

Chapter

FIVE

Management Accounting Theory of Cost Behavior

Management accounting contains a number of decision-making tools that require the conversion of all operating costs and expenses into fixed and variable components. The responsibility for providing this cost behavior information falls squarely upon the shoulders of the management accountant. The conversion of ordinary financial data as typically found in the general ledger accounts requires that the management accountant have a thorough understanding of cost behavior theory.

The identification and measurement of fixed and variable costs is somewhat complicated by the fact that some costs are fixed or variable at the discretion of management, while other costs are not. Furthermore, for those expenditures that are inherently variable, management has the ability, within limits, to control the magnitude of the variable cost factors. In order to exercise this control, management also needs a solid understanding of the nature of cost behavior.

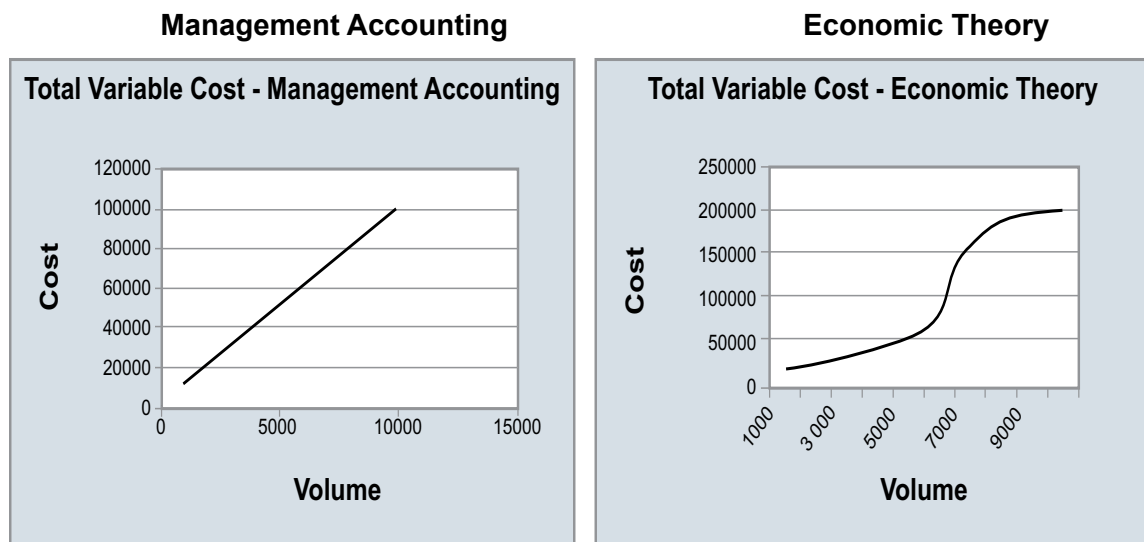
In management accounting, the classification and measurement of fixed and variable cost is based on a body of knowledge that involves a number of assumptions. In many cases, the usefulness of fixed and variable cost data depends on the validity of these assumptions. In order to avoid poor operating results and faulty decision-making that is likely to occur when false cost assumptions are made, the ability to recognize and measure cost behavior is essential. The remainder of this chapter will examine in some depth the theory of cost behavior.

Management Accounting Theory of Variable Costs

The most volatile variable in any business is volume; that is, units produced or units sold. A change in volume has an immediate impact on variable costs. Variable costs are those costs that increase or decrease with corresponding changes in volume. However, the exact relationship between total variable cost and volume in practice is not always easy to describe or measure. Therefore, in both management accounting and economic theory, the relationship between volume and total variable cost is often determined by assumption.

In management accounting theory, the relationship between volume and total variable cost is presented as a continuous linear function; that is, a straight line when plotted on a graph. In economic theory, the relationship is assumed to be curvilinear. These differences in assumptions, which are illustrated in Figure 5.1, need to be clearly understood.

Figure 5.1



The assumption of a curvilinear relationship is probably more realistic; however, there are special reasons why the relationship is assumed linear. The reasons for use of straight-line relationships will be explained later in this chapter. At this point, you should keep in mind that all management accounting models requiring fixed and variable cost data assume that the relationship between total cost and volume is direct and proportionate; that is, on a graph the relationship is seen as a straight-line.

Variable costs are those costs that increase or decrease in direct proportion to changes in activity or volume. Variable costs are caused by activity. In other words, at zero activity there would be no variable costs. Some typical examples of variable costs and expenses directly resulting from either production or sales activity would include the following:

Manufacturing Variable Costs	Selling Variable Expenses
Material used	Commissions
Direct labor	Supplies
Manufacturing overhead	Salesmen travel expense
Utilities for machines	Packaging
Supplies	Travel

The ability to identify and measure variable costs from historical cost data is often important. The measurement of variable cost is enhanced by an understanding of why some costs are variable in nature. Variable costs increase or decrease with activity because there is a fixed relationship between a single unit of output and certain

physical and cost factors. For example, assume that a furniture manufacturer makes a table consisting of four 30" legs and a plywood top measuring 3'x 5'. Each leg costs \$2 and the plywood top can be purchased for \$4.00. Therefore, due to the material design specifications of the table, the material cost of each table manufactured is \$12(4 legs x \$2 + \$4 for top). Assuming production increments of 100, at different levels of production total material cost would be:

Production	Cost per Unit	Total Material Cost
100	\$12	\$1,200
200	\$12	\$2,400
300	\$12	\$3,600
400	\$12	\$4,800

Notice that the increase in total cost is directly proportionate to the increase in volume. For example, an increase from 200 to 400 units (a 100% increase) would result in a corresponding 100% increase in total cost. The physical material specifications of the table design create a fixed relationship between a unit of product (the table) and the amount of material used. As unusual as it may sound, it is this fixed relationship that causes the direct variability of cost. For other types of variable costs such as direct labor, there are similar fixed relationships.

Methods of Explaining and Presenting Cost Behavior

The concept of variable cost is obviously important to both accountants and management. Communication of cost behavior from the accountant to management is also critically important. The presentation of cost behavior may be done in three ways: tabular, mathematical, and graphical.

Tabular presentation - A common method is to present cost behavior in the form of a table. For example, in the illustration above cost behavior was presented in tabular form. In terms of including more manufacturing costs at different levels of activity, the table on the next page is an example of the tabular method.

The advantage of this method is that the variable cost at set intervals of activity can be seen without first doing any math. However, some computations are necessary when cost is needed at an activity level for which a special column does not exist.

Mathematical Presentation - Because in management accounting the relationship between variable cost and volume is assumed, linear total variable cost may be defined by the following equation:

$$TVC = V(Q) \quad (1)$$

Where:

V = variable cost rate and **Q** = quantity (units sold or units manufactured). Mathematically, **TVC** represents the dependent variable and **Q** or quantity represents the independent variable. Mathematically speaking, **V** may be called the constant of variation.

Let **V** = \$12 and **Q** = 1,000

Then **TVC** = 12(1,000) = \$12,000

Given a rate of \$12 per unit and at a volume of 1,000, total variable cost is \$12,000.

Manufacturing Variable costs						
	Variable Cost Rate	Volume (units of product)				
		1,000	2,000	3,000	4,000	5,000
Material	\$10	\$10,000	\$20,000	\$30,000	\$40,000	\$50,000
Factory Labor	\$ 8	\$ 8,000	\$16,000	\$24,000	\$32,000	\$40,000
Manufacturing overhead	\$ 5	\$ 5,000	\$10,000	\$15,000	\$20,000	\$25,000

Total variable cost is completely determined by the variable cost rate and the level of activity. Given a specified value for **V**, total variable cost for any level of activity can be easily computed.

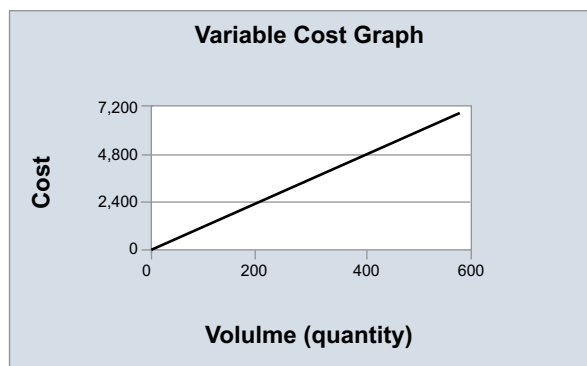
The key to understanding variable cost behavior is a knowledge of **V**, the variable cost rate. **V** represents the average variable cost rate. The major assumption underlying the equation, $TVC = V(Q)$, is that regardless of the level of activity the average variable cost rate will remain the same. From this assumption results the linear relationship between volume and total variable costs. As long as **V** remains unchanged, the effect of changes in volume will be direct and proportionate. In other words, the relationship is linear. Regardless of how cost behavior is communicated, the foundation of cost behavior remains at its core mathematical in nature.

Graphical Presentation - The behavior of variable cost can be illustrated graphically. As true of all mathematical equations, by assigning different values to **Q**, the independent variable, the resulting dependent values can be plotted on a graph. To illustrate, assume a variable cost rate of \$12 and activity increasing in increments of 100. The graph in Figure 5.2 may be drawn:

Figure 5.2

Q	V	TVC
100	\$12	1,200
200	\$12	2,400
300	\$12	3,600
400	\$12	4,800

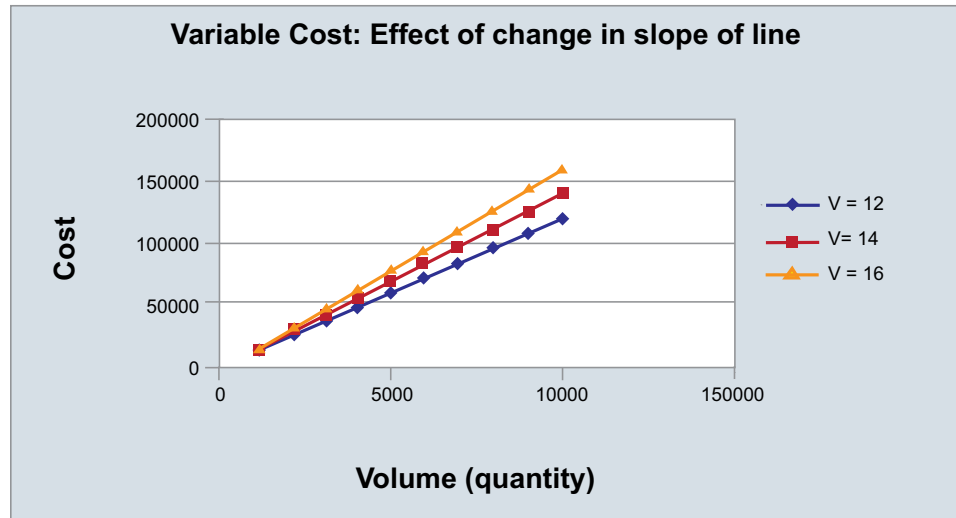
2A



2B

In Figure 5.2A, the relationship between volume and variable cost is shown in tabular form. In many cases, management prefers to see costs in this fashion. However, the graphical portrayal is more effective in demonstrating the theoretical nature of variable costs from a management accounting viewpoint. The increase in cost resulting from increases in volume can easily be visualized. It is interesting to note that V , the variable cost rate, from a mathematical viewpoint measures the slope of the total variable cost line. The greater the value of V the steeper the slope. The effect on slope of the line for different values of V is illustrated in Figure 5.3. As the rate increases, the slope also becomes steeper.

Figure 5.3



As explained previously, V may be interpreted as the average variable cost rate. One method of computing V is to divide the total variable cost by the related level of activity; that is, $AVC = TVC / Q$. Graphically, average variable cost may be illustrated as shown in Figure 5.4.

Figure 5.4 A

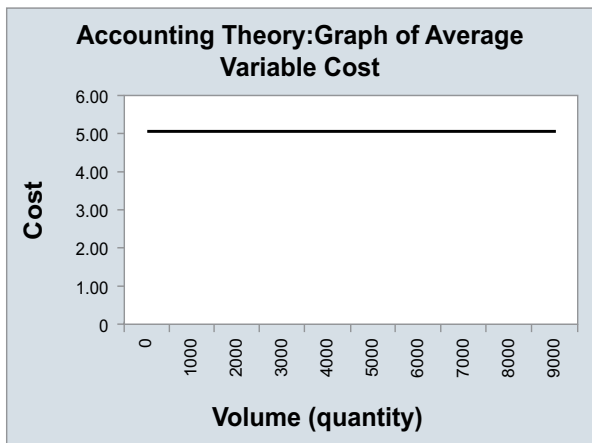
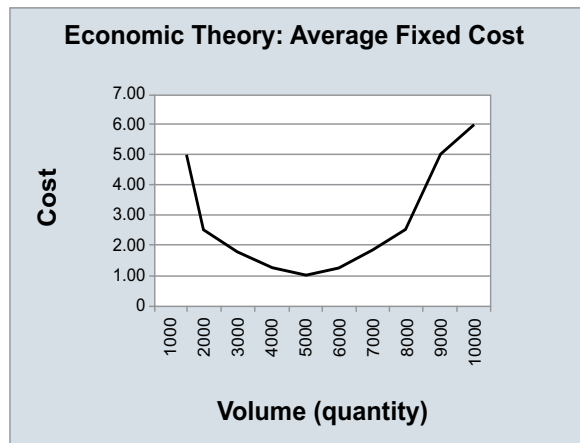


Figure 5.4 B



Graph A visually illustrates an important management accounting assumption concerning variable cost: changes in volume have no effect on the average variable cost rate. In contrast, the average variable cost curve in economic theory is presented as a U-shaped curve as illustrated in Figure 5.4B. The justification of a constant average variable cost will be explained in a later section of this chapter.

Variable Cost Rate Components - Variable costs can be discussed at two levels: the aggregate and micro levels. At the aggregate level, V represents the sum of the individual variable costs rates. Variable costs/expenses are commonly classified as material, labor, overhead, selling, and administrative. Consequently, from a micro or analytical viewpoint, V is the aggregate of these individual rates. Mathematically, the average variable cost rate or V may be defined as:

$$V = V^m + V^l + V^o + V^s + V^a$$

Where:

- V^m - variable material cost rate
- V^l - variable labor cost rate
- V^o - variable overhead rate
- V^s - variable selling expense rate
- V^a - variable administrative rate

In theory the variable cost rate, or V , also may be computed from historical data by dividing the total variable cost by the related level of activity; that is, from a macro point of view $V = TVC / Q$. However, in practice the computation of V in this manner is not always easy. Very seldom is the total variable cost known without considerable analysis of cost data at a subclassification or micro level. The computation of V is, therefore, likely to be preceded by an analysis of variable cost in terms of material, labor, manufacturing overhead, selling, and administrative costs. After measurement of the individual rates, the aggregate rate is simply the sum of the individual variable cost rates.

Illustration of Using Cost Behavior

The management of K. L. Widget Company is considering closing out a plant that has been operating at a loss. Management is tentatively planning to increase advertising and certain other fixed expenses that should increase sales to \$300,000 or 15,000 units. The selling price of the Widget is currently \$20.00. Fixed expenses including the proposed increases is \$110,000.

Variable costs have been determined to be:

Material (V^m)	-	\$5
Labor (V^l)	-	\$3
Variable M/O (V^o)	-	\$1
Selling (V^s)	-	\$3
Administrative (V^a)	-	\$1

If the increased expenditures do not result in a profit, then the plant will be closed. Should the proposed expenditures be made and the plant kept open?

Analysis:

$$V = V^m + V^l + V^o + V^s + V^a = (\$5 + \$3 + \$1 + \$3 + \$1) = \$13$$

$$TVC = V(Q) = \$13(Q)$$

Sales (15,000 units)	\$300,000
Variable costs (\$13 x 15,000)	\$195,000
Fixed expenses	\$110,000
Total expenses	<u>\$305,000</u>
Net loss	<u>(\$ 5,000)</u>

Decision: Close the plant as the plant would still operate at a loss. The computation of total cost at the new level of activity is still greater than revenue.

Managerial Decisions and Variable Costs

An important point that needs understanding is that some costs are not inherently fixed or variable but become one or the other by management exercising its decision-making powers. Management has the discretionary power to make some costs either variable or fixed. For example, sales people compensation can be either fixed or variable. If management decides to reward sales people on the basis of a commission, then sales people's compensation is variable. If the basis for rewarding sales effort is a salary, then sales people's compensation is a fixed expense. If factory workers are paid a wage rate, then factory workers' compensation is variable. The decision to pay workers a salary would make the factory labor compensation a fixed cost in the short-run.

Some expenditures are unavoidably variable. For example, the direct use of material will always be a variable cost. However, this per unit cost of material is to a large extent controllable by the decision-making powers of management. The total material variable cost may be defined by the equation:

$$TVMC = V^m(Q) \quad (2)$$

In this equation V^m represents the variable material cost rate. V^m is the amount of material cost incurred per unit of product manufactured. The variable material rate, V^m ; however, is the result of two factors: units of material per unit of product and the cost per unit of material. For example, if a product requires 6 units of material and the material cost per unit is \$2, then the material variable cost rate would be \$12. V^m , then, may be defined by the following equation:

$$V^m = U^m \times C^m$$

Where:

U^m = number of units of material and C^m = cost per unit of material.

As this example illustrates, the number of units and the cost per unit are, within limits, controllable by management. For example, in the manufacture of furniture the variable cost rate for material could be decreased by the decision to use less material.

Management might use 1/2 inch wood rather than 3/4 inch. Also management could lower the variable cost rate by deciding to purchase from another seller of material whose price is lower or management might decide to use a lower quality material such as particle board.

As will be explained later, the average variable cost can be computed from historical data, however, you should remember that at any given moment management can change the variable cost rate by making decisions directly affecting the physical and cost factors that determined the variable cost rate.

Another example of a cost that is unavoidably variable is direct labor when the method of compensation is a wage rate. The equation for direct labor is:

$$TVLC = V^L(Q) \quad (3)$$

In this equation, V^L represents the variable labor cost rate. It is the dollar amount of labor incurred each time one unit of product is manufactured. As in the case of material, V^L is the result of two factors—labor hours per product and the wage rate. For example, if a product requires two hours of labor and the wage rate is \$10 per hour, then the variable direct labor rate would be \$20. V^L then may be defined by the following equation:

$$V^L = H^L \times R^L$$

Where:

H^L denotes the standard hours per product and R^L the wage rate.

The important principle to remember is that for most types of variable costs, the factors that determine the variable cost rates can be identified. Furthermore, in all cases these fixed factors, within limits, can be changed by explicit decisions on the part of management. In Figure 5.5, a summary of the fixed factors for the five classifications of variable costs is presented. In addition, management's ability to affect the magnitude of the variable cost rates through decision-making is also revealed. For example, management may be able to reduce the variable cost rate for material by finding a supplier willing to sell the same grade of material at a lower price.

Variable Cost Behavior and Linearity

In management accounting, the relationship between activity and total variable cost is assumed to be linear. There are several reasons for this assumption.

First, mathematical equations involving curvilinear relationships can be quite complex. Furthermore, fitting cost data to nonlinear equations may be difficult. Although the use of nonlinear equations may be preferable, the use of linear equations which are much easier to use has been found to be useful.

Also, in many cases, actual cost behavior for a significant portion of the activity range tends to be linear. The use of standard measurements and automated equipment in many cases results in a uniform rate of output. Within a relevant range of activity, the cost per unit of output is the same. Consequently, the use of linear relationships in management accounting is justified only in what is called the "relevant range of activity." If the cost per unit of output sharply changes outside of this range of activity,

Figure 5.5

Variable Cost Factors			
Variable costs	Fixed factors per unit of product (physical and cost)		Variable cost Rate
Material	units of material	(U^m)	$V^m = U^m \times C^m$
	cost per unit	(C^m)	
Direct labor	hours per unit	(H^L)	$V^L = H^L \times R^L$
	wage rate per hour	(R^L)	
Overhead *	units of service	(U^o)	$V^o = U^o \times C^s$
	cost per unit of service	(C^s)	
Selling **	units of service	(U^s)	$V^s = U^s \times C^s$
	cost per unit of service	(C^s)	
Administrative	units of services	(U^a)	$V^a = U^a \times C^s$
	cost per unit of service	(C^s)	

* Examples of units of overhead service include factory supplies, quarts of oil, kilowatt hours, repair hours, etc.

** Examples of selling service units include supplies, credit checking time, wrapping or packaging, accounting time, etc.

then the use of a constant average cost per unit values should be avoided. The concept of the relevant cost range is illustrated in Figure 5.6.

Management Accounting Theory of Fixed Costs

In order to be used, many management accounting decision-making models explicitly require that all costs be classified as either fixed or variable. On the surface, it would appear that the measurement and use of fixed costs is fairly simple matter. After variable costs have been measured, the remaining costs may be treated as fixed. However, the very nature of fixed costs presents conceptual problems that far exceeds those pertaining to variable costs.

While direct material and direct labor are variable in nature, manufacturing overhead may be both variable and fixed. The accounting for fixed costs is at the same time a problem of accounting for manufacturing overhead. An understanding of fixed manufacturing overhead also requires an understanding of the concepts underlying the setting of fixed overhead rates. Because of the complexity of accounting for fixed manufacturing costs, two theories exist, absorption costing and direct costing. These two approaches treat fixed manufacturing overhead quite differently.

Fixed costs provide capacity to manufacture or to sell. When actual activity is less than capacity available, a major problem exist. Theoretically, the portion of unused capacity cost should be measured as idle capacity cost and not treated as

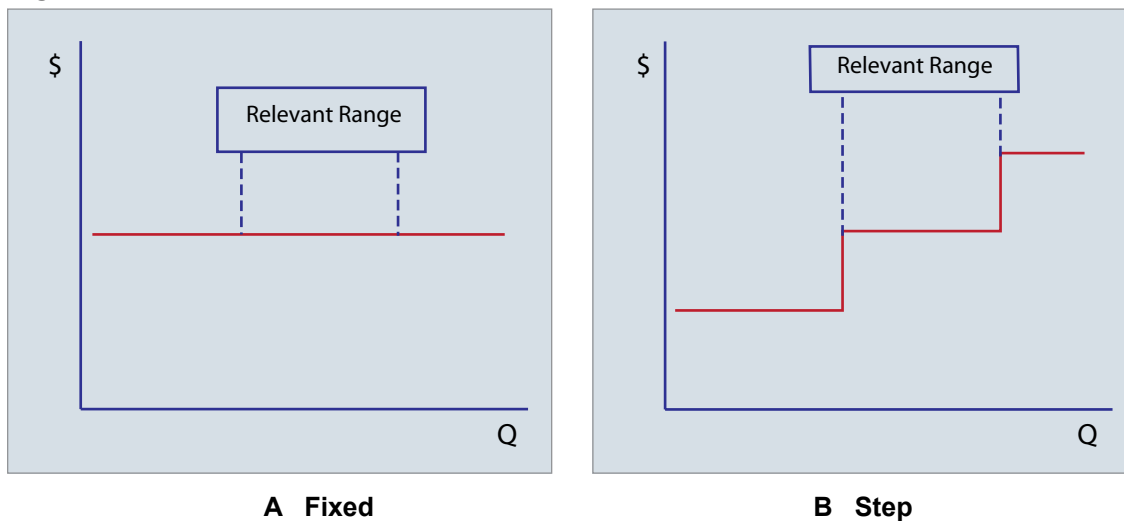
a production cost. In practice, many firms do not measure idle capacity cost. The consequence is that the per unit cost of goods manufactured varies significantly with the percentage of capacity utilized. For example, assume that the fixed cost of the K. L. Widget Manufacturing Company is \$10,000, and that the firm has the capacity to manufacture 10,000 units. When the firm manufactures 1,000 units, the cost per unit is \$10. However, when only 500 units are manufactured the cost per unit is \$20 and when volume is 10,000 the cost is \$1 per unit

A second serious problem exists concerning the measurement of fixed costs. The term “fixed” costs implies that changes in volume have no effect on the costs classified as such. Certain management accounting models previously identified in this book are based on the assumption that the costs identified as fixed hold constant over a range of activity. However, the assumption that these costs remain constant from zero activity to the limit of capacity is not always true.

In reality, costs defined as fixed seldom hold constant over the entire range of activity. Only in very small businesses with limited changes in activity would some fixed costs not vary. In most businesses, and in large businesses in particular, fixed costs classified as fixed in management accounting are actually step cost. When significant increases in activity occur, additional staff, equipment, and other resources involving fixed costs must be acquired.

A graphical illustration of fixed and step cost is shown in Figure 5.6 (A and B).

Figure 5.6



Despite the more realistic portrayal in Figure 5.6B, fixed costs are usually illustrated as shown in Figure 5.6A. To justify the assumption of non variation of fixed costs as illustrated in Figure 5.6A, the concept of the relevant range is used. As long as activity remains within the relevant range, no harm is done by portraying step costs as fixed over the entire range of activity. The relevant range may be defined as that range of activity in which actual sales or production are likely to occur. Outside of this range, fixed costs on the lower end of volume are smaller and outside of the high end of the relevant range fixed costs are higher. However, the magnitude of these costs outside the relevant range is not likely to be known; and even if known,

they are irrelevant. Consequently, to draw fixed costs as in Figure 5.6A is a matter of convenience rather than a portrayal of reality. In the following discussion, therefore, you should remember that the definition and discussion of fixed costs actually refers to the costs incurred within the relevant range of activity.

Another interesting aspect of fixed costs is that as soon as fixed costs exist, a business automatically has a break even point. Conceptually, no business can report net income until all fixed costs have been covered. Break even point analysis will be discussed in detail in the next chapter.

Fixed costs are those cost that do not change with increases or decreases in volume, that is, sales or production. In the short run, fixed costs such as rent and salaries remain the same regardless of the level of activity. Fixed costs, unlike variable costs which relate to activity, are time-related costs. For example, rent is always for a period of time such as a month or year. Likewise salaries also relate to a period of time such as a month or year. Consequently, fixed costs are commonly called period charges because these costs expire in the same time period in which they are incurred.

While variable costs are incurred directly as activity takes place, fixed costs are incurred in anticipation of providing services for an estimated level of activity, and, consequently, the expenditure is contractually made or committed prior to actual activity. Fixed cost expenditures are determined prior to the period of activity for a defined quantity of service potential. Building rent, for example, reflects the right to use a defined amount of floor space. The lease of equipment provides the right to a defined number of operating hours per period. Fixed cost expenditures are then capacity costs. An understanding of fixed costs requires an understanding of the different facets of capacity. Fixed costs, therefore, make a range of production activity possible.

The term capacity in the singular is somewhat misleading. Rather than use the term “capacity”, a more accurate statement would be that fixed costs provide the “capacities” to produce. Each type of fixed cost provides a different capacity service and, unless management has exercised exceptional care in planning, the capacity related to each cost might not be in balance. Imbalance in capacities created by fixed costs can create bottlenecks or constraints in both production and sales.

Examples of different fixed costs and the corresponding capacities provided are shown in Figure 5.7.

Figure 5.7 • Examples of Fixed Cost and Capacities Provided

Type of Fixed Cost	Service Provided
Manufacturing:	
Equipment lease/rent	Material processing services
Utilities	Heat, power, lights
Insurance	Financial protection
Indirect labor	Supervision of factory workers

continued on next page

Building rent	Shelter and auxiliary equipment space
Selling:	
Salesmen salaries	Order taking services
Automobile lease/rent	Transportation
Telephone	Order taking
Advertising	Customer product awareness
Administrative	
Management salaries	Supervision and planning
Utilities	Lighting, heating, air conditioning
Telephone	Communication of information
Computer lease	Processing of information

As implied in the discussion above, fixed costs are those expenditures that are not caused by activity but rather make activity or production possible. Fixed cost provide both the ability or capacity to manufacture and also determine the limits to production. For example, without the services provided by buildings, equipment, and supervision production could not take place. Expenditures for fixed costs represent the acquisition of the various capacities necessary for actual activity to take place.

The K. L. Widget Company has 15 machines capable of producing a total of 15,000 units per quarter. One production supervisor is required for every 5 machines. Currently two supervisors are each paid a \$10,000 salary. Five machines are not in use because of a lack of a supervisor. The building which the company rents has enough space to hold 20 machines. Consequently, the company has a machine capacity of 15,000 units while it has supervision capacity of 10,000 units. The building space capacity is adequate to manufacture 20,000 units.

This example illustrates that different types of fixed costs provide different types of production services each of which provides a different capacity level. In this example, there are three capacities: machine, supervision, and space. A major concern of management is to have a balance or equality among the different ranges of capacity services. Also, in this example, each type of fixed cost provide different output limits. Actual production is limited to the lower of the three levels. Furthermore, production cannot exceed 10,000 units, even though machine and space capacity is larger. A major responsibility of management is to make those fixed cost decisions that create a balance among the different types of capacity services.

In contrast to variable costs, fixed costs expire with the passing of time. Fixed costs are expenditures that contractually provide services for a defined period of time. At the end of the contract period, the services are no longer available without a new contract or time commitment of resources by management.

For example, the decision to rent ten automobiles for a year provides management with transportation services for a year. If one auto has the potential to be driven 200 miles a day, then ten autos for a year provide a capacity of 730,000 miles (200 x 365 x 10). At the end of the year, the year's purchase of transportation has fully expired.

The unused portion of miles driven cannot be transferred to the next year. The rent expenditure for autos is the same whether or not the potential services are used. The passing of each day proportionately reduces the service potential regardless of whether activity is ongoing.

Inherent in the nature of fixed cost is the potential for idle capacity. Consequently, from a management accounting viewpoint, the measurement of idle capacity is important. The cost of idle capacity cannot be transferred to another period in the manner in which unused material can be stored and used in a later period. The constant relationship between fixed costs and capacity or volume can be explained and illustrated from three points of view: tabular, mathematical, and graphical.

Tabular Presentation - The presentation of fixed costs in a table at different levels of activity is basically unnecessary for the reason that regardless of the level of activity the cost is the same. However, for illustrative purposes, a simple table of fixed costs will be presented for three types of fixed costs common in all manufacturing businesses:

Table of Fixed Costs				
	Volume (units of product)			
	1,000	2,000	3,000	4,000
Manufacturing	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000
Selling expenses	\$180,000	\$180,000	\$180,000	\$180,000
General and Administrative	\$ 90,000	\$ 90,000	\$ 90,000	\$ 90,000

Mathematical Presentation - Fixed costs may be defined mathematically in terms of total costs and in terms of average cost. On a total cost basis, volume or quantity, **Q**, is not a determining factor; however, for average cost quantity or **Q** is the important factor in the equation. Total fixed cost may be mathematically defined:

$$TFC = F \tag{4}$$

Where:

TFC represents total fixed cost and **F** is the amount or magnitude of fixed costs for a given period of time such as a quarter or a year.

The interpretation of this equation is that regardless of the level of activity, the amount of fixed cost is totally independent of actual quantity. The importance of defining fixed cost mathematically as presented in the above equation will be appreciated in a later section when fixed and variable cost are combined in a total cost equation.

For some decisions such as price, a knowledge of cost per unit or average cost is very important. Mathematically, average fixed cost may be defined as follows:

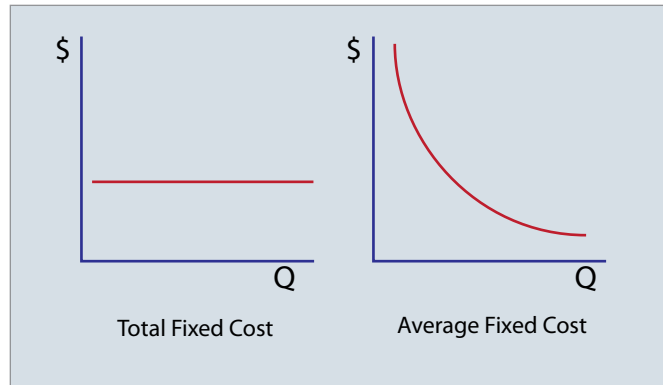
$$AFC = F/Q \tag{5}$$

where **AFC** represent average fixed cost and **Q** is the current level of activity; that is, units manufactured or units sold. In the following section, the importance of average fixed cost will be discussed and illustrated.

Graphical Presentation - The behavior of both total fixed cost and average fixed cost can be effectively illustrated graphically. In the following illustration, **TFC** and **AFC** are dependent variables while quantity or **Q** is the independent variable concerning the computation of average fixed cost. Consequently, values assigned to **Q** for **TFC** and **AFC** can be plotted graphically. To illustrate, assume that fixed cost is \$10,000 and activity increases in increments of 100. The following graphs may be drawn:

Figure 5.8

Q	TFC	AFC
100	10,000	100.00
200	10,000	50.00
300	10,000	33.33
400	10,000	25.00



These graphs effectively display the relationship of volume to total costs. In the case of total fixed costs, there is no effect or change. However, regarding average fixed cost, the opposite is true. As quantity increases, the average fixed cost becomes less. The effect of different levels of quantity on average fixed cost is extremely important and requires an in-depth understanding. Without a complete understanding of the impact of different capacity levels on average fixed costs, poor decisions e.g., the pricing decision, could have severe profitability consequences.

Fixed Cost Components- As the case for variable costs, fixed costs can be analyzed at two levels: the aggregate level and the micro level. At the aggregate level, **F** represents the sum of all the individual fixed costs. Fixed costs can be divided into subclassification levels: labor, manufacturing overhead, selling, and administrative. From a micro or analytical viewpoint, **F** is the aggregate of these individual rates. Mathematically, then **F** may be defined as:

$$F = F^L + F^o + F^s + F^a \quad (6)$$

Where:

$$\begin{array}{ll} F^L - \text{fixed labor cost} & F^s - \text{fixed selling expenses} \\ F^o - \text{fixed overhead costs} & F^a - \text{fixed administrative expenses} \end{array}$$

In practice, the amount of total fixed cost, **F**, will simply be the sum of the individual fixed cost elements. Some of the techniques used to measure the individual fixed rates will be discussed later in this chapter.

Management Control of Fixed Costs - An important point that must be understood by both management and management accountants is that fixed costs are subject to a high degree of control. The management accountant as well as management must understand the consequences of making a cost fixed or variable. In order to

understand the consequences of decisions that convert variable costs to fixed costs, a more detailed discussion of capacity is required.

To illustrate the importance of the decision to make a cost either fixed or variable, the following example is presented.

The Acme Retail Company is a new retail company. Ten sales people are required to sell the product. The sales forecast indicates that average sales per sales person should be \$200,000. Management is contemplating a 10% commission versus a salary of \$20,000. How should sales people be compensated?

This is not an easy decision. There are important cost and psychological factors involved. A commission is likely to motivate sales people, but at the same time for an individual inexperienced sales person, the inability to attain sufficient sales may result in discouragement and thus quitting. Sales people content with a salary of \$20,000 may never be tempted to quit, but because of the lack of motivation may never reach their quota. If sales due to a recession or competition decreases, then the sales people's compensation remains the same. With a commission, a decrease in sales would be accompanied with a proportionate decrease in compensation. A fixed salary would increase the risk of operating at a loss, but in times of prosperity and easy sales, compensation of sales people on a salary basis might maximize net income. In practice, management often compromises by paying sales people a combination of salary and commission.

As another example, management might be able to control the nature of costs by changing the type of equipment. Current production equipment that now requires a high degree of direct labor might be replaced with automated equipment that requires considerable less direct labor and more indirect labor. For example, in many companies computerized tooling and machining equipment have replaced direct labor. The effect on cost behavior has been a shift from a variable cost to a fixed cost.

Control over Capacity Limits - As true of variable costs, fixed costs are also subject to the decision-making powers of management. Fixed costs and their related capacities provide some difficult choices concerning the amount of capacity that is available at any given time. The greater the expenditure the greater the capacity. For example, the lease on a medium size computer might be \$500 per month, but for a larger computer the cost might be \$1,500. The capacity of the larger machine might be five times greater. However, now only the smaller machine is needed. Would management be better off to invest in the larger machine in anticipation of growth? For the short run, profits might be less, but in the long run profits might be greater, if the machine with the greater capacity is purchased.

Definition of Capacity - A major task of management is to manage the level of expenditures for fixed cost; that is, to make decisions determining the capacity to manufacture and to sell. Therefore, a major question is: what is capacity? This concept is without question the most important concept related to fixed cost. Unfortunately, the concept is elusive and very difficult to define quantitatively. In cost accounting, various degrees of capacity are recognized and defined: theoretical, practical, normal, and

expected actual. In a general sense, capacity refers to the maximum number of units that can be manufactured in a given time period. However, this concept of capacity is a flexible quantity when such factors as overtime, employee training, second shifts, speed of equipment, holidays, and vacations are taken into account.

In management accounting, capacity is a strictly a short-run notion that imposes limits on sales and production capacity. Consequently, any increase in the spending for fixed manufacturing costs will normally increase capacity. For example, the leasing of additional equipment or the hiring of an additional production supervisor will increase capacity. In this sense, the short run is that length of time in which expenditures cannot be immediately increased.

Other costs such as rent are inherently time-oriented and, consequently, fixed in nature. The production services provided do not easily, if at all, divide into small discrete units. Material, for example, is easily divided and associated with individual units; however, the services of a manufacturing plant, is not easily unitized and allocated to individual units of finished product. The major problem created by fixed costs is that for costing and pricing purposes fixed costs must be converted to a per unit basis. Various methods of unitizing fixed costs have been developed including various allocation and overhead rate methodologies. The following table indicates some possible bases for allocation of various types of fixed costs.

Cost Item	Service Provided	Basis of Allocation
Building rent	Shelter, protection	Space
Equipment	Processing of material	Direct labor hours
Indirect labor	Supervisor	Number of workers
Insurance	Financial protection	Value of equipment
Computer Cost	Processing time	CPU time
Staff	E.g., secretarial services	Hours of service
Utilities	Lighting	Floor space
Preventive maintenance	Efficiency and safety	Value of equipment

Total Fixed and Variable Costs

Based on the above discussions, we have arrived at a point where we can now talk about total fixed and variable costs. For the moment, we will assume that in a given operating period production equals sales. Therefore, the problems associated with inventory increasing or decreasing from period to period can be avoided. Given this assumption, we can now define total costs by the following equation:

$$TC = F + V(Q) \quad (7)$$

Where:

TC	-	total cost
V	-	variable cost rate
Q	-	quantity
F	-	fixed cost

Given that we know V , the variable cost rate and F , the amount of total fixed cost, we are able to compute total cost at any level of activity. For example, if we assume that $V = \$10.00$ and $F = \$100,000$, then total fixed cost at different assumed levels of activity would be as shown in the following table. The change in costs is due to the increase in the variable costs. The change in activity had no affect on total fixed cost. If fixed costs change, it is because of the change in some other factor than volume, for example, an increase in monthly rent of equipment.

Volume	V	TVC	F	TC
10,000	\$10.00	\$100,000	\$100,000	\$200,000
20,000	\$10.00	\$200,000	\$100,000	\$300,000
30,000	\$10.00	\$300,000	\$100,000	\$400,000
40,000	\$10.00	\$400,000	\$100,000	\$500,000

Total costs can sometimes be better understood when presented graphically as shown in Figure 5.9 and Figure 5.10:

Figure 5.9 • Total Fixed and Variable Cost

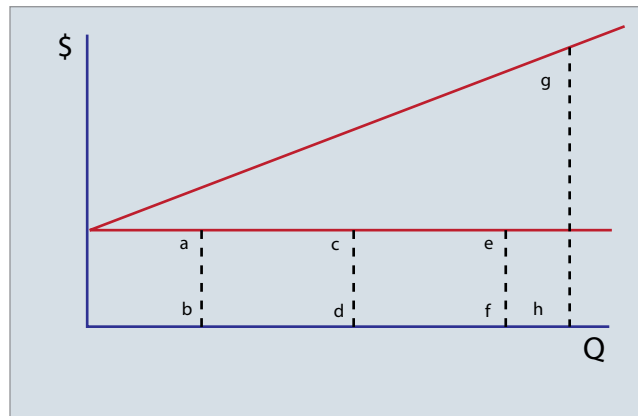
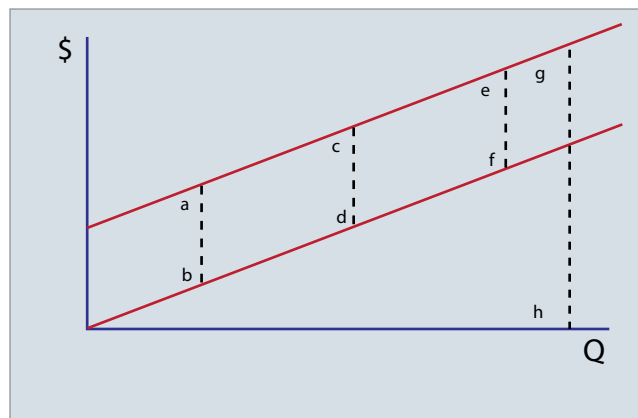


Figure 5.10 • Total Variable and Fixed Cost



In Figure 5.9, fixed cost is shown first and the distances a - b, c - d, and e - f are the same at their respective volume. In this graph, the fixed nature of fixed costs is easily grasped. Line g - h represents total fixed and variable cost.

Total cost may also be defined as follow:

$$TC = V(Q) + F \quad (8)$$

In this equation, we start with total variable cost and add to this amount total fixed cost. It might seem trivial whether we define total cost using equation 7 or equation 8. However, the two equations are quite different when it comes to showing total cost graphically.

Most students have difficulty in visualizing the graph shown in Figure 5.10 because it seems that fixed cost is increasing with volume. Admittedly, Figure 5.9 is easier to understand because the top line of the fixed cost is horizontal. However, it is not the line that is fixed in amount but rather the distance from the horizontal line as shown in Figure 5.9 to the base line that is fixed. As shown in Figure 5.10, the lines a - b, c - d and e - f are equal in length, and are also the same length as the same lines in Figure 5.9. Line g - h in Figure 5.10 represents total cost and is the same as line g - h in Figure 5.9.

It would seem that it is irrelevant which graph is used to portray fixed and variable costs. Figure 5.9 which shows the top line of total fixed cost as a horizontal line might be to be the preferred method. However, in fact, this is not the case. The preferred method is to graphically show fixed and variable cost as shown in Figure 5.10. The reason is that when total sales is introduced, as will be discussed in the next chapter, it is possible then to illustrate an important concept, total contribution margin, which can not be illustrated if Figure 5.9 is used. Cost-volume-profit analysis (chapter 7) can be more effectively presented graphically using the graph as shown in Figure 5.10.

Average Total Cost

The use of averages to communicate information and greater understanding is quite common in business, economics, and also government issued statistics. Relationships are often easier to understand when averages are used. For example, rather than say that disposable net income in the USA is \$600,000,000,000, it is easy to understand if one were to say that the average disposable income per person in the USA is \$20,000 per person.

In equation (5), average fixed cost was defined as follows:

$$AFC = F / Q$$

It is also possible to define average variable cost as follows:

$$AVC = V(Q) / Q = V \quad (9)$$

The variable cost rate as previously discussed earlier in this chapter is simply average variable cost under the condition that regardless of the change in volume the average remains constant; that is, the total variable cost line is linear.

Consequently, average total cost now may be defined mathematically as follows:

$$AVC = V + F/Q$$

To illustrate, assume the following data:

$$V = \$10,000$$

$$F = \$200,000$$

Now at volumes of 10,000, 20,000, 30,000, and 40,000 we get the following results.

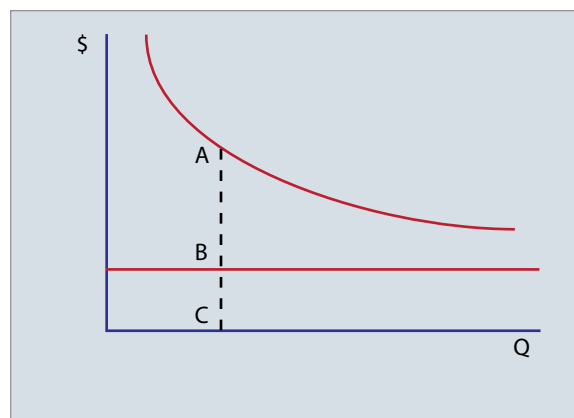
Volume	Variable Cost Rate	Average Fixed Cost	Average Total Cost
10,000	\$10.00	\$20.00	\$30.00
20,000	\$10.00	\$10.00	\$20.00
30,000	\$10.00	\$ 6.67	\$16.67
40,000	\$10.00	\$ 5.00	\$15.00

The above analysis reveals a very important business principle. The cost of a product per unit is highly dependent on volume when the fixed cost in a business represents a major portion of the total cost. As volume (production) increases, the total cost per unit of output decreases and as the volume decreases the total cost per unit of output increases. In modern business where fixed costs tend to be very high relative to variable costs, the key to getting a low production cost per unit is to have a high volume of production and sales. Many products in our modern economy are available to consumers as a whole only because of mass production.

Since the middle of the 19th century, in large businesses the fixed costs of production have become dominant while the variable costs associated with materials and labor have decreased significantly in total amounts. This shift in costs where fixed costs are significantly greater percentage wise means that the break even point in these businesses have become much greater. Consequently, a high volume of sales and production is required first to break even and secondly, required to make a reasonable profit. The benefit to customers is that at high volumes the cost per unit becomes relatively low. Therefore, because of this fact, it is absolutely critical that management has a good understanding of average fixed and average variable cost.

Like total fixed and variable cost, average fixed and variable cost may be presented graphically.

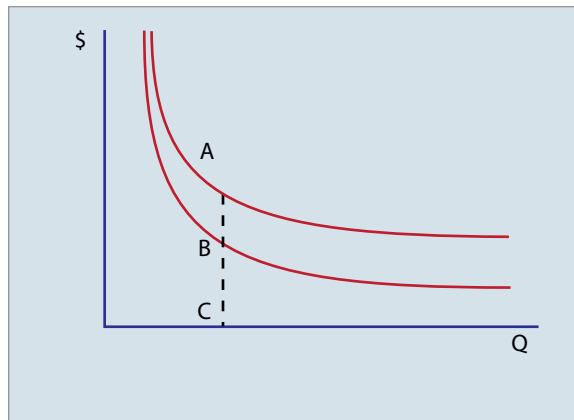
Figure 5.11 • Graph A



In the above graph (Graph A), line B - C represents average variable cost and line A - B represents average fixed cost. Line A - C then represents total average cost. This graph portrays effectively that as volume increases the total average cost of the product decreases. The consequence of operating at less than full capacity is a much higher per unit cost of the product.

As with total fixed and variable cost (see page 79), it is possible to present a graph where average fixed cost is shown first and average variable cost is shown as an addition to average fixed cost.

Figure 5.12 • Graph B



In Figure 5.12, graph B, we again show average fixed and variable cost. As before, line A - C represents total average cost. However, now line B - C represents average fixed cost whereas in graph A line B - C represents average variable cost. Similarly, in Figure 5.12 now line A - B represents average variable cost.

Strange as it may sound, it is correct to say that in terms of average costs, it is the variable costs that are constant and the fixed costs that are variable. Increases in volume have no effect on the average variable cost, but do decrease the average fixed cost with each successive increase in volume.

Illustrative Problem

The K. L. Widget Company's fixed manufacturing costs including depreciation, supervisor salaries, and equipment leasing costs total \$100,000. Material and direct labor cost \$12 per unit. Currently the company has the potential capacity to manufacture 1,000 units, but is actually operating at an 80% level or 800 units. The company can sell 200 units of its product to the Ace Retail Company which has offered to pay \$120 per unit. If the company accepts this special offer, would a profit be made?

Obviously the company should charge \$12 to recover its variable cost. The problem is: how much should be charged for fixed expenses? The obvious answer is to divide fixed cost by capacity. However, there are two levels of capacity: actual capacity utilized and full capacity. If the company divides fixed cost by actual capacity utilized, the charge for fixed expenses would be \$125 ($\$100,000/800$) per unit; whereas the charge for fixed expenses based on maximum capacity, the charge would be \$100. If the company sells to the Ace Retail Company and uses actual activity, a loss would

of \$17 a unit would be reported. On the other hand, charging fixed costs on the basis of maximum capacity would result in a gain of \$8 per unit.

	Full Capacity (1,000)	Actual Capacity used (800)
Sales price	\$120	\$120
Variable cost	\$ 12	\$ 12
Fixed overhead	\$100	\$125
Total cost	\$112	\$137
Profit per unit (special offer)	\$ 8	\$(17)

Therefore, for many businesses the accounting for fixed costs determine whether or not new business is obtained. However, as discussed in a later chapter, an incorrect treatment of fixed manufacturing overhead can result in a wrong decision. In the above example, fixed manufacturing overhead is actually irrelevant to the decision, if it can be assumed that the difference between 1,000 units and 800 units is idle capacity

Separating Fixed and Variable Costs

In many cases, identifying what costs are fixed and variable is fairly easy. For example, regarding sales people commissions, if the price of the product is \$300 and the commission rate is 10%, then it is fairly obvious that the variable rate is \$30 per unit of product sold. Similarly for many expenses, it is obvious that the expenses are fixed in nature. For example, assume that the monthly lease on equipment is \$5,000 per month. Again, it is fairly obvious that the annual cost of \$60,000 is a fixed expense. However, some expenses contain both elements and are, therefore, both fixed and variable in nature.

Expenses that are both fixed and variable in nature are commonly called mixed expenses or semi-variable. A cursory examination of these types of expenses does not reveal what amount is fixed and what amount is variable. For example, it is not uncommon for utility charges for electricity or for water to contain a fixed charge for the service and a variable charge for usage. If, as a consumer, you were able to not use any electricity for a month, you would still receive a bill of a set amount for the fact that the service was available. The same principle is true of many expenses in business.

If the mixed expenses are important in terms of amounts, then it is important that the fixed and variable portions be measured and separated. Three methods exists for separating fixed and variable components from mixed expenses. These methods are :

1. Scatter graph method
2. High-low method
3. Least-squares regression equation method

Scatter graph Method - The scatter graph method requires that actual cost values from preferably four or more operating periods be obtained and then plotted on a graph. Since is it highly unlikely that the plotted points will fall in a straight line, the graph is called a scatter graph. The remaining steps are to identify fixed and variable costs:

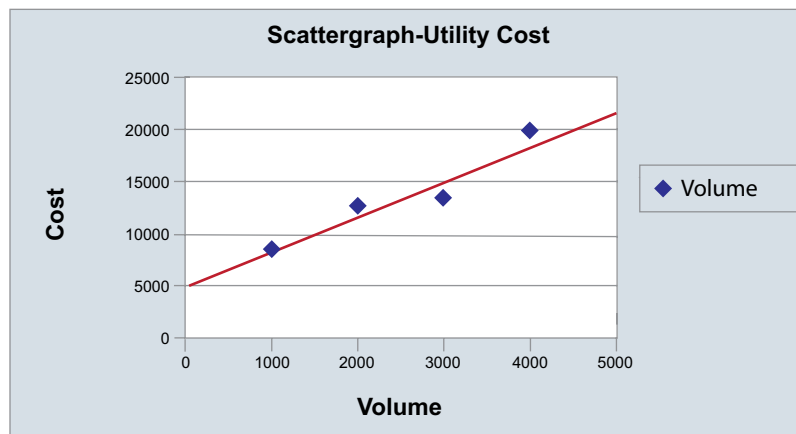
- Step 1** Draw a straight line of best fit.
This line should be drawn so that the data points (the scatter) is about equally divided on both sides of the line. Also, the line should touch the Y axis of the graph.
- Step 2** Determine the amount of fixed expense.
Where the line touches the Y axis, the distance from this point to the base line of the graph is the amount of fixed expense.
- Step 3** Determine the total cost on the line of best fit by selecting any point on the line of best fit other than the point on the Y axis.
This point will then be a measure of the total expense which includes both the variable and fixed portion.
- Step 4** Compute the amount of the variable expense.
The variable expense can be found by subtracting the fixed expense measured in step 2 from the total expense measured in step 3.
- Step 5** Compute the variable cost rate.
The variable cost rate can be easily computed by dividing the amount of variable cost by the activity level indicated in step 3.

To illustrate, assume the following:

The K. L. Widget Company wants to estimate the total utility cost next year at a planned volume of 3,500 units of product. Last year's utility cost for each quarter of the year was as follows:

	Volume	Utility Cost
1 st	2,000	\$12,500
2 nd	4,000	\$20,000
3 rd	3,000	\$13,500
4 th	1,000	\$ 8,500

A scatter graph and line of best may be prepared as follows:



1. Total fixed = \$5,000
2. Cost on line of best fit at 3,000 units = \$15,000
3. Variable cost (\$15,000 - \$5,000) = \$10,000
4. Variable cost rate = \$10,000/3000 = \$3.33

$$TC = \$5,000 + \$3.33 (Q)$$

5. Total cost at 3,500 units of product

$$TC = \$5,000 + \$3.33 (3,500) = \$16,655.00$$

The disadvantage of this method is that the line of fit is somewhat arbitrary. How the line is drawn can make a significant difference in the fixed cost amount and the variable cost rate.

High-low Method - The high-low method is an easy to use and effective method for separating the variable component of a mixed cost from the fixed cost. The high-low method is based on the realization that from period to period any change in total cost is presumed to be caused by a change in volume. The fixed portion of the cost is assumed to remain the same. Therefore, the variable portion can be computed by using the cost at two different levels of activity.

The steps of this method are as follows:

Step 1 Obtain data points (volume and related cost) from several periods of operations.

Step 2 Select two different levels of activity and arrange the data as follows: (Values here are assumed for illustrative purposes.)

	<u>Volume</u>	<u>Cost</u>
High	10,000	\$50,000
Low	5,000	\$30,000

Step 3 Compute the difference in volume and costs.

	<u>Volume</u>	<u>Cost</u>
High	10,000	\$50,000
Low	<u>5,000</u>	<u>\$30,000</u>
	5,000	\$20,000

This computations shows that a 5,000 increase in volume caused a \$20,000 increase in variable costs.

Step 4 Compute the variable cost rate by dividing the difference in cost by the difference in volume.

$$\text{Variable cost rate} = (\$20,000 / 5,000) = \$4.00$$

Step 5 Compute the amount of fixed cost by first selecting a level of activity (either the high or the low) and then compute the total variable cost at that level of activity (e.g., \$10,000 x \$4.00). Secondly, subtract the total variable cost from the total cost at that level of activity (e.g., (\$50,000 - \$40,000)). In this example, total fixed cost is \$10,000.

The high-low method is an easy method of computing the fixed and variable components in a mixed cost. However, depending on what high and low data points are selected, a different in answers can be obtained. The values selected should appear to be representative and not be the most extreme values.

Least Squares Regression Method - The least squares method is a more scientific and accurate approach to determining values for fixed and variable costs from mixed costs. The method is a statistical method for computing the two key variables of a straight line. The assumption is that from an array of data points there is one best line of fit. The least squares method is able to find the **A** and **b** values of a straight line where **A** is the value at the y-intercept and **b** is the slope of the line.

The equation for a straight line is generally defined as follows:

$$Y = A + b(X)$$

If the values for **A** and **b** are known, then **Y**, the value of the dependent variable, can be computed for any given value of **X**.

The total cost equation, equation (7), was previously presented as follows:

$$TC = F + V(Q)$$

It is apparent by inspection that the two equations are equivalent. Fixed costs or **F** is equivalent to **A** and **V**, the variable cost rate, is equivalent to **b**. Consequently, the least squares method can be used to find the values for **F** and **V**.

The least squares method will not be illustrated here. Any introductory statistics book will explain how the method works. Also, the management accounting tools in *The Management/Accounting Simulation* contains the least squares method as one of its computer-based management accounting tools.

Summary

An understanding of cost behavior is critical in management accounting because several of the management accounting tools require using fixed and variable costs. Since the general ledger does not contain separate accounts for fixed and variable costs nor labels them as such if a cost is clearly all fixed or all variable, it is necessary by one method or another to determine what costs are fixed and what are variable.

The assumption that costs are either pure fixed or pure variable is an arbitrary assumption. In fact, costs in some businesses may be curvilinear in nature or mixed as previously discussed. The assumption that costs are linear in nature makes it much easier to use various management accounting tools. The question is whether this simplicity in assumption causes the results of analysis to be inaccurate and misleading. The argument generally is that as long as the user of management accounting tools stays within a relevant range of activity, the use of linear fixed costs and variable costs will produce very useful results. When using tools that require fixed and variable costs, it is important to realize there will always be a margin of error.

QUESTIONS

- Q. 5.1 Explain the difference between cost classification and cost behavior.
- Q. 5.2 Explain the difference between a variable cost and a variable expense.
- Q. 5.3 Explain the technical difference between a fixed cost and a fixed expense.
- Q. 5.4 What are the two primary measures of volume that determine total costs and expenses.
- Q. 5.5 What is the equation for total variable cost?
- Q. 5.6 What is the total cost equation?
- Q. 5.7 List some of the management accounting tools that require knowing fixed and variable costs or expenses.
- Q. 5.8 What is a mixed or semi-variable expense?
- Q. 5.9 What techniques may be used to separate fixed and variable cost components of mixed costs?
- Q. 5.10 In the high-low method, which cost is first computed?
- Q. 5.11 In the scatter graph method, which cost is first computed?
- Q. 5.12 Define the following terms:
- Variable cost
 - Fixed cost
 - Average fixed cost
 - Average variable cost
- Q. 5-13 Identify the following:
- $V(Q)$
 - F/Q
 - $F + V(Q)$
 - V

EXERCISES

Exercise 5.1 • Graphical Illustration of Cost Behavior

You have been provided the following information

Total fixed costs	\$100,000
Variable cost per unit	\$ 20.00
Sales price	\$ 80.00

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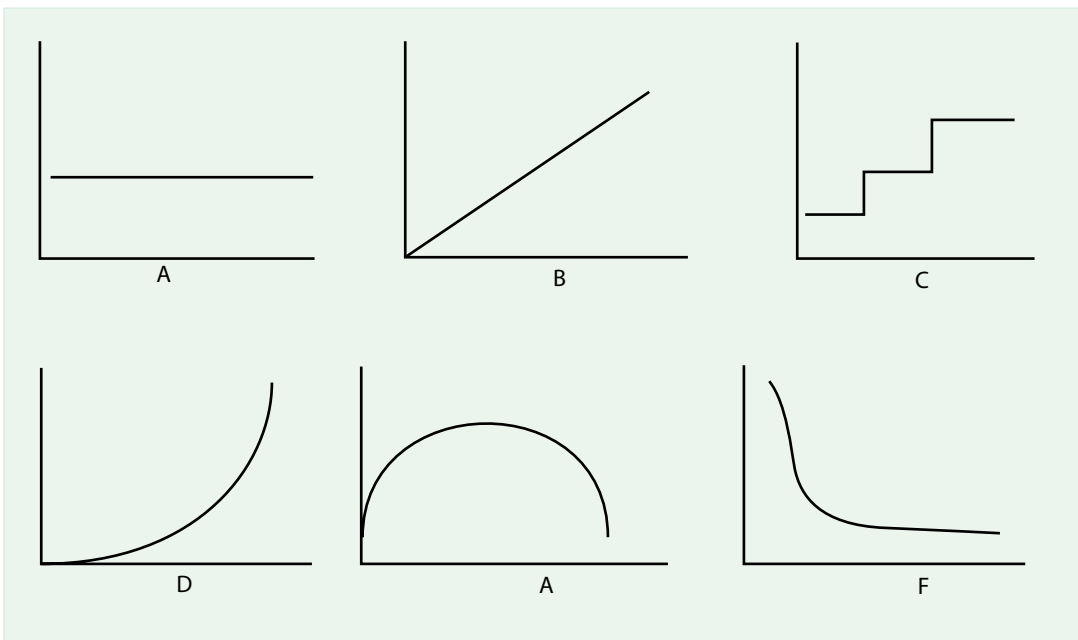
Required:

Based on the above information, prepare a graph showing:

- Total fixed costs. (Start with 1,000 units and show increases in activity in increments of 1,000 units up to 10,000 units.)
- Prepare a graph showing average fixed costs. (Start with 1,000 units and show increases in activity in increments of 1,000 units up to 10,000 units.)
- Prepare a graph showing total variable costs. (Start with 1,000 units and show increases in activity in increments of 1,000 units up to 10,000 units.)
- Prepare a graph showing average variable cost. (Start with 1,000 units and show increases in activity in increments of 1,000 units up to 10,000 units.)
- Prepare a graph showing total cost, both fixed and variable. (Start with 1,000 units and show increases in activity in increments of 1,000 units up to 10,000 units.)

Exercise 5.2 • Identifying Cost Behavior

Following are some graphs that show different kinds of cost behavior that are commonly found in various businesses.

**Required:**

Select the appropriate graph to illustrate the costs listed on the next page.

continued on next page

Cost Behavior	
Cost Items	Graph
1. Total factory workers' wages	
2. Salaries of production engineers	
3. Salaries of management	
4. Total material cost (cost per unit is same at any quantity of output)	
5. Average fixed manufacturing overhead	
6. Average direct labor cost (assume constant wages)	
7. Total cost of fuel consumption (Assume increase in activity is due to increases in running speed of machines.)	
8. Total clerical salaries (A new clerk is hired each time activity increases by 1,000 units of product.)	
9. Average sales people commissions	

Exercise 5.3 • Computing Fixed and Variable Costs

The K. L. Widget Company has decided to open a new territory. The company is not sure what the customer response will be when their product is introduced in the new territory. The company wants to set the price high enough so that a profit results. This price, therefore, must cover the costs of manufacturing and selling.

The company's controller knows that a significant portion of the manufacturing and selling costs are fixed in nature. The cost per unit then can vary depending on how many units are sold in the new territory. The following cost information is available to the controller:

Material

Units of material per unit of product	4
Cost per unit of material	\$2.00

Factory labor

Labor required per unit of product (hours)	1.5
Wage rate per hour	\$15.00

Variable overhead last years (50,000 units)	\$250,000
Selling variable cost(sales = 45,000 units)	\$270,000

Fixed manufacturing cost	\$500,000
Fixed selling expenses	\$800,000

Required:

Assume that you are the controller of the company and that you have been asked to compute the cost per unit of manufacturing and selling the product.

continued on next page

You have decided to use the following work sheet to make your computations. Since sales have varied between 40,000 and 60,000 units in the past few years, you have decided to make cost per unit computations in increments of 5,000 units.

Cost Item	Computation	Cost per Unit
Material		
Factory Labor		
Variable manufacturing overhead		
Variable selling		
Total variable cost per unit		
Fixed cost:		
Manufacturing		
40,000 units		
45,000 units		
50,000 units		
55,000 units		
60,000 units		
Selling		
40,000 units		
45,000 units		
50,000 units		
55,000 units		
60,000 units		

Cost Per Unit Summary			
Activity Level (production)	Variable Cost Per Unit	Fixed Cost Per Unit	Total Cost per Unit
40,000			
45,000			
50,000			
55,000			
60,000			

1. Which type of cost is responsible for total cost per unit to vary with production?
2. If cost varies with production and production will vary with sales demand, then what cost figure should be used to determine price?

Exercise 5.4 • Computing Variable Cost Rates

You have been provided the following information:

Variable Costs

Material

Cost per unit of material	\$ 2.00
Units of material required per unit of product	6

Factory labor

Wage rate per hour	\$ 12.00
Labor hours required per unit of product	4

Manufacturing overhead

Utilities

Cost per kilowatt hour	\$.06
Number of kilowatt hours per unit of product	10

Supplies

One unit of supplies	2
Cost per unit of supplies	\$ 4.00

Repairs and maintenance

Hours of maintenance per unit of product	.5
Repair cost per hour	\$ 15.00

Selling

Commission rate (price of product - \$300)	10%
Packaging cost per unit of product	\$ 2.00

General and administrative

Clerical and staff (hours)	1.50
Average wage rate	\$10.00

Fixed costs/expenses

Manufacturing overhead

Production salaries	\$100,000
Equipment depreciation	\$ 10,000
Insurance and taxes	\$ 5,000

Selling

Advertising	\$ 50,000
-------------	-----------

General and administrative

Salaries	\$ 80,000
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continued on next page

Required:

- (1) Compute the variable rate for
 - a. Material
 - b. Factory labor
 - c. Manufacturing overhead
 - d. Selling expenses
 - e. Administrative expenses
- (2) What is the total amount of fixed expenses?
- (3) Prepare a simple income statement showing net income at the following levels of sales (assume production = sales). Price of the product is \$300.00.
 - a. 10,000 units of sales
 - b. 20,000 units of sales
 - c. 30,000 units of sales
 - d. 40,000 units of sales

Exercise 5.5 • High-low and Scatter Graph Methods

The K. L. Widget Company in connection with its cost accounting and budgeting system classifies its cost as either fixed or variable. However, some of the company's manufacturing costs are in fact semi-variable in nature. In order to prepare a flexible budget for manufacturing expenses, it is necessary to separate these costs into their fixed and variable components. The cost accounting records for the year just ended showed the following data.

	Units of product	Utilities expense	Repairs and Maintenance Expense
1 st quarter	10,000	\$40,000	\$ 82,000
2 nd quarter	15,000	\$56,000	\$115,000
3 rd quarter	18,000	\$65,000	\$133,000
4 th quarter	8,000	\$36,000	\$ 64,000

Required:

Based on the above data, compute the fixed and variable cost components of the above costs/expenses:

1. Assuming the high-low method is used
2. Assuming the scatter-graph method is used.