

CHAPTER 5

Cost-Volume-Profit

SOLUTIONS TO BRIEF EXERCISES

BRIEF EXERCISE 5-1

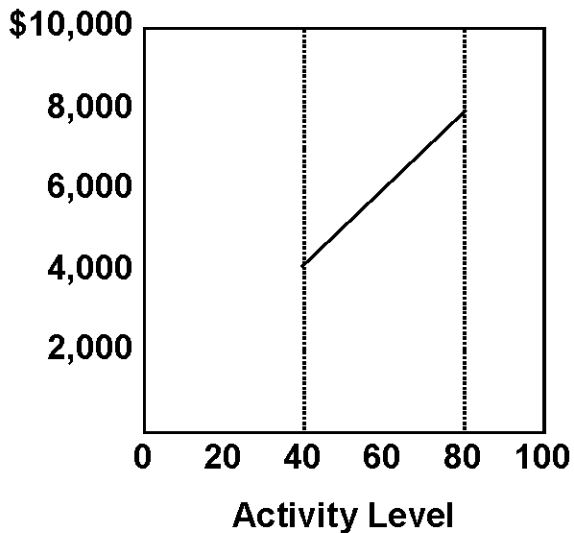
Indirect labor is a variable cost because it increases in total directly and proportionately with the change in the activity level.

Supervisory salaries is a fixed cost because it remains the same in total regardless of changes in the activity level.

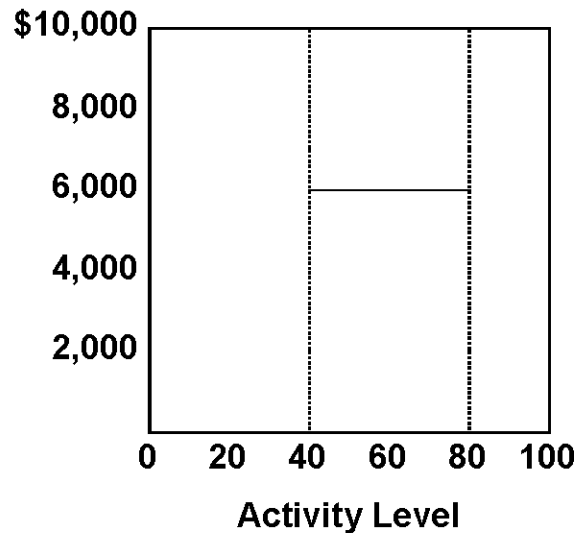
Maintenance is a mixed cost because it increases in total but not proportionately with changes in the activity level.

BRIEF EXERCISE 5-2

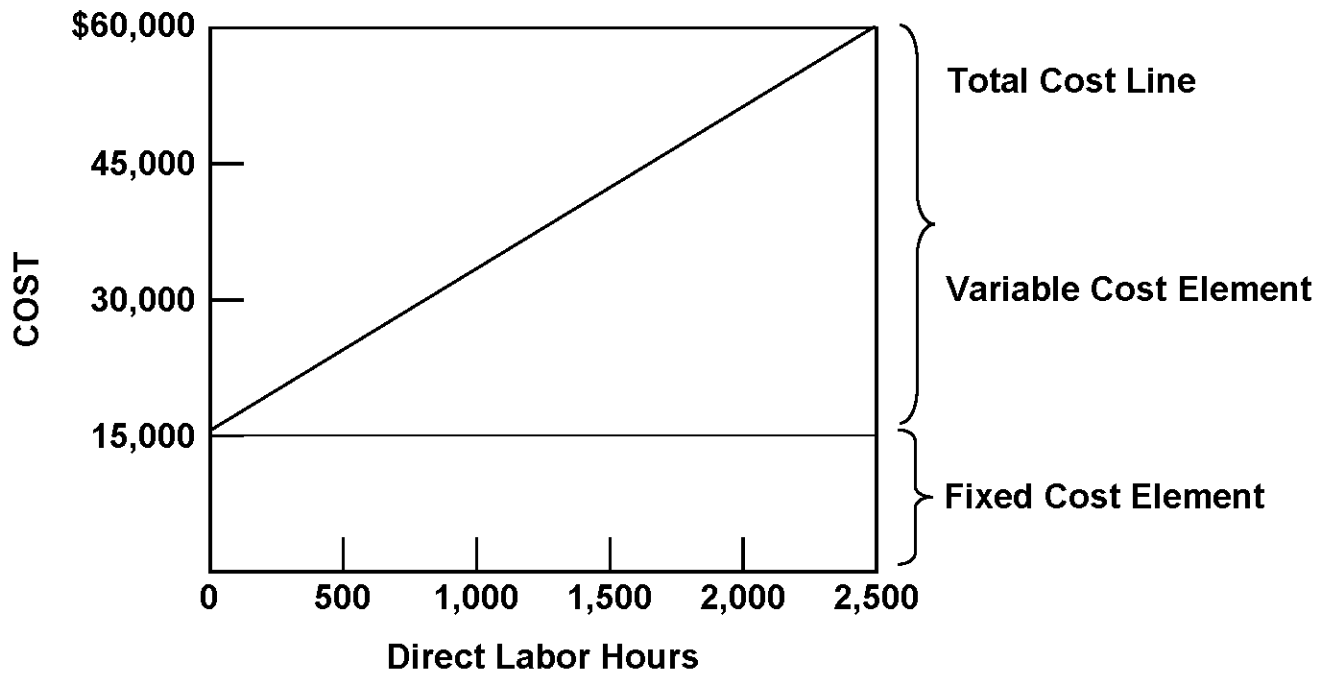
VARIABLE COST
Relevant Range



FIXED COST
Relevant Range



BRIEF EXERCISE 5-3



BRIEF EXERCISE 5-4

High	Low	Difference
\$15,000	\$13,500	\$1,500
8,500	7,500	1,000

$\$1,500 \div 1,000 = \1.50 —Variable cost per mile.

	High	Low
Total cost	\$15,000	\$13,500
Less: Variable costs		
8,500 X \$1.50	12,750	
7,500 X \$1.50		11,250
Total fixed costs	<u>\$ 2,250</u>	<u>\$ 2,250</u>

The mixed cost is \$2,250 plus \$1.50 per mile.

BRIEF EXERCISE 5-5

<u>High</u>	<u>Low</u>	<u>Difference</u>
<u>\$74,500</u>	<u>– \$36,000</u>	<u>= \$38,500</u>
40,000	– 18,000	= 22,000

$\$38,500 \div 22,000 = \1.75 per unit.

	<u>Activity Level</u>	
	<u>High</u>	<u>Low</u>
Total cost	\$74,500	\$36,000
Less: Variable costs		
40,000 X \$1.75	70,000	
18,000 X \$1.75		<u>31,500</u>
Total fixed costs	<u>\$ 4,500</u>	<u>\$ 4,500</u>

BRIEF EXERCISE 5-6

1. (a) $\$288 = (\$640 - \$352)$
 (b) $45\% (\$288 \div \$640)$
2. (c) $\$207 = (\$300 - \$93)$
 (d) $31\% (\$93 \div \$300)$
3. (e) $\$1,300 = (\$325 \div 25\%)$
 (f) $\$975 (\$1,300 - \$325)$

BRIEF EXERCISE 5-7

RUSSELL INC.
CVP Income Statement
 For the Quarter Ended March 31, 2017

Sales.....	\$2,200,000
Variable costs (\$920,000 + \$70,000 + \$86,000)	1,076,000
Contribution margin	<u>1,124,000</u>
Fixed costs (\$440,000 + \$45,000 + \$98,000).....	583,000
Net income	<u>\$ 541,000</u>

BRIEF EXERCISE 5-8

(a) $\$520Q - \$286Q - \$163,800 = \0
 $\$234Q = \$163,800$
 $Q = 700 \text{ units}$

(b) Contribution margin per unit \$234, or $(\$520 - \$286)$
 $X = \$163,800 \div \234
 $X = 700 \text{ units}$

BRIEF EXERCISE 5-9

Contribution margin ratio = $[(\$300,000 - \$180,000) \div \$300,000] = 40\%$
Required sales in dollars = $\$110,000 \div 40\% = \$275,000$

BRIEF EXERCISE 5-10

If variable costs are 70% of sales, the contribution margin ratio is $(\$1 - \$0.70) \div \$1 = .30$.
Required sales in dollars = $(\$195,000 + \$75,000) \div .30 = \$900,000$

BRIEF EXERCISE 5-11

Margin of safety = $\$1,000,000 - \$800,000 = \$200,000$
Margin of safety ratio = $\$200,000 \div \$1,000,000 = 20\%$

BRIEF EXERCISE 5-12

Contribution margin per unit \$1.60 is $(\$6.00 - \$4.40)$
Required sales in units = $(\$480,000 + \$1,500,000) \div \$1.60 = 1,237,500$.

SOLUTIONS FOR DO IT! REVIEW EXERCISES

DO IT! 5-1

Variable costs: Indirect labor, direct labor, and direct materials.

Fixed costs: Property taxes and depreciation.

Mixed costs: Utilities and maintenance.

DO IT! 5-2

(a) Variable cost: $(\$18,580 - \$16,200) \div (10,500 - 8,800) = \1.40 per unit

Fixed cost: $\$18,580 - (\$1.40 \times 10,500 \text{ units}) = \$3,880$

or $\$16,200 - (\$1.40 \times 8,800) = \$3,880$

(b) Total cost to produce 9,200 units: $\$3,880 + (\$1.40 \times 9,200) = \$16,760$

DO IT! 5-3

Cedar Grove Industries
CVP Income Statement
For the Month Ended May 31, 2017

	<u>Total</u>	<u>Per Unit</u>
Sales	\$360,000	\$45
Variable costs	<u>176,000</u>	<u>22</u>
Contribution margin	184,000	<u>\$23</u>
Fixed costs	<u>120,000</u>	
Net income	<u>\$ 64,000</u>	

DO IT! 5-4

(a) The formula is $\$250Q - \$170Q - \$160,000 = 0$. Therefore, $80Q = \$160,000$, and the breakeven point in units is 2,000 ($\$160,000 \div \80).

(b) The contribution margin per unit is $\$80$ ($\$250 - \170). The formula therefore is $\$160,000 \div \80 , and the breakeven point in units is 2,000.

DO IT! 5-5

(a) **CM per unit = Unit selling price – Unit variable costs**

$$\$12 = \$30 - \$18$$

CM ratio = CM per unit/Unit selling price

$$40\% = \$12/\$30$$

Break-even point in dollars = Fixed costs ÷ Contribution margin ratio

$$= \$220,000 \div 40\%$$

$$= \$550,000$$

(b) **Margin of safety = $\frac{\text{Actual sales} - \text{Break-even sales}}{\text{Actual sales}}$**

$$= \frac{\$800,000 - \$550,000}{\$800,000}$$

$$= 31.25\%$$

(c) **Sales – Variable costs – Fixed costs = Net income**

$$\$30Q - \$18Q = \$220,000 + \$140,000$$

$$\$12Q = \$360,000$$

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

$$30,000 \text{ units} \times \$30 = \$900,000 \text{ required sales}$$

SOLUTIONS TO EXERCISES

EXERCISE 5-1

- (a) The determination as to whether a cost is variable, fixed, or mixed can be made by comparing the cost in total or on a per-unit basis at two different levels of production.

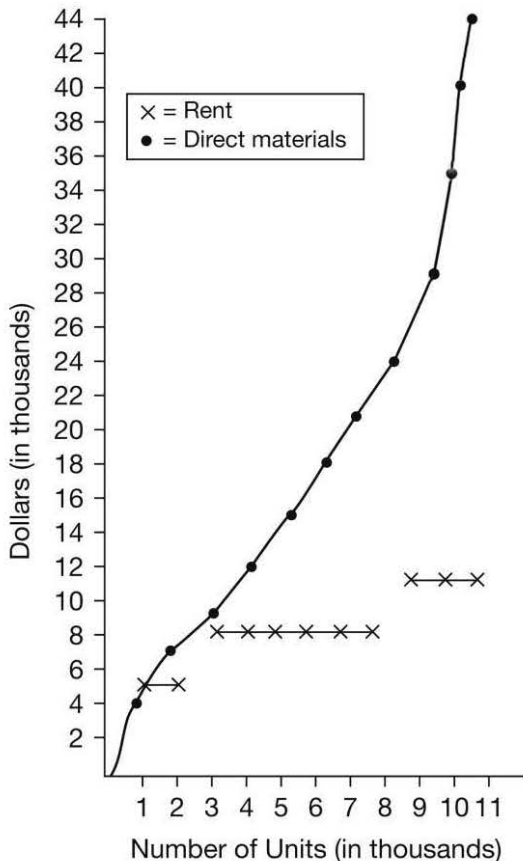
Variable Costs Vary in total but remain constant on a per-unit basis.
Fixed Costs Remain constant in total but vary on a per-unit basis.
Mixed Costs Contain both a fixed element and a variable element.
 Vary both in total and on a per-unit basis.

- (b) Using these criteria as a guideline, the classification is as follows:

Direct materials	Variable	Rent	Fixed
Direct labor	Variable	Maintenance	Mixed
Utilities	Mixed	Supervisory salaries	Fixed

EXERCISE 5-2

- (a)



EXERCISE 5-2 (Continued)

- (b) The relevant range is 3,000 – 8,000 units of output since a straight-line relationship exists for both direct materials and rent within this range.
- (c) Variable cost per unit

$$\begin{aligned} \text{Within the relevant range} & & & = & \frac{\text{Cost}}{\text{Units}} \\ \text{(3,000 – 8,000 units)} & & & = & \frac{\$15,000^*}{5,000^*} = \$3 \text{ per unit} \end{aligned}$$

*Any costs and units within the relevant range could have been used to calculate the same unit cost of \$3.

- (d) Fixed cost within the relevant range = \$8,000
(3,000 – 8,000 units)

EXERCISE 5-3

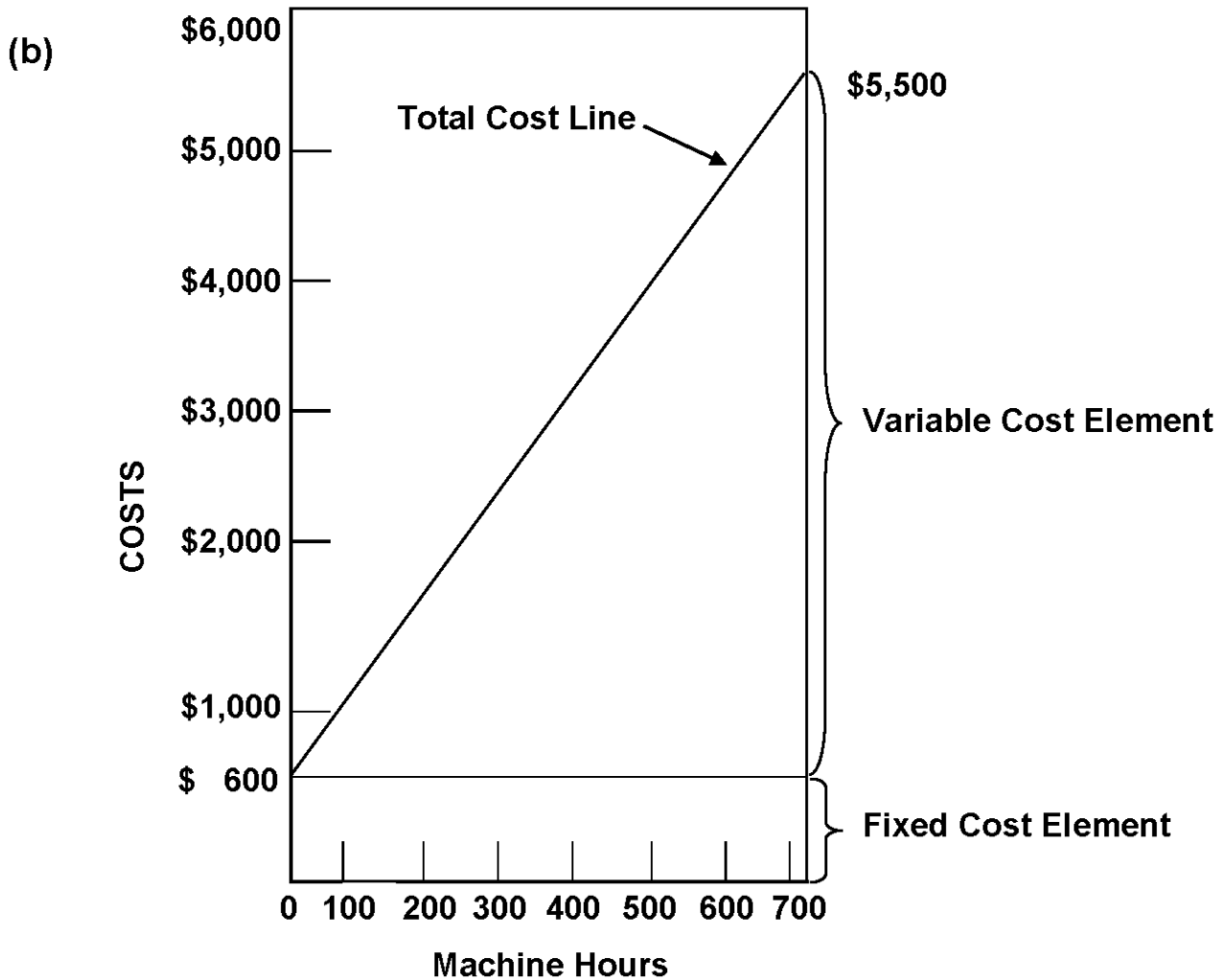
- (a) Maintenance Costs:

$$\frac{\$5,500 - \$2,700}{700 - 300} = \frac{\$2,800}{400} = \$7 \text{ variable cost per machine hour}$$

	<u>700 Machine Hours</u>	<u>300 Machine Hours</u>
Total costs	\$5,500	\$2,700
Less: Variable costs		
700 X \$7	4,900	
300 X \$7		<u>2,100</u>
Total fixed costs	<u>\$ 600</u>	<u>\$ 600</u>

Thus, maintenance costs are \$600 per month plus \$7 per machine hour.

EXERCISE 5-3 (Continued)



EXERCISE 5-4

- | | |
|----------------------------------------------------|-----------|
| 1. Wood used in the production of furniture. | Variable. |
| 2. Fuel used in delivery trucks. | Variable. |
| 3. Straight-line depreciation on factory building. | Fixed. |
| 4. Screws used in the production of furniture. | Variable. |
| 5. Sales staff salaries. | Fixed. |
| 6. Sales commissions. | Variable. |
| 7. Property taxes. | Fixed. |
| 8. Insurance on buildings. | Fixed. |
| 9. Hourly wages of furniture craftsmen. | Variable. |
| 10. Salaries of factory supervisors. | Fixed. |
| 11. Utilities expense. | Mixed. |
| 12. Telephone bill. | Mixed. |

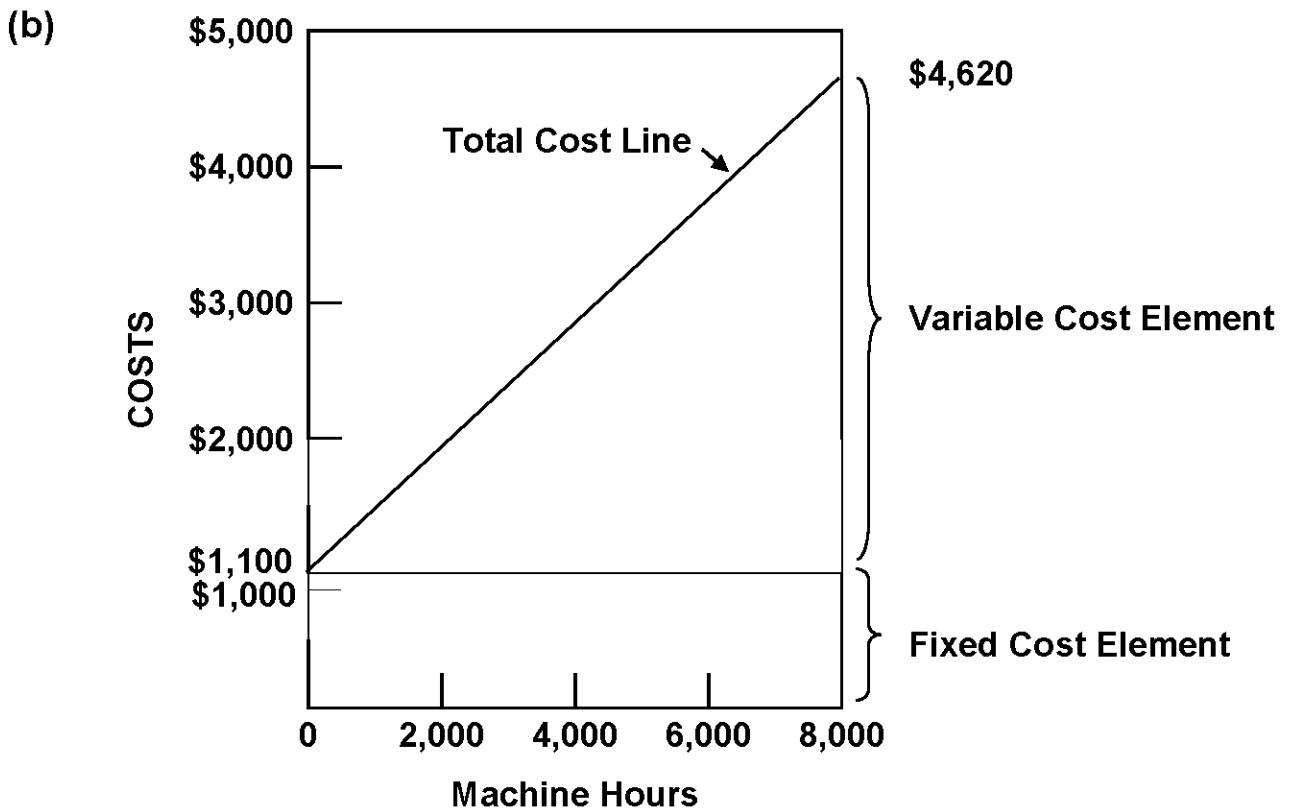
EXERCISE 5-5

(a) Maintenance Costs:

$$\frac{\$4,620 - \$2,640}{8,000 - 3,500} = \frac{\$1,980}{4,500} = \$0.44 \text{ variable cost per machine hour}$$

	Activity Level	
	High	Low
Total cost	\$4,620	\$2,640
Less: Variable costs		
8,000 X \$.44	3,520	
3,500 X \$.44		<u>1,540</u>
Total fixed costs	<u>\$1,100</u>	<u>\$1,100</u>

Thus, maintenance costs are \$1,100 per month plus \$.44 per machine hour.



EXERCISE 5-6

(a) <u>Cost</u>	<u>Fixed</u>	<u>Variable</u>	<u>Mixed</u>
Direct materials		X	
Direct labor		X	
Utilities			X
Property taxes	X		
Indirect labor		X	
Supervisory salaries	X		
Maintenance			X
Depreciation	X		

(b) Fixed costs = \$1,000 + \$1,900 + \$2,400 + \$300 + \$200
= \$5,800

Variable costs to produce 3,000 units = \$7,500 + \$18,000 + \$4,500
= \$30,000

Variable cost per unit = \$30,000/3,000 units
= \$10 per unit

Variable cost portion of mixed cost = Total cost – Fixed portion

Utilities:

Variable cost to produce 3,000 units = \$2,100 – \$300
= \$1,800

Variable cost per unit = \$1,800/3,000 units
= \$.60 per unit

Maintenance:

Variable cost to produce 3,000 units = \$1,100 – \$200
= \$900

Variable cost per unit = \$900/3,000 units
= \$.30 per unit

Cost to produce 5,000 units = (Variable costs per unit X 5,000 units) + Fixed cost
= ((\$10 + \$.60 + \$.30) X 5,000) + \$5,800
= \$54,500 + \$5,800
= \$60,300

EXERCISE 5-7

MEMO

To: Marty Moser

From: Student

Re: Assumptions underlying CVP analysis

CVP analysis is a useful tool in analyzing the effects of changes in costs and volume on a company's profits. However, there are some assumptions which underlie CVP analysis. When these assumptions are not valid, the results of CVP analysis may be inaccurate.

The five assumptions are:

1. The behavior of both costs and revenues is linear throughout the relevant range of the activity index.
2. Costs can be classified accurately as either fixed or variable.
3. Changes in activity are the only factors that affect costs.
4. All units produced are sold.
5. When more than one type of product is sold, the sales mix will remain constant.

If you want further explanation of any of these assumptions, please contact me.

EXERCISE 5-8

$$(a) \text{ Contribution margin per lawn} = \$60 - (\$12 + \$10 + \$2)$$

$$\text{Contribution margin per lawn} = \$36$$

$$\text{Contribution margin ratio} = \$36 \div \$60 = 60\%$$

$$\text{Fixed costs} = \$1,400 + \$200 + \$2,000 = \$3,600$$

$$\text{Break-even point in lawns} = \$3,600 \div \$36 = 100$$

$$(b) \text{ Break-even point in dollars} = 100 \text{ lawns} \times \$60 \text{ per lawn} \\ = \$6,000 \text{ per month}$$

OR

$$\text{Fixed costs} \div \text{Contribution margin ratio} = \$3,600 \div .60 \\ = \$6,000 \text{ per month}$$

EXERCISE 5-9

1. Contribution margin per room = $\$60 - (\$14 + \$28)$

Contribution margin per room = $\$18$

Contribution margin ratio = $\$18 \div \$60 = 30\%$

Fixed costs = $\$5,900 + \$1,100 + \$1,000 + \$100 = \$8,100$

Break-even point in rooms = $\$8,100 \div \$18 = 450$

2. Break-even point in dollars = 450 rooms X \$60 per room
= \$27,000 per month

OR

Fixed costs \div Contribution margin ratio = $\$8,100 \div .30$
= \$27,000 per month

EXERCISE 5-10

(a) Contribution margin in dollars: Sales = $560 \times \$120 =$ $\$67,200$
Variable costs = $\$67,200 \times .60 =$ $\underline{40,320}$
Contribution margin $\underline{\underline{\$26,880}}$

Contribution margin per unit: $\$120 - \$72 (\$120 \times 60\%) = \$48.$

Contribution margin ratio: $\$48 \div \$120 = 40\%.$

(b) Break-even sales in dollars: $\frac{\$21,024}{40\%} = \$52,560.$

Break-even sales in units: $\frac{\$21,024}{\$48} = 438.$

EXERCISE 5-11

(a) 1. Contribution margin ratio is: $\frac{\$27,000}{\$36,000} = 75\%$

$$\text{Break-even point in dollars} = \frac{\$18,000}{75\%} = \underline{\underline{\$24,000}}$$

2. Round-trip fare = $\frac{\$36,000}{1,500 \text{ fares}} = \24

$$\text{Break-even point in fares} = \frac{\$24,000}{\$24} = \underline{\underline{1,000 \text{ fares}}}$$

(b) At the break-even point fixed costs and contribution margin are equal. Therefore, the contribution margin at the break-even point would be \$18,000.

EXERCISE 5-12

(a) Unit contribution margin = $\frac{\text{Fixed costs}}{\text{Break-even sales in units}}$

$$= \frac{\$112,000}{(\$350,000 \div \$5)}$$
$$= \$1.60$$

Variable cost per unit = Unit selling price – Unit contribution margin

$$= \$5.00 - \$1.60$$
$$= \$3.40$$

OR

$$70,000 \times \$5.00 = 70,000X + \$112,000$$

where X = Variable cost per unit

$$\text{Variable cost per unit} = \$3.40$$

$$\text{Contribution margin ratio} = \$1.60 \div \$5.00 = 32\%$$

EXERCISE 5-12 (Continued)

(b) Fixed costs ÷ Contribution margin ratio = Break-even sales in dollars
 Fixed costs ÷ .32 = \$420,000
 = \$134,400 (\$420,000 X .32)

Since fixed costs were \$112,000 in 2016, the increase in 2017 is \$22,400 (\$134,400 – \$112,000).

EXERCISE 5-13

(a) and (b) **BILLINGS COMPANY**
CVP Income Statement
 For the Month Ended September 30, 2017

	<u>Total</u>	<u>Per Unit</u>
Sales (600 video game consoles)	\$240,000	\$400
Variable costs	<u>168,000</u>	<u>280</u>
Contribution margin	72,000	<u>\$120</u>
Fixed costs	<u>54,000</u>	
Net income	<u>\$ 18,000</u>	

(c) Sales = Variable costs + Fixed costs
 \$400X = \$280X + \$54,000
 \$120X = 54,000
 X = 450 units

(d) **BILLINGS COMPANY**
CVP Income Statement
 For the Month Ended September 30, 2017

	<u>Total</u>	<u>Per Unit</u>
Sales (450 video game consoles).....	\$180,000	\$400
Variable costs	<u>126,000</u>	<u>280</u>
Contribution margin.....	54,000	<u>\$120</u>
Fixed costs	<u>54,000</u>	
Net income.....	<u>\$ -0-</u>	

EXERCISE 5-14

$$(a) \text{ Units sold in 2016} = \frac{\$570,000 + \$210,000}{\$150 - \$90} = \underline{13,000} \text{ units}$$

$$(b) \text{ Units needed in 2017} = \frac{\$570,000 + \$262,000^*}{\$150 - \$90} = \underline{13,867} \text{ units}$$

(rounded)

$$*\$210,000 + \$52,000 = \$262,000$$

$$(c) \frac{\$570,000 + \$262,000}{X - \$90} = 13,000 \text{ units, where } X = \text{new selling price}$$

$$\$832,000 = 13,000X - \$1,170,000$$

$$\$2,002,000 = 13,000X$$

$$X = \underline{\$154}$$

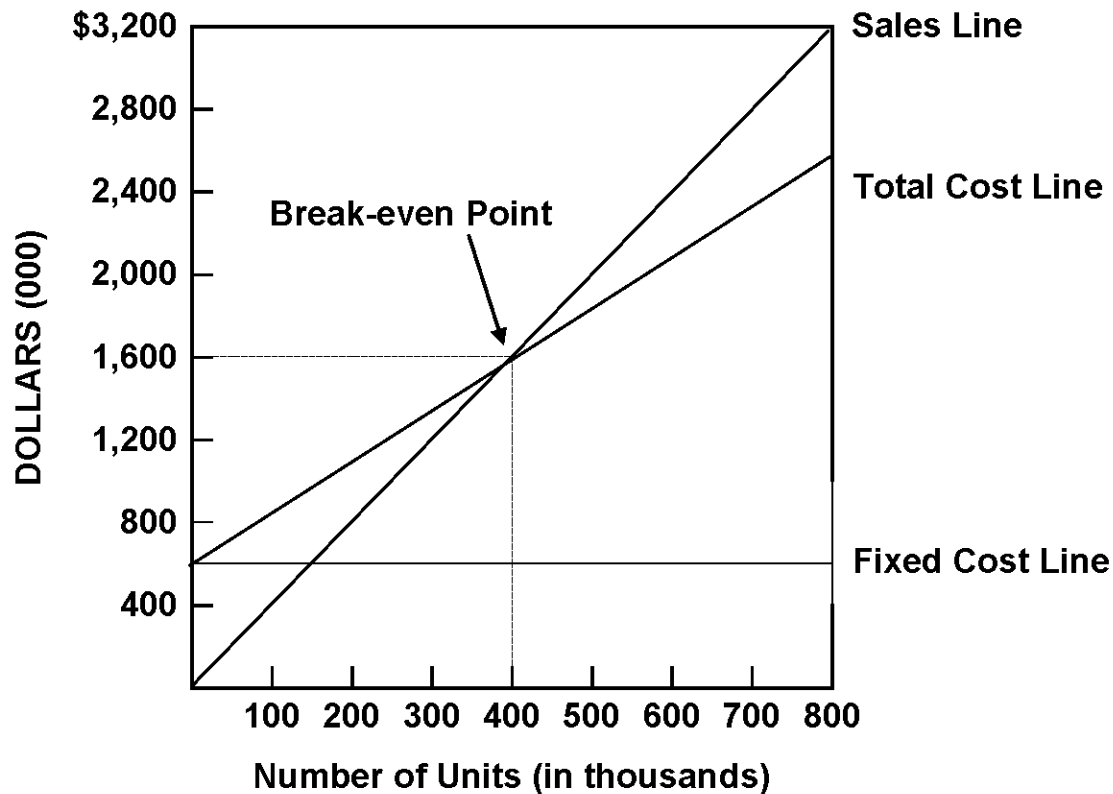
EXERCISE 5-15

1. Unit sales price = $\$400,000 \div 5,000 \text{ units} = \80
Increase selling price to \$88, or $(\$80 \times 110\%)$.
Net income = $\$440,000 - \$240,000 - \$90,000 = \$110,000$.
2. Reduce variable costs to 55% of sales.
Net income = $\$400,000 - \$220,000 - \$90,000 = \$90,000$.

Alternative 1, increasing selling price, will produce the higher net income.

EXERCISE 5-16

(a)



(b) 1. Break-even sales in units:

$$\begin{aligned} \$4X &= \$2.50X + \$600,000 \\ \$1.50X &= \$600,000 \\ X &= 400,000 \text{ units} \end{aligned}$$

2. Break-even sales in dollars:

$$\begin{aligned} X &= .625X + \$600,000 \\ .375X &= \$600,000 \\ X &= \$1,600,000 \text{ or } \$600,000 \div 37.5\% \end{aligned}$$

(c) 1. Margin of safety in dollars: $\$2,000,000 - \$1,600,000 = \$400,000$

2. Margin of safety ratio: $\$400,000 \div \$2,000,000 = 20\%$

EXERCISE 5-17

- (a) Contribution ratio = Contribution margin ÷ Sales
 $(\$40 - \$24) \div \$40 = 40\%$
- (b) Break-even in dollars: $\$19,500 \div 40\% = \$48,750$
- (c) Margin of safety = $(2,500 \times \$40) - \$48,750 = \$51,250$
 $\$51,250 \div \$100,000 = 51.25\%$
- (d) Current contribution margin $\$40 - \$24 = \$16$
Total contribution margin is $\$16 \times 2,500 = \$40,000$
30% increase in contribution margin is $\$40,000 \times 30\% = \$12,000$
Total increase in sales required: $\$12,000 \div 40\% = \$30,000$