

Break-even analysis with multiple products

A multi-product company means a company that sells two or more products. For computing break-even point of a company with two or more products, we must know **the sales percentage of individual products in the total sales mix**. This information is used in computing weighted average selling price and weighted average variable expenses (**weighted average CM per unit**).

, following assumptions are made in addition to those already made for CVP analysis:

1. The proportion of sales mix must be predetermined. In other words, the proportion of each product in a sales mix is fixed
2. The sales mix must not change within the relevant time period.

Example: Formulas and Calculation Procedure

Following information is related to sales mix of product A, B and C.

Product	A	B	C
Sales Price per Unit	\$15	\$21	\$36
Variable Cost per Unit	\$9	\$14	\$19
Sales Mix Percentage	20%	20%	60%
Total Fixed Cost	\$40,000		

Calculate the break-even point in units and in dollars.

Calculation

Step 1: Calculate the contribution margin per unit for each product:

Product	A	B	C
Sales Price per Unit	\$15	\$21	\$36
– Variable Cost per Unit	\$9	\$14	\$19
Contribution Margin per Unit	\$6	\$7	\$17

Step 2: Calculate the weighted-average contribution margin per unit for the sales mix using the following formula:

$$\begin{aligned}
 & \text{Product A CM per Unit} \times \text{Product A Sales Mix Percentage} \\
 & + \text{Product B CM per Unit} \times \text{Product B Sales Mix Percentage} \\
 & + \text{Product C CM per Unit} \times \text{Product C Sales Mix Percentage} \\
 & = \text{Weighted Average Unit Contribution Margin}
 \end{aligned}$$

Sales mix, Target income

Ahmed F. Saleh

Product	A	B	C
Sales Price per Unit	\$15	\$21	\$36
– Variable Cost per Unit	\$9	\$14	\$19
Contribution Margin per Unit	\$6	\$7	\$17
× Sales Mix Percentage	20%	20%	60%
	\$1.2	\$1.4	\$10.2
Sum: Weighted Average CM per Unit		\$12.80	

Step 3: Calculate total units of sales mix required to break-even using the formula:

Break-even Point in Units of Sales Mix = Total Fixed Cost ÷ Weighted Average CM per Unit

Total Fixed Cost	\$40,000
÷ Weighted Average CM per Unit	\$12.80
Break-even Point in Units of Sales Mix	3,125 units

Step 4: Calculate number units of product A, B and C at break-even point:

Product	A	B	C
Sales Mix Ratio	20%	20%	60%
× Total Break-even Units	3,125	3,125	3,125
Product Units at Break-even Point	625	625	1,875

Step 5: Calculate Break-even Point in dollars as follows:

Product	A	B	C
Product Units at Break-even Point	625	625	1,875
× Price per Unit	\$15	\$21	\$36
Product Sales in Dollars	\$9,375	\$13,125	\$67,500
Sum: Break-even Point in Dollars		\$90,000	

$$\text{Break-even point} = \frac{\text{Total fixed expenses}}{\text{Weighted average contribution margin per unit}}$$

Example:

Ali's company manufactures three products – product X, product Y and product Z. The variable expenses and sales prices of all the products are given below:

	Product X	Product Y	Product Z
Sale per unit	\$200	\$100	\$50
Variable expenses per unit	\$100	\$75	\$25

The total fixed expenses of the company are **\$50,000** per month. For the coming month, Monster expects the sale of three products in the following ratio:

Product X: 20%;

Product Y: 30%;

Product Z: 50%

Required: Compute the break-even point of Ali Company **in units** and **dollars** for the coming month!

Solution:

His company sells three products and is, therefore, a multi-product company. Its break-even point can be computed by applying the above formula:

$$\text{Break-even point} = \frac{\text{Total fixed expenses}}{\text{Weighted average selling price} - \text{weighted average variable expenses}}$$

$$= \$50,000 / \$95^* - \$55^{**}$$

$$= \$50,000 / \$40$$

$$= 1,250 \text{ units}$$

*Weighted average selling price:

$$= (\$200 \times 20\%) + (\$100 \times 30\%) + (\$50 \times 50\%)$$

$$= \$40 + \$30 + \$25$$

$$= \$95 \quad \text{TWAOF THE SELLING PRICE}$$

**Weighted average variable expenses:

$$= (\$100 \times 20\%) + (\$75 \times 30\%) + (\$25 \times 50\%)$$

$$= \$20 + 22.50 + 12.50$$

$$= \$55 \quad \text{TWAof VC}$$

Sales mix, Target income

Ahmed F. Saleh

The company will have to sell 1,250 units to break-even. Now we would compute the number of units of each product to be sold:

Product X ($1,250 \times 20\%$): 250 units

Product Y ($1,250 \times 30\%$): 375 units

Product Z ($1,250 \times 50\%$): 625 units

Total: 250 units + 375 units + 625 units = 1,250 units

As the number of units of each individual product to be sold have been computed, I can compute the break even point in dollars as follows:

Product X (250 units \times \$200)	\$ 50,000
Product Y (375 units \times \$100)	37,500
Product Z (625 units \times \$50)	31,250
	<hr/>
Break-even point in dollars	\$ 118,750
	<hr/>

The break-even point of Ali company is \$118,750. It can be verified by preparing a contribution margin income statement as follows:

Sales (BEP in dollars)	\$ 118,750
Less variable expenses	68,750*
	<hr/>
Contribution margin	50,000
Less fixed expenses	50,000
	<hr/>
Net operating income	\$ 0
	<hr/>

* $(250 \text{ units} \times \$100) + (375 \text{ units} \times \$75) + (625 \text{ units} \times \$25) = \$68,750$

Example:

The NORAN company sells two products; product X and product Y. The information about sales price, variable expenses per unit and total fixed expenses is given below:

	Product X	Product Y
Sale per unit	\$50	\$100
Variable expenses per unit	\$30	\$40

The total monthly fixed expenses of the company are **\$270,000**. The company wants to generate a sales revenue of **\$1,000,000** in the next month. To obtain this goal the company has the following options:

- (A). Sell 6,000 units of product X and 7,000 units of product Y.
 (B). Sell 14,000 units of product X and 3,000 units of product Y.

Required:

1. Prepare contribution margin income statement and calculate break-even point if NORAN decides to select option (a).
2. Prepare contribution margin income statement and calculate break-even point if NORAN decides to select option (b).
3. Whichever is the better option, (a) or (b)?
4. Explain the reason of change in break-even point in dollars (if any).

Solution:

(1). If option (a) is selected:

	Product X	Product Y	Total
Sales	\$ 300,000	\$ 700,000	\$ 1,000,000
Variable expenses	180,000	280,000	460,000
Contribution margin	\$ 120,000	\$ 420,000	540,000
Less fixed expenses			270,000
Net operating income			\$ 270,000

Break-even point = Total fixed expenses / Overall contribution margin ratio

$$= \$270,000 / 54\% *$$

$$= \$500,000$$

$$*540,000 / 1,000,000$$

(2). If option (ii) is selected:

	Product X	Product Y	Total
Sales	\$ 700,000	\$ 300,000	\$ 1,000,000
Variable expenses	420,000	120,000	540,000
Contribution margin	\$ 280,000	\$ 180,000	460,000
Less fixed expenses			270,000
Net operating income			\$ 190,000

Break-even point = Total fixed expenses / Overall contribution margin ratio

= \$270,000/.46*

= \$586,957

*460,000/1,000,000

(3) The better option:

Option (a) is better than option (b) because it generates more net operating income.

(4). The reason of change in break-even point:

A change in sales mix usually have a strong effect on the break-even point. The break-even point has increased from \$500,000 to \$586,957 because the shift in sales mix from high margin product (product Y) to low margin product (product X) has dropped the overall contribution margin ratio from 0.54 to 0.46.

A shift in sales mix from high contribution margin product to low contribution margin product increases the dollar sales required to break-even while a shift from low contribution margin product to high contribution margin product reduces the dollar sales required to break-even.

Homework #1 about Target income:

Sales mix, Target income

Ahmed F. Saleh

Assume that LWD Fashion LLC is selling three products as shown in the table below.

	Jeans	T-Shirts	Sweaters	Total
Sales Price per Unit	\$95	\$45	\$90	
Variable Cost per Unit	\$55	\$35	\$60	
Percentage of Sales Mix	40%	20%	40%	100%
Fixed Costs				\$600,000
Target Profit				\$450,000

The company's management expects to earn a profit of \$450,000. Let's perform target profit analysis if the proportion of jeans in the sales mix is 40%, T-shirts 20%, and sweaters 40%.

Homework #2

ABC Company sells products A,B and C. data about three products are as follows:

	A	B	C
Selling price per unit	\$100	\$120	\$50
Variable cost per unit	60	90	40
Contribution margin per unit	40	30	10
Sales in units	1,000	2,000	5,000
Total fixed costs			\$8,000

Required? Calculate the BEP in units and \$?