

Chapter 6

Part II – Multiple Product Case

If a company sells more than one product with different selling prices, variable costs and contribution margins, it becomes more difficult to determine required sales needed to achieve a target profit. To simplify the complexity of finding the BEP or the point to achieve the target profit for individual products separately, we assume that the sales mix is constant.

Sales Mix:

- The term sales mix refer to the relative proportions in which a company's products are sold. The sales mix can be stated in terms of either units or dollars of sales revenues.
- To illustrate the concept of sales mix, suppose a fast food restaurant such as McDonald sells three products: burger sandwiches, french-fries, and soft drinks. Assume further that when the store sells 2 Burger sandwiches, it sells an order of one French Fries to the same or different customer and then sells 3 Soft Drinks sold to the same or different customers. The sales mix *in units* for this McDonald's store is 2 to 1 to 3. The sales mix in this case is expressed in standard form as **(2 : 1 : 3)**. In other words, out of every 6 items sold, this store typically sells 2 burger sandwiches, 1 order of french-fries of chips, and 3 soft drinks. This group of 6 items is often known as a bundle or a package.
- In order to consider the sales mix when calculating the breakeven point in units for multiple products, you must determine a *weighted average contribution margin amount*, which considers the differing selling prices, variable costs per unit, and number of units for each product.
- When calculating the breakeven point or target profit in *units*, use the weighted average contribution margin per unit (*WACM/unit*). When calculating the breakeven point in *sales dollars*, use the weighted average contribution margin *ratio* (*WACM%*).
- CVP analysis with multiple products assumes that sales will continue at the same mix of products, expressed in *packages, units, or sales dollars*. Accordingly, one can calculate the sales (volume or dollars) to achieve a the desired target profit using one of three alternative equations to answer three possible questions:
 1. How many packages (bundle) that the company should sell to achieve an overall target profit.
 2. How many units of each product that the company should sell to achieve a target profit.
 3. Total sales revenues (\$) that the company should generate from all products to achieve an overall target profit.

1. How many packages that the company should sell to achieve its target profit.

$$\text{Total \# Packages to achieve target profits} = \frac{\text{Fixed Costs} + \text{Target profits}}{\text{CM /package}} \quad (3)$$

Where:

CM/package = sum of total contribution margin from selling one package
 = (CM per unit of the first product * # of units of the first product in the package + CM per unit of the second product * the # of units in the second product in the package + ...etc.)

Example 1.1 from the single product case: (David’s Pizza store- Continued)

Assume that David Martin (in Example 1 of Part I) decided to expand his Pizza business to offer his customers three different sizes of Pizza: small, medium and large. Total fixed cost per month for the company is \$15,000 and the target net income after tax is \$9,000 (tax rate is 25%).

Following is pertinent information about the three products:

(1) Sales Mix in Units	1	2	2	5 units/package
	Small	Medium	Large	Total
(2) SP/unit	10	15	20	
(3) - VC/unit	6	12	15	
(4) CM/unit	4	3	5	
CM/Package = Row 1 x Row 4				

Required:

1. How many packages to breakeven?
2. How many total units of each product to breakeven?
3. How much is total sales revenues to breakeven?
4. Repeat each of the above three requirements for achieving the target income.

Hint: You need to state the Sales Mix (Units and Dollars) in the **lowest terms**.

Requirement 1: How many packages to breakeven

(5) Sales Mix in Units	1	2	2	5 units/package
	Small	Medium	Large	Total
(6) SP/unit	10	15	20	
(7) - VC/unit	6	12	15	
(8) CM/unit	4	3	5	
CM/Package = Row 1 x Row 4				

2. Total # of all units that the company should sell to achieve an overall target profit.

Total **Units** from *all products* to achieve target profits = $\frac{\text{Fixed Costs} + \text{Target profits}}{\text{WACM/unit}}$ (4)

Where:

WACM/unit = Weighted Average contribution margin *per unit*

WACM/unit = (CM per unit of the First product x weight of the first product in the package)
+ (CM per unit of Second product x weight of the Second product) +

Or

WACM/unit = Total CM per package/ total # of units in the package from all products

Requirement 2: How many units of each product to breakeven

(1) Sales Mix in Units (Given)	1	2	2	5
(2) Weight of each product in a Package				
	Small	Medium	Large	Total
(3) SP/unit	10	15	20	
(4) - VC/unit	6	12	15	
(5) CM/unit	4	3	5	
(6) WACM/Unit = Row (2) x Row (5)				

Alternative way to calculate WACM/unit

WACM/Unit = CM per package/Total # of units in a package

3. Total sales revenues (\$) that the company should generate from all products to achieve target profit.

$$\text{Total Sales \$ from all products to achieve target profits} = \frac{\text{Fixed expenses} + \text{Target profits}}{\text{WACM ratio}} \quad (5)$$

Where:

WACM% = Weighted Average contribution margin **percentage**

$$\text{WACM\%} = (\text{CM\% of First product} \times \text{Percent of sales of the first product in total sales}) + (\text{CM\% of Second product} \times \text{Percent of sales of the second product in total sales}) + \dots$$

Or

$$\text{WACM/unit} = \frac{\text{Total CM for the company from all products (or per package)}}{\text{Total Sales Revenues from all products (or per package)}}$$

Requirement 3: How much is the total sales revenues from all products to breakeven?

(1) Sales Mix in \$ (Given)	\$10	\$30	\$40	\$80
(2) Weight of each product in total Sales				
	Small	Medium	Large	Total
(4) SP/unit	10	15	20	
(5) - VC/unit	6	12	15	
(6) CM/unit	4	3	5	
(7) CM% for each unit= Row (6)/Row(1)				
(8) WACM% = Row (2) x Row (7) =				

[Alternative way to calculate WACM%](#)

$$\text{WACM\%} = \frac{\text{Total CM per Package}}{\text{Total Sales per Package}}$$

MC Questions:

Use the following data to answer the next three questions:

The following annual information is for Barnett Corporation:

	<u>Product X</u>	<u>Product Y</u>	
Revenue per unit:	\$10.00	\$15.00	
Variable cost per unit:	\$ 2.50	\$ 5.00	
Total fixed costs:			\$50,000

1. If the sales mix consists of two units of Product X and one unit of Product Y, what is the weighted revenue per unit of composite product?
 - a. \$10.00
 - b. \$11.66
 - c. \$13.33
 - d. \$15.00

2. If the sales mix consists of two units of Product X and one unit of Product Y, what is the break-even point in units for a year?
 - a. 1,000 units of Y and 2,000 units of X
 - b. 1012.5 units of Y and 2,025 units of X
 - c. 2012.5 units of Y and 4,025 units of X
 - d. 2,000 units of Y and 4,000 units of X

3. What is the operating income for a year, assuming actual sales total 150,000 units, and the sales mix is two units of Product X and one unit of Product Y?
 - a. \$1,200,000
 - b. \$1,250,000
 - c. \$1,750,000
 - d. None of the above is correct.

4. ABC Company sells three products with exactly the same price of \$20 a unit. However, A's variable cost is at 40%, B's at 50%, and C's at 60%. Sales mix for A, B, and C is at 500, 1500, and 3000 units respectively. Fixed costs amount to \$18,000. Breakeven sales for B should be
 - a. 600
 - b. 1,200
 - c. 1,800
 - d. 2,000

5. ABC Company sells three products with exactly the same price of \$20 a unit. However, A's variable cost is at 40%, B's at 50%, and C's at 60%. Fixed costs amount to \$18,000. An additional \$9,000 needs to be spent on advertising to boost sales. Sales mix is at 500, 1500, and 3000 units for A, B, and C respectively. Sales in dollars for C at breakeven amounts to
 - a. \$18,000
 - b. \$27,000
 - c. \$36,000
 - d. \$45,000

6. ABC's sales mix has drastically changed due to market conditions to 3000, 1500, and 500 units for A, B, and C respectively. Fixed costs have increased to \$22,000 per period. The selling price is at \$20 a unit for all products with a variable cost of 40%, 50%, and 60% for A, B, and C respectively. Breakeven units for A will be
 - a. 300
 - b. 600
 - c. 900
 - d. 1,200

Use the following data to answer the next two questions:

Crown Co. can produce two types of lamps, the Enlightner and Foglighter. The data on the two lamp models are as follows:

	Enlightner	Foglighter
Sales volume in units	500	400
Unit sales price	\$300	\$400
Unit variable cost	<u>(200)</u>	<u>(240)</u>
Unit contribution margin	<u>\$100</u>	<u>\$160</u>

It takes one machine hour to produce each product. Total fixed costs for the manufacture of both products is \$90,000. Demand is high enough for either product to keep the plant operating at maximum capacity.

7. Assuming that sales mix remains constant in units, the breakeven point in total units is:
- A) \$ 687.
 - B) \$ 710.
 - C) \$ 805.
 - D) \$ 945.
 - E) \$1,006.
- Answer: B

8. Assuming that sales mix remains constant in dollars, the breakeven point in units is:
- A) \$ 687.
 - B) \$ 710.
 - C) \$ 805.
 - D) \$ 945.
 - E) \$1,006.
- Answer: A

9. Twin Products Company produces and sells two products. Product M sells for \$12 and has variable costs of \$6. Product W sells for \$15 and has variable costs of \$10. Twin predicted sales of 25,000 units of M and 20,000 of W. Fixed costs are \$60,000 per month. Assume that Twin achieved its sales goal of \$600,000 for September, but fell short of its expected operating income of \$190,000. Which of the following descriptions best describes the actual results reported of revenue of \$600,000 and operating income of less than \$190,000?

- a. Twin sold 50,000 of M and no product W.
- b. Twin sold more of both products M and W than expected.
- c. Twin sold more of product W and less of product M than expected.
- d. Twin sold more of product M and less of product W than expected.

1	2	3	4	5	6	7	8	9
b	d	b	a	c	d	b	a	c