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Chapter 2
Cost-Volume-Profit Relationships

Solutions to Questions

2-1 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.

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

2-3 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.

2-4 Operating leverage measures the impact on net operating income of a given percentage change in unit 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.

2-5 The break-even point is the level of sales at which profits are zero.

2-6 (a) If the selling price decreased, then the total revenue line would rise less steeply, and the break-even point would occur at a higher unit volume. (b) If the fixed cost increased, then both the fixed cost line and the total cost line would shift upward and the break-even point would occur at a higher unit volume. (c) If the variable cost per unit increased, then the total cost line would rise more steeply and the break-even point would occur at a higher unit volume.

2-7 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.

2-8 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.

2-9 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.

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Chapter 2: Applying Excel

The completed worksheet is shown below.

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	20,000	units		
5	Selling price per unit	$60	per unit		
6	Variable expenses per unit	$45	per unit		
7	Fixed expenses	$240,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$60	per unit		
14	Variable expenses per unit	45	per unit		
15	Contribution margin per unit	$15	per unit		
16					
17	CM ratio	25%			
18	Variable expense ratio	75%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	16,000	units		
22	Break-even in dollar sales	$960,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$240,000			
26	Margin of safety percentage	20%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$1,200,000			
30	Variable expenses	900,000			
31	Contribution margin	300,000			
32	Fixed expenses	240,000			
33	Net operating income	$ 60,000			
34					
35	Degree of operating leverage	5.00			
36					

Filled in Chapter 2 Form

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Chapter 2: Applying Excel (continued)

The completed worksheet, with formulas displayed, is shown below.

	A	B	C	D
1	Chapter 2: Applying Excel			
2				
3	**Data**			
4	Unit sales	20000	units	
5	Selling price per unit	60	per unit	
6	Variable expenses per unit	45	per unit	
7	Fixed expenses	240000		
8				
9	*Enter a formula into each of the cells marked with a ? below*			
10	**Review Problem: CVP Relationships**			
11				
12	***Compute the CM ratio and variable expense ratio***			
13	Selling price per unit	=B5	per unit	
14	Variable expenses per unit	=B6	per unit	
15	Contribution margin per unit	=B13-B14	per unit	
16				
17	CM ratio	=B15/B13		
18	Variable expense ratio	=B14/B13		
19				
20	***Compute the break-even***			
21	Break-even in unit sales	=B7/B15	units	
22	Break-even in dollar sales	=B7/B17		
23				
24	***Compute the margin of safety***			
25	Margin of safety in dollars	=B4*B5-B22		
26	Margin of safety percentage	=B25/(B4*B5)		
27				
28	***Compute the degree of operating leverage***			
29	Sales	=B4*B13		
30	Variable expenses	=B4*B6		
31	Contribution margin	=B29-B30		
32	Fixed expenses	=B7		
33	Net operating income	=B31-B32		
34				
35	Degree of operating leverage	=B31/B33		
36				

... Chapter 2 Formulas Chapte ...

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Chapter 2: Applying Excel (continued)

1. When the fixed expenses are changed to $270,000, the worksheet changes as shown below:

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	20,000	units		
5	Selling price per unit	$60	per unit		
6	Variable expenses per unit	$45	per unit		
7	Fixed expenses	$270,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$60	per unit		
14	Variable expenses per unit	45	per unit		
15	Contribution margin per unit	$15	per unit		
16					
17	CM ratio	25%			
18	Variable expense ratio	75%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	18,000	units		
22	Break-even in dollar sales	$1,080,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$120,000			
26	Margin of safety percentage	10%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$1,200,000			
30	Variable expenses	900,000			
31	Contribution margin	300,000			
32	Fixed expenses	270,000			
33	Net operating income	$ 30,000			
34					
35	Degree of operating leverage	10.00			
36					

... Chapter 2 Requirement 1 ...

The margin of safety percentage is now 10%, whereas it was 20% before. This change occurred because the increase in fixed expenses increased the break-even point and hence reduced the margin of safety available for the current level of unit sales.

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Chapter 2: Applying Excel (continued)

2. With the changes in the data, the worksheet should look like this:

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	10,000	units		
5	Selling price per unit	$120	per unit		
6	Variable expenses per unit	$72	per unit		
7	Fixed expenses	$420,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$120	per unit		
14	Variable expenses per unit	72	per unit		
15	Contribution margin per unit	$48	per unit		
16					
17	CM ratio	40%			
18	Variable expense ratio	60%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	8,750	units		
22	Break-even in dollar sales	$1,050,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$150,000			
26	Margin of safety percentage	13%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$1,200,000			
30	Variable expenses	720,000			
31	Contribution margin	480,000			
32	Fixed expenses	420,000			
33	Net operating income	$ 60,000			
34					
35	Degree of operating leverage	8.00			
36					

... Chapter 2 Requirement 2 ...

The margin of safety percentage is 13% and the degree of operating leverage is 8.

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Chapter 2: Applying Excel (continued)

3. The degree of operating leverage can be used to estimate the expected percentage increase in net operating income from a 15% increase in unit sales as follows:

   Percentage change in net operating income = Degree of operating leverage × Percentage change in sales = 8.00 × 15% = 120%

   An increase of 120% over the current net operating income of $60,000 would result in net operating income of $132,000. This is verified in part (4) that follows.

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Chapter 2: Applying Excel (continued)

4. Increasing the unit sales by 15% results in net operating income of $132,000—an increase of 120% over the previous net operating income of $60,000.

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	11,500	units		
5	Selling price per unit	$120	per unit		
6	Variable expenses per unit	$72	per unit		
7	Fixed expenses	$420,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$120	per unit		
14	Variable expenses per unit	72	per unit		
15	Contribution margin per unit	$48	per unit		
16					
17	CM ratio	40%			
18	Variable expense ratio	60%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	8,750	units		
22	Break-even in dollar sales	$1,050,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$330,000			
26	Margin of safety percentage	24%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$1,380,000			
30	Variable expenses	828,000			
31	Contribution margin	552,000			
32	Fixed expenses	420,000			
33	Net operating income	$ 132,000			
34					
35	Degree of operating leverage	4.18			
36					

Chapter 2 Requirement 4

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Chapter 2: Applying Excel (continued)

5. a. The initial plan for the Western Hombre motorcycle is summarized below:

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	600	units		
5	Selling price per unit	$10,000	per unit		
6	Variable expenses per unit	$7,500	per unit		
7	Fixed expenses	$1,200,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$10,000	per unit		
14	Variable expenses per unit	7,500	per unit		
15	Contribution margin per unit	$2,500	per unit		
16					
17	CM ratio	25%			
18	Variable expense ratio	75%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	480	units		
22	Break-even in dollar sales	$4,800,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$1,200,000			
26	Margin of safety percentage	20%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$6,000,000			
30	Variable expenses	4,500,000			
31	Contribution margin	1,500,000			
32	Fixed expenses	1,200,000			
33	Net operating income	$ 300,000			
34					
35	Degree of operating leverage	5.00			
36					

Chapter 2 Requirement 5(a)

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Chapter 2: Applying Excel (continued)

5. b. The modified plan for the Western Hombre motorcycle is summarized below:

	A	B	C	D	E
1	Chapter 2: Applying Excel				
2					
3	**Data**				
4	Unit sales	600	units		
5	Selling price per unit	$9,000	per unit		
6	Variable expenses per unit	$7,500	per unit		
7	Fixed expenses	$900,000			
8					
9	*Enter a formula into each of the cells marked with a ? below*				
10	**Review Problem: CVP Relationships**				
11					
12	***Compute the CM ratio and variable expense ratio***				
13	Selling price per unit	$9,000	per unit		
14	Variable expenses per unit	7,500	per unit		
15	Contribution margin per unit	$1,500	per unit		
16					
17	CM ratio	17%			
18	Variable expense ratio	83%			
19					
20	***Compute the break-even***				
21	Break-even in unit sales	600	units		
22	Break-even in dollar sales	$5,400,000			
23					
24	***Compute the margin of safety***				
25	Margin of safety in dollars	$0			
26	Margin of safety percentage	0%			
27					
28	***Compute the degree of operating leverage***				
29	Sales	$5,400,000			
30	Variable expenses	4,500,000			
31	Contribution margin	900,000			
32	Fixed expenses	900,000			
33	Net operating income	$ -			
34					
35	Degree of operating leverage	#DIV/0!			
36					

... Chapter 2 Requirement 5(b) ...

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This does not appear to be a good plan. At best, Thad would only break even—and that assumes that 600 units would still be sold despite the drastic reduction in advertising expenses. The margin of safety is zero which means that any decrease in sales to below 600 units would result in a loss.

The degree of operating leverage is displayed in the worksheet as #DIV/0!. This means that Excel is unable to compute the degree of operating leverage because the divisor is 0. The divisor is 0 because the degree of operating leverage is the contribution margin divided by the net operating income and the net operating income is zero. Technically, the degree of operating leverage is undefined when net operating income is zero.

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The Foundational 15

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

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

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

2. The contribution margin ratio is calculated as follows:

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

3. The variable expense ratio is calculated as follows:

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

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4. The increase in net operating income 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 income would be computed as follows:

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

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The Foundational 15 (continued)

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

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

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

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

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

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

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

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

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

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The Foundational 15 (continued)

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

Profit = Unit CM × Q − Fixed expenses
$5,000 = ($20 − $12) × Q − $6,000
$5,000 = ($8) × Q − $6,000
$8Q = $11,000
Q = $11,000 ÷ $8
Q = 1,375 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%

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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 unit sales should result in a 20% increase in net operating income, computed as follows:

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

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

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

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The Foundational 15 (continued)

15. A 5% increase in unit sales should result in a 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%

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Exercise 2-1 (20 minutes)

1. The revised net operating income would be:

	Total	*Per Unit*
Sales (10,100 units)	$353,500	$35.00
Variable expenses	202,000	20.00
Contribution margin	151,500	$15.00
Fixed expenses	135,000	
Net operating income	$ 16,500	

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 revised net operating income would be:

	Total	*Per Unit*
Sales (9,900 units)	$346,500	$35.00
Variable expenses	198,000	20.00
Contribution margin	148,500	$15.00
Fixed expenses	135,000	
Net operating income	$ 13,500	

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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

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Exercise 2-1 (continued)

3. The revised net operating income would be:

	Total	*Per Unit*
Sales (9,000 units)	$315,000	$35.00
Variable expenses	180,000	20.00
Contribution margin	135,000	$15.00
Fixed expenses	135,000	
Net operating income	$ 0	

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

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Exercise 2-2 (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) ..	$192,000

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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:

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\ &= (\$24 - \$18) \times 4{,}000 - \$24{,}000\\ &= \$6 \times 4{,}000 - \$24{,}000\\ &= \$24{,}000 - \$24{,}000\\ &= \$0\end{aligned}$$

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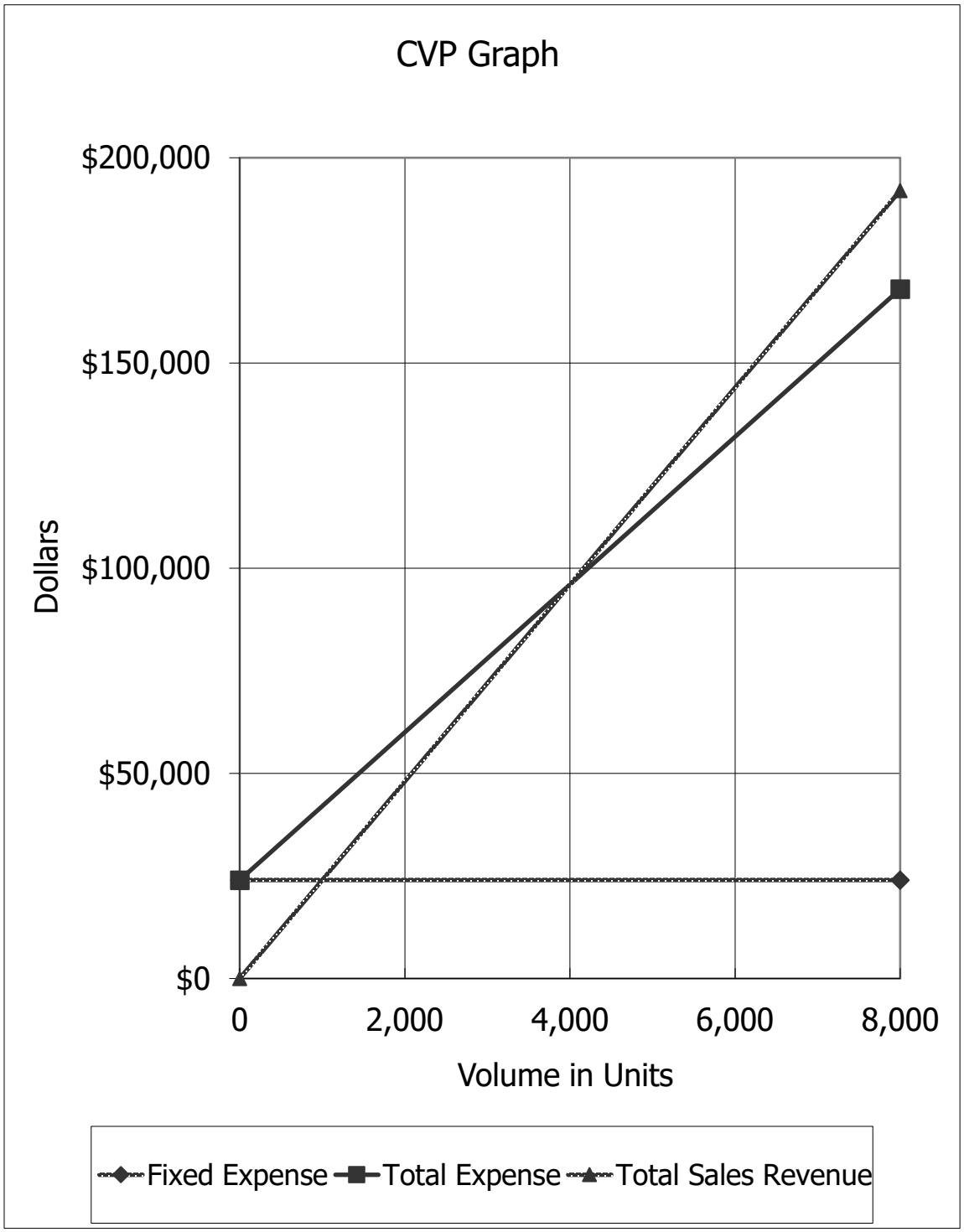
Exercise 2-2 (continued)



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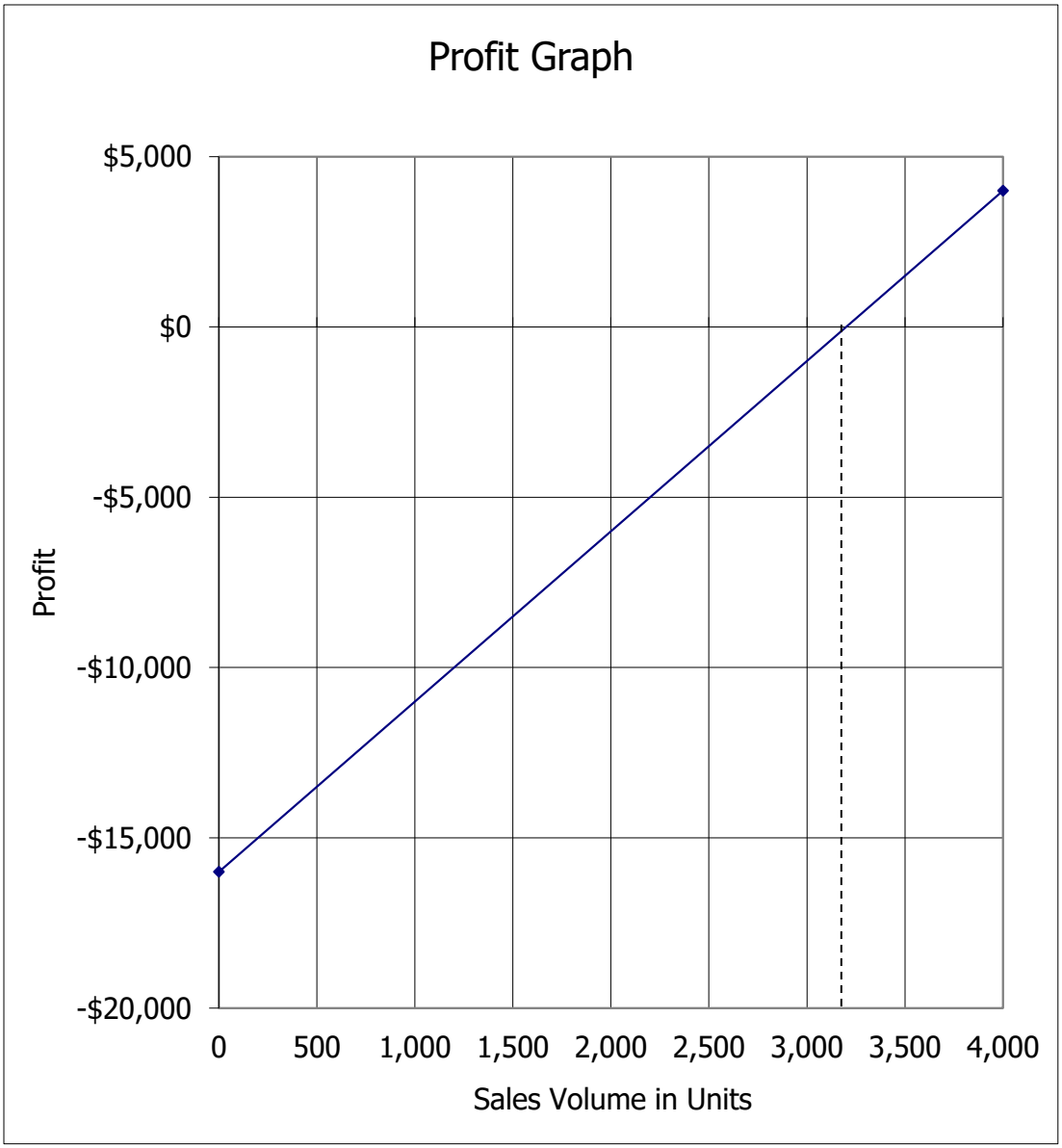
Exercise 2-3 (15 minutes)

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

   Profit = Unit CM × Q − Fixed expenses
   Profit = ($16 − $11) × Q − $16,000
   Profit = $5 × 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 × 0 − $16,000) and $4,000 (= $5 × 4,000 − $16,000).



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Exercise 2-3 (continued)

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

$$\begin{aligned}\text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses}\\ &= \$5 \times Q - \$16{,}000\\ &= \$5 \times 3{,}200 - \$16{,}000\\ &= \$16{,}000 - \$16{,}000\\ &= \$0\end{aligned}$$

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Exercise 2-4 (10 minutes)

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

Total sales	$200,000
Total variable expenses	120,000
Total contribution margin (a) .	$ 80,000

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

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

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

This computation can be verified as follows:

Total sales (a).....	$200,000
Total units sold (b).....	50,000 units
Selling price per unit (a) ÷ (b) ..	$4.00 per unit

Increase in total sales (a)	$1,000
Selling price per unit (b).....	$4.00 per unit
Increase in unit sales (a) ÷ (b) .	250 units

Increase in unit sales	250 units
Original total unit sales.....	50,000 units
New total unit sales.....	50,250 units

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

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Exercise 2-5 (20 minutes)

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

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

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

Alternative Solution 1

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

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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)

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Exercise 2-5 (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:	
2,000 units × 1.1 × $25 per unit	$55,000
Present total contribution margin:	
2,000 units × $27 per unit	54,000
Change in total contribution margin.....	$ 1,000

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

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Exercise 2-6 (20 minutes)

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

Profit = Unit CM × Q − Fixed expenses
$0 = ($15 − $12) × Q − $4,200
$0 = ($3) × Q − $4,200
$3Q = $4,200
Q = $4,200 ÷ $3
Q = 1,400 baskets

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

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

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

Profit = Unit CM × Q − Fixed expenses
$0 = ($15 − $12) × Q − $4,800
$0 = ($3) × Q − $4,800
$3Q = $4,800
Q = $4,800 ÷ $3
Q = 1,600 baskets

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

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

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Exercise 2-7 (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:

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

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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

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Exercise 2-8 (10 minutes)

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

   Profit = Unit CM × Q − Fixed expenses
   $0 = ($30 − $20) × Q − $7,500
   $0 = ($10) × Q − $7,500
   $10Q = $7,500
   Q = $7,500 ÷ $10
   Q = 750 units; or, at $30 per unit, $22,500

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) ÷ (b)	25%

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Exercise 2-9 (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 unit sales should result in a 24% increase in net operating income, computed as follows:

Degree of operating leverage (a)	4.8
Percent increase in unit sales (b)	5%
Estimated percent increase in net operating income (a) × (b).	24%

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

	Amount	*Percent of Sales*
Sales	$84,000	100%
Variable expenses	33,600	40%
Contribution margin	50,400	60%
Fixed expenses	38,000	
Net operating income	$12,400	

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%

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Exercise 2-10 (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:

	Claimjumper	*Makeover*	*Total*
Original dollar sales.....	$30,000	$70,000	$100,000
Percent of total	30%	70%	100%
Sales at break-even.....	$24,000	$56,000	$80,000

	Claimjumper	*Makeover*	*Total*
Sales	$24,000	$56,000	$80,000
Variable expenses*	16,000	40,000	56,000
Contribution margin	$ 8,000	$16,000	24,000
Fixed expenses			24,000
Net operating income			$ 0

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

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Exercise 2-11 (20 minutes)

a.

	Case #1		*Case #2*	
Number of units sold ..	15,000 *		4,000	
Sales	$180,000 *	$12	$100,000 *	$25
Variable expenses.....	120,000 *	8	60,000	15
Contribution margin....	60,000	$ 4	40,000	$10 *
Fixed expenses.....	50,000 *		32,000 *	
Net operating income .	$ 10,000		$ 8,000 *	

	Case #3		*Case #4*	
Number of units sold ..	10,000 *		6,000 *	
Sales	$200,000	$20	$300,000 *	$50
Variable expenses.....	70,000 *	7	210,000	35
Contribution margin....	130,000	$13 *	90,000	$15
Fixed expenses.....	118,000		100,000 *	
Net operating income (loss)..	$ 12,000 *		$ (10,000)*	

b.

	Case #1		*Case #2*	
Sales.....	$500,000 *	100%	$400,000 *	100%
Variable expenses.....	400,000	80%	260,000 *	65%
Contribution margin....	100,000	20% *	140,000	35%
Fixed expenses.....	93,000		100,000 *	
Net operating income..	$ 7,000 *		$ 40,000	

	Case #3		*Case #4*	
Sales	$250,000	100%	$600,000 *	100%
Variable expenses	100,000	40%	420,000 *	70%
Contribution margin ...	150,000	60% *	180,000	30%
Fixed expenses	130,000 *		185,000	
Net operating income (loss).	$ 20,000 *		$ (5,000) *	

*Given

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Exercise 2-12 (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:

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

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

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

$100,000 × 52.5% 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.

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Exercise 2-13 (20 minutes)

	Total	*Per Unit*
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	

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Exercise 2-14 (30 minutes)

1. Variable expenses: $40 × (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.....	28	70%
Contribution margin	$12	30%

Profit = Unit CM × Q – Fixed expenses
$0 = $12 × Q – $180,000
$12Q = $180,000
Q = $180,000 ÷ $12
Q = 15,000 units

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

Alternative solution:

Profit = CM ratio × Sales – Fixed expenses
$0 = 0.30 × Sales – $180,000
0.30 × Sales = $180,000
Sales = $180,000 ÷ 0.30
Sales = $600,000

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

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

Profit = Unit CM × Q – Fixed expenses
$60,000 = $12 × Q – $180,000
$12Q = $60,000 + $180,000
$12Q = $240,000
Q = $240,000 ÷ $12
Q = 20,000 units

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

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Exercise 2-14 (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

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).....	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

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Exercise 2-14 (continued)

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

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

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Exercise 2-15 (15 minutes)

1.

	Total	*Per Unit*
Sales (15,000 games).....	$300,000	$20
Variable expenses	90,000	6
Contribution margin.....	210,000	$14
Fixed expenses.....	182,000	
Net operating income	$ 28,000	

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%).

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

Last year's net operating income.....	$28,000
Expected increase in net operating income next year (150% × $28,000)	42,000
Total expected net operating income.....	$70,000

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Exercise 2-16 (30 minutes)

1. The contribution margin per person would be:

Price per ticket.....		$35
Variable expenses:		
Dinner.....	$18	
Favors and program.....	2	20
Contribution margin per person.....		$15

The fixed expenses of the dinner-dance total $6,000 (= $2,800 + $900 + $1,000 + $1,300). The break-even point would be:

Profit = Unit CM × Q − Fixed expenses
$0 = ($35 − $20) × Q − $6,000
$0 = ($15) × Q − $6,000
$15Q = $6,000
Q = $6,000 ÷ $15
Q = 400 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

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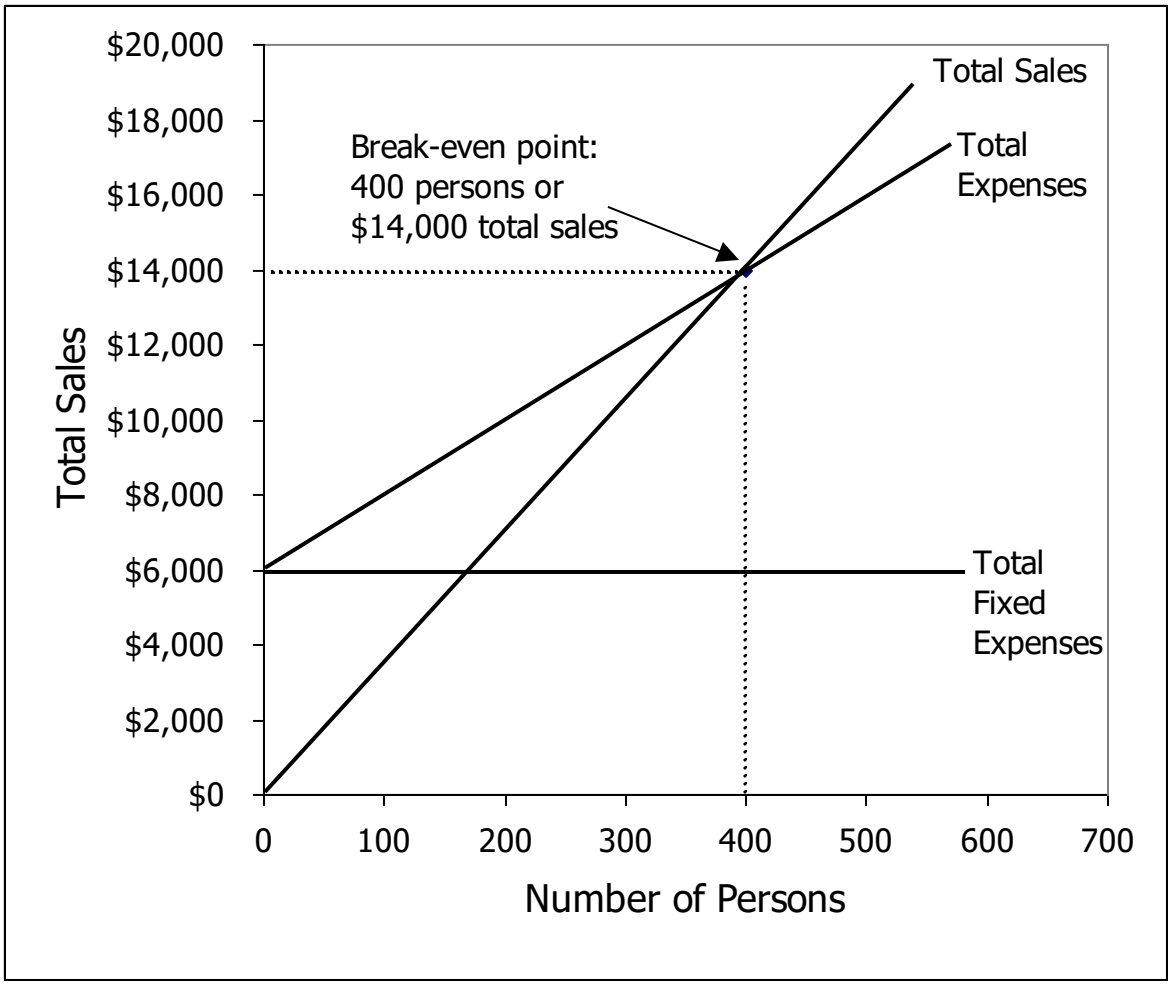
Exercise 2-16 (continued)

3. Cost-volume-profit graph:



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Exercise 2-17 (30 minutes)

1. Profit = Unit CM × Q − Fixed expenses
   $0 = ($50 − $32) × Q − $108,000
   $0 = ($18) × Q − $108,000
   $18Q = $108,000
   Q = $108,000 ÷ $18
   Q = 6,000 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.

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3.

	Present: 8,000 Stoves		*Proposed: 10,000 Stoves**		
	Total	*Per Unit*	*Total*	*Per Unit*	
Sales	$400,000	$50	$450,000	$45	**
Variable expenses.....	256,000	32	320,000	32	
Contribution margin.....	144,000	$18	130,000	$13	
Fixed expenses.....	108,000		108,000		
Net operating income	$ 36,000		$ 22,000		

*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.

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Exercise 2-17 (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:

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

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

= 11,000 stoves

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Exercise 2-18 (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:

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

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

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.

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3. The unit sales to attain the target profit is computed as follows:

$$\text{Units sold to attain target profit} = \frac{\text{Target profit + Fixed expenses}}{\text{Unit contribution margin}}$$

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

$$= 17{,}000 \text{ units}$$

	Total	*Unit*
Sales (17,000 units × $30 per unit).....	$510,000	$30
Variable expenses (17,000 units × $12 per unit).....	204,000	12
Contribution margin	306,000	$18
Fixed expenses	216,000	
Net operating income	$ 90,000	

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Exercise 2-18 (continued)

4. Margin of safety in dollar terms:

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

$$= \$450{,}000 - \$360{,}000 = \$90{,}000$$

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% [= ($30 – $12) ÷ $30].

Expected total contribution margin: ($500,000 × 60%) ..	$300,000
Present total contribution margin: ($450,000 × 60%)	270,000
Increased contribution margin.....	$ 30,000

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Alternative solution:
$50,000 incremental sales × 60% CM ratio = $30,000

Given that the company's fixed expenses will not change, monthly net operating income will also increase by $30,000.

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Problem 2-19 (45 minutes)

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.

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

$$= \frac{\$540{,}000}{\$70 \text{ per unit} - \$40 \text{ per unit}}$$

$$= 18{,}000 \text{ units}$$

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:

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

$$= \frac{\$540{,}000}{\$18}$$

$$= 30{,}000 \text{ units}$$

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.

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Problem 2-19 (continued)

3.

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

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The maximum profit is $270,000. This level of profit can be earned by selling 45,000 units at a price of $58 each.

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Problem 2-20 (75 minutes)

1. a.

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

Profit = Unit CM × Q − Fixed expenses
$0 = $10 × Q − $210,000
$10Q = $210,000
Q = $210,000 ÷ $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:

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

$$= \frac{\$300{,}000}{\$90{,}000} = 3.33 \text{ (rounded)}$$

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 × Q − Fixed expenses
$0 = $7 × Q − $210,000
$7Q = $210,000
Q = $210,000 ÷ $7
Q = 30,000 balls

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Problem 2-20 (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.

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$90{,}000 &= \$7 \times Q - \$210{,}000 \\ \$7Q &= \$90{,}000 + \$210{,}000 \\ Q &= \$300{,}000 \div \$7 \\ Q &= 42{,}857 \text{ balls (rounded)} \end{aligned}$$

Alternative solution:

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

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$$= \frac{\$90{,}000 + \$210{,}000}{\$7} = 42{,}857 \text{ balls}$$

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:

	Present	*Expected*
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.

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Problem 2-20 (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 × 40%) = $9

The new break-even point would be:

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

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 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].

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Problem 2-20 (continued)

6. a.

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expenses}$$
$$\$90{,}000 = \$16 \times Q - \$420{,}000$$
$$\$16Q = \$90{,}000 + \$420{,}000$$
$$Q = \$510{,}000 \div \$16$$
$$Q = 31{,}875 \text{ balls}$$

Alternative solution:

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

$$= \frac{\$90{,}000 + \$420{,}000}{\$16}$$

$$= 31{,}875 \text{ balls}$$

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].

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b. The contribution income statement would be:

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

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

$$= \frac{\$480{,}000}{\$60{,}000} = 8$$

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Problem 2-20 (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.

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Problem 2-21 (30 minutes)

1.

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

*$390,000 ÷ $750,000 = 52%

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2. Break-even sales would be:

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

$$= \frac{\$449,280}{0.52} = \$864,000$$

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Problem 2-21 (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.

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Problem 2-22 (60 minutes)

1. The CM ratio is 30%.

	Total	*Per Unit*	*Percent of Sales*
Sales (19,500 units)	$585,000	$30.00	100%
Variable expenses	409,500	21.00	70%
Contribution margin.....	$175,500	$ 9.00	30%

The break-even point is:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$30 - \$21) \times Q - \$180{,}000 \\ \$0 &= (\$9) \times Q - \$180{,}000 \\ \$9Q &= \$180{,}000 \\ Q &= \$180{,}000 \div \$9 \\ Q &= 20{,}000 \text{ units} \end{aligned}$$

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

Alternative solution:

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

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

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

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

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 – $4,500 = $3,500).

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Problem 2-22 (continued)

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:

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

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

$$= 23{,}000 \text{ units}$$

   **$30.00 – $21.75 = $8.25

5. a. The new CM ratio would be:

	Per Unit	*Percent of Sales*
Sales.....	$30.00	100%
Variable expenses.....	18.00	60%
Contribution margin	$12.00	40%

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Problem 2-22 (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:

	Not Automated			*Automated*		
	Total	*Per Unit*	*%*	*Total*	*Per Unit*	*%*
Sales (26,000 units).....	$780,000	$30.00	100	$780,000	$30.00	100
Variable expenses	546,000	21.00	70	468,000	18.00	60
Contribution margin.....	234,000	$ 9.00	30	312,000	$12.00	40
Fixed expenses ..	180,000			252,000		
Net operating income	$ 54,000			$ 60,000		

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Problem 2-22 (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 (= $60,000 – $54,000) 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.

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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:

$$\begin{aligned} \text{Let } Q &= \text{Point of indifference in units sold} \\ \$21.00Q + \$180{,}000 &= \$18.00Q + \$252{,}000 \\ \$3.00Q &= \$72{,}000 \\ Q &= \$72{,}000 \div \$3.00 \\ Q &= 24{,}000 \text{ units} \end{aligned}$$

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).

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Problem 2-23 (60 minutes)

1. The CM ratio is 60%:

Sales price.....	$20.00	100%
Variable expenses	8.00	40%
Contribution margin	$12.00	60%

2. $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

$$= \frac{\$180{,}000}{0.60}$$

$$= \$300{,}000$$

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

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4a. The degree of operating leverage is calculated as follows:

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

$$= \frac{\$240{,}000}{\$60{,}000}$$

$$= 4$$

4b. 4 × 20% = 80% increase in net operating income. In dollars, this increase would be 80% × $60,000 = $48,000.

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Problem 2-23 (continued)

5. This year's net operating income is computed as follows:

Sales (25,000 units × $18 per unit).....	$450,000
Variable expenses (25,000 units × $8 per unit)...	200,000
Contribution margin	250,000
Fixed expenses ($180,000 + $30,000).....	210,000
Net operating income	$ 40,000

The sales manager's suggestions should not be implemented because they will lower net operating income by $20,000 (= $60,000 – $40,000).

6. Expected total contribution margin:

20,000 units × 1.25 × $11.00 per unit*.....	$275,000
Present total contribution margin	240,000
Incremental contribution margin, and the amount by which advertising can be increased with net operating income remaining unchanged.....	$ 35,000

*$20.00 – ($8.00 + $1.00) = $11.00

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Problem 2-24 (30 minutes)

The key to solving the requirements of this problem is understanding that the sweatshirts represent a step-fixed cost. They cannot be purchased at a cost of $8 each. They must be bought in batches of 75 sweatshirts at a cost of $600 per batch (75 sweatshirts × $8 per shirt = $600 per batch).

1. A good starting point for solving this problem is to compute the profit from buying and selling one batch of 75 sweatshirts:

Sales (75 shirts × $13.50)	$1,012.50
Variable expenses (75 shirts × $1.50)	112.50
Contribution margin	900.00
Step-fixed expense ($600 × 1 batch)	600.00
Net operating income	$ 300.00

If the profit from selling one batch of 75 sweatshirts is $300, then the profit from selling four batches of 75 sweatshirts, or 300 sweatshirts in total, will equal the target profit of $1,200 ($300 per batch × 4 batches = $1,200).

Unit sales of 300 sweatshirts corresponds with dollar sales of $4,050 (= 300 sweatshirts × $13.50).

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2. The contribution margin per sweatshirt is:

Selling price	$13.50
Variable expenses	1.50
Contribution margin.....	$12.00

The fixed cost associated with buying 75 sweatshirts is $600; therefore, the break-even point would be 50 sweatshirts computed as follows:

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

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

50 sweatshirts × $13.50 per sweatshirt = $675 in total sales

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Problem 2-24 (continued)

3. Purchasing four batches of sweatshirts, or a total of 300 sweatshirts, yields a profit of $1,200. If Hooper purchased and sold five batches of sweatshirts, or a total of 375 sweatshirts, he would earn a profit of $1,500 ($1,200 + $300). Since the target profit of $1,320 is between $1,200 and $1,500, Hooper will need to attain a sales volume between 300 and 375 sweatshirts to achieve his target profit.

   Given that the selling price per unit $13.50, the variable cost per unit is $1.50, the target profit is $1,320, and the step-fixed cost in this scenario is $3,000 (5 batches × $600 per batch) The correct answer of 360 sweatshirts is calculated as follows:

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$1{,}320 &= (\$13.50 - \$1.50) \times Q - \$3{,}000 \\ \$1{,}320 &= (\$12) \times Q - \$3{,}000 \\ \$12Q &= \$4{,}320 \\ Q &= \$4{,}320 \div \$12 \\ Q &= 360 \text{ sweatshirts} \end{aligned}$$

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Problem 2-25 (60 minutes)

1. The break-even point is calculated as follows:

Profit = Unit CM × Q − Fixed expenses
$0 = ($3 − $1) × Q − $22,000
$0 = ($2) × Q − $22,000
$2Q = $22,000
Q = $22,000 ÷ $2
Q = 11,000 units

2a. If Neptune produces and sells 18,000 units, it will earn net operating income of $14,000, calculated as follows:

Sales (18,000 units × $3.00).....	$54,000
Variable expenses (18,000 units × $1.00)..	18,000
Contribution margin	36,000
Fixed expenses	22,000
Net operating income	$14,000

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2b. If Neptune buys 18,000 units from its supplier and then resells them, it will earn net operating income of $7,500, calculated as follows:

Sales (18,000 units × $3.00).....	$54,000
Variable expenses (18,000 units × $1.75)..	31,500
Contribution margin	22,500
Fixed expenses	15,000
Net operating income	$ 7,500

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Problem 2-25 (continued)

3. In this scenario, the total fixed expenses are $37,000 ($22,000 + $15,000), the contribution margin per unit for the first 18,000 units produced in-house is $2.00 per unit, and the contribution margin per unit for each unit produced by the supplier is $1.25 per unit. Thus, the break-even point of 18,800 units is computed as follows:

Fixed expenses ($22,000 + $15,000)	$37,000
Contribution margin from in-house production (18,000 units × $2.00).....	36,000
Contribution margin that must be earned on outsourced units to cover fixed expenses.....	$ 1,000

Contribution margin that must be earned on outsourced units to cover fixed expenses (a).	$1,000
Contribution margin per unit from supplier (b).	$1.25
Unit sales needed from supplier to break-even (a) ÷ (b).....	800

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The total unit sales required to break-even is 18,000 units produced in-house plus 800 units provided by the supplier, or a total of 18,800 units.

4a. In this scenario, the total fixed expenses plus target profit is $51,000 ($22,000 + $15,000 + $14,000), the contribution margin per unit for the first 18,000 units produced in-house is $2.00 per unit, and the contribution margin per unit for each unit produced by the supplier is $1.25 per unit. Thus, the required unit sales is computed as follows:

Fixed expenses plus target profit ($22,000 + $15,000 +$14,000).....	$51,000
Contribution margin from in-house production (18,000 units × $2.00).....	36,000
Contribution margin that must be realized on outsourced units to earn target profit.....	$15,000

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Problem 2-25 (continued)

Contribution margin that must be realized on outsourced units to earn target profit (a)	$15,000
Contribution margin per unit from supplier (b) .	$1.25
Unit sales needed from supplier to earn target profit (a) ÷ (b)	12,000

The total unit sales required to earn the target profit is 30,000 units, which includes 18,000 units produced in-house plus 12,000 units provided by the supplier.

4b. This scenario is identical to requirement 4a except the target profit changes from $14,000 to $16,500; hence, the required unit sales is calculated as follows:

Fixed expenses plus target profit ($22,000 + $15,000 +$16,500).....	$53,500
Contribution margin from in-house production (18,000 units × $2.00).....	36,000
Contribution margin that must be realized on outsourced units to earn target profit.....	$17,500

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Contribution margin that must be realized on outsourced units to earn target profit (a)	$17,500
Contribution margin per unit from supplier (b) .	$1.25
Unit sales needed from supplier to earn target profit (a) ÷ (b)	14,000

The total unit sales required to earn the target profit is 32,000 units, which includes 18,000 units produced in-house plus 14,000 units provided by the supplier.

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Problem 2-25 (continued)

4c. The net operating income is computed as follows:

Sales (35,000 units × $3.00).....	$105,000
Variable expenses (18,000 units × $1.00) + (17,000 units × $1.75)	47,750
Contribution margin	57,250
Fixed expenses ($22,000 + $15,000)	37,000
Net operating income	$ 20,250

4d. The net operating income is computed as follows:

Sales (35,000 units × $3.00).....	$105,000
Variable expenses (18,000 units × $1.00) + (800 units × $1.75) + (16,200 units × $1.85).....	49,370
Contribution margin	55,630
Fixed expenses ($22,000 + $15,000)	37,000
Net operating income	$ 18,630

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5. The net operating income is computed as follows:

Sales (35,000 units × $3.00).....	$105,000
Variable expenses (35,000 units × $1.75)..	61,250
Contribution margin	43,750
Fixed expenses ($15,000 × 2).....	30,000
Net operating income	$ 13,750

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Problem 2-26 (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:

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

$$= \frac{\$150{,}000}{\$12.00} = 12{,}500 \text{ pairs}$$

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

$$= \frac{\$150{,}000}{0.40} = \$375{,}000 \text{ in sales}$$

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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)

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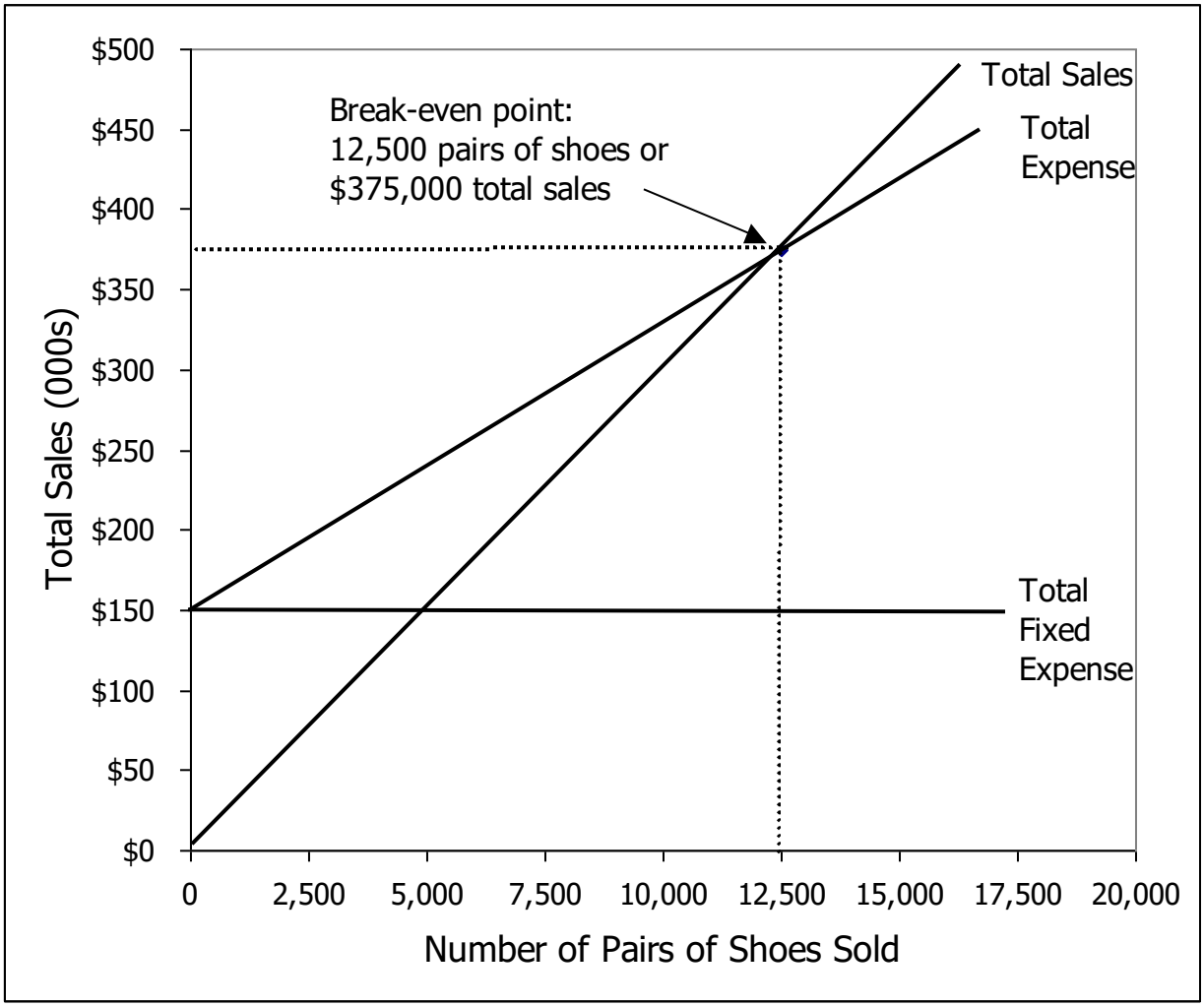
Problem 2-26 (continued)

2. Cost-volume-profit graph:



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Problem 2-26 (continued)

4. The variable expenses will now be $18.75 per pair, and the contribution margin will be $11.25 per pair.

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$30.00 - \$18.75) \times Q - \$150{,}000 \\ \$0 &= (\$11.25) \times Q - \$150{,}000 \\ \$11.25Q &= \$150{,}000 \\ Q &= \$150{,}000 \div \$11.25 \\ Q &= 13{,}333 \text{ pairs (rounded)} \end{aligned}$$

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

Alternative solution:

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

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

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

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

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 pairs × $11.50 per pair* = $28,750 profit

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

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Problem 2-26 (continued)

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

$$\begin{aligned} \text{Profit} &= \text{Unit CM} \times Q - \text{Fixed expenses} \\ \$0 &= (\$30.00 - \$13.50) \times Q - (\$150{,}000 + \$31{,}500) \\ \$0 &= (\$16.50) \times Q - \$181{,}500 \\ \$16.50Q &= \$181{,}500 \\ Q &= \$181{,}500 \div \$16.50 \\ Q &= 11{,}000 \text{ pairs} \end{aligned}$$

11,000 pairs × $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.

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Problem 2-27 (45 minutes)

1. a.

	Hawaiian Fantasy (20,000 units)		*Tahitian Joy (5,000 units)*		*Total*	
	Amount	*%*	*Amount*	*%*	*Amount*	*%*
Sales.....	$300,000	100%	$500,000	100%	$800,000	100%
Variable expenses.....	180,000	60%	100,000	20%	280,000	35%
Contribution margin....	$120,000	40%	$400,000	80%	520,000	65%
Fixed expenses.....					475,800	
Net operating income..					$ 44,200	

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

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

$$= \$800{,}000 - \$732{,}000 = \$68{,}000$$

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

$$= \frac{\$68{,}000}{\$800{,}000} = 8.5\%$$

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Problem 2-27 (continued)

2. a.

	Hawaiian Fantasy (20,000 units)		*Tahitian Joy (5,000 units)*		*Samoan Delight (10,000 units)*		*Total*	
	Amount	*%*	*Amount*	*%*	*Amount*	*%*	*Amount*	*%*
Sales	$300,000	100%	$500,000	100%	$450,000	100%	$1,250,000	100.0%
Variable expenses	180,000	60%	100,000	20%	360,000	80%	640,000	51.2%
Contribution margin	$120,000	40%	$400,000	80%	$ 90,000	20%	610,000	48.8%
Fixed expenses							475,800	
Net operating income							$ 134,200	

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Problem 2-27 (continued)

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

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

$$= \$1{,}250{,}000 - \$975{,}000 = \$275{,}000$$

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

$$= \frac{\$275{,}000}{\$1{,}250{,}000} = 22\%$$

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.

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Problem 2-28 (60 minutes)

1. April's Income Statement:

	Standard		*Deluxe*		*Pro*		*Total*	
	Amount	*%*	*Amount*	*%*	*Amount*	*%*	*Amount*	*%*
Sales	$80,000	100	$60,000	100	$450,000	100	$590,000	100
Variable expenses:								
Production	44,000	55	27,000	45	157,500	35	228,500	38.7
Selling	4,000	5	3,000	5	22,500	5	29,500	5.0
Total variable expenses	48,000	60	30,000	50	180,000	40	258,000	43.7
Contribution margin	$32,000	40	$30,000	50	$270,000	60	332,000	56.3
Fixed expenses:								
Production							120,000	
Advertising							100,000	
Administrative							50,000	
Total fixed expenses							270,000	
Net operating income							$ 62,000	

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Problem 2-28 (continued)

May's Income Statement:

	Standard		*Deluxe*		*Pro*		*Total*	
	Amount	*%*	*Amount*	*%*	*Amount*	*%*	*Amount*	*%*
Sales	$320,000	100	$60,000	100	$270,000	100	$650,000	100.0
Variable expenses:								
Production.....	176,000	55	27,000	45	94,500	35	297,500	45.8
Selling.....	16,000	5	3,000	5	13,500	5	32,500	5.0
Total variable expenses.	192,000	60	30,000	50	108,000	40	330,000	50.8
Contribution margin.....	$128,000	40	$30,000	50	$162,000	60	320,000	49.2
Fixed expenses:								
Production.....							120,000	
Advertising							100,000	
Administrative.....							50,000	
Total fixed expenses							270,000	
Net operating income ...							$ 50,000	

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Problem 2-28 (continued)

2. The sales mix has shifted over the last month from a greater concentration of Pro rackets to a greater concentration of Standard rackets. This shift has caused a decrease in the company's overall CM ratio from 56.3% in April to only 49.2% in May. For this reason, even though total sales (both in units and in dollars) is greater, net operating income is lower than last month in the division.

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

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$270{,}000}{0.563} = \$479{,}574 \text{ (rounded)}$$

4. May's break-even point has gone up. The reason is that the division's overall CM ratio has declined for May as stated in (2) above. Unchanged fixed expenses divided by a lower overall CM ratio would yield a higher break-even point in sales dollars.

5.

	Standard	*Pro*
Increase in sales	$20,000	$20,000
Multiply by the CM ratio	× 40%	× 60%
Increase in net operating income*	$ 8,000	$12,000

*Assuming that fixed costs do not change.

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Problem 2-29 (60 minutes)

1. The income statements would be:

	Present		
	Amount	*Per Unit*	*%*
Sales.....	$450,000	$30	100%
Variable expenses.....	315,000	21	70%
Contribution margin...	135,000	$ 9	30%
Fixed expenses.....	90,000		
Net operating income.	$ 45,000		

	Proposed		
	Amount	*Per Unit*	*%*
Sales.....	$450,000	$30	100%
Variable expenses*	180,000	12	40%
Contribution margin...	270,000	$18	60%
Fixed expenses.....	225,000		
Net operating income.	$ 45,000		

*$21 – $9 = $12

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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:

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

$$= \frac{\$270,000}{\$45,000} = 6$$

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Problem 2-29 (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:

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

$$= \$450{,}000 - \$300{,}000 = \$150{,}000$$

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

$$= \frac{\$150{,}000}{\$450{,}000} = 33.33\%$$

Proposed:

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

$$= \$450{,}000 - \$375{,}000 = \$75{,}000$$

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

$$= \frac{\$75{,}000}{\$450{,}000} = 16.67\%$$

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Problem 2-29 (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:

$$\begin{aligned} \text{Profit} &= (\text{Sales} - \text{Variable expenses}) - \text{Fixed expenses} \\ \$54{,}000^{**} &= (\$585{,}000^{*} - \text{Variable expenses}) - \$180{,}000 \\ \text{Variable expenses} &= \$585{,}000 - \$180{,}000 - \$54{,}000 \\ &= \$351{,}000 \end{aligned}$$

   *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:

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$180{,}000}{0.40} = \$450{,}000$$

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Problem 2-29 (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:

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

$$= \frac{\$45{,}000 + \$180{,}000}{0.40}$$

$$= \$562{,}500 \text{ in sales each month}$$

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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.

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Problem 2-30 (60 minutes)

1. Profit = Unit CM × Q − Fixed expenses
   $0 = ($40 − $16) × Q − $60,000
   $0 = ($24) × Q − $60,000
   $24Q = $60,000
   Q = $60,000 ÷ $24
   Q = 2,500 pairs, or at $40 per pair, $100,000 in sales

   Alternative solution:

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

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$60{,}000}{0.60} = \$100{,}000$$

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

3. Profit = Unit CM × Q − Fixed expenses
   $18,000 = $24 × Q − $60,000
   $24Q = $18,000 + $60,000
   Q = $78,000 ÷ $24
   Q = 3,250 pairs

   Alternative solution:

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

$$= \frac{\$18{,}000 + \$60{,}000}{\$24.00} = 3{,}250 \text{ pairs}$$

4. Incremental contribution margin:

$25,000 increased sales × 60% 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.

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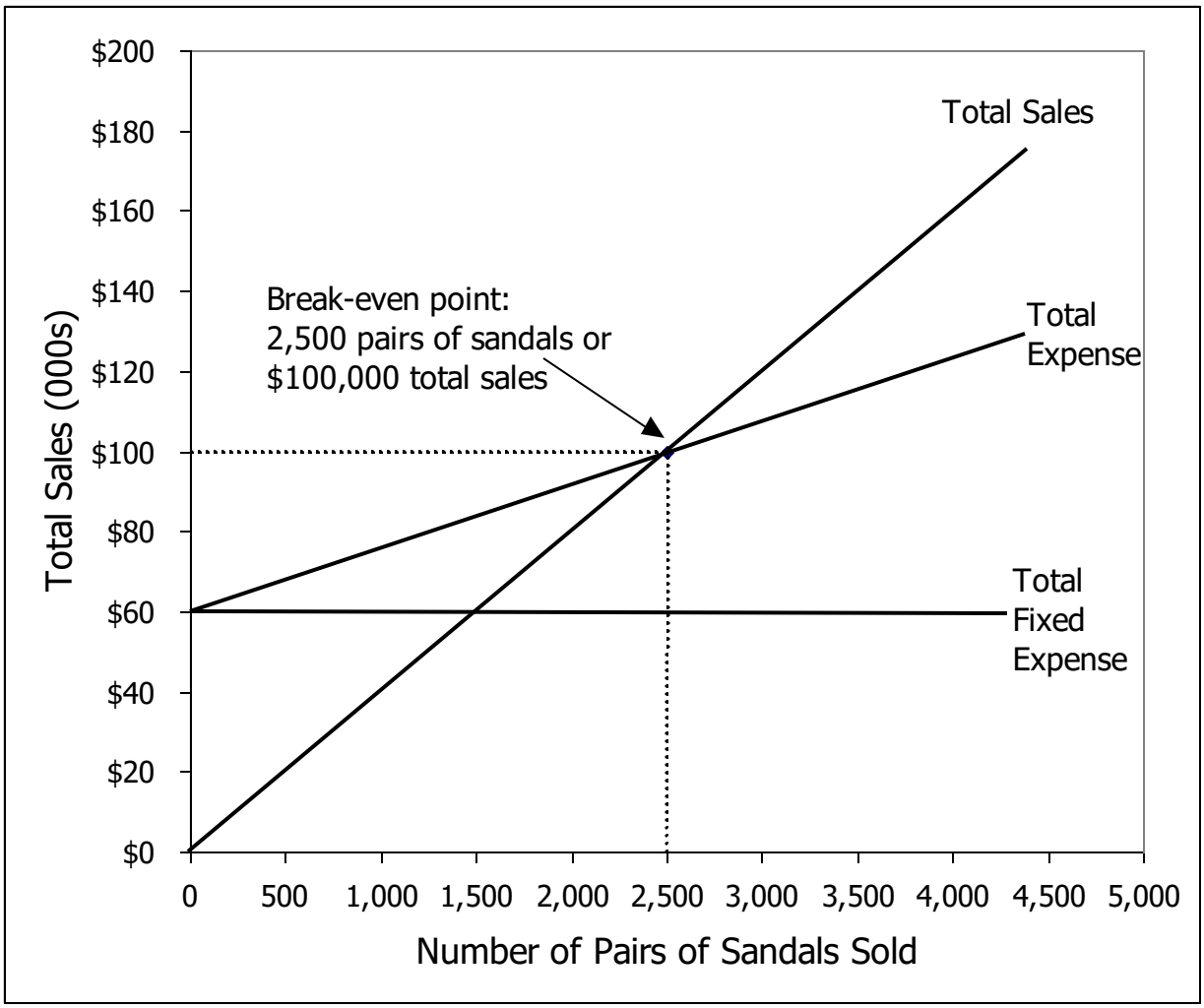
Problem 2-30 (continued)

5. a.

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

b. 6 × 50% sales increase = 300% *increase* in net operating income. Thus, net operating income next year would be: $12,000 + ($12,000 × 300%) = $48,000.

2. Cost-volume-profit graph:



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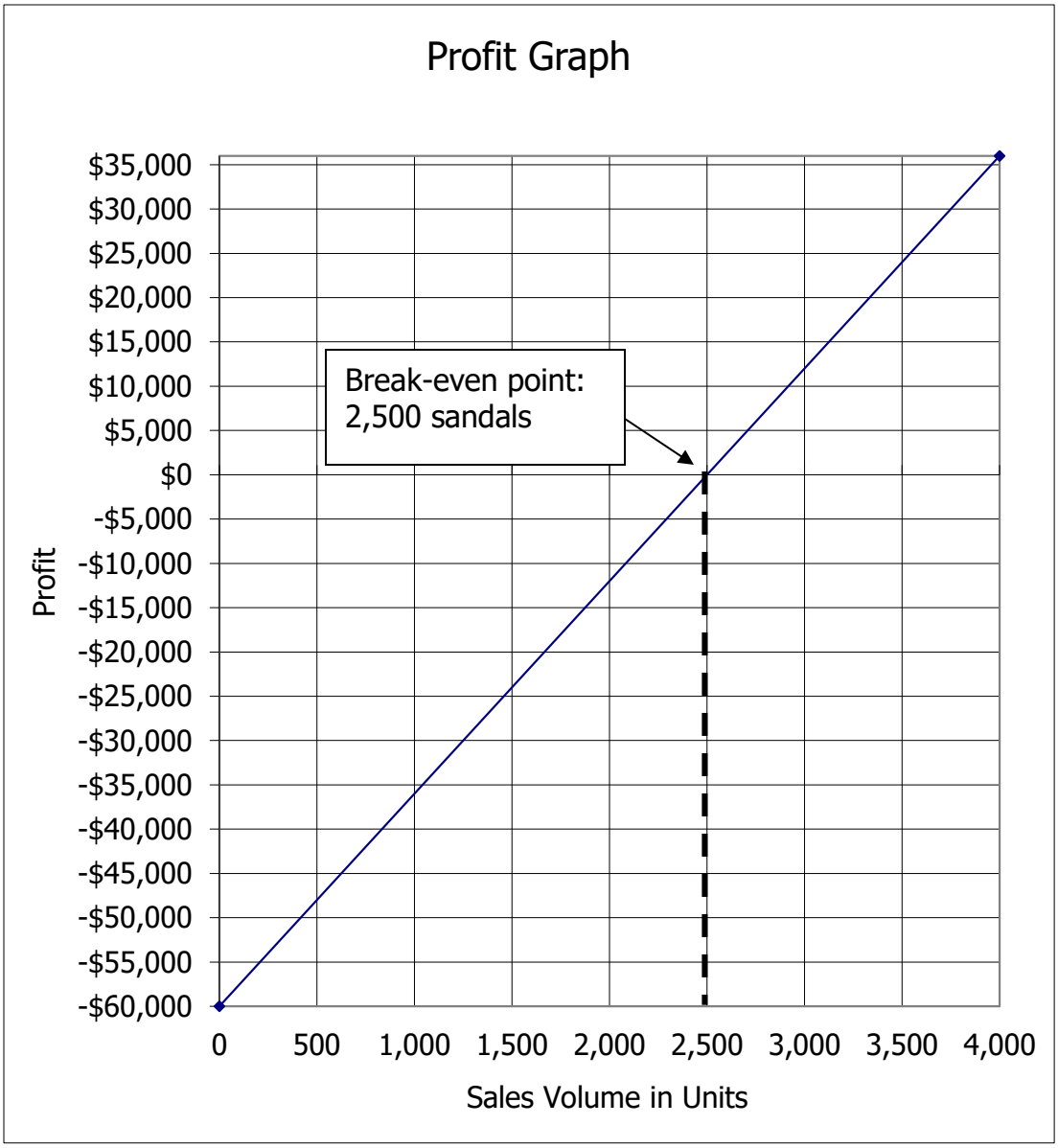
Problem 2-30 (continued)

Profit graph:



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Problem 2-31 (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

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Problem 2-31 (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.

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Case 2-32 (75 minutes)

Before proceeding with the solution, it is helpful first to restructure the data into contribution format for each of the three alternatives. (The data in the statements below are in thousands.)

	15% Commission		*20% Commission*		*Own Sales Force*	
Sales	$16,000	100%	$16,000	100%	$16,000.00	100.0%
Variable expenses:						
Manufacturing	7,200		7,200		7,200.00	
Commissions (15%, 20%, 7.5%)	2,400		3,200		1,200.00	
Total variable expenses	9,600	60%	10,400	65%	8,400.00	52.5%
Contribution margin	6,400	40%	5,600	35%	7,600.00	47.5%
Fixed expenses:						
Manufacturing overhead	2,340		2,340		2,340.00	
Marketing	120		120		2,520.00 *	
Administrative	1,800		1,800		1,725.00 **	
Interest	540		540		540.00	
Total fixed expenses	4,800		4,800		7,125.00	
Income before income taxes	1,600		800		475.00	
Income taxes (30%)	480		240		142.50	
Net income	$ 1,120		$ 560		$ 332.50	

*$120,000 + $2,400,000 = $2,520,000
**$1,800,000 – $75,000 = $1,725,000

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Case 2-32 (continued)

1. When the income before taxes is zero, income taxes will also be zero and net income will be zero. Therefore, the break-even calculations can be based on the income before taxes.

   a. Break-even point in dollar sales if the commission remains 15%:

   $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$4{,}800{,}000}{0.40} = \$12{,}000{,}000$$

   b. Break-even point in dollar sales if the commission increases to 20%:

   $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$4{,}800{,}000}{0.35} = \$13{,}714{,}286$$

   c. Break-even point in dollar sales if the company employs its own sales force:

   $$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}} = \frac{\$7{,}125{,}000}{0.475} = \$15{,}000{,}000$$

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2. In order to generate a $1,120,000 net income, the company must generate $1,600,000 in income before taxes. Therefore,

   $$\text{Dollar sales to attain target} = \frac{\text{Target income before taxes + Fixed expenses}}{\text{CM ratio}}$$

   $$= \frac{\$1{,}600{,}000 + \$4{,}800{,}000}{0.35}$$

   $$= \frac{\$6{,}400{,}000}{0.35} = \$18{,}285{,}714$$

3. To determine the volume of sales at which net income would be equal under either the 20% commission plan or the company sales force plan, we find the volume of sales where costs before income taxes under the two plans are equal. See the next page for the solution.

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Case 2-32 (continued)

$$X = \text{Total sales revenue}$$
$$0.65X + \$4{,}800{,}000 = 0.525X + \$7{,}125{,}000$$
$$0.125X = \$2{,}325{,}000$$
$$X = \$2{,}325{,}000 \div 0.125$$
$$X = \$18{,}600{,}000$$

Thus, at a sales level of $18,600,000 either plan would yield the same income before taxes and net income. Below this sales level, the commission plan would yield the largest net income; above this sales level, the sales force plan would yield the largest net income.

4. a., b., and c.

	15% Commission	*20% Commission*	*Own Sales Force*
Contribution margin (Part 1) (a).....	$6,400,000	$5,600,000	$7,600,000
Income before taxes (Part 1) (b)....	$1,600,000	$800,000	$475,000
Degree of operating leverage:			
(a) ÷ (b).....	4	7	16

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5. We would continue to use the sales agents for at least one more year, and possibly for two more years. The reasons are as follows:

   First, use of the sales agents would have a less dramatic effect on net income.

   Second, use of the sales agents for at least one more year would give the company more time to hire competent people and get the sales group organized.

   Third, the sales force plan doesn't become more desirable than the use of sales agents until the company reaches sales of $18,600,000 a year. This level probably won't be reached for at least one more year, and possibly two years.

   Fourth, the sales force plan will be highly leveraged since it will increase fixed costs (and decrease variable costs). One or two years from now, when sales have reached the $18,600,000 level, the company can benefit greatly from this leverage. For the moment, profits will be greater and risks will be less by staying with the agents, even at the higher 20% commission rate.

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Appendix 2A
Analyzing Mixed Costs

Exercise 2A-1 (20 minutes)

1.

	Occupancy-Days	*Electrical Costs*
High activity level (August) ..	2,406	$5,148
Low activity level (October) .	124	1,588
Change.....	2,282	$3,560

Variable cost = Change in cost ÷ Change in activity
= $3,560 ÷ 2,282 occupancy-days
= $1.56 per occupancy-day

Total cost (August).....	$5,148
Variable cost element	
($1.56 per occupancy-day × 2,406 occupancy-days) .	3,753
Fixed cost element	$1,395

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2. Electrical costs may reflect seasonal factors other than just the variation in occupancy days. For example, common areas such as the reception area must be lighted for longer periods during the winter than in the summer. This will result in seasonal fluctuations in the fixed electrical costs.

Additionally, fixed costs will be affected by the number of days in a month. In other words, costs like the costs of lighting common areas are variable with respect to the number of days in the month, but are fixed with respect to how many rooms are occupied during the month.

Other, less systematic, factors may also affect electrical costs such as the frugality of individual guests. Some guests will turn off lights when they leave a room. Others will not.

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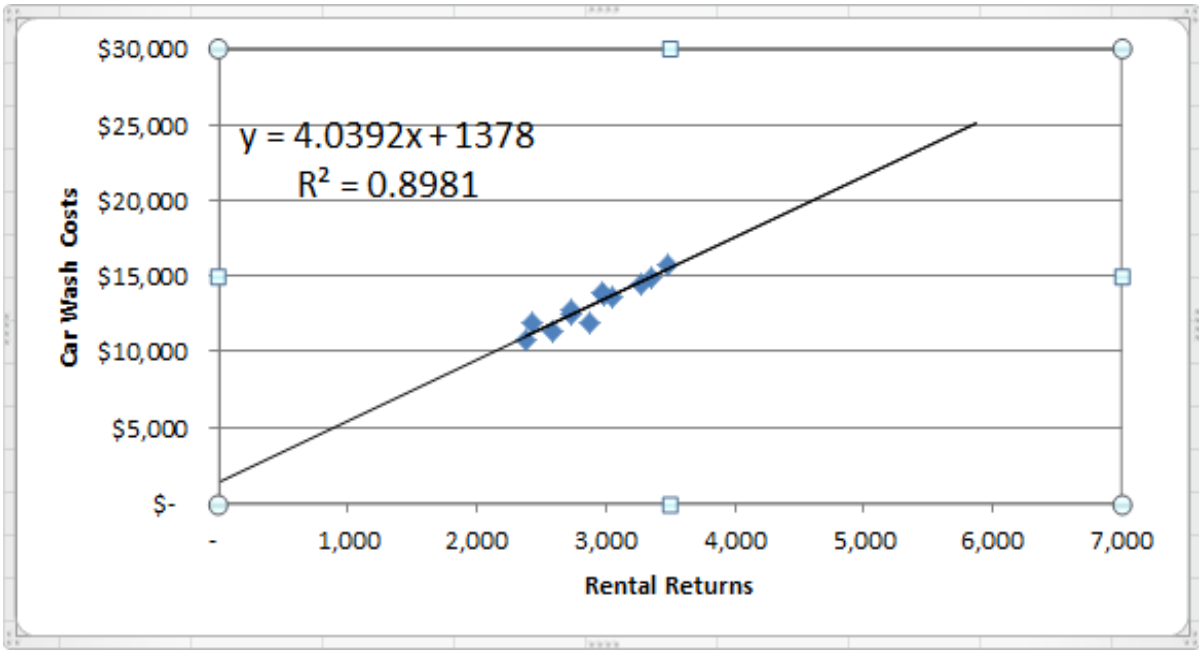
Exercise 2A-2 (20 minutes)

1. and 2.

The scattergraph plot and least-squares regression estimates of fixed and variable costs using Microsoft Excel are shown below:



The intercept provides the estimate of the fixed cost element, $1,378 per month, and the slope provides the estimate of the variable cost element, $4.04 per rental return. Expressed as an equation in the form $Y = a + bX$, the relation between car wash costs and rental returns is

$$Y = \$1{,}378 + \$4.04X$$

where X is the number of rental returns.

Note that the R^2 is approximately 0.90, which is quite high, and indicates a strong linear relationship between car wash costs and rental returns.

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Exercise 2A-3 (20 minutes)

1.

	Kilometers Driven	*Total Annual Cost**
High level of activity	105,000	$11,970
Low level of activity	70,000	9,380
Change	35,000	$ 2,590

* 105,000 kilometers × $0.114 per kilometer = $11,970
70,000 kilometers × $0.134 per kilometer = $9,380

Variable cost per kilometer:

$$\frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$2{,}590}{35{,}000 \text{ kilometers}} = \$0.074 \text{ per kilometer}$$

Fixed cost per year:

Total cost at 105,000 kilometers	$11,970
Less variable portion:	
105,000 kilometers × $0.074 per kilometer	7,770
Fixed cost per year	$ 4,200

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2. Y = $4,200 + $0.074X

3.

Fixed cost	$ 4,200
Variable cost:	
80,000 kilometers × $0.074 per kilometer	5,920
Total annual cost	$10,120

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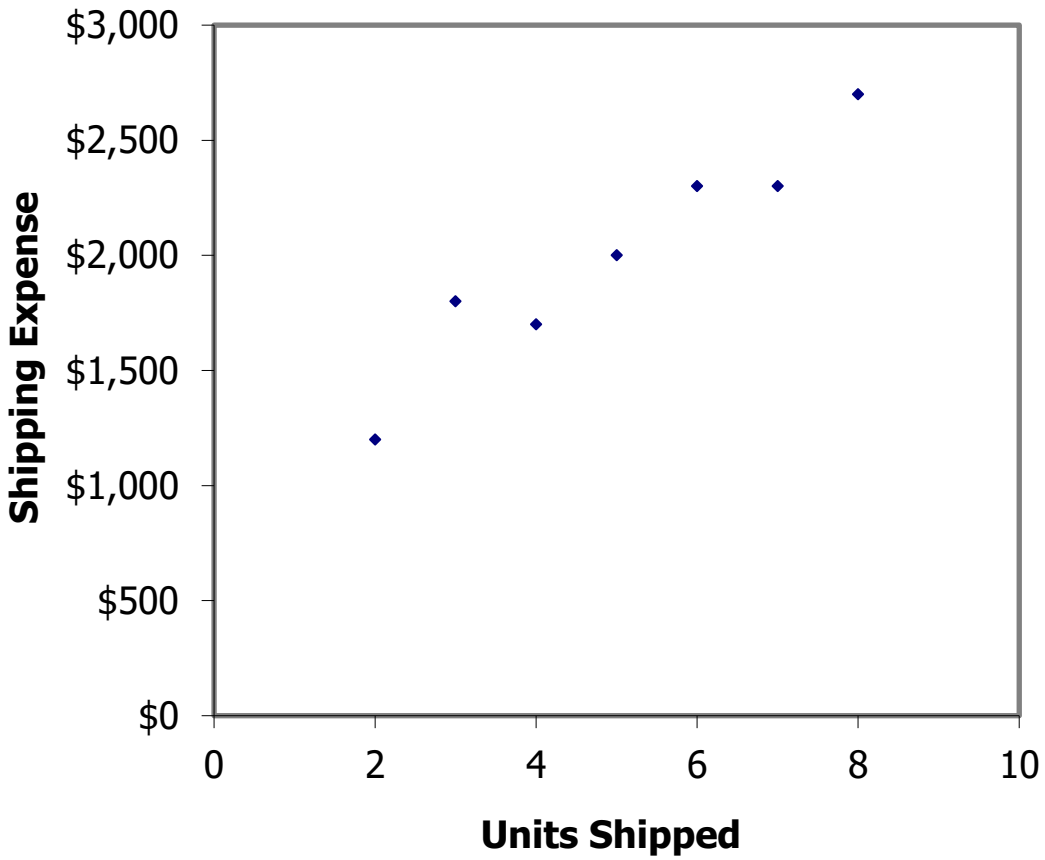
Exercise 2A-4 (45 minutes)

1. The scattergraph appears below:



Yes, there is an approximately linear relationship between the number of units shipped and the total shipping expense.

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Exercise 2A-4 (continued)

2. The high-low estimates and cost formula are computed as follows:

	Units Shipped	*Shipping Expense*
High activity level (June)	8	$2,700
Low activity level (July)	2	1,200
Change.....	6	$1,500

Variable cost element:

$$\frac{\text{Change in expense}}{\text{Change in activity}} = \frac{\$1{,}500}{6 \text{ units}} = \$250 \text{ per unit.}$$

Fixed cost element:

Shipping expense at high activity level.....	$2,700
Less variable cost element ($250 per unit × 8 units) ..	2,000
Total fixed cost.....	$ 700

The cost formula is $700 per month plus $250 per unit shipped or

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$$Y = \$700 + \$250X,$$

where X is the number of units shipped.

The scattergraph on the following page shows the straight line drawn through the high and low data points.

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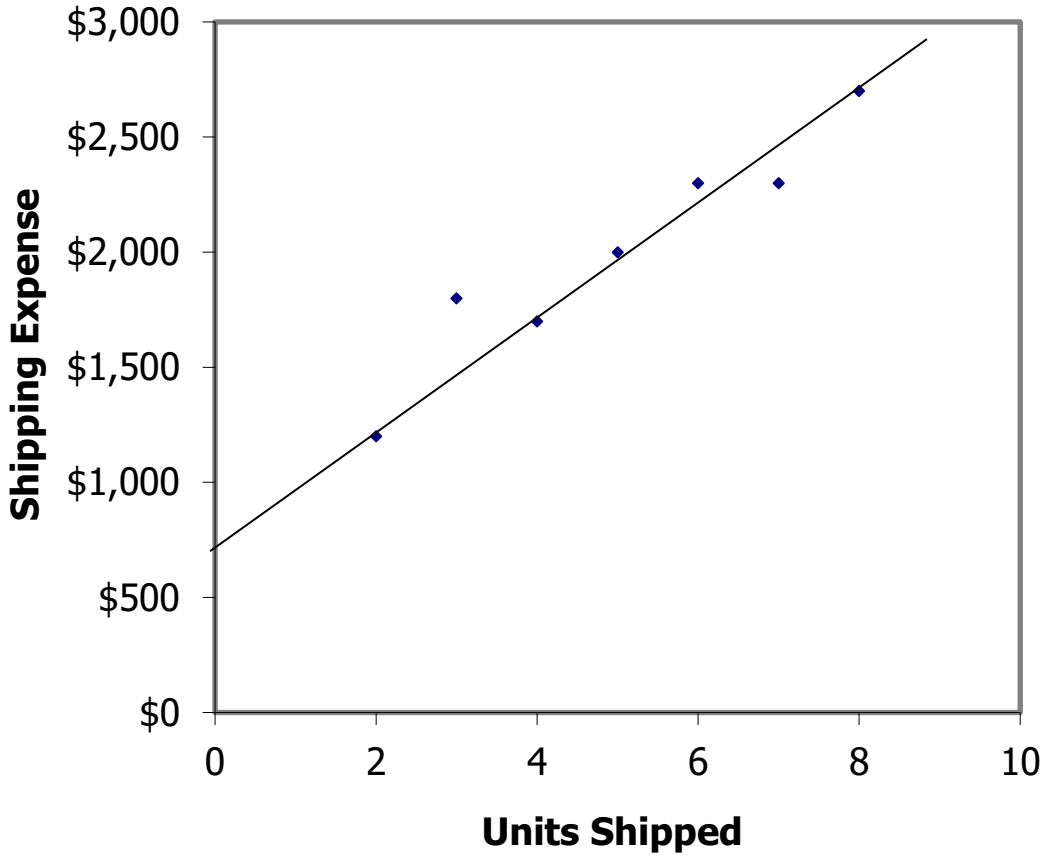
Exercise 2A-4 (continued)



3. The high-low estimate of fixed costs is $210.71 (= $910.71 – $700.00) lower than the estimate provided by least-squares regression. The high-low estimate of the variable cost per unit is $32.14 (= $250.00 – $217.86) higher than the estimate provided by least-squares regression. A straight line that minimized the sum of the squared errors would intersect the Y-axis at $910.71 instead of $700. It would also have a flatter slope because the estimated variable cost per unit is lower than the high-low method.

4. The cost of shipping units is likely to depend on the weight and volume of the units shipped and the distance traveled as well as on the number of units shipped. In addition, higher cost shipping might be necessary to meet a deadline.

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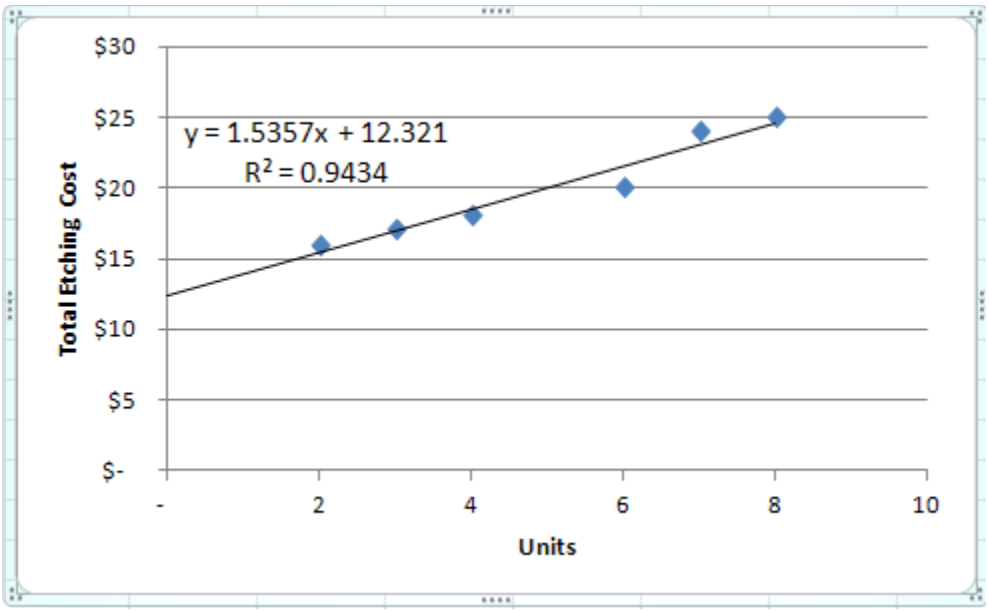
Exercise 2A-5 (20 minutes)

1. and 2.

The scattergraph plot and regression estimates of fixed and variable costs using Microsoft Excel are shown below:



Note that the R^2 is approximately 0.94, which means that 94% of the variation in etching costs is explained by the number of units etched. This is a very high R^2 which indicates a very good fit.

The regression equation, in the form $Y = a + bX$, is as follows (where a is rounded to nearest dollar and b is rounded to the nearest cent):

Y = $12.32 + $1.54X

3. Total expected etching cost if 5 units are processed:

Variable cost: 5 units × $1.54 per unit.....	$ 7.70
Fixed cost	12.32
Total expected cost	$20.02

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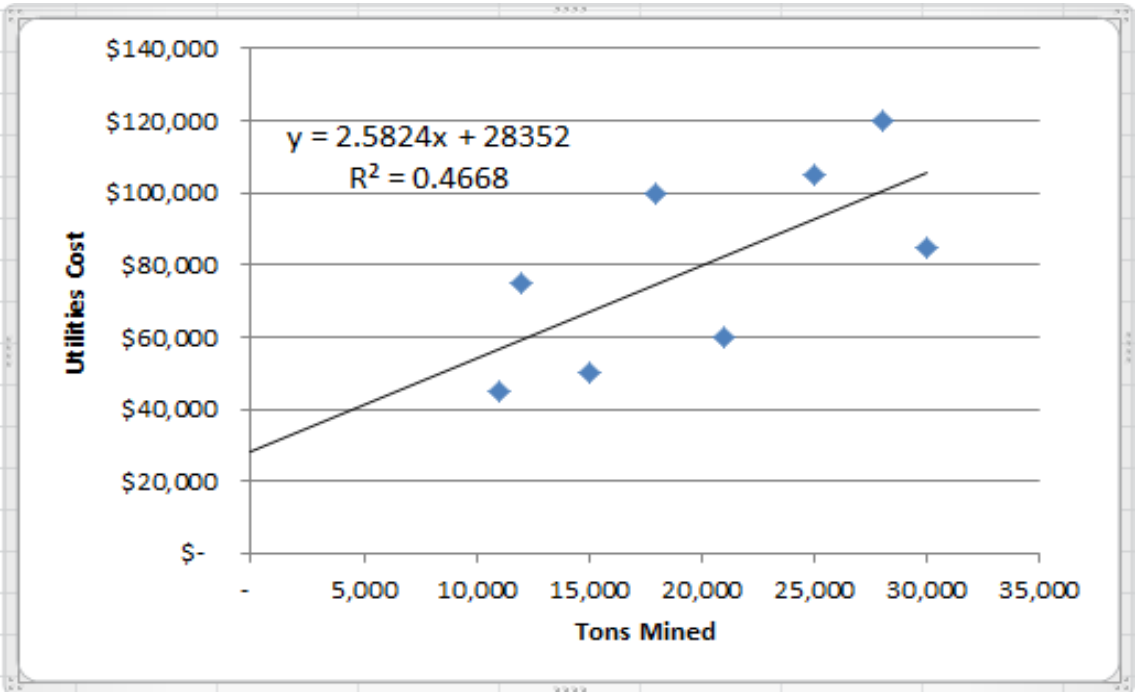
Problem 2A-6 (30 minutes)

1. The scattergraph plot and regression estimates of fixed and variable costs using Microsoft Excel are shown below:



The cost formula, in the form $Y = a + bX$, using tons mined as the activity base is $28,352 per quarter plus $2.58 per ton mined, or

$$Y = \$28{,}352 + \$2.58X$$

Note that the R^2 is approximately 0.47, which means that only 47% of the variation in utility costs is explained by the number of tons mined.

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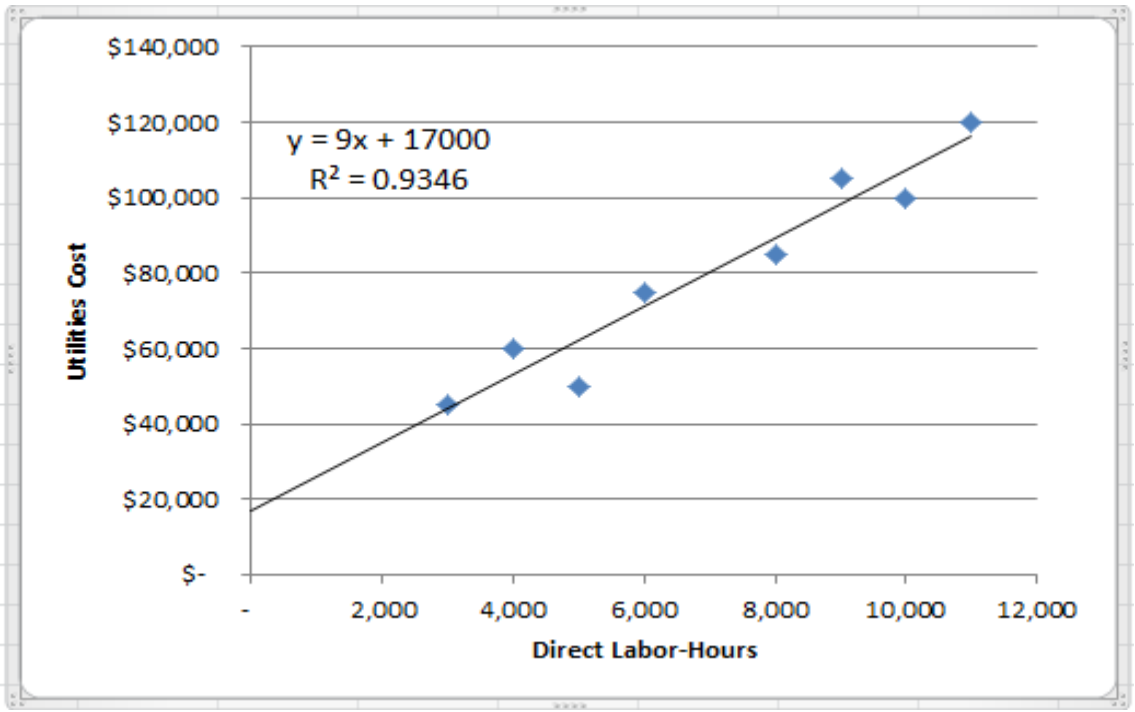
Problem 2A-6 (continued)

2. The scattergraph plot and regression estimates of fixed and variable costs using Microsoft Excel are shown below:



The cost formula, in the form $Y = a + bX$, using direct labor-hours as the activity base is $17,000 per quarter plus $9.00 per direct labor-hour, or:

$$Y = \$17{,}000 + \$9.00X$$

Note that the R^2 is approximately 0.93, which means that 93% of the variation in utility costs is explained by direct labor-hours. This is a very high R^2 which is an indication of a very good fit.

3. The company should probably use direct labor-hours as the activity base, since the fit of the regression line to the data is much tighter than it is with tons mined. The R^2 for the regression using direct labor-hours as the activity base is twice as large as for the regression using tons mined as the activity base. However, managers should look more closely at the costs and try to determine why utilities costs are more closely tied to direct labor-hours than to the number of tons mined.

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Problem 2A-7 (45 minutes)

1. Cost of goods sold..... Variable
   Advertising expense ..... Fixed
   Shipping expense..... Mixed
   Salaries and commissions ..... Mixed
   Insurance expense ..... Fixed
   Depreciation expense ..... Fixed

2. Analysis of the mixed expenses:

	Units	*Shipping Expense*	*Salaries and Commissions Expense*
High level of activity	5,000	$38,000	$90,000
Low level of activity	4,000	34,000	78,000
Change	1,000	$ 4,000	$12,000

Variable cost element:

$$\text{Variable rate} = \frac{\text{Change in cost}}{\text{Change in activity}}$$

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$$\text{Shipping expense: } \frac{\$4{,}000}{1{,}000 \text{ units}} = \$4 \text{ per unit}$$

$$\text{Salaries and commissions expense: } \frac{\$12{,}000}{1{,}000 \text{ units}} = \$12 \text{ per unit}$$

Fixed cost element:

	Shipping Expense	*Salaries and Commissions Expense*
Cost at high level of activity ...	$38,000	$90,000
Less variable cost element:		
5,000 units × $4 per unit	20,000	
5,000 units × $12 per unit...		60,000
Fixed cost element.....	$18,000	$30,000

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Problem 2A-7 (continued)

The cost formulas are:

Shipping expense:
$18,000 per month plus $4 per unit
or
Y = $18,000 + $4X

Salaries and commissions expense:
$30,000 per month plus $12 per unit
or
Y = $30,000 + $12X

3.

Morrisey & Brown, Ltd.
Income Statement
For the Month Ended September 30

Sales (5,000 units × $100 per unit).....		$500,000
Variable expenses:		
Cost of goods sold (5,000 units × $60 per unit).....	$300,000	
Shipping expense (5,000 units × $4 per unit).....	20,000	
Salaries and commissions expense (5,000 units × $12 per unit).....	60,000	380,000
Contribution margin		120,000
Fixed expenses:		
Advertising expense.....	21,000	
Shipping expense	18,000	
Salaries and commissions expense	30,000	
Insurance expense	6,000	
Depreciation expense.....	15,000	90,000
Net operating income		$ 30,000

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Problem 2A-8 (20 minutes)

1. Maintenance cost at the 90,000 machine-hour level of activity can be isolated as follows:

	Level of Activity	
	60,000 MHs	*90,000 MHs*
Total factory overhead cost.....	$174,000	$246,000
Deduct:		
Utilities cost @ $0.80 per MH*.	48,000	72,000
Supervisory salaries.....	21,000	21,000
Maintenance cost.....	$105,000	$153,000

*$48,000 ÷ 60,000 MHs = $0.80 per MH

2. High-low analysis of maintenance cost:

	Machine-Hours	*Maintenance Cost*
High activity level.....	90,000	$153,000
Low activity level.....	60,000	105,000
Change.....	30,000	$ 48,000

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Variable rate:

$$\frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$48{,}000}{30{,}000 \text{ MHs}} = \$1.60 \text{ per MH}$$

Total fixed cost:

Total maintenance cost at the high activity level..	$153,000
Less variable cost element	
(90,000 MHs × $1.60 per MH).....	144,000
Fixed cost element	$ 9,000

Therefore, the cost formula for maintenance is $9,000 per month plus $1.60 per machine-hour or

$$Y = \$9{,}000 + \$1.60X$$

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Problem 2A-8 (continued)

3.

	Variable Cost per Machine-Hour	*Fixed Cost*
Utilities cost.....	$0.80	
Supervisory salaries cost..		$21,000
Maintenance cost.....	1.60	9,000
Total overhead cost.....	$2.40	$30,000

Thus, the cost formula would be: Y = $30,000 + $2.40X.

4. Total overhead cost at an activity level of 75,000 machine-hours:

Fixed costs	$ 30,000
Variable costs: 75,000 MHs × $2.40 per MH .	180,000
Total overhead costs	$210,000

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Problem 2A-9 (30 minutes)

1. High-low method:

	Units Sold	*Shipping Expense*
High activity level	20,000	$210,000
Low activity level	10,000	119,000
Change	10,000	$91,000

$$\text{Variable cost per unit} = \frac{\text{Change in cost}}{\text{Change in activity}}$$

$$= \frac{\$91{,}000}{10{,}000 \text{ units}} = \$9.10 \text{ per unit}$$

Fixed cost element:

Total shipping expense at high activity level	$210,000
Less variable element:	
20,000 units × $9.10 per unit.....	182,000
Fixed cost element	$ 28,000

Therefore, the cost formula is: Y = $28,000 + $9.10X.

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Problem 2A-9 (continued)

2.

Milden Company
Budgeted Contribution Format Income Statement
For the First Quarter, Year 3

Sales (12,000 units × $100 per unit)		$1,200,000
Variable expenses:		
Cost of goods sold (12,000 units × $35 unit)	$420,000	
Sales commission (6% × $1,200,000)	72,000	
Shipping expense (12,000 units × $9.10 per unit)	109,200	
Total variable expenses		601,200
Contribution margin		598,800
Fixed expenses:		
Advertising expense	210,000	
Shipping expense	28,000	
Administrative salaries	145,000	
Insurance expense	9,000	
Depreciation expense	76,000	
Total fixed expenses		468,000
Net operating income		$ 130,800

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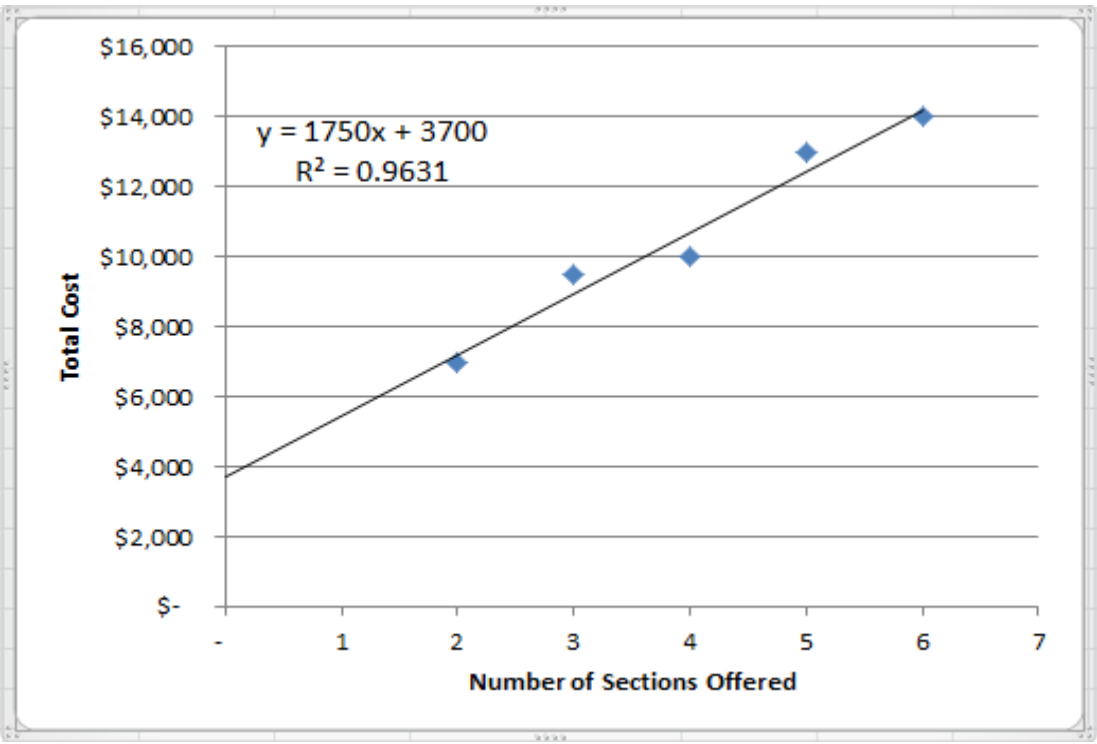
Problem 2A-10 (30 minutes)

1. and 2.

The scattergraph plot and regression estimates of fixed and variable costs using Microsoft Excel are shown below:



The cost formula, in the form $Y = a + bX$, using number of sections offered as the activity base is $3,700 per quarter plus $1,750 per section offered, or:

$$Y = \$3{,}700 + \$1{,}750X$$

Note that the R^2 is approximately 0.96, which means that 96% of the variation in cost is explained by the number of sections. This is a very high R^2 which indicates a very good fit.

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Problem 2A-10 (continued)

3. Expected total cost would be:

Fixed cost	$ 3,700
Variable cost (8 sections × $1,750 per section)	14,000
Total cost	$17,700

The problem with using the cost formula from (2) to derive total cost is that an activity level of 8 sections may lie outside the relevant range—the range of activity within which the fixed cost is approximately $3,700 per term and the variable cost is approximately $1,750 per section offered. These approximations appear to be reasonably accurate within the range of 2 to 6 sections, but they may be invalid outside this range.

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Case 2A-11 (60 minutes)

1. High-low method:

	Hours	*Cost*
High level of activity	25,000	$99,000
Low level of activity	10,000	64,500
Change	15,000	$34,500

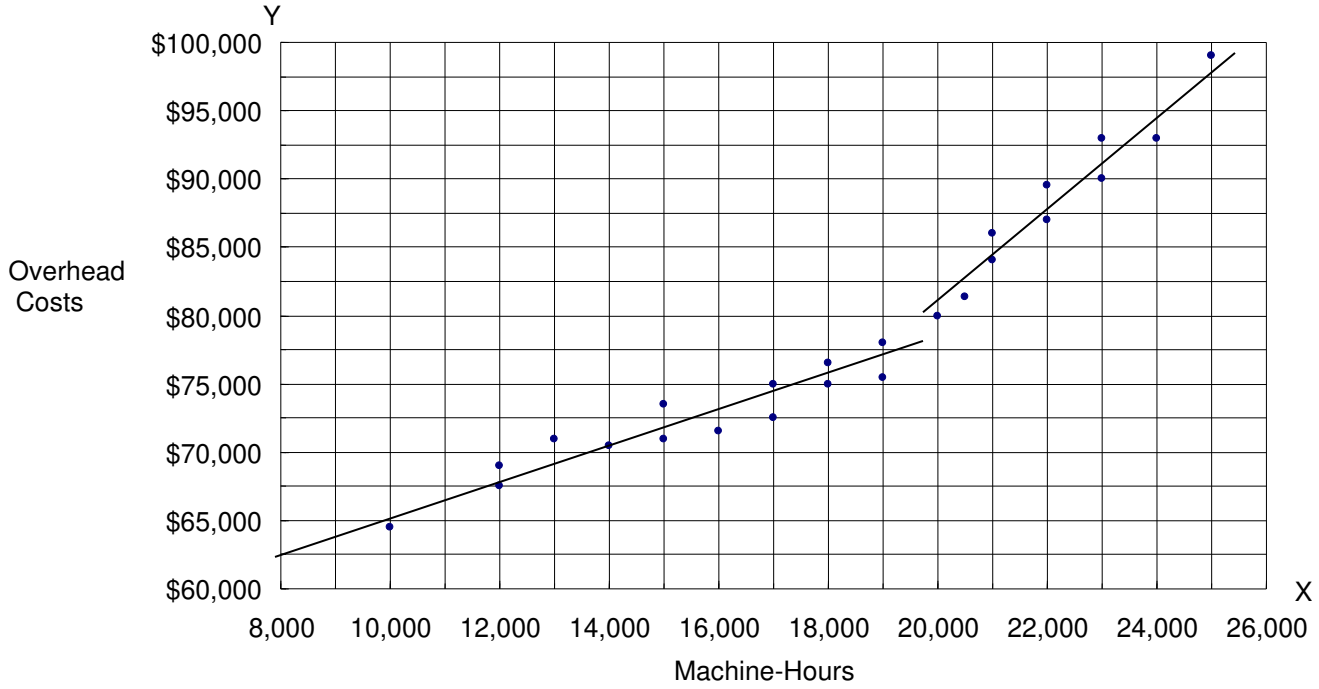
Variable element: $34,500 ÷ 15,000 DLH = $2.30 per MH

Fixed element:

Total cost—25,000 MH	$99,000
Less variable element:	
25,000 MH × $2.30 per MH	57,500
Fixed element.....	$41,500

Therefore, the cost formula is: Y = $41,500 + $2.30X

2. The scattergraph is shown below:



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Case 2A-11 (continued)

2. The scattergraph shows that there are two relevant ranges—one below 19,500 MH and one above 19,500 MH. The change in equipment lease cost from a fixed fee to an hourly rate causes the slope of the regression line to be steeper above 19,500 MH, and to be discontinuous between the fixed fee and hourly rate points.

3. The cost formulas computed with the high-low and regression methods are faulty since they are based on the assumption that a single straight line provides the best fit to the data. Creating two data sets related to the two relevant ranges will enable more accurate cost estimates.

4. High-low method:

	Hours	*Cost*
High level of activity	25,000	$99,000
Low level of activity	20,000	80,000
Change	5,000	$19,000

Variable element: $19,000 ÷ 5,000 MH = $3.80 per MH

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Fixed element:

Total cost—25,000 MH	$99,000
Less variable element:	
25,000 MH × $3.80 per MH	95,000
Fixed element.....	$4,000

Expected overhead costs when 22,500 machine-hours are used:

Variable cost: 22,500 hours × $3.80 per hour	$85,500
Fixed cost	4,000
Total cost.....	$89,500

5. The high-low estimate of fixed costs is $6,090 (= $10,090 – $4,000) lower than the estimate provided by least-squares regression. The high-low estimate of the variable cost per machine hour is $0.27 (= $3.80 – $3.53) higher than the estimate provided by least-squares regression. A straight line that minimized the sum of the squared errors would intersect the Y-axis at $10,090 instead of $4,000. It would also have a flatter slope because the estimated variable cost per unit is lower than the high-low method.

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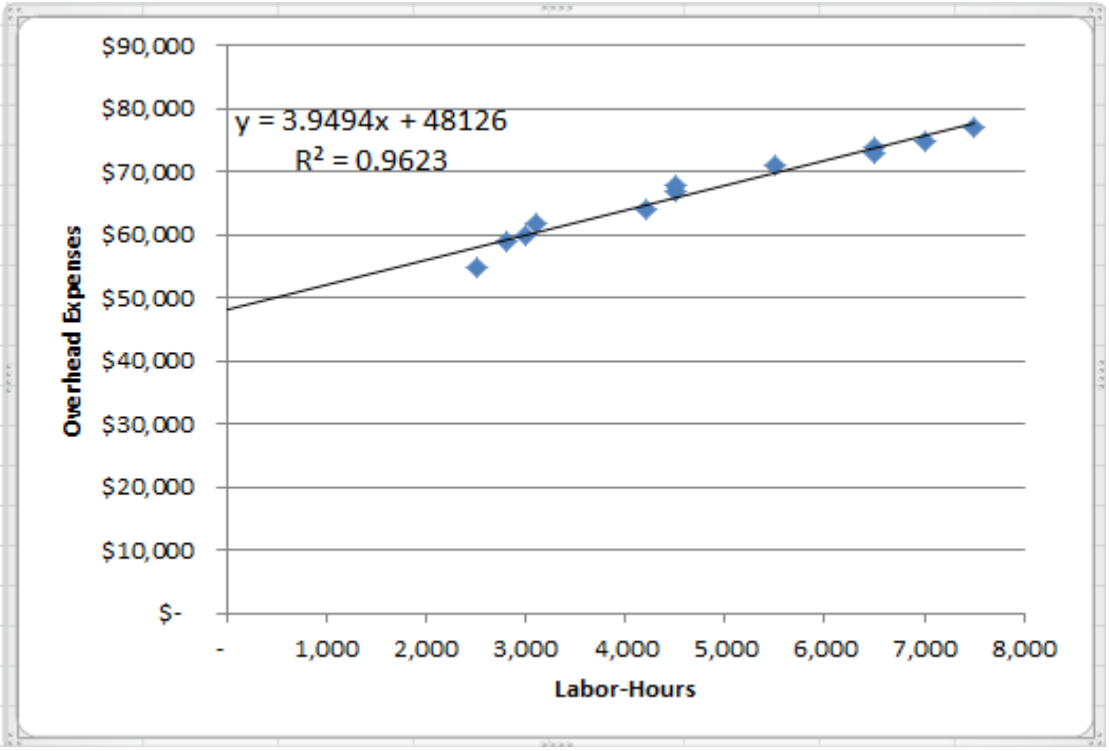
Case 2A-12 (45 minutes)

1. and 2.

The scattergraph plot and regression estimates of fixed and variable costs using Microsoft Excel are shown below:



The scattergraph reveals three interesting findings. First, it indicates the relation between overhead expense and labor hours is approximated reasonably well by a straight line. (However, there appears to be a slight downward bend in the plot as the labor-hours increase—evidence of increasing returns to scale. This is a common occurrence in practice. See Noreen & Soderstrom, "Are overhead costs strictly proportional to activity?" *Journal of Accounting and Economics*, vol. 17, 1994, pp. 252-278.)

Second, the data points are all fairly close to the straight line. This indicates that most of the variation in overhead expenses is explained by labor hours. As a consequence, there probably wouldn't be much benefit to investigating other possible cost drivers for the overhead expenses.

Third, most of the overhead expense appears to be fixed. Maria should ask herself if this is reasonable. Does the company have large fixed expenses such as rent, depreciation, and salaries?

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CASE 2A-12 (continued)

The cost formula, in the form $Y = a + bX$, using labor-hours as the activity base is $48,126 per month plus $3.95 per labor-hour, or:

$$Y = \$48,126 + \$3.95X$$

Note that the R^2 is approximately 0.96, which means that 96% of the variation in cost is explained by labor-hours. This is a very high R^2 which indicates a very good fit.

3. Using the least-squares regression estimate of the variable overhead cost, the total variable cost per guest is computed as follows:

Food and beverages.....	$15.00
Labor (0.5 hour @ $10 per hour).....	5.00
Overhead (0.5 hour @ $3.95 per hour)..	1.98
Total variable cost per guest.....	$21.98

The total contribution from 180 guests paying $31 each is computed as follows:

Sales (180 guests @ $31.00 per guest).....	$5,580.00
Variable cost (180 guests @ $21.98 per guest)...	3,956.40
Contribution to profit	$1,623.60

Fixed costs are not included in the above computation because there is no indication that any additional fixed costs would be incurred as a consequence of catering the cocktail party. If additional fixed costs were incurred, they should also be subtracted from revenue.

4. Assuming that no additional fixed costs are incurred as a result of catering the charity event, any price greater than the variable cost per guest of roughly $22 would contribute to profits.

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CASE 2A-12 (continued)

5. We would favor bidding slightly less than $30 to get the contract. Any bid above $22 would contribute to profits and a bid at the normal price of $31 is unlikely to land the contract. And apart from the contribution to profit, catering the event would show off the company's capabilities to potential clients. The danger is that a price that is lower than the normal bid of $31 might set a precedent for the future or it might initiate a price war among caterers. However, the price need not be publicized and the lower price could be justified to future clients because this is a charity event. Another possibility would be for Maria to maintain her normal price but throw in additional services at no cost to the customer. Whether to compete on price or service is a delicate issue that Maria will have to decide after getting to know the personality and preferences of the customer.

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I. Appendix 2A: Analyzing Mixed Costs (Slide 1 is the title slide)

2

A. **Mixed cost – A cost that contains both variable and fixed elements.**

i. For example, utility bills often contain fixed and variable cost components.

1. The fixed portion of the utility bill is constant regardless of kilowatt hours consumed. This cost represents the minimum cost that is incurred to have the service ready and available for use.
2. The variable portion of the bill varies in direct proportion to the consumption of kilowatt hours.

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3

B. **The analysis of mixed costs**

ii. Account analysis and the engineering approach

1. In **account analysis**, an account is classified as variable or fixed based on the analyst's prior knowledge about how cost in the account behaves.
   a. For example, direct materials would be classified as variable and a building lease cost would be classified as fixed because of the nature of those costs.

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2. The **engineering approach** involves a detailed analysis of what cost behavior should be based upon an industrial engineer's evaluation of production methods to be used, the material specifications, labor requirements, equipment usage, production efficiency, power consumption, and so on.

ii. **Diagnosing cost behavior with a scattergraph plot**

4

Learning Objective 10: Analyze a mixed cost using a scattergraph plot and the high-low method.

5

1. Background data relating to hours of maintenance work and total maintenance costs for six months is presented on this slide.

6

2. The first step in applying the high-low method or the least-squares regression method is to diagnose cost behavior with a scattergraph plot.
   a. The total maintenance cost, *Y*, is plotted on the *Y* vertical axis. Cost is known as the **dependent variable** because the amount of cost incurred during a period depends on the level of activity for the period.
   b. The activity, *X* (hours of maintenance here), is plotted on the horizontal axis. Activity is known as the **independent variable** because it causes variations in the cost.

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6

3. After plotting the data, examine the points on the scattergraph to see if the points lie more or less along a straight line that slopes upward and to the right.
   a. **Linear cost behavior** exists whenever a straight line is a reasonable approximation for the relation between cost and activity.
   b. If the scattergraph plot does not depict linear cost behavior, then it makes no sense to proceed any further in analyzing the data.
   c. In this example, the dots are linear so we can proceed to the high-low method.

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7

iii. An equation can be used to express the relationship between mixed costs and the level of the activity. This equation can be used to calculate what the total mixed cost would be for any level of activity.

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1. The equation is $Y = a + bX$
   a. Y = The total mixed cost.
   b. a = The total fixed cost (the vertical intercept of the line).
   c. b = The variable cost per unit of activity (the slope of the line).
   d. X = The level of activity.

8

2. For example, if your fixed monthly utility charge is **$40**, your variable cost is **$0.03 per kilowatt hour**, and your monthly activity level was **2,000 kilowatt hours**, this equation can be used to calculate your total utility cost of **$100**.

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9

iv. The **high-low method**

1. This method can be used to analyze mixed costs if a scattergraph plot reveals a linear relationship between the *X* and *Y* variables. Let's continue with our data from the scattergraph plot.
2. The first step is to choose the data points pertaining to the highest and lowest activity levels (high = **850** units; low = **450** units).
   a. Notice that this method relies on two data points to estimate the fixed and variable portions of a mixed cost.
3. The second step is to determine the total costs associated with the two chosen points (high = **$9,800**; low = **$7,400**).

Helpful Hint: Emphasize that the high and low points are identified by the level of activity and not by the level of the cost.

9

4. The third step is to calculate the change in cost between the two data points (**$2,400**) and divide it by the change in activity level between the two data points (**400** units).
   a. The quotient represents an estimate of variable cost per unit of activity (**$6.00 per unit**).

10

5. The fourth step is to take the total cost at either activity level (in this case, **$9,800**) and deduct the variable cost component (**$5,100**). The residual represents the estimate of total fixed costs (**$4,700**).

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10

a. The variable cost component (**$5,100**) is determined by multiplying the level of activity (**850 units**) by the estimated variable cost per unit of the activity (**$6.00 per unit**).

11

6. The fifth step is to construct an equation that can be used to estimate the total cost at any activity level (**Y = $4,700 + $6.00X**).

12-15

Quick Check – the high-low method

v. The **least-squares regression method**

16

Learning Objective 11: Analyze a mixed cost using a scattergraph plot and the least-squares regression method.

17

1. Unlike the high-low method, the **least squares regression method** uses **all of the data** to separate a mixed cost into its fixed and variable components.
2. The basic goal of this method is to fit a straight line to the data that **minimizes the sum of the squared errors**. The regression errors are the deviations from the plotted points to the regression line and are measured vertically on the graph.
3. The formulas that are used for least-squares regression are complex. Fortunately, Excel can be used to estimate the intercept (fixed cost) and slope (variable cost per unit) that minimize the sum of the squared errors.

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18

a. Excel also provides a statistic called the R^2, which is a measure of "goodness of fit."
b. The R^2 tells us the percentage of the variation in the dependent variable (cost) that is explained by variation in the independent variable (activity). It varies from 0% to 100%; the higher the percentage, the better.

19

4. The least-squares regression method uses all of the data and generates a regression line of the form $Y = a + bX$ fitted to the data.
   a. The intercept a represents the estimated fixed cost.
   b. The slope b represents the estimated variable cost per unit of activity.
   c. The R^2 indicates that percent of the variation in the cost that is explained by the variation in the activity.

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20

5. The high-low and least-squares regression methods provide **different estimates** of the fixed and variable cost components of a mixed cost.
   a. This is to be expected because each method uses differing amounts of the data points to provide estimates.
   b. Least-squares regression provides the most accurate estimates because it uses all of the data points.

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Chapter 2 Lecture Notes

1 Chapter theme: Cost-volume-profit (CVP) analysis helps managers understand the interrelationships among **cost, volume, and profit** by focusing their attention on the interactions among the **prices** of products, **volume** of activity, **per unit variable costs**, **total fixed costs**, and **mix** of products sold. It is a vital tool used in many business decisions such as deciding what products and services to offer, what prices to charge, what marketing strategy to use, and what cost structure to maintain.

I. Assumptions of CVP analysis

2 A. **Three key assumptions** underlie CVP analysis:

i. Selling price is **constant**.

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ii. Costs are **linear** and can be accurately divided into variable and fixed components. The variable costs are **constant** per unit, and the fixed costs are **constant** in total over the entire relevant range.

iii. In multiproduct companies, the mix of products sold remains **constant**.

Helpful Hint: Point out that nothing is sacred about these assumptions. When violations of these assumptions are significant, managers can and do modify the basic CVP model. Spreadsheets allow practical models that incorporate more realistic assumptions. For example, nonlinear cost functions with step fixed costs can be modeled using "If…Then" functions.

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II. The basics of cost-volume-profit (CVP) analysis

3 *Learning Objective 1: Explain how changes in sales volume affect contribution margin and net operating income.*

4 A. **The contribution format income statement** is helpful to managers in judging the impact on profits of changes in selling price, cost, or volume. For example, let's look at a hypothetical contribution format income statement for Racing Bicycle Company (RBC). Notice:

i. The **emphasis is on cost behavior**. Variable expenses are separate from fixed expenses.

ii. The **contribution margin** is defined as the amount remaining from sales revenue after variable expenses have been deducted.

5 iii. Contribution margin is used first to cover **fixed expenses**. Any remaining contribution margin contributes to **net operating income**.

6 iv. Sales, variable expenses, and contribution margin can also be expressed on a **per unit basis**. Thus:

1. For each additional unit RBC sells, **$200** more in contribution margin will help to cover fixed expenses and provide a profit.

7 2. Notice, each month RBC must generate at least $80,000 in total contribution margin to **break-even (which is the level of sales at which profit is zero)**.

8 3. Therefore, if RBC sells **400 units** a month, it will be operating at the **break-even point**.

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9 4. If RBC sells one more bike (**401 bikes**), net operating income will increase by **$200**.

10 v. You do not need to prepare an income statement to estimate profits at a particular sales volume. Simply multiply the number of units sold above break-even by the contribution margin per unit.

1. For example, if RBC sells **430 bikes**, its net operating income will be **$6,000**.

11 B. **CVP relationships in equation form** (for those who prefer an algebraic approach to solving problems in the chapter)

i. The contribution format income statement can be expressed in equation form as shown on this slide.

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12 1. This equation can be used to show the profit RBC earns if it sells **401 bikes**. Notice, the answer of **$200** mirrors our earlier solution.

13 ii. When a company has only one product we can further refine this equation as shown on this slide.

14 1. This equation can also be used to show the $200 profit RBC earns if it sells **401 bikes**.

15 iii. The profit equation can also be expressed in terms of **unit contribution margin** as shown on this slide.

16 1. This equation can also be used to compute RBC's **$200** profit if it sells **401 bikes**.

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17 *Learning Objective 2: Prepare and interpret a cost-volume-profit (CVP) graph and a profit graph.*

18 C. **CVP relationships in graphic form**

i. The relationships among revenue, cost, profit, and volume can be expressed graphically by preparing a cost-volume-profit (CVP) graph. To illustrate, we will use contribution format income statements for RBC at **0**, **200**, **400**, and **600** units sold.

Helpful Hint: Mention to students that the graphic form of CVP analysis may be preferable to them if they are uncomfortable with algebraic equations.

ii. A CVP graph can be prepared in **four steps**.

19 1. In a CVP graph, **unit volume** is represented on the **horizontal (X) axis** and **dollars** on the **vertical (Y) axis**.

20 2. Draw a line parallel to the volume axis to represent total fixed expenses.

21 3. Choose some sales volume (e.g., **400 units**) and plot the point representing total expenses (e.g., fixed and variable) at that sales volume. Draw a line through the data point back to where the fixed expenses line intersects the dollar axis.

22 4. Choose some sales volume (e.g., **400 units**) and plot the point representing total sales dollars at the chosen activity level. Draw a line through the data point back to the origin.

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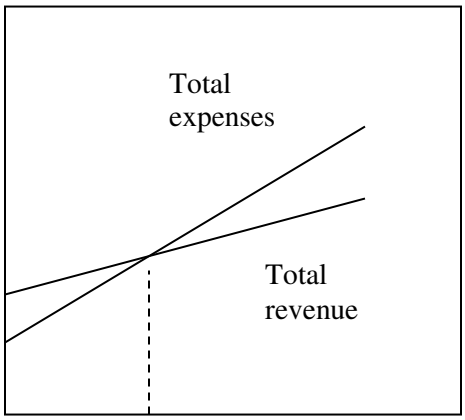
iii. **Interpreting the CVP graph**.

1. The **break-even point** is where the total revenue and total expense lines intersect.
2. The **profit or loss** at any given sales level is measured by the vertical distance between the total revenue and the total expense lines.

Helpful Hint: Ask students what the CVP graph would look like for a public agency like a county hospital receiving a fixed budget each year and collecting fees less than its variable costs. It would look like this:



This is the reverse of the usual situation. If such an organization has volume above the break-even point, it will experience financial difficulties.

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24 iv. An even simpler form of the CVP graph is called the **profit graph**. The profit graph is based on the equation shown on this slide.

1. To plot the graph, compute the profit at two different sales volumes, plot the points, and then connect them with a straight line. This slide contains the profit graph for RBC. Notice:
   a. The sales volumes plotted on this graph are **300** and **500** bikes.
   25 b. The breakeven point is **400** bikes.

D. **Contribution margin ratio (CM ratio) and the variable expense ratio**

26 *Learning Objective 3: Use the contribution margin ratio (CM ratio) to compute changes in contribution margin and net operating income resulting from changes in sales volume.*

27 i. The CM ratio is calculated by dividing the **total** contribution margin by **total** sales.

1. For RBC, the CM ratio is **40%**. Thus, each $1.00 increase in sales results in a total contribution margin increase of 40¢.

28 ii. The CM ratio can also be calculated by dividing the contribution margin **per unit** by the selling price **per unit**.

1. For RBC, the CM ratio is **40%**.

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29 iii. Similarly, variable expenses as a percentage of sales is referred to as the **variable expense ratio.**

1. For RBC, the variable expense ratio is **60%**.

30 iv. The contribution margin ratio and the variable expense ratio can be mathematically related to one another: CM ratio = 1 – Variable expense ratio.

31 v. If RBC increases sales from 400 to 500 bikes, the increase in contribution margin (**$20,000**) can be calculated by multiplying the increase in sales (**$50,000**) by the CM ratio (**40%**).

32-33 *Quick Check – contribution margin ratio*

34 vi. The relation between profit and the CM ratio can also be expressed in terms of the equation shown on this slide.

1. For example, we can use this equation to calculate RBC's profit of **$20,000** at a volume of **500 bikes**.

E. **Additional applications of CVP concepts**

35 *Learning Objective 4: Show the effects on net operating income of changes in variable costs, fixed costs, selling price, and sales volume.*

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Helpful Hint: The five examples that are forthcoming should indicate to students the range of uses of CVP analysis. In addition to assisting management in determining the level of sales that is needed to break-even or generate a certain dollar amount of profit, the examples illustrate how the results of alternative decisions can be quickly determined.

i. **Change in fixed cost and sales volume.**

36 1. What is the profit impact if RBC can increase unit sales from 500 to 540 by increasing the monthly advertising budget by $10,000?

37 a. Preparing a contribution format income statement reveals a **$2,000 decrease** in profits.

38 b. A shortcut solution using **incremental analysis** also reveals a $2,000 decrease in profits.

ii. **Change in variable costs and sales volume**.

39 1. What is the profit impact if RBC can use higher quality raw materials, thus increasing variable costs per unit by $10, to generate an increase in unit sales from 500 to 580?

40 a. The contribution format income statement reveals a **$10,200 increase** in profits.

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41 iii. **Change in fixed cost, sales price, and sales volume**.

1. What is the profit impact if RBC: (1) cuts its selling price $20 per unit, (2) increases its advertising budget by $15,000 per month, and (3) increases unit sales from 500 to 650 units per month?

42 a. The contribution format income statement reveals a **$2,000 increase** in profits.

43 iv. **Change in variable cost, fixed cost, and sales volume.**

1. What is the profit impact if RBC: (1) pays a $15 sales commission per bike sold instead of paying salespersons flat salaries that currently total $6,000 per month, and (2) increases unit sales from 500 to 575 bikes?

44 a. The contribution format income statement reveals a **$12,375 increase** in profits.

45 v. **Change in selling price.**

1. If RBC has an opportunity to sell 150 bikes to a wholesaler without disturbing sales to other customers or fixed expenses, what price should it quote to the wholesaler if it wants to increase monthly profits by $3,000?

46 a. The price quote should be **$320 per bike**.

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III. Break-even and target profit analysis

47 *Learning Objective 5: Determine the break-even point.*

48 A. The equation and formula methods can be used to determine the unit sales and dollar sales needed to achieve a target profit of zero. For example, let's revisit the information from RBC:

49 i. Suppose RBC wants to know how many bikes must be sold to break-even (i.e., earn a target profit of $0). The equation shown on this slide can be used to answer this question.

50 1. The **equation method** reveals that **400 bikes** must be sold to breakeven.

51 2. The **formula method** can also be used to determine that **400 bikes** must be sold to breakeven.

52 ii. Suppose RBC wants to compute the sales dollars required to break-even (i.e., earn a target profit of **$0**). The equation shown here can be used to answer this question.

53 1. The **equation method** reveals that sales of **$200,000** will enable the company to break-even.

54 2. The **formula method** can also be used to determine that sales of **$200,000** will enable the company to break-even.

55-58 *Quick Check – break-even calculations*

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B. **Target profit analysis**

59 *Learning Objective 6: Determine the level of sales needed to achieve a desired target profit.*

60 i. In **target profit analysis**, we estimate what sales volume is needed to achieve a specific target profit. We can compute the number of **units** that must be sold to attain a target profit using either the **equation method** or the **formula method**.

61
1. The **equation method** is summarized on this slide**.** Our goal is to solve for the unknown "Q" which represents the quantity of units that must be sold to attain the target profit.
2. For example: Suppose RBC wants to know how many bikes must be sold to earn a target profit of $100,000.
   a. The **equation method** can be used to determine that **900 bikes** must be sold to earn the desired target profit.

62
   b. The formula method is summarized on this slide. It can also be used to compute the quantity of units that must be sold to attain a target profit.

63
3. For example: Suppose RBC wants to know how many bikes must be sold to earn a target profit of $100,000.
   a. The **formula method** can be used to determine that **900 bikes** must be sold to earn the desired target profit.

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64 ii. We can also compute the target profit in terms of **sales dollars** using either the **equation method** or the **formula method**.

65
1. The **equation method** is summarized on this slide**.** Our goal is to solve for the unknown "Sales," which represents the dollar amount of sales that must be sold to attain the target profit.
2. For example: Suppose RBC wants to compute the sales dollars required to earn a **target profit of $100,000**.
   a. The **equation method** can be used to determine that sales must be **$450,000** to earn the desired target profit.

66
   b. The **formula method** is summarized on this slide. It can also be used to compute the dollar sales needed to attain a target profit.

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67-70 *Quick Check – target profit calculations*

C. The margin of safety

71 *Learning Objective 7: Compute the margin of safety and explain its significance.*

72 i. The margin of safety in dollars is the **excess of budgeted (or actual) sales over the break-even volume of sales**.

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73 1. For example: If we assume that RBC has actual sales of $250,000, given that we have already determined the break-even sales to be $200,000, the **margin of safety** is **$50,000**.

74 2. The margin of safety can be expressed as a percent of sales.
   a. For example: RBC's **margin of safety** is **20% of sales**.

75 3. The margin of safety can be expressed in terms of the number of units sold.
   a. For example: RBC's **margin of safety** is **100 bikes**.

76-77 *Quick Check – margin of safety calculations*

IV. CVP considerations in choosing a cost structure

A. Cost structure and profit stability

78 i. **Cost structure** refers to the relative proportion of fixed and variable costs in an organization. Managers often have some latitude in determining their organization's cost structure.

79 ii. There are **advantages and disadvantages** to high fixed cost (or low variable cost) and low fixed cost (or high variable cost) structures.

   1. An advantage of a high fixed cost structure is that income will be higher in good years compared to companies with a lower proportion of fixed costs.

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2. A disadvantage of a high fixed cost structure is that income will be lower in bad years compared to companies with a lower proportion of fixed costs.
3. Companies with low fixed cost structures enjoy greater stability in income across good and bad years.

80

Learning Objective 8: Compute the degree of operating leverage at a particular level of sales and explain how it can be used to predict changes in net operating income.

B. **Operating leverage**

81

i. Operating leverage is a measure of **how sensitive net operating income is to percentage changes in sales**. TBEXAM.COM

i. The degree of operating leverage is a measure, at any given level of sales, of how a percentage change in sales volume will affect profits. It is computed as shown on this slide.

82

ii. To illustrate, let's revisit the contribution format income statement for RBC:

1. RBC's degree of operating leverage is **5** ($100,000/$20,000).

83

2. With an operating leverage of 5, if RBC increases its sales by 10%, net operating income would increase by **50%**.

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84 a. The 50% increase can be verified by preparing a contribution approach income statement.

85-89 *Quick Check – operating leverage calculations*

Helpful Hint: Emphasize that the degree of operating leverage is not a constant like unit variable cost or unit contribution margin that a manager can apply with confidence in a variety of situations. The degree of operating leverage depends on the level of sales and must be recomputed each time the sales level changes. Also, note that operating leverage is greatest at sales levels near the break-even point and it decreases as sales and profits rise.

V. Structuring sales commissions

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90 A. Companies generally compensate salespeople by paying them either a commission based on sales or a salary plus a sales commission. **Commissions based on sales dollars can lead to lower profits in a company.** Consider the following illustration:

91 i. Pipeline Unlimited produces two types of surfboards, the XR7 and the Turbo. The XR7 sells for **$100** and generates a contribution margin per unit of **$25**. The Turbo sells for **$150** and earns a contribution margin per unit of **$18**.

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92

ii. Salespeople compensated based on sales commission will push hard to sell the Turbo even though the XR7 earns a higher contribution margin per unit.

iii. To eliminate this type of conflict, **commissions can be based on contribution margin** rather than on selling price alone.

VI. Sales mix

93

Learning Objective 9: Compute the break-even point for a multiproduct company and explain the effects of shifts in the sales mix on contribution margin and the break-even point.

94

A. The term **sales mix** refers to the relative proportions in which a company's products are sold. Since different products have different selling prices, variable costs, and contribution margins, when a company sells more than one product, break-even analysis becomes more complex as the following example illustrates:

Helpful Hint: Mention that these calculations typically assume a constant sales mix. The rationale for this assumption can be explained as follows. To use simple break-even and target profit formulas, we must assume the firm has a single product. So we do just that – even for multi-product companies. The trick is to assume the company is really selling baskets of products and each basket **always contains the various products in the same proportions.**

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95 i. Assume the RBC sells bikes and carts. The bikes comprise 45% of the company's total sales revenue and the carts comprise the remaining 55%. **The contribution margin ratio for both products combined is 48.2% (rounded)**.

96 ii. The break-even point in sales would be **$352,697**. The bikes would account for 45% of this amount, or **$158,714**. The carts would account for 55% of the break-even sales, or **$193,983**.

1. Notice a slight rounding error of **$176**.

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