

In engineering economic studies and industrial operations management, a primary focus is understanding how production volume affects corporate profitability. To assess whether a production line or facility is economically viable, engineers utilize a foundational methodology known as **Break-Even Analysis**. This financial technique maps out relationships between fixed operational overloads, unit variable inputs, and market retail prices to establish a baseline threshold where the firm eliminates its risk of financial deficits.

To protect a business from incurring operational losses, a firm must reach or exceed its **Break-Even Point (BEP)**. The BEP defines an exact operational volume where a manufacturing venture shifts from generating a net operating loss to generating a net operating profit. At this specific volume boundary, the total income generated from market sales perfectly matches the cumulative expenses incurred through production:

$$Income (I) = Expenses (E)$$

*XYZ Corporation manufactures book cases that it sells for ₱65 each. It costs XYZ ₱38,000 per year to operate its plant. The sum includes rent, depreciation charges on equipment, and salary payments. If the cost to produce one bookcase is ₱50, how many cases must be sold each year for XYZ to avoid taking a loss?*

### 1. Market Unit Selling Price (SP)

The retail value at which a finished unit is exchanged in the marketplace is given as ₱65. This value dictates the steepness of the linear revenue trajectory. The total annual income (I) function is modeled as a direct product of this selling price per unit (SP) and the number of units sold (x):

$$I = (SP)(x) = 65x$$

### 2. Plant Operational Fixed Costs (FC)

The problem notes that operating the factory costs ₱38,000 annually, explicitly detailing that this lump sum covers rent, equipment depreciation charges, and administrative salaries. These expenses represent classic examples of **Fixed Costs**. Fixed costs must be fully satisfied by the enterprise regardless of plant output, remaining completely constant even if the production output falls to zero units. Therefore:

$$FC = ₱38,000 \text{ per year}$$

### 3. Unit Variable Cost (vc)

The physical cost to manufacture one individual bookcase is given as ₱50. This value embodies a **Variable Cost**, which encompasses direct factory labor, raw material inputs, and equipment operating utilities that fluctuate in a direct linear fashion with production volume (x). The total annual variable cost (VC) is modeled as:

$$VC = (vc)(x) = 50x$$

Combining fixed and variable components yields the full multi-variable linear equation representing total corporate expenses (E):

$$E = FC + (vc)(x)$$

$$E = ₱38,000 + 50x$$

To find the exact quantity of cases (x) needed to completely neutralize losses, we set up our mathematical equality where total income equals total expenses (I=E).

### **Step 1: Formulate the Equilibrium Equation**

Substitute our derived linear models directly into the break-even equilibrium condition:

$$65x = 38,000 + 50x$$

### **Step 3: Solve for the Exact Break-Even Volume**

Divide both sides of the expression by the contribution margin to isolate the exact quantity x:

$$x = \frac{38,000}{15} = 2,533.3333 \text{ cases per year}$$

Therefore, any fractional unit resulting in a break-even context must always be **rounded up to the next nearest whole integer**, regardless of how small the decimal value is. Rounding 2,533.33 upward yields a final required operational target of **2,534 cases**.