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 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.
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:

   \[
   \begin{array}{lcl}
   \text{Total} & \text{Per Unit} \\
   \text{Sales (900 units)} & $18,000 & $20.00 \\
   \text{Variable expenses} & 10,800 & 12.00 \\
   \text{Contribution margin} & 7,200 & $8.00 \\
   \text{Fixed expenses} & 6,000 \\
   \text{Net operating income} & $1,200 \\
   \end{array}
   \]
The Foundational 15 (continued)

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

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (900 units</td>
<td>$19,800</td>
<td>$22.00</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>10,800</td>
<td>12.00</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>9,000</td>
<td>$10.00</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>6,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$3,000</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (1,250 units)</td>
<td>$25,000</td>
<td>$20.00</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>16,250</td>
<td>13.00</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>8,750</td>
<td>$7.00</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>7,500</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$1,250</td>
<td></td>
</tr>
</tbody>
</table>

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

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

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

\[
\text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
\begin{align*}
0 &= 0.40 \times \text{Sales} - $6,000 \\
0.40 \times \text{Sales} &= $6,000 \\
\text{Sales} &= $6,000 \div 0.40 \\
\text{Sales} &= $15,000
\]

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:

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

\[
$5,000 = ($20 - $12) \times Q - $6,000
\]

\[
$5,000 = ($8) \times Q - $6,000
\]

\[
$8Q = $11,000
\]

\[
Q = $11,000 ÷ $8
\]

\[
Q = 1,375 \text{ units}
\]

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 (a) ....................... $14,000
Net operating income (b) ....................... $2,000

Degree of operating leverage (a) ÷ (b) . 7.0
The Foundational 15 (continued)

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 5-1 (20 minutes)

1. The new income statement would be:

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (10,100 units)</td>
<td>$353,500</td>
<td>$35.00</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>202,000</td>
<td>20.00</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>151,500</td>
<td>$15.00</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>135,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$16,500</td>
<td></td>
</tr>
</tbody>
</table>

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).. 1,500
New net operating income........ $16,500

2. The new income statement would be:

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (9,900 units)</td>
<td>$346,500</td>
<td>$35.00</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>198,000</td>
<td>20.00</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>148,500</td>
<td>$15.00</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>135,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$13,500</td>
<td></td>
</tr>
</tbody>
</table>

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).......... (1,500)
New net operating income ............ $13,500
**Exercise 5-1** (continued)

3. The new income statement would be:

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (9,000 units)</td>
<td>$315,000</td>
<td>$35.00</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>180,000</td>
<td>20.00</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>135,000</td>
<td><strong>$15.00</strong></td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>135,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$0</td>
<td></td>
</tr>
</tbody>
</table>

Note: This is the company’s break-even point.
Exercise 5-2 (30 minutes)

1. The CVP graph can be plotted using the three steps outlined in the text. The graph appears on the next page.

   Step 1. Draw a line parallel to the volume axis to represent the total fixed expense. For this company, the total fixed expense is $24,000.

   Step 2. Choose some volume of sales and plot the point representing total expenses (fixed and variable) at the activity level you have selected. We’ll use the sales level of 8,000 units.

   Fixed expenses ......................................................... $ 24,000
   Variable expenses (8,000 units × $18 per unit)..... 144,000
   Total expense .......................................................... $168,000

   Step 3. Choose some volume of sales and plot the point representing total sales dollars at the activity level you have selected. We’ll use the sales level of 8,000 units again.

   Total sales revenue (8,000 units × $24 per unit)...

2. The break-even point is the point where the total sales revenue and the total expense lines intersect. This occurs at sales of 4,000 units. This can be verified as follows:

   Profit = Unit CM × Q − Fixed expenses
   = ($24 − $18) × 4,000 − $24,000
   = $6 × 4,000 − $24,000
   = $24,000− $24,000
   = $0
Exercise 5-2 (continued)
Exercise 5-3 (15 minutes)

1. The profit graph is based on the following simple equation:

   \[ \text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \]
   \[ \text{Profit} = ($16 - $11) \times Q - $16,000 \]
   \[ \text{Profit} = $5 \times Q - $16,000 \]

   To plot the graph, select two different levels of sales such as \( Q=0 \) and \( Q=4,000 \). The profit at these two levels of sales are \(-$16,000\) (\(=$5 \times 0 - $16,000\)) and \$4,000\) (\(=$5 \times 4,000 - $16,000\)).
**Exercise 5-3 (continued)**

2. Looking at the graph, the break-even point appears to be 3,200 units. This can be verified as follows:

   \[
   \text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \\
   = 5 \times Q - 16,000 \\
   = 5 \times 3,200 - 16,000 \\
   = 16,000 - 16,000 \\
   = 0
   \]
Exercise 5-4 (10 minutes)

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

\[
\begin{align*}
\text{Total sales} & : \$200,000 \\
\text{Total variable expenses} & : 120,000 \\
= \text{Total contribution margin} & : 80,000 \\
\div \text{Total sales} & : \$200,000 \\
\text{CM ratio} & : 40\%
\end{align*}
\]

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:

\[
\begin{align*}
\text{Change in total sales} & : \$1,000 \\
\times \text{CM ratio} & : 40\% \\
= \text{Estimated change in net operating income} & : \$400
\end{align*}
\]

This computation can be verified as follows:

\[
\begin{align*}
\text{Total sales} & : \$200,000 \\
\div \text{Total units sold} & : 50,000 \text{ units} \\
= \text{Selling price per unit} & : \$4.00 \text{ per unit} \\
\text{Increase in total sales} & : \$1,000 \\
\div \text{Selling price per unit} & : \$4.00 \text{ per unit} \\
= \text{Increase in unit sales} & : 250 \text{ units} \\
\text{Original total unit sales} & : 50,000 \text{ units} \\
\text{New total unit sales} & : 50,250 \text{ units}
\end{align*}
\]

\[
\begin{array}{ccc}
\text{Original} & \text{New} \\
\text{Total unit sales} & 50,000 & 50,250 \\
\text{Sales} & $200,000 & $201,000 \\
\text{Variable expenses} & 120,000 & 120,600 \\
\text{Contribution margin} & 80,000 & 80,400 \\
\text{Fixed expenses} & 65,000 & 65,000 \\
\text{Net operating income} & $15,000 & $15,400
\end{array}
\]
Exercise 5-5 (20 minutes)

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

<table>
<thead>
<tr>
<th></th>
<th>Sales With Additional Advertising</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current Sales</td>
<td>Budget</td>
</tr>
<tr>
<td>Sales</td>
<td>$180,000</td>
<td>$189,000</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>126,000</td>
<td>132,300</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>54,000</td>
<td>56,700</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>30,000</td>
<td>35,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$24,000</td>
<td>$21,700</td>
</tr>
</tbody>
</table>

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)
Exercise 5-5 (continued)

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:
   
   \[
   2,200 \text{ units} \times \$25 \text{ per unit} = $55,000
   \]

   Present total contribution margin:
   
   \[
   2,000 \text{ units} \times \$27 \text{ per unit} = 54,000
   \]

   Change in total contribution margin
   
   $1,000

   Assuming no change in fixed expenses and all other factors remain the same, the higher-quality components should be used.
Exercise 5-6 (20 minutes)

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

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

2. The equation method can be used to compute the break-even point in dollar sales as follows:

   \[
   \text{CM ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}} \\
   = \frac{$3}{$15} = 0.20 \\
   \\
   \text{Profit} = \text{CM ratio} \times \text{Sales} - \text{Fixed expenses} \\
   \$0 = 0.20 \times \text{Sales} - \$4,200 \\
   0.20 \times \text{Sales} = \$4,200 \\
   \text{Sales} = \$4,200 \div 0.20 \\
   \text{Sales} = \$21,000
   \]

3. The formula method gives an answer that is identical to the equation method for the break-even point in unit sales:

   \[
   \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}} \\
   = \frac{$4,200}{$3} = 1,400 \text{ baskets}
   \]
**Exercise 5-6 (continued)**

4. The formula method also gives an answer that is identical to the equation method for the break-even point in dollar sales:

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{$4,200}{0.20} = $21,000
\]
Exercise 5-7 (10 minutes)

1. The equation method yields the required unit sales, Q, as follows:

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

2. The formula approach yields the required unit sales as follows:

   \[
   \frac{\text{Units sold to attain the target profit}}{\text{Target profit + Fixed expenses}} = \frac{\text{Target profit + Fixed expenses}}{\text{Unit contribution margin}}
   \]
   \[
   = \frac{$15,000 + $50,000}{$40}
   \]
   \[
   = \frac{$65,000}{$40} = 1,625 \text{ units}
   \]
Exercise 5-8 (10 minutes)

1. To compute the margin of safety, we must first compute the break-even unit sales.

   \[ \text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \]
   \[ $0 = ($30 - $20) \times Q - $7,500 \]
   \[ $0 = ($10) \times Q - $7,500 \]
   \[ $10Q = $7,500 \]
   \[ Q = $7,500 \div $10 \]
   \[ Q = 750 \text{ units} \]

   Sales (at the budgeted volume of 1,000 units) .. $30,000
   Less break-even sales (at 750 units) ................. 22,500
   Margin of safety (in dollars) .......................... $7,500

2. The margin of safety as a percentage of sales is as follows:

   Margin of safety (in dollars) (a) ................. $7,500
   Sales (b) ................................................... $30,000
   Margin of safety percentage (a) \div (b) ...... 25%
Exercise 5-9 (20 minutes)

1. The company’s degree of operating leverage would be computed as follows:
   Contribution margin (a) ...................... $48,000
   Net operating income (b) ...................... $10,000
   Degree of operating leverage (a) ÷ (b).... 4.8

2. A 5% increase in sales should result in a 24% increase in net operating income, computed as follows:
   Degree of operating leverage (a) ...................... 4.8
   Percent increase in sales (b) ...................... 5%
   Estimated percent increase in net operating income (a) × (b). 24%

3. The new income statement reflecting the change in sales is:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Percent of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$84,000</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>33,600</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>50,400</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>38,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$12,400</td>
</tr>
</tbody>
</table>

   Net operating income reflecting change in sales...... $12,400
   Original net operating income (a) ...................... 10,000
   Change in net operating income (b) ...................... $ 2,400
   Percent change in net operating income (b) ÷ (a)... 24%
**Exercise 5-10** (20 minutes)

1. The overall contribution margin ratio can be computed as follows:

   \[
   \text{Overall CM ratio} = \frac{\text{Total contribution margin}}{\text{Total sales}} \\
   = \frac{\$30,000}{\$100,000} = 30\%
   \]

2. The overall break-even point in dollar sales can be computed as follows:

   \[
   \text{Overall break-even} = \frac{\text{Total fixed expenses}}{\text{Overall CM ratio}} \\
   = \frac{\$24,000}{30\%} = \$80,000
   \]

3. To construct the required income statement, we must first determine the relative sales mix for the two products:

<table>
<thead>
<tr>
<th></th>
<th><strong>Claimjumper</strong></th>
<th><strong>Makeover</strong></th>
<th><strong>Total</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Original dollar sales</td>
<td>$30,000</td>
<td>$70,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>Percent of total</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>Sales at break-even</td>
<td>$24,000</td>
<td>$56,000</td>
<td>$80,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th><strong>Claimjumper</strong></th>
<th><strong>Makeover</strong></th>
<th><strong>Total</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$24,000</td>
<td>$56,000</td>
<td>$80,000</td>
</tr>
<tr>
<td>Variable expenses*</td>
<td>$16,000</td>
<td>$40,000</td>
<td>$56,000</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$8,000</td>
<td>$16,000</td>
<td>$24,000</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td></td>
<td></td>
<td>$24,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td></td>
<td></td>
<td>$0</td>
</tr>
</tbody>
</table>

*Claimjumper variable expenses: ($24,000/$30,000) × $20,000 = $16,000
Makeover variable expenses: ($56,000/$70,000) × $50,000 = $40,000
**Exercise 5-11** (20 minutes)

**a.**

<table>
<thead>
<tr>
<th></th>
<th>Case #1</th>
<th>Case #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of units sold</td>
<td>15,000 *</td>
<td>4,000</td>
</tr>
<tr>
<td>Sales</td>
<td>$180,000 * $12</td>
<td>$100,000 * $25</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>120,000 * 8</td>
<td>60,000 15</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>60,000 $4</td>
<td>40,000 $10 *</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>50,000</td>
<td>32,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$ 10,000</td>
<td>$ 8,000 *</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Case #3</th>
<th>Case #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of units sold</td>
<td>10,000 *</td>
<td>6,000 *</td>
</tr>
<tr>
<td>Sales</td>
<td>$200,000</td>
<td>$300,000 * $50</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>70,000 * 7</td>
<td>210,000 35</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>130,000 $13 *</td>
<td>90,000 $15</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>118,000</td>
<td>100,000 *</td>
</tr>
<tr>
<td>Net operating income (loss)</td>
<td>$ 12,000 *</td>
<td>$(10,000) *</td>
</tr>
</tbody>
</table>

**b.**

<table>
<thead>
<tr>
<th></th>
<th>Case #1</th>
<th>Case #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$500,000 * 100%</td>
<td>$400,000 * 100%</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>400,000 80%</td>
<td>260,000 65%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>100,000 20% *</td>
<td>140,000 35%</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>93,000</td>
<td>100,000 *</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$ 7,000 *</td>
<td>$ 40,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Case #3</th>
<th>Case #4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$250,000 100%</td>
<td>$600,000 * 100%</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>100,000 40%</td>
<td>420,000 70%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>150,000 60% *</td>
<td>180,000 30%</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>130,000 *</td>
<td>185,000</td>
</tr>
<tr>
<td>Net operating income (loss)</td>
<td>$ 20,000 *</td>
<td>$(5,000) *</td>
</tr>
</tbody>
</table>

*Given
Exercise 5-12 (30 minutes)

1. | Flight Dynamic | Sure Shot | Total Company |
   | Amount       | %     | Amount       | %     | Amount       | %     |
   | Sales        | $150,000 | 100 | $250,000 | 100 | $400,000 | 100.0 |
   | Variable expenses | $30,000 | 20 | $160,000 | 64 | $190,000 | 47.5 |
   | Contribution margin | $120,000 | 80 | $90,000 | 36 | $210,000 | 52.5* |
   | Fixed expenses | | | | | 183,750 |
   | Net operating income | | | | | $26,250 |

*$210,000 ÷ $400,000 = 52.5%$

2. The break-even point for the company as a whole is:

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{Overall CM ratio}}
\]

\[
= \frac{$183,750}{0.525} = $350,000
\]

3. The additional contribution margin from the additional sales is computed as follows:

\[
$100,000 \times 52.5\% \text{ CM ratio} = $52,500
\]

Assuming no change in fixed expenses, all of this additional contribution margin of $52,500 should drop to the bottom line as increased net operating income.

This answer assumes no change in selling prices, variable costs per unit, fixed expense, or sales mix.
**Exercise 5-13** (20 minutes)

1. Sales (20,000 units × 1.15 = 23,000 units).... $345,000  $15.00  
   Variable expenses ...................................... 207,000  9.00  
   Contribution margin................................. 138,000  $ 6.00  
   Fixed expenses .......................................... 70,000  
   Net operating income ............................... $ 68,000  

2. Sales (20,000 units × 1.25 = 25,000 units).... $337,500  $13.50  
   Variable expenses ...................................... 225,000  9.00  
   Contribution margin................................. 112,500  $ 4.50  
   Fixed expenses .......................................... 70,000  
   Net operating income ............................... $ 42,500  

3. Sales (20,000 units × 0.95 = 19,000 units).... $313,500  $16.50  
   Variable expenses ...................................... 171,000  9.00  
   Contribution margin................................. 142,500  $ 7.50  
   Fixed expenses .......................................... 90,000  
   Net operating income ............................... $ 52,500  

4. Sales (20,000 units × 0.90 = 18,000 units).... $302,400  $16.80  
   Variable expenses ...................................... 172,800  9.60  
   Contribution margin................................. 129,600  $ 7.20  
   Fixed expenses .......................................... 70,000  
   Net operating income ............................... $ 59,600
Exercise 5-14 (30 minutes)

1. Variable expenses: $40 \times (100\% - 30\%) = $28

2. a. Selling price.......................... $40 100%
   Variable expenses ................. 28 70%
   Contribution margin .............. $12 30%

   Profit = Unit CM \times Q - Fixed expenses
   \$0 = 12 \times Q - \$180,000
   12Q = $180,000
   Q = $180,000 \div 12
   Q = 15,000 units

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

   Alternative solution:
   Profit = CM ratio \times Sales - Fixed expenses
   \$0 = 0.30 \times Sales - \$180,000
   0.30 \times Sales = $180,000
   Sales = $180,000 \div 0.30
   Sales = $600,000

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

b. Profit = Unit CM \times Q - Fixed expenses
   \$60,000 = 12 \times Q - \$180,000
   12Q = $60,000 + $180,000
   12Q = $240,000
   Q = $240,000 \div 12
   Q = 20,000 units

   In dollar sales: 20,000 units \times $40 per unit = $800,000
Exercise 5-14 (continued)

Alternative solution:

Profit = CM ratio × Sales − Fixed expenses
$60,000 = 0.30 × Sales − $180,000
0.30 × Sales = $240,000
Sales = $240,000 ÷ 0.30
Sales = $800,000

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

c. The company’s new cost/revenue relation will be:

Selling price ......................... $40 100%
Variable expenses ($28 − $4) ....... 24 60%
Contribution margin............... $16 40%

Profit = Unit CM × Q − Fixed expenses
$0 = ($40 − $24) × Q − $180,000
$16Q = $180,000
Q = $180,000 ÷ $16 per unit
Q = 11,250 units

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

Alternative solution:

Profit = CM ratio × Sales − Fixed expenses
$0 = 0.40 × Sales − $180,000
0.40 × Sales = $180,000
Sales = $180,000 ÷ 0.40
Sales = $450,000

In unit sales: $450,000 ÷ $40 per unit = 11,250 units
Exercise 5-14 (continued)

3. a.

Unit sales to break even = \( \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \)

\[ = \frac{$180,000}{$12 \text{ per unit}} = 15,000 \text{ units} \]

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

Alternative solution:

Dollar sales to break even = \( \frac{\text{Fixed expenses}}{\text{CM ratio}} \)

\[ = \frac{$180,000}{0.30} = \$600,000 \]

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

b.

Unit sales to attain target profit = \( \frac{\text{Fixed expenses} + \text{Target profit}}{\text{Unit contribution margin}} \)

\[ = \frac{$180,000 + $60,000}{$12 \text{ per unit}} = 20,000 \text{ units} \]

In dollar sales: 20,000 units \( \times \$40 \text{ per unit} = \$800,000 \)

Alternative solution:

Dollar sales to attain target profit = \( \frac{\text{Fixed expenses} + \text{Target profit}}{\text{CM ratio}} \)

\[ = \frac{$180,000 + $60,000}{0.30} = \$800,000 \]

In unit sales: \$800,000 \( \div \$40 \text{ per unit} = 20,000 \text{ units} \)
Exercise 5-14 (continued)

(c).

\[
\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}
\]

\[
= \frac{\$180,000}{\$16 \text{ per unit}} = 11,250 \text{ units}
\]

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

Alternative solution:

\[
\text{Break-even point in sales dollars} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{\$180,000}{0.40} = \$450,000
\]

In unit sales: $450,000 ÷ $40 per unit = 11,250 units
Exercise 5-15 (15 minutes)

1. 

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (15,000 games)</td>
<td>$300,000</td>
<td>$20</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>90,000</td>
<td>$6</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>210,000</td>
<td>$14</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>182,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$28,000</td>
<td></td>
</tr>
</tbody>
</table>

The degree of operating leverage is:

\[
\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}
\]

\[
= \frac{210,000}{28,000} = 7.5
\]

2. a. Sales of 18,000 games represent a 20% increase over last year’s sales. Because the degree of operating leverage is 7.5, net operating income should increase by 7.5 times as much, or by 150% (7.5 × 20%).

b. The expected total dollar amount of net operating income for next year would be:

\[
\begin{align*}
\text{Last year’s net operating income} & : \quad 28,000 \\
\text{Expected increase in net operating income next year} & \quad (150\% \times 28,000) = 42,000 \\
\text{Total expected net operating income} & \quad 70,000
\end{align*}
\]
Exercise 5-16 (30 minutes)

1. The contribution margin per person would be:

<table>
<thead>
<tr>
<th>Price per ticket</th>
<th>$35</th>
</tr>
</thead>
</table>

   Variable expenses:
   | Dinner            | $18 |
   | Favors and program| 2  |
   |                   | 20  |
   | Contribution margin per person | $15 |

   The fixed expenses of the dinner-dance total $6,000. The break-even point would be:

   \[
   \text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \\
   0 = ($35 - $20) \times Q - $6,000 \\
   0 = ($15) \times Q - $6,000 \\
   \frac{15Q}{6,000} = 1 \text{ person} \\
   Q = 6,000 \div 15 \\
   Q = 400 \text{ persons; or, at $35 per person, $14,000} \\
   
   \]

   Alternative solution:

   \[
   \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \\
   = \frac{6,000}{15} = 400 \text{ persons} \\
   
   \]

   or, at $35 per person, $14,000.

2. Variable cost per person ($18 + $2).................  $20

   Fixed cost per person ($6,000 ÷ 300 persons)........  20

   Ticket price per person to break even................. 40
Exercise 5-16 (continued)

3. Cost-volume-profit graph:

![Cost-volume-profit graph](image-url)
Exercise 5-17 (30 minutes)

1. Profit = Unit CM × Q − Fixed expenses
   
   \[ 0 = (50 - 32) \times Q - 108,000 \]
   
   \[ 0 = (18) \times Q - 108,000 \]
   
   \[ 18Q = 108,000 \]
   
   \[ Q = 108,000 \div 18 \]
   
   \[ Q = 6,000 \text{ stoves, or at $50 per stove, $300,000 in sales} \]

   Alternative solution:

   \[
   \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}
   \]
   
   \[ = \frac{108,000}{18.00 \text{ per stove}} = 6,000 \text{ stoves} \]
   
   or at $50 per stove, $300,000 in sales.

2. An increase in variable expenses as a percentage of the selling price would result in a higher break-even point. If variable expenses increase as a percentage of sales, then the contribution margin will decrease as a percentage of sales. With a lower CM ratio, more stoves would have to be sold to generate enough contribution margin to cover the fixed costs.

3. 

<table>
<thead>
<tr>
<th></th>
<th>Present: 8,000 Stoves</th>
<th>Proposed: 10,000 Stoves*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Per Unit</td>
</tr>
<tr>
<td>Sales</td>
<td>$400,000</td>
<td>$50</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>256,000</td>
<td>32</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>144,000</td>
<td>$18</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>108,000</td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$36,000</td>
<td></td>
</tr>
</tbody>
</table>

   *8,000 stoves × 1.25 = 10,000 stoves

   **$50 × 0.9 = $45

   As shown above, a 25% increase in volume is not enough to offset a 10% reduction in the selling price; thus, net operating income decreases.
Exercise 5-17 (continued)

4. Profit = Unit CM × Q − Fixed expenses
   $35,000 = ($45 − $32) × Q − $108,000
   $35,000 = ($13) × Q − $108,000
   $13 × Q = $143,000
   Q = $143,000 ÷ $13
   Q = 11,000 stoves

Alternative solution:

\[
\text{Unit sales to attain target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}}
\]

\[
= \frac{$35,000 + $108,000}{$13}
\]

\[
= 11,000 \text{ stoves}
\]
**Exercise 5-18** (30 minutes)

1. Profit = Unit CM × Q − Fixed expenses
   
   $0 = ($30 − $12) × Q − $216,000
   $0 = ($18) × Q − $216,000
   
   $18Q = $216,000
   
   Q = $216,000 ÷ $18
   
   Q = 12,000 units, or at $30 per unit, $360,000

   Alternative solution:

   Unit sales to break even = \( \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \)

   = \( \frac{$216,000}{$18} \) = 12,000 units

   or at $30 per unit, $360,000

2. The contribution margin is $216,000 because the contribution margin is equal to the fixed expenses at the break-even point.

3. Units sold to attain target profit = \( \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}} \)

   = \( \frac{$90,000 + $216,000}{$18} \)

   = 17,000 units

<table>
<thead>
<tr>
<th>Total</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$510,000</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>$204,000</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$306,000</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>$216,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$90,000</td>
</tr>
</tbody>
</table>
Exercise 5-18 (continued)

4. Margin of safety in dollar terms:

\[
\text{Margin of safety in dollars} = \text{Total sales} - \text{Break-even sales}
\]

\[
= \$450,000 - \$360,000 = \$90,000
\]

Margin of safety in percentage terms:

\[
\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Total sales}}
\]

\[
= \frac{\$90,000}{\$450,000} = 20\%
\]

5. The CM ratio is 60%.

Expected total contribution margin: ($500,000 \times 60\%) \cdots \$300,000

Present total contribution margin: ($450,000 \times 60\%) \cdots \$270,000

Increased contribution margin \cdots \$30,000

Alternative solution:

$50,000 \text{ incremental sales} \times 60\% \text{ CM ratio} = \$30,000

Given that the company’s fixed expenses will not change, monthly net operating income will also increase by $30,000.
1. Sales (15,000 units × $70 per unit) ....................... $1,050,000
   Variable expenses (15,000 units × $40 per unit) ... 600,000
   Contribution margin ........................................ 450,000
   Fixed expenses .................................................. 540,000
   Net operating loss ........................................... $ (90,000)

2. Unit sales to break even = \( \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \)

   \[ \frac{540,000}{30 \text{ per unit}} = 18,000 \text{ units} \]

   18,000 units × $70 per unit = $1,260,000 to break even

3. See the next page.

4. At a selling price of $58 per unit, the contribution margin is $18 per unit. Therefore:

   Unit sales to break even = \( \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \)

   \[ \frac{540,000}{18} = 30,000 \text{ units} \]

   30,000 units × $58 per unit = $1,740,000 to break even

   This break-even point is different from the break-even point in part (2) because of the change in selling price. With the change in selling price, the unit contribution margin drops from $30 to $18, resulting in an increase in the break-even point.
### Problem 5-19 (continued)

3.  

<table>
<thead>
<tr>
<th>Unit Selling Price</th>
<th>Unit Variable Expense</th>
<th>Unit Contribution Margin</th>
<th>Volume (Units)</th>
<th>Total Contribution Margin</th>
<th>Fixed Expenses</th>
<th>Net operating income (loss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$70</td>
<td>$40</td>
<td>$30</td>
<td>15,000</td>
<td>$450,000</td>
<td>$540,000</td>
<td>$(90,000)</td>
</tr>
<tr>
<td>$68</td>
<td>$40</td>
<td>$28</td>
<td>20,000</td>
<td>$560,000</td>
<td>$540,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>$66</td>
<td>$40</td>
<td>$26</td>
<td>25,000</td>
<td>$650,000</td>
<td>$540,000</td>
<td>$110,000</td>
</tr>
<tr>
<td>$64</td>
<td>$40</td>
<td>$24</td>
<td>30,000</td>
<td>$720,000</td>
<td>$540,000</td>
<td>$180,000</td>
</tr>
<tr>
<td>$62</td>
<td>$40</td>
<td>$22</td>
<td>35,000</td>
<td>$770,000</td>
<td>$540,000</td>
<td>$230,000</td>
</tr>
<tr>
<td>$60</td>
<td>$40</td>
<td>$20</td>
<td>40,000</td>
<td>$800,000</td>
<td>$540,000</td>
<td>$260,000</td>
</tr>
<tr>
<td>$58</td>
<td>$40</td>
<td>$18</td>
<td>45,000</td>
<td>$810,000</td>
<td>$540,000</td>
<td>$270,000</td>
</tr>
<tr>
<td>$56</td>
<td>$40</td>
<td>$16</td>
<td>50,000</td>
<td>$800,000</td>
<td>$540,000</td>
<td>$260,000</td>
</tr>
</tbody>
</table>

The maximum profit is $270,000. This level of profit can be earned by selling 45,000 units at a price of $58 each.
Problem 5-20 (75 minutes)

1. a. Selling price .................. $25 100%
   Variable expenses ............. 15 60%
   Contribution margin .......... $10 40%

   Profit = Unit CM \times Q - Fixed expenses
   
   $0 = $10 \times Q - $210,000
   $10Q = $210,000
   Q = $210,000 \div $10
   Q = 21,000 balls

   Alternative solution:
   
   \[
   \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}}
   \]
   \[
   = \frac{$210,000}{$10}
   = 21,000 \text{ balls}
   \]

   b. The degree of operating leverage is:

   \[
   \text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}
   \]
   \[
   = \frac{$300,000}{$90,000} = 3.33 \text{ (rounded)}
   \]

2. The new CM ratio will be:

   Selling price .................. $25 100%
   Variable expenses............. 18 72%
   Contribution margin........... $7 28%

   The new break-even point will be:

   Profit = Unit CM \times Q - Fixed expenses
   
   $0 = $7 \times Q - $210,000
   $7Q = $210,000
   Q = $210,000 \div $7
   Q = 30,000 balls
Problem 5-20 (continued)

Alternative solution:

\[
\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \\
= \frac{$210,000}{$7} \\
= 30,000 \text{ balls}
\]

3. Profit = Unit CM \times Q - 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:

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

Thus, sales will have to increase by 12,857 balls (42,857 balls, less 30,000 balls currently being sold) 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:

<table>
<thead>
<tr>
<th>Present</th>
<th>Expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break-even point (in balls)</td>
<td>21,000</td>
</tr>
<tr>
<td>Sales (in balls) needed to earn a $90,000 profit</td>
<td>30,000</td>
</tr>
</tbody>
</table>

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 5-20 (continued)

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

\[ P = $18 + 0.40P \]
\[ 0.60P = $18 \]
\[ P = $18 \div 0.60 \]
\[ P = $30 \]

To verify:

| Selling price | $30 | 100% |
| Variable expenses | $18 | 60% |
| Contribution margin | $12 | 40% |

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 | $9* | 36% |
| Contribution margin | $16 | 64% |

\*\$15 – ($15 \times 40\%) = $9

The new break-even point would be:

\[ \text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \]
\[ $0 = $16 \times Q - $420,000 \]
\[ $16Q = $420,000 \]
\[ Q = $420,000 \div $16 \]
\[ Q = 26,250 \text{ balls} \]

Alternative solution:

\[ \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \]
\[ = \frac{$420,000}{$16} = 26,250 \text{ balls} \]

Although this new break-even is greater than the company’s present break-even 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 5-20 (continued)

6. a. Profit = Unit CM \times Q - Fixed expenses
   $90,000 = 16 \times Q - 420,000$
   $16Q = 90,000 + 420,000$
   $Q = \frac{510,000}{16}$
   $Q = 31,875$ balls

   Alternative solution:
   
   \[
   \text{Unit sales to attain target profit} = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit contribution margin}}
   \]
   
   \[
   = \frac{90,000 + 420,000}{16}
   \]
   
   \[
   = 31,875 \text{ balls}
   \]

   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:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (30,000 balls \times $25 per ball)</td>
<td>$750,000</td>
</tr>
<tr>
<td>Variable expenses (30,000 balls \times $9 per ball)</td>
<td>$270,000</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$480,000</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>$420,000</td>
</tr>
<tr>
<td>Net operating income</td>
<td>$60,000</td>
</tr>
</tbody>
</table>

   Degree of operating leverage = \frac{\text{Contribution margin}}{\text{Net operating income}}

   \[
   = \frac{480,000}{60,000} = 8
   \]
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 5-21 (30 minutes)

1. 

<table>
<thead>
<tr>
<th>Product</th>
<th>White</th>
<th>Fragrant</th>
<th>Loonzain</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of total sales..................</td>
<td>40%</td>
<td>24%</td>
<td>36%</td>
<td>100%</td>
</tr>
<tr>
<td>Sales......................</td>
<td>$300,000 100%</td>
<td>$180,000 100%</td>
<td>$270,000 100%</td>
<td>$750,000 100%</td>
</tr>
<tr>
<td>Variable expenses.....</td>
<td>216,000 72%</td>
<td>36,000 20%</td>
<td>108,000 40%</td>
<td>360,000 48%</td>
</tr>
<tr>
<td>Contribution margin..</td>
<td>$ 84,000 28%</td>
<td>$144,000 80%</td>
<td>$162,000 60%</td>
<td>390,000 52% *</td>
</tr>
<tr>
<td>Fixed expenses........</td>
<td></td>
<td></td>
<td></td>
<td>449,280</td>
</tr>
<tr>
<td>Net operating income (loss)........</td>
<td></td>
<td></td>
<td></td>
<td>$(59,280)</td>
</tr>
</tbody>
</table>

*$390,000 ÷ $750,000 = 52% 

2. Break-even sales would be:

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{$449,280}{0.520} = $864,000
\]
**Problem 5-21 (continued)**

3. Memo to the president:

   Although the company met its sales budget of $750,000 for the month, the mix of products changed substantially from that budgeted. This is the reason the budgeted net operating income was not met, and the reason the break-even sales were greater than budgeted. The company’s sales mix was planned at 20% White, 52% Fragrant, and 28% Loonzain. The actual sales mix was 40% White, 24% Fragrant, and 36% Loonzain.

   As shown by these data, sales shifted away from Fragrant Rice, which provides our greatest contribution per dollar of sales, and shifted toward White Rice, which provides our least contribution per dollar of sales. Although the company met its budgeted level of sales, these sales provided considerably less contribution margin than we had planned, with a resulting decrease in net operating income. Notice from the attached statements that the company’s overall CM ratio was only 52%, as compared to a planned CM ratio of 64%. This also explains why the break-even point was higher than planned. With less average contribution margin per dollar of sales, a greater level of sales had to be achieved to provide sufficient contribution margin to cover fixed costs.
Problem 5-22 (60 minutes)

1. The CM ratio is 30%.

<table>
<thead>
<tr>
<th>Total</th>
<th>Per Unit</th>
<th>Percent of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (19,500 units)........</td>
<td>$585,000</td>
<td>$30.00</td>
</tr>
<tr>
<td>Variable expenses...........</td>
<td>409,500</td>
<td>21.00</td>
</tr>
<tr>
<td>Contribution margin........</td>
<td>$175,500</td>
<td>$9.00</td>
</tr>
</tbody>
</table>

The break-even point is:

Profit = Unit CM × Q − Fixed expenses

$0 = ($30 − $21) × Q − $180,000
$0 = ($9) × Q − $180,000
$9Q = $180,000
Q = $180,000 ÷ $9
Q = 20,000 units

20,000 units × $30 per unit = $600,000 in sales

Alternative solution:

Unit sales to break even = \( \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} \)

= \( \frac{$180,000}{$9.00} \) = 20,000 units

Dollar sales to break even = \( \frac{\text{Fixed expenses}}{\text{CM ratio}} \)

= \( \frac{$180,000}{0.30} \) = $600,000 in sales

2. Incremental contribution margin:

$80,000 increased sales × 0.30 CM ratio........... $24,000
Less increased advertising cost ......................... 16,000
Increase in monthly net operating income ........... $ 8,000

Since the company is now showing a loss of $4,500 per month, if the changes are adopted, the loss will turn into a profit of $3,500 each month ($8,000 less $4,500 = $3,500).
3. Sales (39,000 units @ $27.00 per unit*) .......... $1,053,000
   Variable expenses
     (39,000 units @ $21.00 per unit) ...................... 819,000
   Contribution margin ......................................... 234,000
   Fixed expenses ($180,000 + $60,000) ...................... 240,000
   Net operating loss ........................................... $(6,000)

   *$30.00 – ($30.00 × 0.10) = $27.00

4. Profit = Unit CM × Q – Fixed expenses
   
   $9,750 = ($30.00 – $21.75) × Q – $180,000
   $9,750 = ($8.25) × Q – $180,000
   $8.25Q = $189,750
   Q = $189,750 ÷ $8.25
   Q = 23,000 units

   *$21.00 + $0.75 = $21.75

   Alternative solution:

   Unit sales to attain target profit = \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM per unit}}

   = \frac{$9,750 + $180,000}{8.25**}

   = 23,000 units

   **$30.00 – $21.75 = $8.25

5. a. The new CM ratio would be:

<table>
<thead>
<tr>
<th>Per Unit</th>
<th>Percent of Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales ....................... $30.00 100%</td>
<td></td>
</tr>
<tr>
<td>Variable expenses ....... 18.00 60%</td>
<td></td>
</tr>
<tr>
<td>Contribution margin ...... $12.00 40%</td>
<td></td>
</tr>
</tbody>
</table>
Problem 5-22 (continued)

The new break-even point would be:

\[
\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit contribution margin}} = \frac{\$180,000 + \$72,000}{\$12.00} = 21,000 \text{ units}
\]

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$180,000 + \$72,000}{0.40} = \$630,000
\]

b. Comparative income statements follow:

<table>
<thead>
<tr>
<th></th>
<th>Not Automated</th>
<th></th>
<th></th>
<th>Automated</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Per Unit</td>
<td>%</td>
<td>Total</td>
<td>Per Unit</td>
<td>%</td>
</tr>
<tr>
<td>Sales (26,000 units)</td>
<td>$780,000</td>
<td>$30.00</td>
<td>100</td>
<td>$780,000</td>
<td>$30.00</td>
<td>100</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>$546,000</td>
<td>$21.00</td>
<td>70</td>
<td>$468,000</td>
<td>$18.00</td>
<td>60</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$234,000</td>
<td>$9.00</td>
<td>30</td>
<td>$312,000</td>
<td>$12.00</td>
<td>40</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>$180,000</td>
<td></td>
<td></td>
<td>$252,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$54,000</td>
<td></td>
<td></td>
<td>$60,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Problem 5-22 (continued)

c. Whether or not the company should automate its operations depends on how much risk the company is willing to take and on prospects for future sales. The proposed changes would increase the company’s fixed costs and its break-even point. However, the changes would also increase the company’s CM ratio (from 0.30 to 0.40). The higher CM ratio means that once the break-even point is reached, profits will increase more rapidly than at present. If 26,000 units are sold next month, for example, the higher CM ratio will generate $6,000 more in profits than if no changes are made.

The greatest risk of automating is that future sales may drop back down to present levels (only 19,500 units per month), and as a result, losses will be even larger than at present due to the company’s greater fixed costs. (Note the problem states that sales are erratic from month to month.) In sum, the proposed changes will help the company if sales continue to trend upward in future months; the changes will hurt the company if sales drop back down to or near present levels.

Note to the Instructor: Although it is not asked for in the problem, if time permits you may want to compute the point of indifference between the two alternatives in terms of units sold; i.e., the point where profits will be the same under either alternative. At this point, total revenue will be the same; hence, we include only costs in our equation:

Let $Q = \text{Point of indifference in units sold}$

\[
21.00Q + 180,000 = 18.00Q + 252,000 \\
3.00Q = 72,000 \\
Q = 72,000 \div 3.00 \\
Q = 24,000 \text{ units}
\]

If more than 24,000 units are sold in a month, the proposed plan will yield the greater profits; if less than 24,000 units are sold in a month, the present plan will yield the greater profits (or the least loss).
Problem 5-23 (60 minutes)

1. The CM ratio is 60%:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales price</td>
<td>$20.00</td>
<td>100%</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>$8.00</td>
<td>40%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$12.00</td>
<td>60%</td>
</tr>
</tbody>
</table>

2. Dollar sales to break even = \( \frac{\text{Fixed expenses}}{\text{CM ratio}} \)
   
   \[
   = \frac{180,000}{0.60} = $300,000
   \]

3. $75,000 increased sales \times 0.60 \text{ CM ratio} = $45,000 increased contribution margin. Because the fixed costs will not change, net operating income should also increase by $45,000.

4. a. \[
\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}
\]
   
   \[
   = \frac{240,000}{60,000} = 4
   \]

   b. \(4 \times 20\% = 80\%\) increase in net operating income. In dollars, this increase would be \(80\% \times 60,000 = 48,000\).
Problem 5-23 (continued)

5. | Last Year: 18,000 units | Proposed: 24,000 units* |
   | Amount | Per Unit | Amount | Per Unit |
   | Sales | $360,000 | $20.00 | $432,000 | $18.00 ** |
   | Variable expenses | 144,000 | 8.00 | 192,000 | 8.00 |
   | Contribution margin | 216,000 | $12.00 | 240,000 | $10.00 |
   | Fixed expenses | 180,000 | | 210,000 | |
   | Net operating income | $36,000 | $12.00 | $30,000 | $10.00 |

*18,000 units + 6,000 units = 24,000 units
**$20.00 × 0.9 = $18.00
No, the changes should not be made.

6. Expected total contribution margin:
   18,000 units × 1.25 × $11.00 per unit* .................. $247,500

Present total contribution margin:
   18,000 units × $12.00 per unit ............................. 216,000

Incremental contribution margin, and the amount by which advertising can be increased with net operating income remaining unchanged .................. $31,500

*$20.00 − ($8.00 + $1.00) = $11.00
Problem 5-24 (30 minutes)

1. The contribution margin per sweatshirt would be:

   Selling price ........................................ $13.50

   Variable expenses:
   Purchase cost of the sweatshirts .......... $8.00
   Commission to the student salespersons . 1.50 9.50

   Contribution margin .............................. $ 4.00

   Since there are no fixed costs, the number of unit sales needed to yield the desired $1,200 in profits can be obtained by dividing the target $1,200 profit by the unit contribution margin:

   \[
   \frac{\text{Target profit}}{\text{Unit CM}} = \frac{$1,200}{\$4.00} = 300 \text{ sweatshirts}
   \]

   \[300 \text{ sweatshirts} \times \$13.50 \text{ per sweatshirt} = \$4,050 \text{ in total sales}\]

2. Since an order has been placed, there is now a “fixed” cost associated with the purchase price of the sweatshirts (i.e., the sweatshirts can’t be returned). For example, an order of 75 sweatshirts requires a “fixed” cost (investment) of $600 (=75 sweatshirts \times $8.00 per sweatshirt). The variable cost drops to only $1.50 per sweatshirt, and the new contribution margin per sweatshirt becomes:

   Selling price ........................................ $13.50
   Variable expenses (commissions only) ... 1.50

   Contribution margin .............................. $12.00

   Since the “fixed” cost of $600 must be recovered before Mr. Hooper shows any profit, the break-even computation would be:

   \[
   \text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{Unit CM}}
   \]

   \[= \frac{$600}{\$12.00} = 50 \text{ sweatshirts}\]

   \[50 \text{ sweatshirts} \times \$13.50 \text{ per sweatshirt} = \$675 \text{ in total sales}\]

   If a quantity other than 75 sweatshirts were ordered, the answer would change accordingly.
Problem 5-25 (45 minutes)

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

   \[
   \begin{array}{ll}
   \text{Per Unit} & \\
   \text{Sales price} & \$3.00 \\
   \text{Variable expenses} & 1.25 \\
   \text{Contribution margin} & \$1.75 \\
   \end{array}
   \]

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

   \[
   \begin{array}{ll}
   \text{Per Unit} & \\
   \text{Sales price} & \$3.00 \\
   \text{Variable expenses} & 1.40 \\
   \text{Contribution margin} & \$1.60 \\
   \end{array}
   \]

   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:

   \[
   \begin{array}{ll}
   \text{Fixed costs on the first 16,000 units} & \$35,000 \\
   \text{Less contribution margin from the first 16,000 units} & 28,000 \\
   \text{Remaining unrecovered fixed costs} & 7,000 \\
   \text{Add monthly rental cost of the additional space needed to produce more than 16,000 units} & 1,000 \\
   \text{Total fixed costs to be covered by remaining sales} & \$8,000
   \end{array}
   \]
Problem 5-25 (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.
Problem 5-26 (60 minutes)

1. Profit = Unit CM × Q − Fixed expenses
   $0 = ($30 − $18) × Q − $150,000
   $0 = ($12) × Q − $150,000
   $12Q = $150,000
   Q = $150,000 ÷ $12
   Q = 12,500 pairs

   12,500 pairs × $30 per pair = $375,000 in sales

   Alternative solution:

   Unit sales to break even = \frac{\text{Fixed expenses}}{\text{Unit CM}}
   \frac{$150,000}{$12.00} = 12,500 pairs

   Dollar sales to break even = \frac{\text{Fixed expenses}}{\text{CM ratio}}
   \frac{$150,000}{0.40} = $375,000 in sales

2. See the graph on the following page.

3. The simplest approach is:

   Break-even sales......................... 12,500 pairs
   Actual sales ......................... 12,000 pairs
   Sales short of break-even........... 500 pairs

   500 pairs × $12 contribution margin per pair = $6,000 loss

   Alternative solution:
   Sales (12,000 pairs × $30.00 per pair).... $360,000
   Variable expenses
   (12,000 pairs × $18.00 per pair)........ 216,000
   Contribution margin ....................... 144,000
   Fixed expenses ........................... 150,000
   Net operating loss ....................... $(6,000)
Problem 5-26 (continued)
2. Cost-volume-profit graph:

[Graph showing cost-volume-profit analysis with a break-even point indicated at 12,500 pairs of shoes sold or $375,000 total sales.]
Problem 5-26 (continued)

4. The variable expenses will now be $18.75 ($18.00 + $0.75) per pair, and the contribution margin will be $11.25 ($30.00 – $18.75) per pair.

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

\[
0 = (30.00 - 18.75) \times Q - 150,000
\]

\[
0 = (11.25) \times Q - 150,000
\]

\[
11.25Q = 150,000
\]

\[
Q = 150,000 \div 11.25
\]

\[
Q = 13,333 \text{ pairs (rounded)}
\]

13,333 pairs \times $30.00 per pair = $400,000 in sales

Alternative solution:

\[
\text{Unit sales to break even} = \frac{\text{Fixed expenses}}{\text{CM per unit}}
\]

\[
= \frac{150,000}{11.25} = 13,333 \text{ pairs}
\]

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{150,000}{0.375} = 400,000 \text{ in sales}
\]

5. The simplest approach is:

Actual sales ......................... 15,000 pairs
Break-even sales...................... 12,500 pairs
Excess over break-even sales ...... 2,500 pairs

\[
2,500 \text{ pairs} \times \$11.50 \text{ per pair}^* = \$28,750 \text{ profit}
\]

*\$12.00 present contribution margin – $0.50 commission = $11.50

Alternative solution:

Sales (15,000 pairs \times $30.00 per pair) ................. $450,000
Variable expenses (12,500 pairs \times $18.00 per pair + 2,500 pairs \times $18.50 per pair) ................. 271,250
Contribution margin .............................................. 178,750
Fixed expenses ......................................................... 150,000
Net operating income ........................................... \$ 28,750
Problem 5-26 (continued)

6. The new variable expenses will be $13.50 per pair.

\[
\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses} \\
0 = (30.00 - 13.50) \times Q - 181,500 \\
0 = (16.50) \times Q - 181,500 \\
16.50Q = 181,500 \\
Q = 181,500 \div 16.50 \\
Q = 11,000 \text{ pairs} \\
\]

11,000 pairs \times $30.00 per pair = $330,000 in sales

Although the change will lower the break-even point from 12,500 pairs to 11,000 pairs, the company must consider whether this reduction in the break-even point is more than offset by the possible loss in sales arising from having the sales staff on a salaried basis. Under a salary arrangement, the sales staff has less incentive to sell than under the present commission arrangement, resulting in a potential loss of sales and a reduction of profits. Although it is generally desirable to lower the break-even point, management must consider the other effects of a change in the cost structure. The break-even point could be reduced dramatically by doubling the selling price but it does not necessarily follow that this would improve the company’s profit.
Problem 5-27 (45 minutes)

1. a. 

<table>
<thead>
<tr>
<th></th>
<th>Hawaiian</th>
<th>Tahitian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>%</td>
<td>Amount</td>
</tr>
<tr>
<td>Sales</td>
<td>$300,000</td>
<td>100%</td>
<td>$500,000</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>180,000</td>
<td>60%</td>
<td>100,000</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$120,000</td>
<td>40%</td>
<td>$400,000</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td>........</td>
<td></td>
<td>$475,800</td>
</tr>
<tr>
<td>Net operating income</td>
<td></td>
<td></td>
<td>475,800</td>
</tr>
</tbody>
</table>

b. Dollar sales to break even = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{475,800}{0.65} = $732,000

Margin of safety = Actual sales - Break-even sales

= $800,000 - $732,000 = $68,000

Margin of safety percentage = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}}

= \frac{68,000}{800,000} = 8.5\%
Problem 5-27 (continued)

2. a. | Hawaiian Fantasy | Tahitian Joy | Samoan Delight | Total |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$300,000 100%</td>
<td>$500,000 100%</td>
<td>$450,000 100%</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>180,000 60%</td>
<td>100,000 20%</td>
<td>360,000 80%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$120,000 40%</td>
<td>$400,000 80%</td>
<td>$90,000 20%</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Problem 5-27 (continued)

b. Dollar sales to break even
   \[ \text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$475,800}{0.488} = \$975,000 \]

   Margin of safety = Actual sales - Break-even sales
   \[ = \$1,250,000 - \$975,000 = \$275,000 \]

   Margin of safety percentage
   \[ = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}} = \frac{\$275,000}{\$1,250,000} = 22\% \]

3. The reason for the increase in the break-even point can be traced to the decrease in the company’s overall contribution margin ratio when the third product is added. Note from the income statements above that this ratio drops from 65% to 48.8% with the addition of the third product. This product (the Samoan Delight) has a CM ratio of only 20%, which causes the average contribution margin per dollar of sales to shift downward.

   This problem shows the somewhat tenuous nature of break-even analysis when the company has more than one product. The analyst must be very careful of his or her assumptions regarding sales mix, including the addition (or deletion) of new products.

   It should be pointed out to the president that even though the break-even point is higher with the addition of the third product, the company’s margin of safety is also greater. Notice that the margin of safety increases from $68,000 to $275,000 or from 8.5% to 22%. Thus, the addition of the new product shifts the company much further from its break-even point, even though the break-even point is higher.
### Problem 5-28 (60 minutes)

1. **Carbex, Inc.**

   **Income Statement For April**

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th></th>
<th>Deluxe</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>%</td>
<td>Amount</td>
<td>%</td>
<td>Amount</td>
<td>%</td>
</tr>
<tr>
<td>Sales</td>
<td>$240,000</td>
<td>100</td>
<td>$150,000</td>
<td>100</td>
<td>$390,000</td>
<td>100.0</td>
</tr>
<tr>
<td>Variable expenses:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>60,000</td>
<td>25</td>
<td>60,000</td>
<td>40</td>
<td>120,000</td>
<td>30.8</td>
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<tr>
<td>Sales commission</td>
<td>36,000</td>
<td>15</td>
<td>22,500</td>
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<td>58,500</td>
<td>15.0</td>
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<tr>
<td>Total variable expenses</td>
<td>96,000</td>
<td>40</td>
<td>82,500</td>
<td>55</td>
<td>178,500</td>
<td>45.8</td>
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<tr>
<td>Contribution margin</td>
<td>$144,000</td>
<td>60</td>
<td>$67,500</td>
<td>45</td>
<td>$211,500</td>
<td>54.2</td>
</tr>
<tr>
<td>Fixed expenses:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>105,000</td>
</tr>
<tr>
<td>Depreciation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21,700</td>
</tr>
<tr>
<td>Administrative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63,000</td>
</tr>
<tr>
<td>Total fixed expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>189,700</td>
</tr>
<tr>
<td>Net operating income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$21,800</td>
</tr>
</tbody>
</table>

   **Carbex, Inc.**

   **Income Statement For May**

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th></th>
<th>Deluxe</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>%</td>
<td>Amount</td>
<td>%</td>
<td>Amount</td>
<td>%</td>
</tr>
<tr>
<td>Sales</td>
<td>$60,000</td>
<td>100</td>
<td>$375,000</td>
<td>100</td>
<td>$435,000</td>
<td>100.0</td>
</tr>
<tr>
<td>Variable expenses:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>15,000</td>
<td>25</td>
<td>150,000</td>
<td>40</td>
<td>165,000</td>
<td>37.9</td>
</tr>
<tr>
<td>Sales commission</td>
<td>9,000</td>
<td>15</td>
<td>56,250</td>
<td>15</td>
<td>65,250</td>
<td>15.0</td>
</tr>
<tr>
<td>Total variable expenses</td>
<td>24,000</td>
<td>40</td>
<td>206,250</td>
<td>55</td>
<td>230,250</td>
<td>52.9</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>$36,000</td>
<td>60</td>
<td>$168,750</td>
<td>45</td>
<td>$204,750</td>
<td>47.1</td>
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<tr>
<td>Fixed expenses:</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advertising</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>105,000</td>
</tr>
<tr>
<td>Depreciation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21,700</td>
</tr>
<tr>
<td>Administrative</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>63,000</td>
</tr>
<tr>
<td>Total fixed expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>189,700</td>
</tr>
<tr>
<td>Net operating income</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$15,050</td>
</tr>
</tbody>
</table>
Problem 5-28 (continued)

2. The sales mix has shifted over the last year from Standard sets to Deluxe sets. This shift has caused a decrease in the company’s overall CM ratio from 54.2% in April to 47.1% in May. For this reason, even though total sales (in dollars) are greater, net operating income is lower.

3. Sales commissions could be based on contribution margin rather than on sales price. A flat rate on total contribution margin, as the text suggests, might encourage the salespersons to emphasize the product with the greatest contribution to the profits of the firm.

   a. The break-even in dollar sales can be computed as follows:

   \[
   \text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$189,700}{0.542} = \$350,000
   \]

   b. The break-even point is higher with May’s sales mix than with April’s. This is because the company’s overall CM ratio has gone down, i.e., the sales mix has shifted from the more profitable to the less profitable units.
**Problem 5-29** (60 minutes)

1. The income statements would be:

<table>
<thead>
<tr>
<th></th>
<th>Present</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>Per Unit</td>
<td>%</td>
</tr>
<tr>
<td>Sales</td>
<td>$450,000</td>
<td>$30</td>
<td>100%</td>
</tr>
<tr>
<td>Variable expenses</td>
<td>315,000</td>
<td>21</td>
<td>70%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>135,000</td>
<td>$9</td>
<td>30%</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$45,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Present**

<table>
<thead>
<tr>
<th></th>
<th>Proposed</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
<td>Per Unit</td>
<td>%</td>
</tr>
<tr>
<td>Sales</td>
<td>$450,000</td>
<td>$30</td>
<td>100%</td>
</tr>
<tr>
<td>Variable expenses*</td>
<td>180,000</td>
<td>12</td>
<td>40%</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>270,000</td>
<td>$18</td>
<td>60%</td>
</tr>
<tr>
<td>Fixed expenses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net operating income</td>
<td>$45,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*($21 – $9 = $12)

2. a. Degree of operating leverage:

Present:

\[
\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}
\]

\[
= \frac{135,000}{45,000} = 3
\]

Proposed:

\[
\text{Degree of operating leverage} = \frac{\text{Contribution margin}}{\text{Net operating income}}
\]

\[
= \frac{270,000}{45,000} = 6
\]
Problem 5-29 (continued)

b. Dollar sales to break even:

Present:

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{$90,000}{0.30} = $300,000
\]

Proposed:

\[
\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}
\]

\[
= \frac{$225,000}{0.60} = $375,000
\]

c. Margin of safety:

Present:

\[
\text{Margin of safety} = \text{Actual sales} - \text{Break-even sales}
\]

\[
= $450,000 - $300,000 = $150,000
\]

\[
\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}}
\]

\[
= \frac{$150,000}{$450,000} = 33\frac{1}{3}\%
\]

Proposed:

\[
\text{Margin of safety} = \text{Actual sales} - \text{Break-even sales}
\]

\[
= $450,000 - $375,000 = $75,000
\]

\[
\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Actual sales}}
\]

\[
= \frac{$75,000}{$450,000} = 16\frac{2}{3}\%
\]
Problem 5-29 (continued)

3. The major factor would be the sensitivity of the company’s operations to cyclical movements in the economy. Because the new equipment will increase the CM ratio, in years of strong economic activity, the company will be better off with the new equipment. However, in economic recession, the company will be worse off with the new equipment. The fixed costs of the new equipment will cause losses to be deeper and sustained more quickly than at present. Thus, management must decide whether the potential for greater profits in good years is worth the risk of deeper losses in bad years.

4. No information is given in the problem concerning the new variable expenses or the new contribution margin ratio. Both of these items must be determined before the new break-even point can be computed. The computations are:

   New variable expenses:

   \[
   \text{Profit} = (\text{Sales} - \text{Variable expenses}) - \text{Fixed expenses}
   \]

   \[
   $54,000** = ($585,000* - \text{Variable expenses}) - $180,000
   \]

   Variable expenses = $585,000 − $180,000 − $54,000
   = $351,000

   *New level of sales: $450,000 × 1.30 = $585,000
   **New level of net operating income: $45,000 × 1.2 = $54,000

   New CM ratio:

   Sales ....................... $585,000 100%
   Variable expenses ......... 351,000 60%
   Contribution margin .......... $234,000 40%

   With the above data, the new break-even point can be computed:

   \[
   \text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{$180,000}{0.40} = $450,000
   \]
Problem 5-29 (continued)

The greatest risk is that the increases in sales and net operating income predicted by the marketing manager will not happen and that sales will remain at their present level. Note that the present level of sales is $450,000, which is equal to the break-even level of sales under the new marketing method. Thus, if the new marketing strategy is adopted and sales remain unchanged, profits will drop from the current level of $45,000 per month to zero.

It would be a good idea to compare the new marketing strategy to the current situation more directly. What level of sales would be needed under the new method to generate at least the $45,000 in profits the company is currently earning each month? The computations are:

\[
\begin{align*}
\text{Dollar sales to attain target profit} &= \frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM ratio}} \\
&= \frac{$45,000 + $180,000}{0.40} \\
&= $562,500 \text{ in sales each month}
\end{align*}
\]

Thus, sales would have to increase by at least 25% ($562,500 is 25% higher than $450,000) in order to make the company better off with the new marketing strategy than with the current situation. This appears to be extremely risky.
Problem 5-30 (60 minutes)

1. Profit = Unit CM \times Q - Fixed expenses
   
   
   
   $0 = (\$40 - \$16) \times Q - \$60,000$
   
   
   
   $0 = (\$24) \times Q - \$60,000$
   
   
   
   $24Q = $60,000
   
   
   
   Q = $60,000 \div $24
   
   
   
   Q = 2,500 pairs, or at $40 per pair, $100,000 in sales
   
   
   
   Alternative solution:

   
   
   
   Unit sales to break even = \frac{Fixed expenses}{CM per unit} = \frac{$60,000}{$24.00} = 2,500 pairs
   
   
   
   Dollar sales to break even = \frac{Fixed expenses}{CM ratio} = \frac{$60,000}{0.600} = $100,000

2. See the graphs at the end of this solution.

3. Profit = Unit CM \times Q - Fixed expenses
   
   
   
   $18,000 = $24 \times Q - $60,000
   
   
   
   $24Q = $18,000 + $60,000
   
   
   
   Q = $78,000 \div $24
   
   
   
   Q = 3,250 pairs
   
   
   
   Alternative solution:

   
   
   
   Unit sales to attain target profit = \frac{Target profit + Fixed expenses}{Unit contribution margin}
   
   
   
   = \frac{$18,000 + $60,000}{$24.00} = 3,250 pairs

4. Incremental contribution margin:
   
   
   
   $25,000 increased sales \times 60\% \text{ CM ratio} .... $15,000
   
   
   
   Incremental fixed salary cost ......................... $8,000
   
   
   
   Increased net income ................................. $7,000
   
   
   Yes, the position should be converted to a full-time basis.
Problem 5-30 (continued)

5. a. Degree of operating leverage \(= \frac{\text{Contribution margin}}{\text{Net operating income}} = \frac{\$72,000}{\$12,000} = 6\)

b. \(6.00 \times 50\% \text{ sales increase} = 300\% \text{ increase}\) in net operating income.

Thus, net operating income next year would be: \(\$12,000 + (\$12,000 \times 300\%) = \$48,000\).

2. Cost-volume-profit graph:
Problem 5-30 (continued)

Profit graph:

Profit Graph

Break-even point: 2,500 sandals

Sales Volume in Units
Problem 5-31 (30 minutes)

1. (1) Dollars
   (2) Volume of output, expressed in units, % of capacity, sales, or some other measure
   (3) Total expense line
   (4) Variable expense area
   (5) Fixed expense area
   (6) Break-even point
   (7) Loss area
   (8) Profit area
   (9) Sales line
Problem 5-31 (continued)

2. a. Line 3: Remain unchanged.  
Line 9: Have a steeper slope.  
Break-even point: Decrease.

b. Line 3: Have a flatter slope. 
Line 9: Remain unchanged.  
Break-even point: Decrease.

c. Line 3: Shift upward. 
Line 9: Remain unchanged.  
Break-even point: Increase.

d. Line 3: Remain unchanged. 
Line 9: Remain unchanged.  
Break-even point: Remain unchanged.

e. Line 3: Shift downward and have a steeper slope. 
Line 9: Remain unchanged.  
Break-even point: Probably change, but the direction is uncertain.

f. Line 3: Have a steeper slope. 
Line 9: Have a steeper slope.  
Break-even point: Remain unchanged in terms of units; increase in terms of total dollars of sales.

g. Line 3: Shift upward. 
Line 9: Remain unchanged.  
Break-even point: Increase.

h. Line 3: Shift upward and have a flatter slope. 
Line 9: Remain unchanged.  
Break-even point: Probably change, but the direction is uncertain.