes

To incorporate taxes into the breakeven analysis and target profit calculation, we need to adjust our approach. Here is a breakdown of how taxes affect breakeven and target profit calculations:

When aiming for a target profit, it is essential to consider the taxes the organization will incur. Simply adding the target profit to the total fixed costs won't suffice because taxes will diminish the actual profit earned.

To determine the sales needed to achieve the target profit after accounting for taxes, we modify the breakeven formula as illustrated below:

$$\text{Sales in units to achieve target profit after-tax} = \frac{\text{Total fixed costs} + [\text{Target profit} \div (1 - \text{Tax rate})]}{\text{Contribution margin per unit}}$$

$$\text{Sales in dollars to achieve target profit after-tax} = \frac{\text{Total fixed costs} + [\text{Target profit} \div (1 - \text{Tax rate})]}{\text{Contribution margin ratio}}$$

Instead of dividing total fixed costs plus target profit by the contribution margin alone, we divide it by (1 minus the tax rate) to ensure that the target profit reflects the after-tax earnings.

For instance, if the target profit is $20,000, but there's a 30% tax rate, the actual profit received after taxes would be $20,000 minus 30% (i.e., $6,000), resulting in $14,000. Therefore, to achieve the desired after-tax profit of $20,000, we need to aim for a higher target profit.

Calculating the adjusted target profit involves dividing the desired profit by (1 minus the tax rate). In this case, it would be $20,000 divided by (1 - 0.30), which equals approximately $28,571.

This adjustment accounts for the impact of taxes on the target profit and ensures that the organization sets realistic financial goals considering tax liabilities. By incorporating taxes into the breakeven and target profit analysis, businesses can make more accurate projections.

Operating Leverage

Operating leverage functions as a type of "what-if" or sensitivity analysis. Within this framework, operating leverage refers to how many fixed versus variable costs are in a firm's cost structure. Moreover, operating leverage also refers to the mechanics of why increasing sales—which increases contribution margin, while fixed costs stay fixed—leads to a magnifying effect on operating income. In essence, operating leverage operates as a multiplier.

Degree of Operating Leverage

The degree of operating leverage (DOL) is a multiplier that impacts operating income as a result of a percentage change in sales.

$$\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Operating income}}$$

The DOL helps to determine the impact of a percentage increase or decrease in sales on operating income—without having to redo an entire income statement.

Example: Degree of Operating Leverage

In Las Vegas, your company sells very small bottles of water for $6.00 each. Total variable costs per unit are $2.00, including the bottle and water itself, fuel, and marketing costs. Total fixed costs are $30,000, and monthly sales are 10,000 units.

Then your boss says that sales will increase by 10% next month. Then she asks "How that will impact the "bottom line?" (Operating income.)

To answer your boss's question, you quickly find July's income statement and draft the expected results for August, with the 10% increase in unit sales. Results for July are on the left, and the 10% predicted sales increase, factored into August's expected results, will be even hotter.

Solution:

To assess the impact of a 10% increase in sales on operating income, let us utilize the concept of operating leverage. Currently, the company sells 10,000 units of water bottles at $6.00 each, with total variable costs per unit at $2.00, and fixed costs amounting to $30,000.

Firstly, let us calculate the current contribution margin. With 10,000 units sold, the total sales revenue is $60,000 ($6.00 per unit * 10,000 units), while the total variable costs amount to $20,000 (10,000 units * $2.00 per unit). Thus, the contribution margin is $40,000 ($60,000 - $20,000).

Next, we determine the current operating income by subtracting fixed costs from the contribution margin. So, operating income = $40,000 (contribution margin) - $30,000 (fixed costs) = $10,000.

Now, let us evaluate the degree of operating leverage. It is calculated by dividing the contribution margin by the operating income. In this case, it's 4 = ($40,000 / $10,000).

With the degree of operating leverage identified, we can anticipate the impact of a 10% increase in sales on operating income. This increase will amplify the contribution margin, given the fixed costs remain constant. Thus, the operating income will rise in proportion to the degree of operating leverage.

$$\text{CM per unit} = \$6 - \$2 = \$4$$

$$\text{DOL} = \frac{\text{Contribution Margin}}{\text{Operating Income}}$$

$$\text{DOL} = \frac{(\$4 \times 10{,}000 \text{ units})}{(\$40{,}000 - \$30{,}000)}$$

$$\text{DOL} = 4.0$$

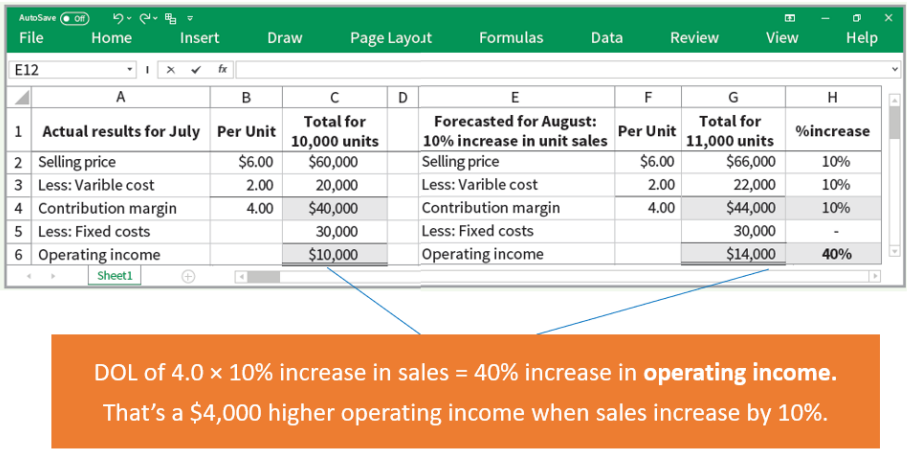
Results for July and August

Following the contribution analysis, let us break down the results for July and August and further explain the concept of operating leverage:

In August, with sales remaining at 10,000 units, the operating income stands at $10,000. Now, let us revisit July's figures and analyse the impact of a 10% increase in sales for August.

With a 10% increase in sales, August's sales volume reaches 11,000 units. Consequently, the contribution margin rises to $44,000, considering the fixed costs remain constant at $10,000. This

results in a notable increase in operating income, soaring from $10,000 to $14,000, marking a 40% surge.



	A	B	C	D	E	F	G	H
1	**Actual results for July**	**Per Unit**	**Total for 10,000 units**		**Forecasted for August: 10% increase in unit sales**	**Per Unit**	**Total for 11,000 units**	**%increase**
2	Selling price	$6.00	$60,000		Selling price	$6.00	$66,000	10%
3	Less: Varible cost	2.00	20,000		Less: Varible cost	2.00	22,000	10%
4	Contribution margin	4.00	$40,000		Contribution margin	4.00	$44,000	10%
5	Less: Fixed costs		30,000		Less: Fixed costs		30,000	-
6	Operating income		$10,000		Operating income		$14,000	**40%**

The beauty of understanding operating leverage lies in its predictive power. Instead of recalculating the entire financial structure, we can leverage the degree of operating leverage, which in this case is 4. This means that for every 10% increase in sales, operating income surges by 40%. This relationship can be expressed as a simple multiplication: the percentage increase in sales multiplied by the degree of operating leverage yields the percentage increase in operating income.

For instance, if sales were to increase by 20%, the resulting increase in operating income would be 80%, calculated as 20% (sales increase) multiplied by 4 (degree of operating leverage). This straightforward calculation allows for quick and accurate forecasting of financial outcomes based on changes in sales volume.

In essence, the degree of operating leverage acts as a multiplier, explaining the proportional impact of sales changes on operating income. It simplifies financial analysis by quantifying the relationship between sales variations and bottom-line results, facilitating informed decision-making.