

## Capítulo 9 Cost-volume profit relationships

### Exercise 6-1 (20 minutes)

1. The revised net operating income would be:

	<i>Total</i>	<i>Per Unit</i>
Sales (10,100 units) .....	\$353,500	\$35.00
Variable expenses .....	<u>202,000</u>	<u>20.00</u>
Contribution margin .....	151,500	<u>\$15.00</u>
Fixed expenses .....	<u>135,000</u>	
Net operating income .....	<u>\$ 16,500</u>	

You can get the same net operating income using the following approach:

Original net operating income .....	\$15,000
Change in contribution margin	
(100 units × \$15.00 per unit) .....	<u>1,500</u>
New net operating income .....	<u>\$16,500</u>

2. The revised net operating income would be:

	<i>Total</i>	<i>Per Unit</i>
Sales (9,900 units) .....	\$346,500	\$35.00
Variable expenses .....	<u>198,000</u>	<u>20.00</u>
Contribution margin .....	148,500	<u>\$15.00</u>
Fixed expenses .....	<u>135,000</u>	
Net operating income .....	<u>\$ 13,500</u>	

You can get the same net operating income using the following approach:

Original net operating income .....	\$15,000
Change in contribution margin	
(-100 units × \$15.00 per unit) .....	<u>(1,500)</u>
New net operating income .....	<u>\$13,500</u>

3. The revised net operating income would be:

	<i>Total</i>	<i>Per Unit</i>
Sales (9,000 units) .....	\$315,000	\$35.00
Variable expenses .....	<u>180,000</u>	<u>20.00</u>
Contribution margin .....	135,000	<u>\$15.00</u>
Fixed expenses .....	<u>135,000</u>	

Net operating income ..... \$ 0

Note: This is the company's break-even point.

**Exercise 6-4** (10 minutes)

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

Total sales.....	\$200,000
Total variable expenses .....	<u>120,000</u>
Total contribution margin (a) .....	<u>\$ 80,000</u>

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 .....	<u>50,000</u> units
New total unit sales .....	<u>50,250</u> units

	<i>Original</i>	<i>New</i>
Total unit sales .....	<u>50,000</u>	<u>50,250</u>
Sales .....	\$200,000	\$201,000
Variable expenses.....	<u>120,000</u>	<u>120,600</u>
Contribution margin .....	80,000	80,400

Fixed expenses .....	<u>65,000</u>	<u>65,000</u>
Net operating income .....	<u>\$ 15,000</u>	<u>\$ 15,400</u>

**Exercise 6-7** (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

**Exercise 6-11** (20 minutes)

a.					
		<u>Case #1</u>		<u>Case #2</u>	
Number of units sold .....		<u>15,000</u> *		<u>4,000</u>	
Sales .....	\$180,000 *	\$12	\$100,000 *	\$25	
Variable expenses .....	<u>120,000</u> *	<u>8</u>	<u>60,000</u>	<u>15</u>	
Contribution margin.....	60,000	<u>\$4</u>	40,000	<u>\$10</u> *	
Fixed expenses .....	<u>50,000</u> *		<u>32,000</u> *		
Net operating income.....	<u>\$ 10,000</u>		<u>\$ 8,000</u> *		
		<u>Case #3</u>		<u>Case #4</u>	
Number of units sold .....		<u>10,000</u> *		<u>6,000</u> *	
Sales .....	\$200,000	\$20	\$300,000 *	\$50	

Variable expenses .....	<u>70,000</u> *	<u>7</u>	<u>210,000</u>	<u>35</u>
Contribution margin.....	130,000	<u>\$13</u> *	90,000	<u>\$15</u>
Fixed expenses .....	<u>118,000</u>		<u>100,000</u> *	
Net operating income (loss)...	<u>\$ 12,000</u> *		<u>\$ (10,000)</u> *	

b.	<u>Case #1</u>		<u>Case #2</u>	
Sales .....	\$500,000 *	100%	\$400,000 *	100%
Variable expenses .....	<u>400,000</u>	<u>80%</u>	<u>260,000</u> *	<u>65%</u>
Contribution margin.....	100,000	<u>20%</u> *	140,000	<u>35%</u>
Fixed expenses .....	<u>93,000</u>		<u>100,000</u> *	
Net operating income .....	<u>\$ 7,000</u> *		<u>\$ 40,000</u>	
	<u>Case #3</u>		<u>Case #4</u>	
Sales.....	\$250,000	100%	\$600,000 *	100%
Variable expenses.....	<u>100,000</u>	<u>40%</u>	<u>420,000</u> *	<u>70%</u>
Contribution margin .....	150,000	<u>60%</u> *	180,000	<u>30%</u>
Fixed expenses .....	<u>130,000</u> *		<u>185,000</u>	
Net operating income (loss).	<u>\$ 20,000</u> *		<u>\$ (5,000)</u> *	

\*Given

**Exercise 6-13** (20 minutes)

	<i>Total</i>	<i>Per Unit</i>
1. Sales (20,000 units × 1.15 = 23,000 units).....	\$345,000	\$ 15.00
Variable expenses.....	<u>207,000</u>	<u>9.00</u>
Contribution margin .....	138,000	<u>\$ 6.00</u>
Fixed expenses .....	<u>70,000</u>	
Net operating income .....	<u>\$ 68,000</u>	
2. Sales (20,000 units × 1.25 = 25,000 units).....	\$337,500	\$13.50
Variable expenses.....	<u>225,000</u>	<u>9.00</u>
Contribution margin .....	112,500	<u>\$ 4.50</u>
Fixed expenses .....	<u>70,000</u>	
Net operating income .....	<u>\$ 42,500</u>	
3. Sales (20,000 units × 0.95 = 19,000 units).....	\$313,500	\$16.50
Variable expenses.....	<u>171,000</u>	<u>9.00</u>
Contribution margin .....	142,500	<u>\$ 7.50</u>

Fixed expenses .....	<u>90,000</u>	
Net operating income .....	<u>\$ 52,500</u>	
4. Sales (20,000 units × 0.90 = 18,000 units).....	\$302,400	\$16.80
Variable expenses.....	<u>172,800</u>	<u>9.60</u>
Contribution margin .....	129,600	<u>\$ 7.20</u>
Fixed expenses .....	<u>70,000</u>	
Net operating income .....	<u>\$ 59,600</u>	

**Exercise 6-14** (30 minutes)

1. Variable expenses:  $\$40 \times (100\% - 30\%) = \$28$
2. The break-even points in unit sales (Q) and dollar sales are computed as follows:

Selling price.....	\$40	100%
Variable expenses.....	<u>28</u>	<u>70%</u>
Contribution margin .....	<u>\$12</u>	<u>30%</u>

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

$$\$0 = \$12 \times Q - \$180,000$$

$$\$12Q = \$180,000$$

$$Q = \$180,000 \div \$12$$

$$Q = 15,000 \text{ units}$$

$$\text{In dollar sales: } 15,000 \text{ units} \times \$40 \text{ per unit} = \$600,000$$

Alternative solution:

$$\text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses}$$

$$\$0 = 0.30 \times \text{Sales} - \$180,000$$

$$0.30 \times \text{Sales} = \$180,000$$

$$\text{Sales} = \$180,000 \div 0.30$$

$$\text{Sales} = \$600,000$$

$$\text{In unit sales: } \$600,000 \div \$40 \text{ per unit} = 15,000 \text{ units}$$

3. The unit sales and dollar sales needed to attain the target profit are computed as follows:

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

$$\$60,000 = \$12 \times Q - \$180,000$$

$$\$12Q = \$60,000 + \$180,000$$

$$\begin{aligned} \$12Q &= \$240,000 \\ Q &= \$240,000 \div \$12 \\ Q &= 20,000 \text{ units} \end{aligned}$$

In dollar sales: 20,000 units  $\times$  \$40 per unit = \$800,000

**Exercise 6-14** (continued)

Alternative solution:

$$\begin{aligned} \text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$60,000 &= 0.30 \times \text{Sales} - \$180,000 \\ 0.30 \times \text{Sales} &= \$240,000 \\ \text{Sales} &= \$240,000 \div 0.30 \\ \text{Sales} &= \$800,000 \end{aligned}$$

In unit sales: \$800,000  $\div$  \$40 per unit = 20,000 units

4. The new break-even points in unit sales and dollar sales are computed as follows:

The company's new cost/revenue relation will be:

Selling price .....	\$40	100%
Variable expenses (\$28 - \$4).....	<u>24</u>	<u>60%</u>
Contribution margin.....	<u>\$16</u>	<u>40%</u>

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$40 - \$24) \times Q - \$180,000 \\ \$16Q &= \$180,000 \\ Q &= \$180,000 \div \$16 \text{ per unit} \\ Q &= 11,250 \text{ units} \end{aligned}$$

In dollar sales: 11,250 units  $\times$  \$40 per unit = \$450,000

Alternative solution:

$$\begin{aligned} \text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$0 &= 0.40 \times \text{Sales} - \$180,000 \\ 0.40 \times \text{Sales} &= \$180,000 \\ \text{Sales} &= \$180,000 \div 0.40 \\ \text{Sales} &= \$450,000 \end{aligned}$$

In unit sales: \$450,000  $\div$  \$40 per unit = 11,250 units

4. The dollar sales required to attain the target profit is computed as follows:

$$\begin{aligned} \text{Profit} &= \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\ \$60,000 &= 0.40 \times \text{Sales} - \$180,000 \\ 0.40 \times \text{Sales} &= \$240,000 \\ \text{Sales} &= \$240,000 \div 0.40 \\ \text{Sales} &= \$600,000 \end{aligned}$$

**Problem 6-20** (75 minutes)

1. a. Selling price .....	\$25	100%
Variable expenses .....	<u>15</u>	<u>60%</u>
Contribution margin.....	<u>\$10</u>	<u>40%</u>

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= \$10 \times Q - \$210,000 \\ \$10Q &= \$210,000 \\ Q &= \$210,000 \div \$10 \\ Q &= 21,000 \text{ balls} \end{aligned}$$

Alternative solution:

$$\begin{aligned} \text{Unit sales to break even} &= \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \\ &= \frac{\$210,000}{\$10} \\ &= 21,000 \text{ balls} \end{aligned}$$

b. The degree of operating leverage is:

$$\begin{aligned} \text{Degree of operating leverage} &= \frac{\text{Contribution margin}}{\text{Net operating income}} \\ &= \frac{\$300,000}{\$90,000} = 3.33 \text{ (rounded)} \end{aligned}$$

2. The new CM ratio will be:

Selling price .....	\$25	100%
Variable expenses .....	<u>18</u>	<u>72%</u>
Contribution margin.....	<u>\$ 7</u>	<u>28%</u>

The new break-even point will be:

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$

$$\$0 = \$7 \times Q - \$210,000$$

$$\$7Q = \$210,000$$

$$Q = \$210,000 \div \$7$$

$$Q = 30,000 \text{ balls}$$

**Problem 6-20** (continued)

Alternative solution:

$$\begin{aligned} \text{Unit sales to} &= \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \\ \text{break even} &= \frac{\$210,000}{\$7} \\ &= 30,000 \text{ balls} \end{aligned}$$

3.  $\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$

$$\$90,000 = \$7 \times Q - \$210,000$$

$$\$7Q = \$90,000 + \$210,000$$

$$Q = \$300,000 \div \$7$$

$$Q = 42,857 \text{ balls (rounded)}$$

Alternative solution:

$$\begin{aligned} \text{Unit sales to attain} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}} \\ \text{target profit} &= \frac{\$90,000 + \$210,000}{\$7} = 42,857 \text{ balls} \end{aligned}$$

Thus, sales will have to increase by 12,857 balls (= 42,857 balls – 30,000 balls = 12,857 balls) to earn the same amount of net operating income as last year. The computations above and in part (2) show the dramatic effect that increases in variable costs can have on an organization. The effects on Northwood Company are summarized below:

	<i>Present</i>	<i>Expected</i>
Break-even point (in balls) .....	21,000	30,000
Sales (in balls) needed to earn a \$90,000 profit .....	30,000	42,857

Note that if variable costs do increase next year, then the company will just break even if it sells the same number of balls (30,000) as it did last year.



**Problem 6-20** (continued)

4. The contribution margin ratio last year was 40%. If we let P equal the new selling price, then:

$$\begin{aligned}
 P &= \$18 + 0.40P \\
 0.60P &= \$18 \\
 P &= \$18 \div 0.60 \\
 P &= \$30
 \end{aligned}$$

To verify:

Selling price.....	\$30	100%
Variable expenses.....	<u>18</u>	<u>60%</u>
Contribution margin .....	<u>\$12</u>	<u>40%</u>

Therefore, to maintain a 40% CM ratio, a \$3 increase in variable costs would require a \$5 increase in the selling price.

5. The new CM ratio would be:

Selling price .....	\$25	100%
Variable expenses.....	<u>9*</u>	<u>36%</u>
Contribution margin.....	<u>\$16</u>	<u>64%</u>

$$*\$15 - (\$15 \times 40\%) = \$9$$

The new break-even point would be:

$$\begin{aligned}
 \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\
 \$0 &= \$16 \times Q - (\$210,000 \times 2) \\
 \$16Q &= \$420,000 \\
 Q &= \$420,000 \div \$16 \\
 Q &= 26,250 \text{ balls}
 \end{aligned}$$

Alternative solution:

$$\begin{aligned}
 \text{Unit sales to} &= \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \\
 \text{break even} &= \frac{\$420,000}{\$16} = 26,250 \text{ balls}
 \end{aligned}$$

Although this new break-even point is greater than the company's present break-even point of 21,000 balls [see Part (1) above], it is less than the break-even point will be if the company does not automate and variable labor costs rise next year [see Part (2) above].

**Problem 6-20 (continued)**

6. a. Profit = Unit CM × Q – Fixed expenses  
\$90,000 = \$16 × Q – \$420,000  
\$16Q = \$90,000 + \$420,000  
Q = \$510,000 ÷ \$16  
Q = 31,875 balls

Alternative solution:

$$\begin{aligned} \text{Unit sales to attain target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}} \\ &= \frac{\$90,000 + \$420,000}{\$16} \\ &= 31,875 \text{ balls} \end{aligned}$$

Thus, the company will have to sell 1,875 more balls (31,875 – 30,000 = 1,875) than now being sold to earn a profit of \$90,000 per year. However, this is still less than the 42,857 balls that would have to be sold to earn a \$90,000 profit if the plant is not automated and variable labor costs rise next year [see Part (3) above].

b. The contribution income statement would be:

Sales (30,000 balls × \$25 per ball).....	\$750,000
Variable expenses (30,000 balls × \$9 per ball) .....	<u>270,000</u>
Contribution margin.....	480,000
Fixed expenses .....	<u>420,000</u>
Net operating income .....	<u>\$ 60,000</u>

$$\begin{aligned} \text{Degree of operating leverage} &= \frac{\text{Contribution margin}}{\text{Net operating income}} \\ &= \frac{\$480,000}{\$60,000} = 8 \end{aligned}$$

**Problem 6-20** (continued)

- c. This problem illustrates the difficulty faced by some companies. When variable labor costs increase, it is often difficult to pass these cost increases along to customers in the form of higher prices. Thus, companies are forced to automate resulting in higher operating leverage, often a higher break-even point, and greater risk for the company.

There is no clear answer as to whether one should have been in favor of constructing the new plant.

**Problem 6-25** (45 minutes)

1. The contribution margin per unit on the first 16,000 units is:

	<i>Per Unit</i>
Sales price .....	\$3.00
Variable expenses .....	<u>1.25</u>
Contribution margin .....	<u>\$1.75</u>

The contribution margin per unit on anything over 16,000 units is:

	<i>Per Unit</i>
Sales price .....	\$3.00
Variable expenses .....	<u>1.40</u>
Contribution margin .....	<u>\$1.60</u>

Thus, for the first 16,000 units sold, the total amount of contribution margin generated would be:

$$16,000 \text{ units} \times \$1.75 \text{ per unit} = \$28,000$$

Since the fixed costs on the first 16,000 units total \$35,000, the \$28,000 contribution margin above is not enough to permit the company to break even. Therefore, in order to break even, more than 16,000 units would have to be sold. The fixed costs that will have to be covered by the additional sales are:

Fixed costs on the first 16,000 units .....	\$35,000
Less contribution margin from the first 16,000 units.....	<u>28,000</u>
Remaining unrecovered fixed costs .....	7,000
Add monthly rental cost of the additional space needed to produce more than 16,000 units .....	<u>1,000</u>
Total fixed costs to be covered by remaining sales.....	<u>\$ 8,000</u>

**Problem 6-25** (continued)

The additional sales of units required to cover these fixed costs would be:

$$\frac{\text{Total remaining fixed costs}}{\text{Unit CM on added units}} = \frac{\$8,000}{\$1.60} = 5,000 \text{ units}$$

Therefore, a total of 21,000 units (16,000 + 5,000) must be sold in order for the company to break even. This number of units would equal total sales of:

$$21,000 \text{ units} \times \$3.00 \text{ per unit} = \$63,000 \text{ in total sales}$$

2. 
$$\frac{\text{Target profit}}{\text{Unit CM}} = \frac{\$12,000}{\$1.60} = 7,500 \text{ units}$$

Thus, the company must sell 7,500 units above the break-even point to earn a profit of \$12,000 each month. These units, added to the 21,000 units required to break even, equal total sales of 28,500 units each month to reach the target profit.

3. If a bonus of \$0.10 per unit is paid for each unit sold in excess of the break-even point, then the contribution margin on these units would drop from \$1.60 to \$1.50 per unit.

The desired monthly profit would be:

$$25\% \times (\$35,000 + \$1,000) = \$9,000$$

Thus,

$$\frac{\text{Target profit}}{\text{Unit CM}} = \frac{\$9,000}{\$1.50} = 6,000 \text{ units}$$

Therefore, the company must sell 6,000 units above the break-even point to earn a profit of \$9,000 each month. These units, added to the 21,000 units required to break even, would equal total sales of 27,000 units each month.