Chapter 5

Cost-Volume-Profit Relationships

Solutions to Questions

5-1 The contribution margin (CM) ratio is the ratio of the total contribution margin to total sales revenue. It can also be expressed as the ratio of the contribution margin per unit to the selling price per unit. It is used in target profit and break-even analysis and can be used to quickly estimate the effect on profits of a change in sales revenue.

5-2 Incremental analysis focuses on the changes in revenues and costs that will result from a particular action.

5-3 All other things equal, Company B, with its higher fixed costs and lower variable costs, will have a higher contribution margin ratio than Company A. Therefore, it will tend to realize a larger increase in contribution margin and in profits when sales increase.

5-4 Operating leverage measures the impact on net operating income of a given percentage change in sales. The degree of operating leverage at a given level of sales is computed by dividing the contribution margin at that level of sales by the net operating income at that level of sales.

5-5 The break-even point is the level of sales at which profits are zero.

5-6 (a) If the selling price decreased, then the total revenue line would rise less steeply, and the break-even point would occur at a higher unit volume. (b) If the fixed cost increased, then both the fixed cost line and the total cost line would shift upward and the break-even point would occur at a higher unit volume. (c) If the variable cost per unit increased, then the total cost line would rise more steeply and the break-even point would occur at a higher unit volume.

5-7 The margin of safety is the excess of budgeted (or actual) sales over the break-even volume of sales. It is the amount by which sales can drop before losses begin to be incurred.

5-8 The sales mix is the relative proportions in which a company's products are sold. The usual assumption in cost-volume-profit analysis is that the sales mix will not change.

5-9 A higher break-even point and a lower net operating income could result if the sales mix shifted from high contribution margin products to low contribution margin products. Such a shift would cause the average contribution margin ratio in the company to decline, resulting in less total contribution margin for a given amount of sales. Thus, net operating income would decline. With a lower contribution margin ratio, the break-even point would be higher because more sales would be required to cover the same amount of fixed costs.

The Foundational 15

1. The contribution margin per unit is calculated as follows:

Total contribution margin (a)	$8,000
Total units sold (b)	1,000 units
Contribution margin per unit (a) ÷ (b)	$8.00 per unit

The contribution margin per unit ($8) can also be derived by calculating the selling price per unit of $20 (= $20,000 ÷ 1,000 units) and deducting the variable expense per unit of $12 (= $12,000 ÷ 1,000 units).

2. The contribution margin ratio is calculated as follows:

Total contribution margin (a)	$8,000
Total sales (b).....	$20,000
Contribution margin ratio (a) ÷ (b).....	40%

3. The variable expense ratio is calculated as follows:

Total variable expenses (a).....	$12,000
Total sales (b).....	$20,000
Variable expense ratio (a) ÷ (b)	60%

4. The increase in net operating is calculated as follows:

Contribution margin per unit (a)	$8.00 per unit
Increase in unit sales (b).....	1 unit
Increase in net operating income (a) × (b).....	$8.00

5. If sales decline to 900 units, the net operating would be computed as follows:

	Total	*Per Unit*
Sales (900 units).....	$18,000	$20.00
Variable expenses	10,800	12.00
Contribution margin	7,200	$ 8.00
Fixed expenses	6,000	
Net operating income	$ 1,200	

6. The new net operating income would be computed as follows:

	Total	*Per Unit*
Sales (900 units).....	$19,800	$22.00
Variable expenses	10,800	12.00
Contribution margin	9,000	$10.00
Fixed expenses	6,000	
Net operating income	$ 3,000	

7. The new net operating income would be computed as follows:

	Total	*Per Unit*

Sales (1,250 units)	$25,000	$20.00
Variable expenses	16,250	13.00
Contribution margin	8,750	$ 7.00
Fixed expenses	7,500	
Net operating income	$ 1,250	

8. The equation method yields the break-even point in unit sales, Q, as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$20 - \$12) \times Q - \$6{,}000 \\ \$0 &= (\$8) \times Q - \$6{,}000 \\ \$8Q &= \$6{,}000 \\ Q &= \$6{,}000 \div \$8 \\ Q &= 750 \text{ units} \end{aligned}$$

9. The equation method yields the dollar sales to break-even as follows:

$$\begin{aligned} \text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$0 &= 0.40 \times \text{Sales} - \$6{,}000 \\ 0.40 \times \text{Sales} &= \$6{,}000 \\ \text{Sales} &= \$6{,}000 \div 0.40 \\ \text{Sales} &= \$15{,}000 \end{aligned}$$

The dollar sales to break-even ($15,000) can also be computed by multiplying the selling price per unit ($20) by the unit sales to break-even (750 units).

10. The equation method yields the target profit as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$5{,}000 &= (\$20 - \$12) \times Q - \$6{,}000 \\ \$5{,}000 &= (\$8) \times Q - \$6{,}000 \\ \$8Q &= \$11{,}000 \\ Q &= \$11{,}000 \div \$8 \\ Q &= 1{,}375 \text{ units} \end{aligned}$$

11. The margin of safety in dollars is calculated as follows:

Sales	$20,000
Break-even sales (at 750 units)	15,000
Margin of safety (in dollars)	$ 5,000

The margin of safety as a percentage of sales is calculated as follows:

Margin of safety (in dollars) (a)	$5,000
Sales (b)	$20,000
Margin of safety percentage (a) ÷ (b)	25%

12. The degree of operating leverage is calculated as follows:

Contribution margin (a)	$8,000
Net operating income (b)	$2,000
Degree of operating leverage (a) ÷ (b)	4.0

13. A 5% increase in sales should result in a 20% increase in net operating income, computed as follows:

Degree of operating leverage (a)	4.0
Percent increase in sales (b)	5%
Percent increase in net operating income (a) × (b)	20%

14. The degree of operating leverage is calculated as follows:

Contribution margin ($20,000 – $6,000) (a)	$14,000
Net operating income (b)	$2,000
Degree of operating leverage (a) ÷ (b)	7.0

15. A 5% increase in sales should result in 35% increase in net operating income, computed as follows:

Degree of operating leverage (a)	7.0
Percent increase in sales (b)	5%
Percent increase in net operating income (a) × (b)	35%

Exercise 5-4 (10 minutes)

1. The company's contribution margin (CM) ratio is:

Total sales	$200,000
Total variable expenses	120,000
Total contribution margin (a)	$ 80,000
Total contribution margin (a)	$80,000
Total sales (b)	$200,000
CM ratio (a) ÷ (b)	40%

2. The change in net operating income from an increase in total sales of $1,000 can be estimated by using the CM ratio as follows:

Change in total sales (a)	$1,000
CM ratio (b)	40%
Estimated change in net operating income (a) × (b)	$400

This computation can be verified as follows:

Total sales (a)	$200,000	
Total units sold (b)	50,000	units
Selling price per unit (a) ÷ (b)	$4.00	per unit
Increase in total sales (a)	$1,000	
Selling price per unit (b)	$4.00	per unit
Increase in unit sales (a) ÷ (b)	250	units
Increase in unit sales	250	units
Original total unit sales	50,000	units
New total unit sales	50,250	units

	Original	*New*
Total unit sales	50,000	50,250
Sales	$200,000	$201,000
Variable expenses	120,000	120,600
Contribution margin	80,000	80,400
Fixed expenses	65,000	65,000
Net operating income	$ 15,000	$ 15,400

Exercise 5-5 (20 minutes)

1. The following table shows the effect of the proposed change in monthly advertising budget:

	Current Sales	*Sales With Additional Advertising Budget*	*Difference*
Sales	$180,000	$189,000	$ 9,000
Variable expenses	126,000	132,300	6,300
Contribution margin	54,000	56,700	2,700
Fixed expenses	30,000	35,000	5,000
Net operating income	$ 24,000	$ 21,700	$ (2,300)

Assuming no other important factors need to be considered, the increase in the advertising budget should not be approved because it would lead to a decrease in net operating income of $2,300.

Alternative Solution 1

Expected total contribution margin:	
$189,000 × 30% CM ratio	$56,700
Present total contribution margin:	
$180,000 × 30% CM ratio	54,000
Incremental contribution margin	2,700
Change in fixed expenses:	
Less incremental advertising expense	5,000
Change in net operating income	$ (2,300)

Alternative Solution 2

Incremental contribution margin:	
$9,000 × 30% CM ratio	$2,700
Less incremental advertising expense	5,000
Change in net operating income	$ (2,300)

2. The $2 increase in variable expense will cause the unit contribution margin to decrease from $27 to $25 with the following impact on net operating income:

Expected total contribution margin with the higher-quality components:	
2,000 units × 1.1 × $25 per unit	$55,000
Present total contribution margin:	
2,000 units × $27 per unit	54,000
Change in total contribution margin	$ 1,000

Assuming no change in fixed expenses, the net operating income will also increase by $1,000. The higher-quality components should be used.

Exercise 5-6 (20 minutes)

1. The break-even point in unit sales, Q, is computed as follows:

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\ \$0 &= (\$15 - \$12) \times Q - \$4{,}200\\ \$0 &= (\$3) \times Q - \$4{,}200\\ \$3Q &= \$4{,}200\\ Q &= \$4{,}200 \div \$3\\ Q &= 1{,}400 \text{ baskets}\end{aligned}$$

2. The break-even point in dollar sales is computed as follows:

Unit sales to break even (a)	1,400
Selling price per unit (b)	$15
Dollar sales to break even (a) × (b)	$21,000

3. The new break-even point in unit sales, Q, is computed as follows:

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\ \$0 &= (\$15 - \$12) \times Q - \$4{,}800\\ \$0 &= (\$3) \times Q - \$4{,}800\\ \$3Q &= \$4{,}800\\ Q &= \$4{,}800 \div \$3\\ Q &= 1{,}600 \text{ baskets}\end{aligned}$$

The break-even point in dollar sales is computed as follows:

Unit sales to break even (a)	1,600
Selling price per unit (b)	$15
Dollar sales to break even (a) × (b)	$24,000

Exercise 5-7 (10 minutes)

1. The required unit sales, Q, to attain the target profit is computed as follows:

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$10{,}000 &= (\$120 - \$80) \times Q - \$50{,}000 \\
\$10{,}000 &= (\$40) \times Q - \$50{,}000 \\
\$40 \times Q &= \$10{,}000 + \$50{,}000 \\
Q &= \$60{,}000 \div \$40 \\
Q &= 1{,}500 \text{ units}
\end{aligned}$$

2. One approach to solving this requirement is to compute the unit sales required to attain the target profit and then multiply this quantity by the selling price per unit:

$$\begin{aligned}
\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
\$15{,}000 &= (\$120 - \$80) \times Q - \$50{,}000 \\
\$15{,}000 &= (\$40) \times Q - \$50{,}000 \\
\$40 \times Q &= \$15{,}000 + \$50{,}000 \\
Q &= \$65{,}000 \div \$40 \\
Q &= 1{,}625 \text{ units}
\end{aligned}$$

Unit sales to attain the target profit (a)	1,625
Selling price per unit (b)	$120
Dollar sales to attain target profit (a) × (b)	$195,000