

# Chapter 5

## Cost Behavior: Analysis and Use

### Solutions to Questions

#### 5-1

- Variable cost: A variable cost remains constant on a per unit basis, but changes in *total* in direct relation to changes in volume.
- Fixed cost: A fixed cost remains constant in total amount. The *average* fixed cost per unit varies inversely with changes in volume.
- Mixed cost: A mixed cost contains both variable and fixed cost elements.

#### 5-2

- Unit fixed costs decrease as volume increases.
- Unit variable costs remain constant as volume increases.
- Total fixed costs remain constant as volume increases.
- Total variable costs increase as volume increases.

#### 5-3

- Cost behavior: Cost behavior refers to the way in which costs change in response to changes in a measure of activity such as sales volume, production volume, or orders processed.
- Relevant range: The relevant range is the range of activity within which assumptions about variable and fixed cost behavior are valid.

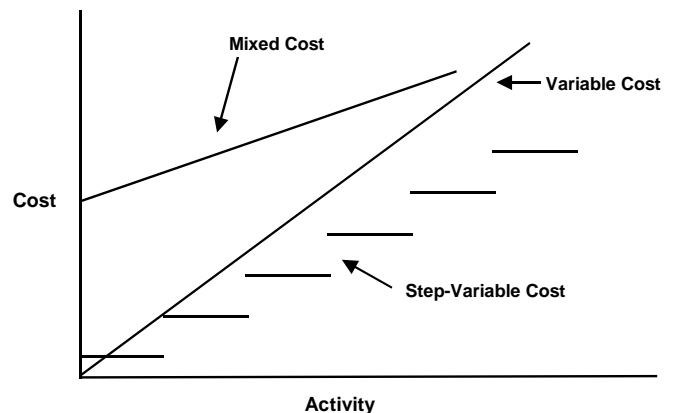
**5-4** An activity base is a measure of whatever causes the incurrence of a variable cost. Examples of activity bases include units produced, units sold, letters typed, beds in a hospital, meals served in a cafe, service calls made, etc.

#### 5-5

- Variable cost: A variable cost remains constant on a per unit basis, but increases or

decreases *in total* in direct relation to changes in activity.

- Mixed cost: A mixed cost is a cost that contains both variable and fixed cost elements.
- Step-variable cost: A step-variable cost is a cost that is incurred in large chunks, and which increases or decreases only in response to fairly wide changes in activity.



**5-6** The linear assumption is reasonably valid providing that the cost formula is used only within the relevant range.

**5-7** A discretionary fixed cost has a fairly short planning horizon—usually a year. Such costs arise from annual decisions by management to spend on certain fixed cost items, such as advertising, research, and management development. A committed fixed cost has a long planning horizon—generally many years. Such costs relate to a company's investment in facilities, equipment, and basic organization. Once such costs have been incurred, they are "locked in" for many years.

**5-8**

- |                  |                  |
|------------------|------------------|
| a. Committed     | d. Committed     |
| b. Discretionary | e. Committed     |
| c. Discretionary | f. Discretionary |

**5-9** Yes. As the anticipated level of activity changes, the level of fixed costs needed to support operations may also change. Most fixed costs are adjusted upward and downward in large steps, rather than being absolutely fixed at one level for all ranges of activity.

**5-10** The high-low method uses only two points to determine a cost formula. These two points are likely to be less than typical since they represent extremes of activity.

**5-11** The formula for a mixed cost is  $Y = a + bX$ . In cost analysis, the "a" term represents the fixed cost, and the "b" term represents the variable cost per unit of activity.

**5-12** The term "least-squares regression" means that the sum of the squares of the deviations from the plotted points on a graph to the regression line is smaller than could be obtained

from any other line that could be fitted to the data.

**5-13** Ordinary single least-squares regression analysis is used when a variable cost is a function of only a single factor. If a cost is a function of more than one factor, multiple regression analysis should be used to analyze the behavior of the cost.

**5-14** The contribution approach income statement organizes costs by behavior, first deducting variable expenses to obtain contribution margin, and then deducting fixed expenses to obtain net operating income. The traditional approach organizes costs by function, such as production, selling, and administration. Within a functional area, fixed and variable costs are intermingled.

**5-15** The contribution margin is total sales revenue less total variable expenses.

**Exercise 5-1** (15 minutes)

1.

	<i>Cups of Coffee Served in a Week</i>		
	<i>1,800</i>	<i>1,900</i>	<i>2,000</i>
Fixed cost.....	\$1,100	\$1,100	\$1,100
Variable cost.....	<u>468</u>	<u>494</u>	<u>520</u>
Total cost.....	<u>\$1,568</u>	<u>\$1,594</u>	<u>\$1,620</u>
Cost per cup of coffee served *.....	\$0.871	\$0.839	\$0.810

\* Total cost ÷ cups of coffee served in a week

2. The average cost of a cup of coffee declines as the number of cups of coffee served increases because the fixed cost is spread over more cups of coffee.

**Exercise 5-3 (20 minutes)**

1.

<i>Month</i>	<i>Occupancy-Days</i>	<i>Electrical Costs</i>
High activity level (August) ..	3,608	\$8,111
Low activity level (October) .	<u>186</u>	<u>1,712</u>
Change .....	<u>3,422</u>	<u>\$6,399</u>

Variable cost = Change in cost ÷ Change in activity  
 = \$6,399 ÷ 3,422 occupancy-days  
 = \$1.87 per occupancy-day

Total cost (August) .....	\$8,111
Variable cost element (\$1.87 per occupancy-day × 3,608 occupancy-days) .	<u>6,747</u>
Fixed cost element .....	<u>\$1,364</u>

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. This will result in seasonal effects on the fixed electrical costs.

Additionally, fixed costs will be affected by how many days are 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.

**Exercise 5-4 (20 minutes)**

1. The Haaki Shop, Inc.  
Income Statement—Surfboard Department  
For the Quarter Ended May 31

Sales.....		\$800,000
Variable expenses:		
Cost of goods sold (\$150 per surfboard × 2,000 surfboards*).....	\$300,000	
Selling expenses (\$50 per surfboard × 2,000 surfboards) .....	100,000	
Administrative expenses (25% × \$160,000) ....	<u>40,000</u>	<u>440,000</u>
Contribution margin .....		360,000
Fixed expenses:		
Selling expenses.....	150,000	
Administrative expenses.....	<u>120,000</u>	<u>270,000</u>
Net operating income .....		<u>\$ 90,000</u>

\*\$800,000 sales ÷ \$400 per surfboard = 2,000 surfboards.

2. Since 2,000 surfboards were sold and the contribution margin totaled \$360,000 for the quarter, the contribution of each surfboard toward fixed expenses and profits was \$180 ( $\$360,000 \div 2,000$  surfboards = \$180 per surfboard). Another way to compute the \$180 is:

Selling price per surfboard.....	\$400	
Less variable expenses:		
Cost per surfboard .....	\$150	
Selling expenses .....	50	
Administrative expenses (\$40,000 ÷ 2,000 surfboards) .....	<u>20</u>	<u>220</u>
Contribution margin per surfboard .....		<u>\$180</u>

**Exercise 5-6** (20 minutes)

1. The company's variable cost per unit would be:

$$\frac{\$150,000}{60,000 \text{ units}} = \$2.50 \text{ per unit.}$$

Taking into account the difference in behavior between variable and fixed costs, the completed schedule would be:

	<i>Units produced and sold</i>		
	<u>60,000</u>	<u>80,000</u>	<u>100,000</u>
Total costs:			
Variable costs .....	\$150,000 *	\$200,000	\$250,000
Fixed costs .....	<u>360,000</u> *	<u>360,000</u>	<u>360,000</u>
Total costs .....	<u>\$510,000</u> *	<u>\$560,000</u>	<u>\$610,000</u>
Cost per unit:			
Variable cost .....	\$2.50	\$2.50	\$2.50
Fixed cost .....	<u>6.00</u>	<u>4.50</u>	<u>3.60</u>
Total cost per unit .....	<u>\$8.50</u>	<u>\$7.00</u>	<u>\$6.10</u>

\*Given.

2. The company's income statement in the contribution format would be:

Sales (90,000 units × \$7.50 per unit) .....	\$675,000
Variable expenses (90,000 units × \$2.50 per unit) .....	<u>225,000</u>
Contribution margin .....	450,000
Fixed expenses .....	<u>360,000</u>
Net operating income .....	<u>\$ 90,000</u>

### Exercise 5-9 (20 minutes)

	<i>Miles Driven</i>	<i>Total Annual Cost*</i>
High level of activity .....	120,000	\$13,920
Low level of activity .....	<u>80,000</u>	<u>10,880</u>
Change .....	<u>40,000</u>	<u>\$ 3,040</u>

\* 120,000 miles × \$0.116 per mile = \$13,920

80,000 miles × \$0.136 per mile = \$10,880

Variable cost per mile:

$$\frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$3,040}{40,000 \text{ miles}} = \$0.076 \text{ per mile}$$

Fixed cost per year:

Total cost at 120,000 miles .....	\$13,920
Less variable cost element:	
120,000 miles × \$0.076 per mile .....	<u>9,120</u>
Fixed cost per year .....	<u>\$ 4,800</u>

2.  $Y = \$4,800 + \$0.076X$

3. Fixed cost .....	\$ 4,800
Variable cost: 100,000 miles × \$0.076 per mile .....	<u>7,600</u>
Total annual cost .....	<u>\$12,400</u>

**Exercise 5-10** (20 minutes)

1.	<i>X-rays Taken</i>	<i>X-ray Costs</i>
High activity level (February) .....	7,000	\$29,000
Low activity level (June) .....	<u>3,000</u>	<u>17,000</u>
Change .....	<u>4,000</u>	<u>\$12,000</u>

Variable cost per X-ray:

$$\frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$12,000}{4,000 \text{ X-rays}} = \$3.00 \text{ per X-ray}$$

Fixed cost per month:

X-ray cost at the high activity level .....	\$29,000
Less variable cost element:	
7,000 X-rays × \$3.00 per X-ray .....	<u>21,000</u>
Total fixed cost .....	<u>\$ 8,000</u>

The cost formula is \$8,000 per month plus \$3.00 per X-ray taken or, in terms of the equation for a straight line:

$$Y = \$8,000 + \$3.00X$$

where X is the number of X-rays taken.

2. Expected X-ray costs when 4,600 X-rays are taken:

Variable cost: 4,600 X-rays × \$3.00 per X-ray .....	\$13,800
Fixed cost .....	<u>8,000</u>
Total cost .....	<u>\$21,800</u>



**Exercise 5-12** (30 minutes)

1. Monthly operating costs at 70% occupancy:

2,000 rooms × 70% = 1,400 rooms;	
1,400 rooms × \$21 per room per day × 30 days...	\$882,000
Monthly operating costs at 45% occupancy (given) .	<u>792,000</u>
Change in cost.....	<u>\$ 90,000</u>

Difference in rooms occupied:

70% occupancy (2,000 rooms × 70%) .....	1,400
45% occupancy (2,000 rooms × 45%) .....	<u>900</u>
Difference in rooms (change in activity) .....	<u>500</u>

$$\text{Variable cost} = \frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$90,000}{500 \text{ rooms}} = \$180 \text{ per room.}$$

\$180 per room ÷ 30 days = \$6 per room per day.

- |  |                  |
|--|------------------|
| 2. Monthly operating costs at 70% occupancy (above)... | \$882,000        |
| Less variable costs:                                   |                  |
| 1,400 rooms × \$6 per room per day × 30 days.....      | <u>252,000</u>   |
| Fixed operating costs per month .....                  | <u>\$630,000</u> |
3. 2,000 rooms × 60% = 1,200 rooms occupied.
- |   |                  |
|---|------------------|
| Fixed costs .....                                 | \$630,000        |
| Variable costs:                                   |                  |
| 1,200 rooms × \$6 per room per day × 30 days..... | <u>216,000</u>   |
| Total expected costs .....                        | <u>\$846,000</u> |

**Problem 5-21** (45 minutes)

1. Maintenance cost at the 70,000 machine-hour level of activity can be isolated as follows:

	<i>Level of Activity</i>	
	<i>40,000 MH</i>	<i>70,000 MH</i>
Total factory overhead cost .....	\$170,200	\$241,600
Deduct:		
Utilities cost @ \$1.30 per MH* .....	52,000	91,000
Supervisory salaries .....	<u>60,000</u>	<u>60,000</u>
Maintenance cost .....	<u>\$ 58,200</u>	<u>\$ 90,600</u>

\*\$52,000 ÷ 40,000 MHs = \$1.30 per MH

2. High-low analysis of maintenance cost:

	<i>Maintenance Cost</i>	<i>Machine- Hours</i>
High activity level .....	\$90,600	70,000
Low activity level .....	<u>58,200</u>	<u>40,000</u>
Change .....	<u>\$32,400</u>	<u>30,000</u>

Variable cost per unit of activity:

$$\frac{\text{Change in cost}}{\text{Change in activity}} = \frac{\$32,400}{30,000 \text{ MHs}} = \$1.08 \text{ per MH}$$

Total fixed cost:

Total maintenance cost at the low activity level .....	\$58,200
Less the variable cost element (40,000 MHs × \$1.08 per MH) .....	<u>43,200</u>
Fixed cost element .....	<u>\$15,000</u>

Therefore, the cost formula is \$15,000 per month plus \$1.08 per machine-hour or  $Y = \$15,000 + \$1.08X$ , where X represents machine-hours.

**Problem 5-21** (continued)

3.	<i>Variable Rate per</i>	
	<i>Machine-Hour</i>	<i>Fixed Cost</i>
Maintenance cost .....	\$1.08	\$15,000
Utilities cost .....	1.30	
Supervisory salaries cost....	<u>        </u>	<u>60,000</u>
Totals .....	<u>\$2.38</u>	<u>\$75,000</u>

Therefore, the cost formula would be \$75,000 plus \$2.38 per machine-hour, or  $Y = \$75,000 + \$2.38X$ .

4. Fixed costs .....	\$ 75,000
Variable costs: \$2.38 per MH × 45,000 MHs .....	<u>107,100</u>
Total overhead costs .....	<u>\$182,100</u>

**Problem 5-23** (30 minutes)

1. Maintenance cost at the 80,000 machine-hour level of activity can be isolated as follows:

	<i>Level of Activity</i>	
	<i>60,000 MH</i>	<i>80,000 MH</i>
Total factory overhead cost ..	274,000 pesos	312,000 pesos
Deduct:		
Indirect materials @ 1.50		
pesos per MH* .....	90,000	120,000
Rent .....	<u>130,000</u>	<u>130,000</u>
Maintenance cost .....	<u>54,000</u> pesos	<u>62,000</u> pesos

\* 90,000 pesos ÷ 60,000 MHs = 1.50 pesos per MH

2. High-low analysis of maintenance cost:

	<i>Maintenance Cost</i>	<i>Machine-Hours</i>
High activity level .....	62,000 pesos	80,000
Low activity level .....	<u>54,000</u>	<u>60,000</u>
Change observed .....	<u>8,000</u> pesos	<u>20,000</u>

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

$$= \frac{8,000 \text{ pesos}}{20,000 \text{ MHs}} = 0.40 \text{ peso per MH}$$

Fixed cost element = Total cost - Variable cost element

$$= 54,000 \text{ pesos} - (60,000 \text{ MHs} \times 0.40 \text{ pesos})$$

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

Therefore, the cost formula is 30,000 pesos per year, plus 0.40 peso per machine-hour or

$$Y = 30,000 \text{ pesos} + 0.40 \text{ peso } X.$$

**Problem 5-23** (continued)

3. Indirect materials (65,000 MHs × 1.50 pesos per MH) .....		97,500 pesos
Rent .....		130,000
Maintenance:		
Variable cost element (65,000 MHs × 0.40 peso per MH) .....	26,000 pesos	
Fixed cost element .....	<u>30,000</u>	<u>56,000</u>
Total factory overhead cost .....		<u>283,500 pesos</u>