Cost-Volume-Profit Analysis

6

©Getty Images/Comstock Images/Stockbyte/Thinkstock

Learning Outcomes

By the end of this chapter, you will be able to:

- Identify fixed and variable costs for healthcare organizations
- Conduct cost-volume-profit (break-even) analyses in fee-for-service and capitated environments

Introduction

After a lower than hoped for level of net income in 2012, Chamberlin Skilled Nursing and Rehabilitation Center, Inc. is seeking ways to improve profitability. Mary Ellen Lahay, the administrator at Chamberlin, has envisioned four ways to improve profits: (1) increase the number of residents, (2) negotiate higher payment rates from insurance companies, (3) reduce the costs that vary with the number of residents, and (4) reduce overhead and costs that don't vary with the number of residents. How feasible are any of these four ways to improve profits? How much could any of these options improve profits? Clearly, Ms. Lahay has some homework to do to examine these options.

This chapter considers the full relationships among costs, volumes, and profits. The cost-volume-profit relationship is at the core of many analyses in managerial accounting. Finding ways to change costs and manage volumes of patients and services provided to patients is an important aspect of managing the finances of any healthcare organization. Understanding and managing revenues was the focus of Chapter 5.

6.1 Cost and Volume

It seems intuitive that costs and patient volume would be closely related in the operations of healthcare organizations. If there are more patients, costs must be higher. Is this always the case? Suppose you are managing an ophthalmology practice where most patients schedule appointments for their eye visits. One day, just before closing, a patient appears at the front desk with a request to see the physician. The patient has recently received new eyeglasses and is experiencing headaches and double vision. The physician sees the patient that day, performs a diagnosis of the condition, and prescribes a treatment. Will the cost for the practice be higher that day? Cost for the practice will probably not change due to one unscheduled patient on one day.

There are some costs that will not increase with patient volume, at least in the short run, such as the rental cost for the office space. We call these **fixed costs**. Other costs, such as supplies used in diagnosis or treatment, increase with the volume of patients. We call these **variable costs**. There are still other costs that exhibit characteristics of both fixed and variable costs. One of the tasks of business managers is to understand the relationships between various costs and volume and to perform analyses that inform financial planning and management. This chapter will describe variable costs, fixed costs, and combinations of costs that define the pattern of costs for the business as a whole and provide analyses using these patterns of costs.

Fixed Cost

Fixed costs are those costs that remain the same for differing numbers of patients. Exhibit 6.1 presents a condensed version of the income statement for Chamberlin Skilled Nursing and

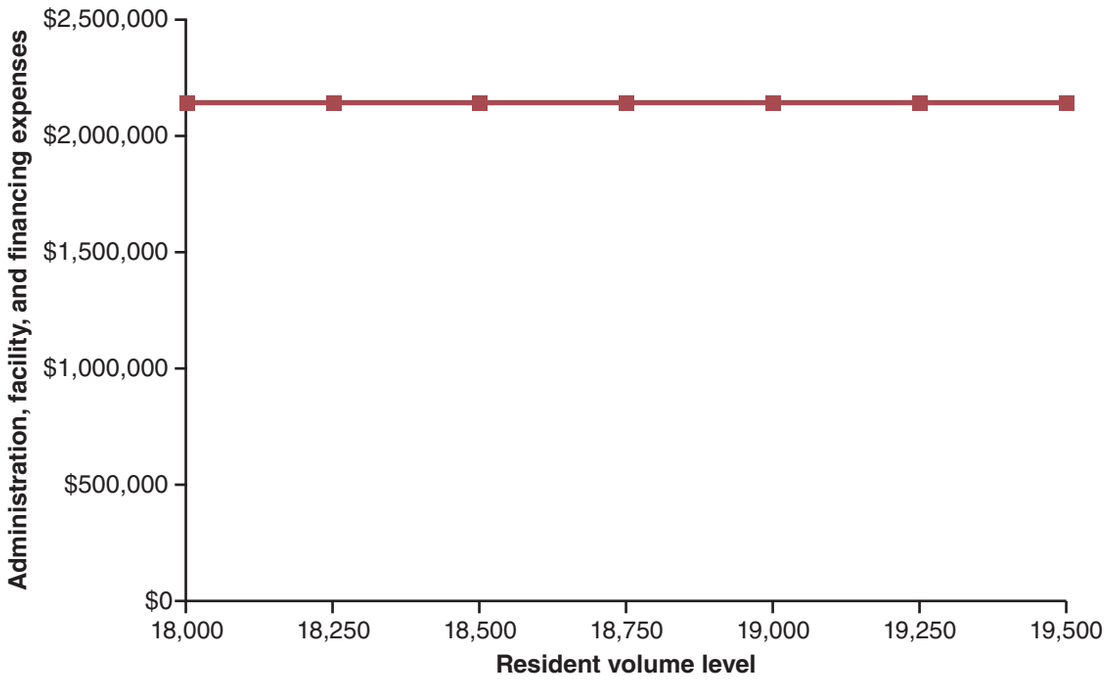
Rehabilitation Center, Inc. Among the many types of expenses, which are fixed costs? This is a trick question. For many healthcare organizations, it is not obvious from a quick look at income statements which expenses are fixed costs. Additional information beyond what is available on the income statement is required to determine which costs are fixed, which are variable, and which are combinations of the two. One source of additional information is the insight of an experienced manager. Oftentimes, managers will know from experience the types of costs that vary with volumes, if not the precise dollar amounts. When prior management experiences are not available, data from several time periods may permit observation and measurement of the cost-volume relationship.

Exhibit 6.1 Condensed income statement, Chamberlin Skilled Nursing and Rehabilitation Center, Inc.

	2012	2011
Revenues		
Net resident services revenue	$10,095,760	$10,509,587
Expenses		
Administration expenses	$560,000	$530,000
Resident service labor expenses	$5,208,144	$5,502,246
Physical, occupational, and speech therapy expenses	$1,940,395	$1,819,298
Pharmacy, laboratory, and other ancillary expenses	$834,010	$1,095,303
Facility and financing expenses	$1,548,640	$1,511,267
Total operating expenses	$10,091,189	$10,458,114
Net operating income (loss)	$4,571	$51,473
Licensed bed capacity	54	54
Total resident days	18,482	18,724
Occupancy rate	93.8%	95.0%
Total resident care staff	155	169

For Chamberlin, Ms. Lahay knows from experience that administrative expenses and facility and financing expenses don't vary much, if at all, with resident volumes. Administrative expenses include her salary and the salary and expenses associated with the clerical and billing personnel. Facility expenses include the cost of the building, equipment, and its maintenance. Financing expenses include the interest and other expenses associated with debt on building and equipment. More residents, within reason, won't affect any of these expenses. The amounts of these expenses may change over time due to salary increases, interest rate changes, and other factors. The key insight is that these expenses don't change simply because of the number of residents. As displayed in Figure 6.1, administration, facility, and financing costs remain the same for levels of resident volume from 18,000 resident days to 19,500 resident days.

Figure 6.1: Fixed costs and resident days, Chamberlin Skilled Nursing

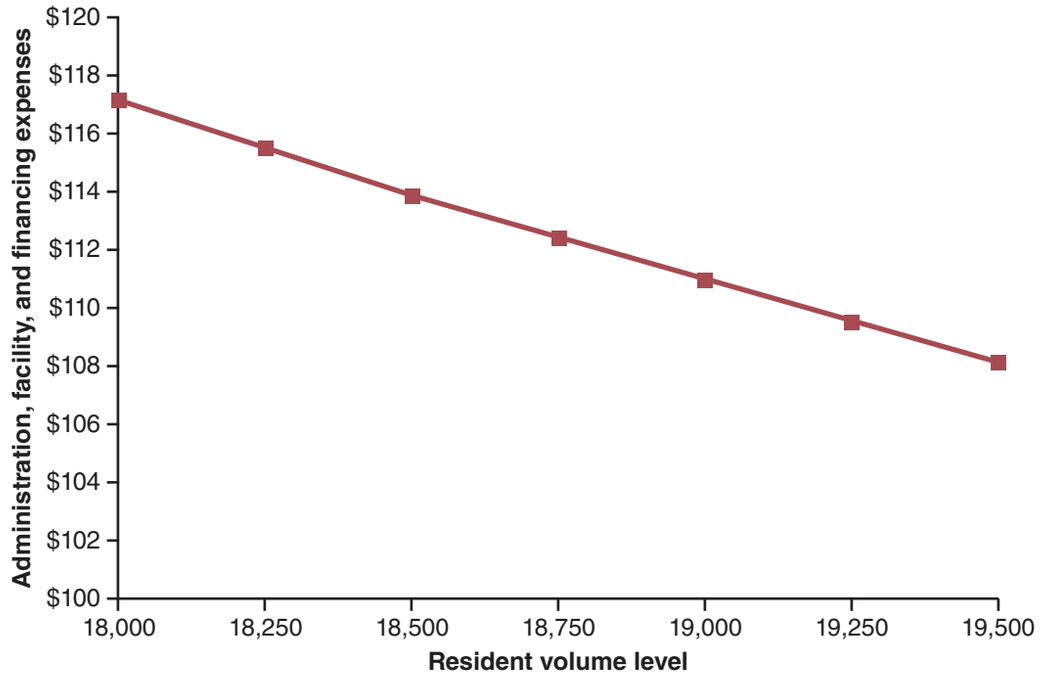


Source: Author's calculations

When administration, facility, and financing costs of $2,108,640 are presented as in Figure 6.1, it is easy to see them as fixed costs. If experienced managers are not available for answers to questions about which costs are fixed and which costs are variable, plotting available data on a graph such as Figure 6.1 is an alternative method.

Another view of fixed costs is presented in Figure 6.2. Fixed cost divided by the number of resident days displays a downward trend. This downward trend depicts the concept of **economies of scale**. Economies of scale means having a lower average cost per resident at a higher volume by more fully utilizing available resources. Lowering costs per resident day by spreading fixed costs over a larger number of residents is an important source of profit potential for skilled nursing facilities and other types of healthcare organizations.

Figure 6.2: Fixed costs per resident day and resident days, Chamberlin Skilled Nursing



Source: Author's calculations

The challenge of using information on fixed costs is remembering that these costs are actually fixed. When administration and other costs are presented on a per resident day basis, it is tempting to think that if the organization were to experience more resident days, these costs might increase. If one calculated administration, facility, and financing costs in 2012 as $114.09 per resident day:

$$\$114.09 \text{ per resident day} = \frac{\$2{,}108{,}640 \text{ administration costs}}{18{,}482 \text{ resident days}}$$

One might inappropriately think that one more resident day would increase costs by $114.09. The actual increase in fixed costs for one more resident will be zero.

Analyze This

If Chamberlin Skilled Nursing and Rehabilitation Center, Inc. were to provide 19,500 resident days of care in 2013, would their total of administration, facilities, and financing costs decrease to $2,106,000? Why or why not?

From the Front Lines

Our robotic equipment and its maintenance represent a fixed cost of $23,320 per month. The cost-effectiveness of robotic-assisted surgery is related to patient volume: With only 10 cases, the fixed cost per case is $2,332, and with 40 cases, the fixed cost per case is $583.

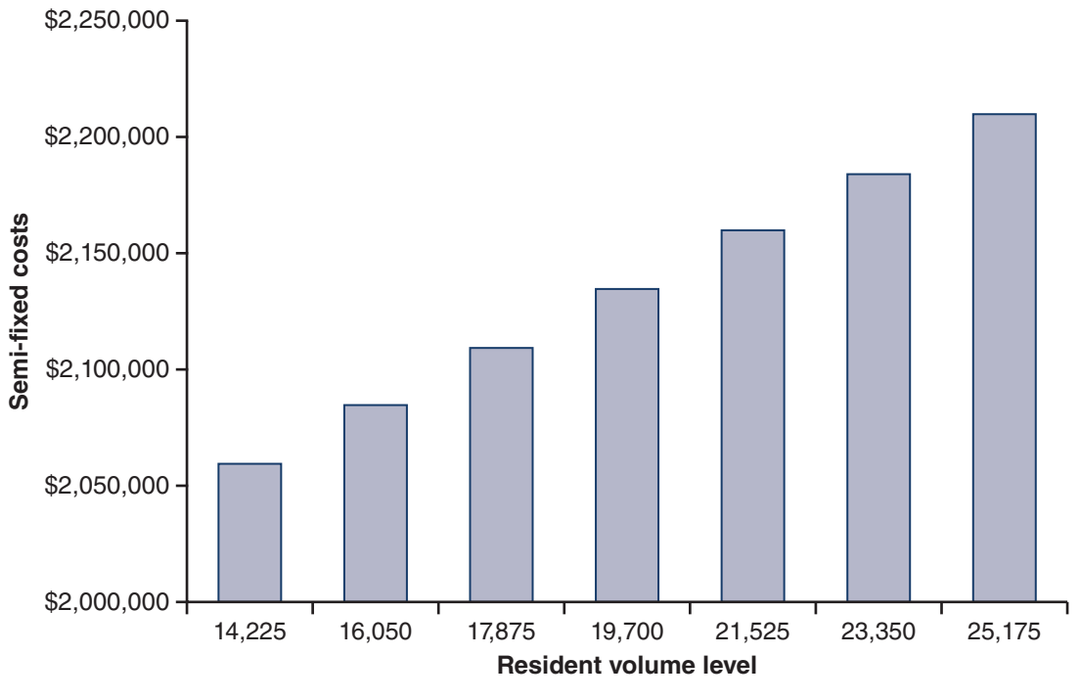
Source: Alemozaffar, Chang, Kacker, Sun, DeWolf, & Wagner (2013).

Beyond the spreading of fixed costs over larger volumes, economies of scale may also be realized through improvements in productivity. In smaller organizations, some staff members may have multiple responsibilities that occupy their time. In larger organizations, there may be more specialization of responsibilities that enable persons to be more productive on each separate activity. Determining the change in average costs through more specialization of responsibilities requires measurement of costs and can't be calculated as simply as the spreading of fixed costs.

Semifixed Cost

There is an important caveat to economies of scale and the use of fixed cost concepts in analysis of organizations. The caveat is that almost all fixed cost elements have capacity limits. For Chamberlin Skilled Nursing, the current capacity limit on facility and financing costs is reached at 19,700 resident days; 54 beds at 100% occupancy for 365 days. Adding more beds will involve an increase in facility costs. Expenses that are fixed for only a range of resident visits are called **semifixed costs** or **step-fixed costs**. As presented in Figure 6.3, fixed costs increase by about $25,000 per year for every 1,825 resident days, representing five additional beds operating at full capacity.

Figure 6.3: Semifixed costs and resident days, Chamberlin Skilled Nursing



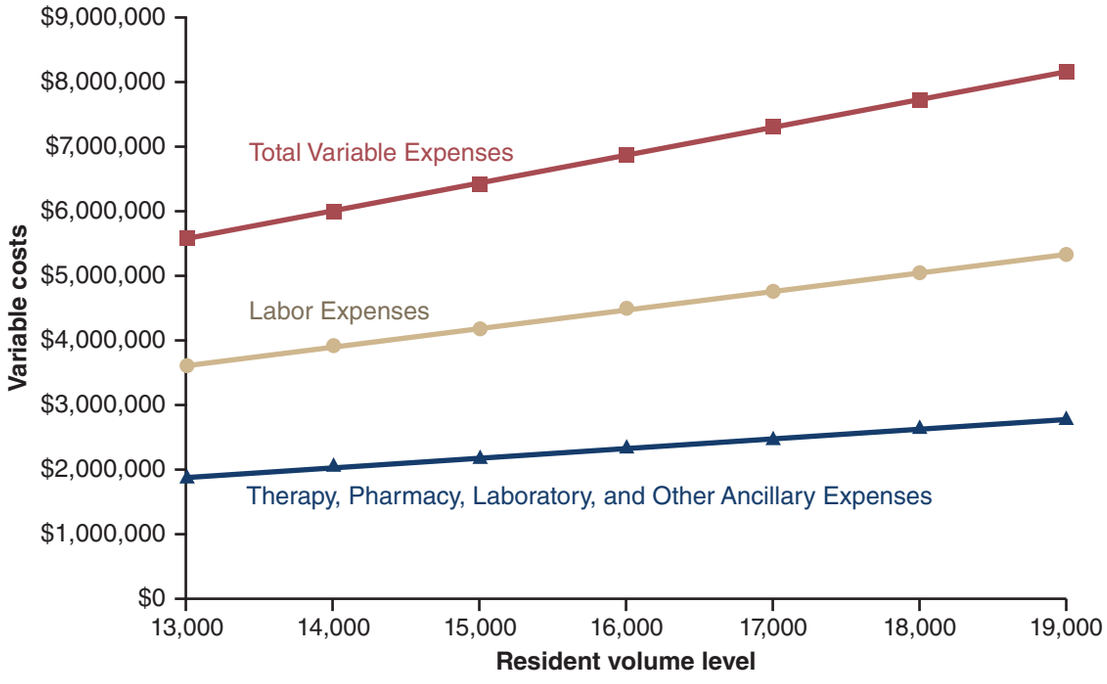
Source: Author's calculations

Given this insight, it is clear that there are few expenses that are truly fixed costs for any number of residents. Most expenses are fixed only for a range of residents. If the range under which expenses are fixed is wide, they might as well be considered fixed costs for all practical purposes. For Chamberlin Skilled Nursing, if most decisions about numbers of residents are within the range of 17,885 to 19,700 resident days per year, the administration, facility, and financing expenses can be treated as fixed costs. When resident visits outside of this range are considered, the capacity limits of fixed costs must be understood. It takes an experienced manager or a good analysis of data to know where the points at which fixed costs change levels—the steps in step fixed costs.

Variable Cost

Variable costs increase with higher numbers of residents. Resident service labor expenses (wages paid to nurses and aides), therapy expenses, and pharmacy, laboratory, and other ancillary expenses are considered to be variable costs. The costs of each of these services are expected to increase proportionally with the number of resident visits. As displayed in Figure 6.4, the variable costs increase at volumes from 13,000 resident days to 19,500 resident days.

Figure 6.4: Variable costs and resident days, Chamberlin Skilled Nursing



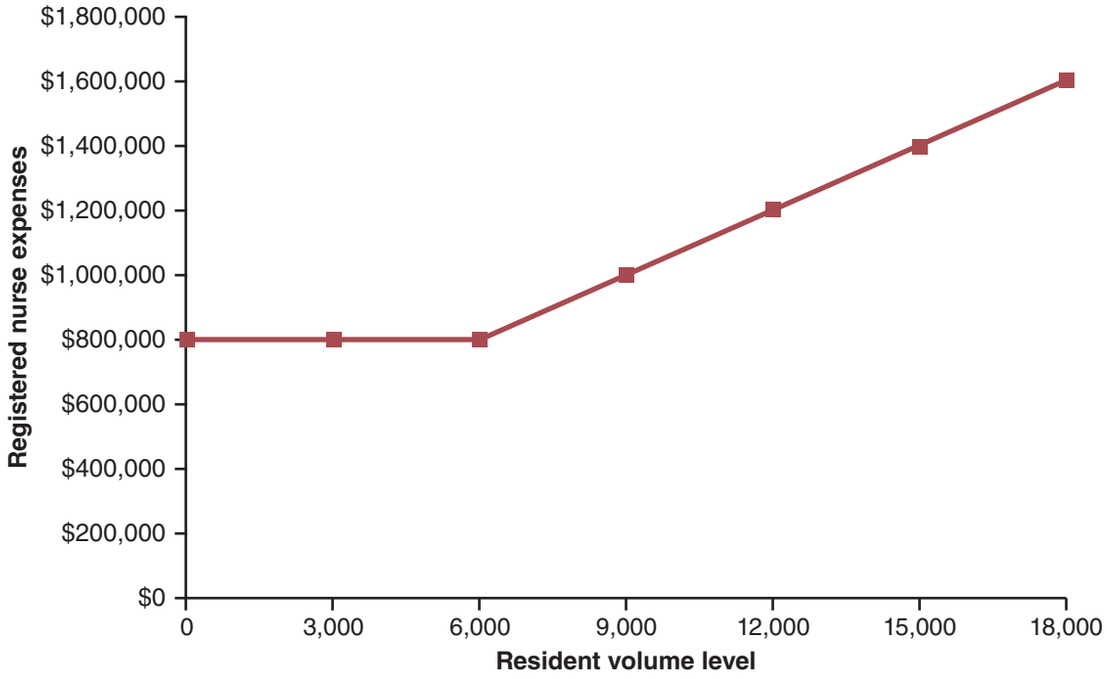
Source: Author's calculations

Semivariable Cost

As with fixed costs, variable costs may also have capacity limits. **Semivariable costs** are variable costs that have a fixed component at low volumes. In the case of healthcare organizations, there may be minimum levels of staffing that make salary expenses fixed costs at low

volumes of resident days. As presented in Figure 6.5, there are a minimum number of registered nurses required at the facility to treat residents. At any level of resident days below 6,000 per year, expenses associated with registered nurses would be a fixed cost. Beyond 6,000 resident days, the expense associated with registered nurses increases like other variable costs, at a rate of about $67,000 per year for every 1,000 resident days. As with semifixed costs, it takes an experienced manager or a good analysis of the data to know the point at which semivariable costs become variable costs.

Figure 6.5: Semivariable costs and resident days, Chamberlin Skilled Nursing



Source: Author's calculations

In addition to the capacity limits that may result in semivariable costs, there are potential efficiency gains at higher volumes of residents that could lead to the increase in costs being other than the simple upward sloping line. In the presentation of Figure 6.4 and the higher resident volume levels of Figure 6.5, total variable costs are the product of average variable cost multiplied by the volume of resident days. To present this relationship as a straight, upward sloping line, average variable cost must be constant over this range of resident days. In most cases, average variable cost will be constant over small ranges in the levels of resident days under consideration. For Chamberlin Nursing Services, average variable costs would be unlikely to change over the range of resident volume from 18,000 resident days to 19,500 resident days.

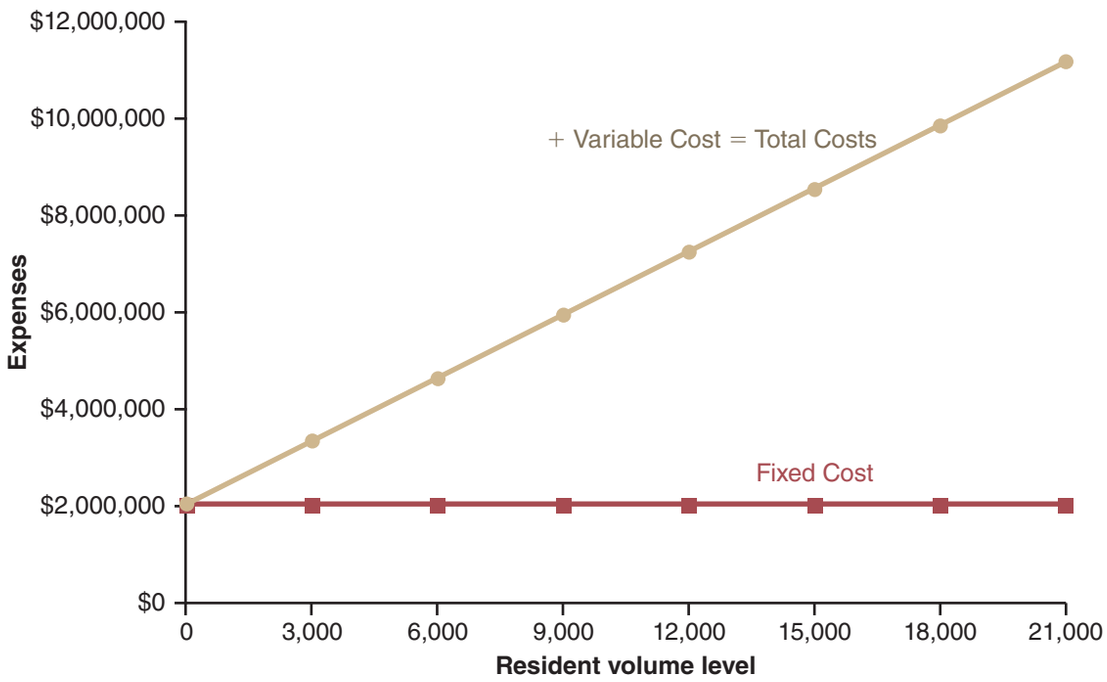
For large increases in resident volume, it is possible that average variable costs may decrease as organizations find ways to provide care more efficiently or purchase inputs in less costly ways. Larger organizations may be able to negotiate lower prices for pharmaceuticals and other items, lowering average variable costs at higher volumes of residents.

As with determining the change in average fixed costs through specialization of responsibilities, determining the change in average variable costs through efficiency increases or effective purchasing requires measurement of costs and can't be simply calculated. Many studies in medical services have documented the improved quality and lower costs associated with high volumes of activity (Yua, Heveloneb, Lipsitzb, Kowalczyka, Nguyenc, & Hud, 2012). In other words, there may be economies of scale that affect the level of average variable costs in addition to the well-known economies of scale observed with average fixed costs.

Total Cost Behavior and Operating Leverage

For healthcare organizations, total costs are not all fixed or semifixed costs, nor are they all variable costs or semivariable costs. Total costs are a combination of all cost patterns. As presented in Figure 6.6, total costs at Chamberlin Skilled Nursing are the sum of the fixed costs of $2,108,640 plus variable costs of $431.91 per resident day.

Figure 6.6: Fixed and variable costs and resident days, Chamberlin Skilled Nursing



Source: Author's calculations

Analyze This

What would you calculate as Chamberlin Skilled Nursing's total cost at 18,000 resident days per year?

The presence of fixed cost elements in the cost structure of an organization places certain burdens on management to achieve high rates of occupancy. Imagine if Chamberlin Skilled Nursing had only one resident for 20 days during the year. The cost of this resident would be all of the fixed costs plus variable costs per resident day:

$$\text{Total cost} = \$2{,}108{,}640 + (\$431.91 \times 20 \text{ days})$$

$$= \$2{,}117{,}278.20$$

Imagine the surprise on the face of a resident receiving this bill! Clearly this is not a viable situation. Even at higher numbers of residents, the presence of fixed costs imposes a burden on the organization to achieve a high rate of occupancy.

The alternative to fixed cost is variable cost. For some cost elements, organizations have choices between fixed and variable costs. Instead of owning the nursing facility, Chamberlin might be able to rent space in another healthcare organization. At a rental rate of $150 per resident per day, Chamberlin would be at a much lower risk of losses in the event of low levels of utilization. For the one resident with a 20-day stay scenario, the cost would be $11,638.20.

$$\text{Total cost} = (\$150 + \$431.91) \times 20 \text{ days}$$

$$= \$581.91 \times 20 \text{ days}$$

$$= \$11{,}638.20$$

While this might still not be a viable situation, it represents a savings of over $2 million compared to the situation where the nursing facility is paying the full cost for the empty beds.

As another example, consider the salary of the skilled nursing facility administrator, which may be $80,000 per year. An organization that is concerned about low-capacity utilization may attempt to substitute variable cost arrangements for fixed cost arrangements and pay the manager $38.46 per hour for 2,080 paid hours per year, plus any amounts required for working overtime (beyond 40 hours per week). If there are times with low occupancy in the nursing facility, the manager may be asked to work fewer than 40 hours per week, and the organization would save money by paying on an hourly basis. In this particular case, state regulations may not permit an administrator to be working less than full-time. Still, the calculation would work for many other positions.

An organization that expects to operate at a high rate of capacity utilization may attempt to substitute fixed cost arrangements for variable cost arrangements. If there are times with high occupancy, the administrator may need to work 50 or more hours per week and the organization would save money by paying a fixed salary. The use of fixed assets to support the operations of the organization is termed **operating leverage**. Higher levels of operating leverage place the organization in a position to have high costs per resident (and perhaps financial losses) when capacity utilization is low, and place the organization in a position to have low costs per resident (and perhaps financial profits) when capacity utilization is high.

As a slight aside, the **degree of operating leverage** is a ratio that is sometimes employed in analysis of financial position. The degree of operating leverage ratio doesn't directly measure leverage. A direct measure of leverage would be the ratio of fixed expenses to total expenses.

Instead, the degree of operating leverage measures the impact of leverage on the profitability of the organization. The ratio is calculated as

$$\text{Degree of operating leverage} = \frac{\text{Percentage change in earnings before interest and taxes}}{\text{Percentage change in operating revenues}}$$

For Chamberlin Skilled Nursing, earnings before interest and taxes were $82,481 in 2012 and $137,847 in 2011, a decrease of 40.2%. Operating revenues were $10,095,760 in 2012 and $10,509,587 in 2011, a decrease of 3.9%. Together, this yields a degree of operating leverage of 10.20.

$$\begin{aligned}\text{Degree of operating leverage} &= \frac{(\$82{,}481 - \$137{,}847) \div \$137{,}847}{(\$10{,}095{,}760 - \$10{,}509{,}587) \div \$10{,}509{,}587} \\ &= 10.20\end{aligned}$$

Organizations with higher levels of fixed costs will have higher degrees of operating leverage. The rationale is that fixed costs will not change with volume, whereas variable costs and revenues change directly with volume. Each percentage change in revenues will be associated with an even larger percentage change in earnings (revenues minus variable costs minus fixed costs), when fixed costs do not change.

Cost Patterns and Budgeting

Understanding the relationships between costs and volumes and having the ability to distinguish between fixed and variable costs are helpful to managers when interpreting financial statements. These same skills are helpful when planning for the future. As will be elaborated upon in Chapter 7, trends in costs and cost patterns are essential in the process of budgeting. To demonstrate the use of fixed and variable costs in budgeting, consider the information presented in Exhibit 6.2, the budgeted income statement for Chamberlin Skilled Nursing for 2013.

Exhibit 6.2 Budgeted income statement, Chamberlin Skilled Nursing

	2013	2012
Revenues		
Total routine resident services revenue	$222.555/day	$4,113,256
Ancillary services revenue (less bad debt)	$323.693/day	$5,982,504
Net resident services revenue	$546.248/day	$10,095,760
Expenses		
Administration expenses	$560,000	$560,000
Resident service labor expenses	$281.80/day	$5,208,144
Physical, occupational, and speech therapy expenses	$104.99/day	$1,940,395
Pharmacy, laboratory, and other ancillary expenses	$45.13/day	$834,010
Facility and financing expenses	$1,548,640	$1,548,640
Total operating expenses	Calculated	$10,091,189
Net operating income (loss)	Calculated	$4,571
Licensed bed capacity	54	54
Total resident days	**KEY DRIVER**	18,482

Source: Author's calculations.

Several items in Exhibit 6.2 are presented as per day amounts. A simple budget for 2013 would only need to forecast total resident days and use the 2012 values of revenues per day, fixed expenses, and variable expenses per day. A more complete budgeting process for 2013 would need to forecast changes in payments per day, changes in fixed expenses, and changes in variable expenses per day. For all budgets, simplistic or complete, the forecast of total resident days is a key driver of the results. Misunderstanding which expenses are fixed costs and which are variable costs could lead to serious errors in budgets.

Analyze This

Following a simple budget process, what would you calculate as Chamberlin Skilled Nursing's net operating income at 19,000 resident days in 2013?

For Review:

1. Why it is important to identify fixed versus variable costs?
   There are many uses of costs in planning and decision making. Since fixed costs do not change with volume of services, and variable costs increase with the volume of services, failing to understand the difference could lead to misguided plans or decisions.

2. What types of costs are likely to be fixed costs?
   Fixed costs do not change with volume of services, either because they can't change or because there are no reasons to change. The annual cost of an inspection, taxes on the property for an organization, and interest payments on bank loans do not change with volume.

3. Salaries of nurse supervisors may be a step-fixed cost. For every group of nurses, a nurse supervisor is required. For how large a group of nurses is a nurse supervisor required? Who would you ask to learn the answer to this question?
   It is not clear what number of nurses requires a nurse supervisor. An experienced nurse supervisor or an experienced nursing home administrator would likely know the answer to this question. A financial manager would not likely know the answer.

4. Do economies of scale have any limits in the case of a skilled nursing and rehabilitation center?
   Economies of scale have limits in the case of almost every fixed cost for every organization. At some level of use of a good or service giving rise to an expense, there are limits on use. An accountant who is paid a salary may be able to work 40 hours per week for a given number of residents, and perhaps even 60 hours per week during certain times of the year. If the volume of services requires working 80 hours every week, a change would have to be made. For this reason, almost all fixed costs are actually step-fixed costs at some volume.

6.2 Cost-Volume-Profit Analysis

As demonstrated in Exhibit 6.2, understanding the relationship between cost and volume permits the calculation of expected profits. **Cost-volume-profit (CVP) analysis** summarizes information used to develop budgeted financial statements to conduct quick analyses for planning and decision making. The starting point for CVP analysis is the definition of the cost factors. To quickly conduct analyses, costs are summarized as fixed and variable costs. The special cases of semifixed and semivariable costs are ignored for the sake of simplicity. The cost equation is written as

$$\text{Total cost} = \text{Total fixed cost (TFC)} + \text{Total variable cost (TVC)}$$

For Chamberlin in 2012:

$$\$10{,}091{,}189 = 2{,}108{,}640 + \$7{,}982{,}549$$

For analysis purposes, the total variable cost equation is written as

$$\text{Total variable cost (TVC)} = \text{Average variable cost (AVC)} \times \text{Volume of services (V)}$$

For Chamberlin in 2012, where volume is measured by the number of days of service provided to residents:

$$\$7{,}982{,}549 = \$431.90937 \times 18{,}482 \text{ days}$$

In many other applications of CVP, volume of services (V) is replaced by quantity of output (Q), and these two terms can be used interchangeably. By writing the equation in this way, and thereafter considering AVC to be a set amount for range of volume, CVP analyses ignore potential economies of scale associated with efficiencies that affect variable costs.

To conduct the analysis of profitability, an equation for revenues and an equation for profit are required. The equation for total revenue is written as

$$\text{Total revenue} = \text{Average net revenue (ANR)} \times \text{Volume of services (V)}$$

For Chamberlin in 2012:

$$\$10{,}095{,}760 = \$546.25 \times 18{,}842 \text{ days}$$

Average net revenue is easy to calculate from financial statements. Average net revenue is simply total net revenue divided by the volume of services. As with average variable costs, CVP analysis assumes that average net revenue does not change over small ranges in the volume of services. For Chamberlin Skilled Nursing, average net revenues would be unlikely to change over the range of resident volume from 18,000 resident days to 19,500 resident days.

Finally, the equation for profit is written as

$$\text{Profit} = \text{Total revenue} - \text{Total cost}$$

For Chamberlin in 2012:

$$\$4{,}571 = \$10{,}095{,}760 - \$10{,}091{,}189$$

Substituting the detailed total revenue and total cost equations into the profit equation gives

$$\text{Profit} = (\text{Average net revenue} \times \text{Volume of services}) - \text{Total fixed cost} - (\text{Average variable cost} \times \text{Volume of services})$$

or

$$\text{Profit} = (\text{ANR} \times \text{V}) - \text{TFC} - (\text{AVC} \times \text{V})$$

For Chamberlin in 2012:

$$\$4{,}571 = (\$546.25 \times 18{,}842 \text{ days}) - 2{,}108{,}640 - (\$431.91 \times 18{,}482 \text{ days})$$

This equation for profit is further simplified by solving the equation for the case where there are zero profits. Solving the equation at zero profits is why CVP analysis is also called **break-even analysis**. By solving the equation for any one of the four variables when the other three are known, the zero profit or **break-even** point for the organization is revealed.

Use the following basic break-even equation to solve for volume of services:

$$\text{V} = \text{TFC} \div (\text{ANR} - \text{AVC})$$

From the Front Lines

We recently purchased an endoscopic ultrasound (EUS), which allows doctors to examine the linings of the esophagus and stomach, as well as the walls of the gastrointestinal tract. It is a necessary, but expensive, piece of equipment, which cost us $20,000 ($11,000 to purchase, plus $9,000 for renovations). Our fixed costs are four full-time equivalent employees at $336,000. Medicare payments are $885 per procedure, and each procedure requires $175 in average variable costs. It has been estimated that we will complete 500 procedures in the first year and 850 procedures in years 2 to 5.

Source: Hospital director of outpatient services.

Using the financial information from Chamberlin Skilled Nursing,

$$\text{Break-even V} = \frac{\$2{,}108{,}640}{\$546.25 - \$431.91} = 18{,}442 \text{ days}$$

At 18,442 resident days per year, Chamberlin Skilled Nursing would earn zero profits. The difference between total revenue and total variable costs is the **contribution margin**. The contribution margin is the amount of revenue above variable costs that is available for fixed costs and profits. The term in the break-even equation for the difference between average net revenue and average variable cost (ANR − AVC) is called the **contribution margin per unit**. In this case, it is the amount earned from each resident day that contributes toward covering the fixed costs of the organization. The contribution margin per unit must be positive if an organization seeks to earn profits. If average variable costs are less than average net revenue, each resident day results in larger losses, and breaking even is not possible.

Analyze This

In the example of the EUS, what is the break-even number of procedures per year?

Similar break-even equations can be solved for each of the other terms in the profit equation:

$$\text{Break-even TFC} = \text{V} \times (\text{ANR} - \text{AVC})$$

The break-even total fixed costs indicates the *maximum* amount that can be spent of fixed costs per year for a given volume, average net revenue, and average variable cost.

$$\text{Break-even ANR} = \text{AVC} + (\text{TFC} \div \text{V})$$

The break-even average net revenue indicates the *minimum* amount that must be received in average net revenue per day for a given average variable cost, total fixed cost, and volume.

$$\text{Break-even AVC} = \text{ANR} - (\text{TFC} \div \text{V})$$

The break-even average variable cost indicates the *maximum* amount that can be spent on variable costs per day for a given average net revenue, total fixed cost, and volume.

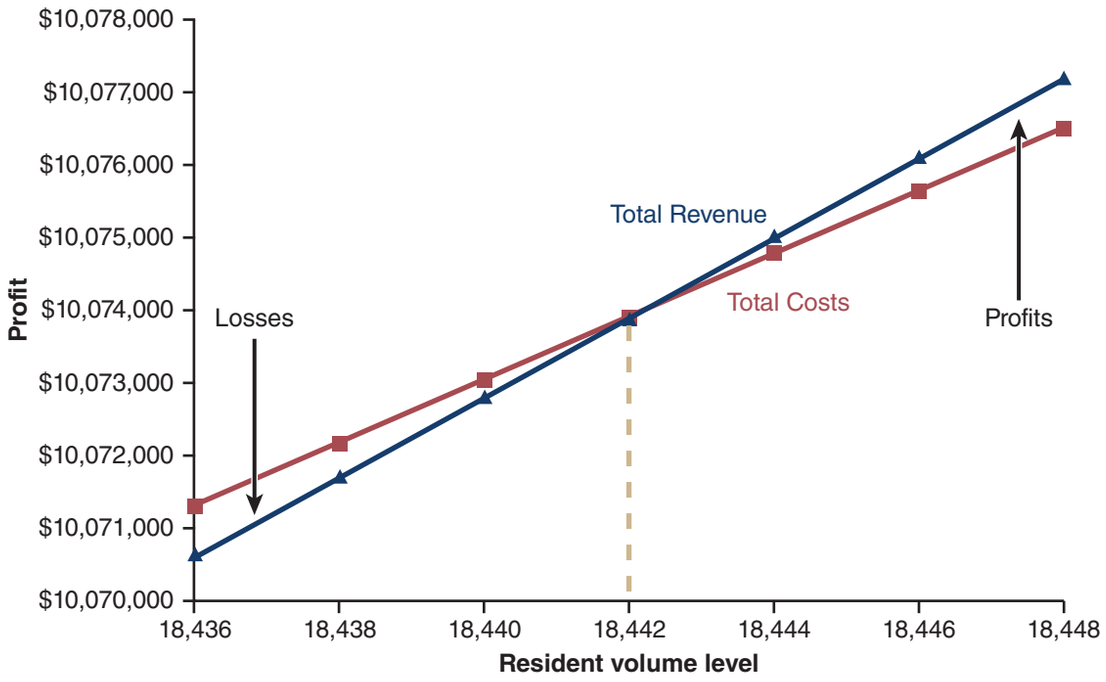
Analyze This

Chamberlin Skilled Nursing expects fixed costs to be $2.2 million for the year, average net revenues to be $560 per day, and 18,600 resident days in 2013. What amount can Chamberlin afford to spend on average variable costs per day and break even, with zero profit, in 2013?

Graphing Cost-Volume-Profit Analysis

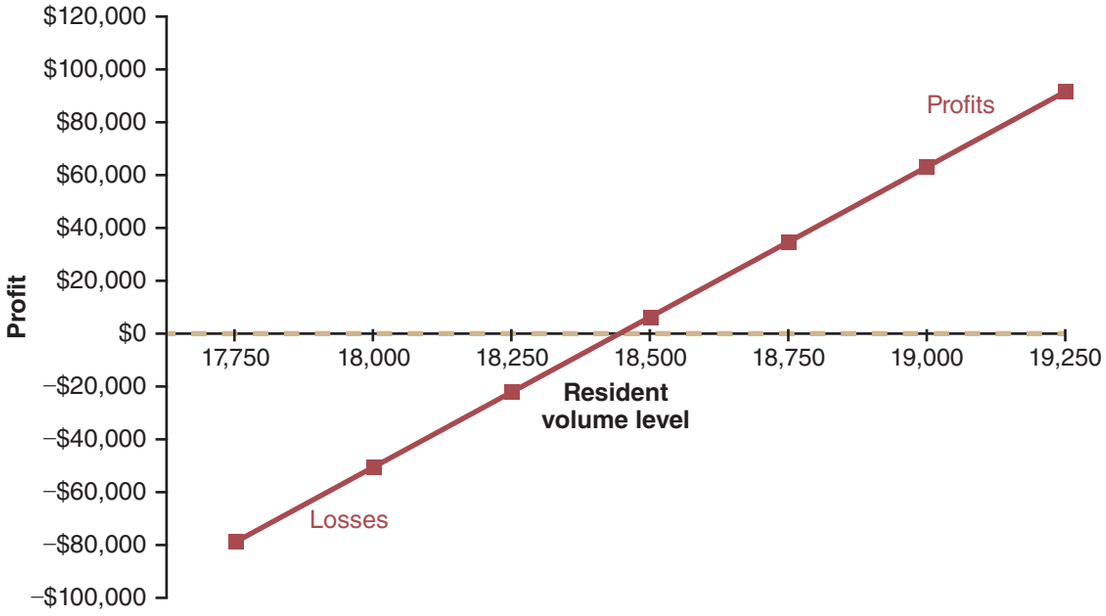
The arithmetic involved with performing a CVP analysis can intimidate potential users of this analysis. Therefore, CVP analyses are often presented in graphical terms. As presented in Figure 6.7 for Chamberlin Skilled Nursing, total revenue equals total cost at 18,442 resident visits per year. At lower levels of resident volume, Chamberlin would experience financial losses. At higher levels of resident volume, Chamberlin would earn profits.

Figure 6.7: Cost-volume-profit analysis, Chamberlin Skilled Nursing



This graphical depiction of the cost-volume-profit relationship is perhaps more readily understood than the equations, but it also presents a lot of information. To focus a CVP graph in order to clearly see the break-even point, the range of volume presented is often quite narrow. For these reasons, a volume-profit graph can also be created, as presented in Figure 6.8. The volume-profit graph also shows that zero profits are earned at 18,442 resident days per year.

Figure 6.8: Volume-profit analysis, Chamberlin Skilled Nursing



The volume-profit graph more clearly shows the level of profit that is earned (lost) at each level of resident days per year, levels that may be helpful for financial planning. If Chamberlin seeks to earn more than the $51,473 in net income that it earned in 2011, how many resident days of service must it provide at the current levels of costs and net revenues per day? Figure 6.8 indicates that at 18,750 resident days, profits are just less than $40,000. It also indicates that at 19,000 resident days, profits are slightly more than $60,000. Thus, the graph helps us to see the general range of resident days required to earn a target level of profit.

To gain a precise number of resident days per year to earn more than $51,473, the CVP equation can be slightly modified. A target level of profit can be interpreted as another fixed financial target that must be earned through more resident days at the same contribution margin per resident day. With this insight, a target profit amount is treated the same as another fixed cost. The new break-even equation, with a target profit, is written as

$$V = (TFC + \text{Target profit}) \div (ANR - AVC)$$

For Chamberlin Skilled Nursing in 2012:

$$\text{Break-even V} = \frac{\$2{,}108{,}640 + \$51{,}473}{\$546.25 - \$431.91}$$
$$= 18{,}892 \text{ days}$$

The precise break-even volume of resident days is 18,892, which is between the 18,750 and 19,000 resident day range that could be observed from the graph. Graphs are an excellent means of communicating concepts and general results. Using the equations is often necessary for providing precise information.

Analyze This

Chamberlin Skilled Nursing expects fixed costs to be $2.2 million for the year, average net revenues to be $560 per day, and the volume to be18,600 resident days in 2013. If Chamberlin wishes to earn $20,000 in profit, what amount can Chamberlin afford to spend on average variable costs per day in 2013?

Break-Even Analysis in a Capitated Environment

The presentation of CVP analysis has thus far assumed that additional revenues can be earned through providing additional resident services. This is a **fee-for-service** environment phenomenon. Fee-for-service is a payment method that provides healthcare organizations with additional payments for each service provided. For most healthcare services in the current U.S. marketplace, providers can earn more net patient revenue by providing more services, and they can earn more profit as long as the net patient service revenue exceeds the average variable cost.

However, the marketplace for healthcare services is changing. For residents enrolled in **health maintenance organizations (HMOs)** or other insurance arrangements that contract with accountable care organizations, there may be fixed payments associated with enrollment rather than fee-for-service payments associated with healthcare services. HMOs are like other insurance companies, with an important difference being that HMOs limit the patient's choice of healthcare providers to a defined set that agree in advance to participate. ACOs are groups of physicians, hospitals, and other healthcare providers that provide coordinated care to designated patients. As described in Chapter 5, when healthcare providers or organizations are paid based upon monthly enrollment in a plan, the payment is called a *capitation*. One study of ACOs found that 40% of participating physicians and 18% of participating hospitals received payment under a capitation method (Muhlestein, Croshaw, & Merrill, 2013).

Under capitation arrangements, the provision of services is associated only with fixed costs and average variable costs, no net resident revenues. Provision of any services reduces profits. Under capitation arrangements, the focus of the analysis changes volume in the cost-volume-profit from number of resident days to number of persons enrolled. Similarly, the analysis changes average net revenue from net resident revenues per service to capitation per person. Capitation doesn't change total fixed costs, but it changes average variable costs from the average variable cost per service to the variable costs generated from all resident visits divided by the number of persons enrolled.

Use the following break-even equation to solve for volume of residents under capitation:

$$\text{Days} = \text{Total fixed costs} \div (\text{Capitation payment} - \text{Variable costs per enrollee})$$

The patient population served by Chamberlin Skilled Nursing consists of 6,161 enrollees who use an average of three days of skilled nursing services per year. The number of patient days of service provided in 2012 is the product of these two values:

$$18{,}482 \text{ days} = 6{,}161 \text{ enrollees} \times 3 \text{ days per person}$$

Of course, not every enrollee used three days of skilled nursing services. Most enrollees did not use any skilled nursing facility services. The average person using skilled nursing services used more than three days per year. Average variable costs per enrollee are determined by dividing the total variable costs by the number of enrollees:

$$\$1{,}296 = \frac{\$7{,}982{,}549}{6{,}161 \text{ enrollees}}$$

With a capitation amount of $1,700, the break-even number of enrollees can be calculated.

$$\text{Break-even V} = \frac{\$2{,}108{,}640 + \text{zero profit}}{\$1{,}700 - \$1{,}296}$$

$$= 5{,}216 \text{ enrollees}$$

If Chamberlin Skilled Nursing was paid on a capitation basis (payment per enrollee) rather than a fee-for-service basis (payment per resident day), they would break even at 5,216 enrollees. At this level of enrollment and an average of three resident days per enrollee, they would be expected to provide 15,648 days of service per year:

$$15{,}648 \text{ days} = 5{,}216 \text{ enrollees} \times 3 \text{ days per person}$$

Unlike payment under fee-for-service, each resident day of service reduces profits by $222.55 per day for routine services and $323.69 per day for physical, occupational, and speech therapy, pharmacy, laboratory, and other ancillary services.

Analyze This

If you were the manager of Chamberlin Skilled Nursing, would you prefer to be paid $546.25 per day of resident care or $1,700 per enrollee for a population? Please explain your reasoning.

It may be clear from this brief analysis why fee-for-service and capitation payment methods are controversial. Under fee-for-service payment methods, healthcare organizations have financial incentives to increase residents' use of services. This can potentially lead to provision of more services than are absolutely necessary and higher total healthcare costs. Under fee-for-service payment methods, insurance companies attempt to control overuse of services to limit their costs and increase their profits. Under capitation payment methods, healthcare organizations have financial incentives to reduce residents' use of services. This can potentially lead to provision of fewer services than are ideally necessary and lower total healthcare costs. Under capitation payment methods, insurance companies use utilization review and other tools to control underuse. There is no clear winner between these two payment methods.

From the Front Lines

We have calculated that 3% of Medicaid patients account for more than half of our total costs. Because of this, we are proposing the removal of the highest risk patients from the primary care physician's office and instead providing all services within a high-risk clinic. Residents will have a team assigned to them, helping them learn to manage their chronic conditions. The CFO sees this plan as a major challenge, because it will reduce fee-for-service revenue by $25 million, and add $2 million in costs for items like the office, staffing, claims analytics, predictive modeling and risk stratification tools, and case management information technology platform. However, we currently lose money on these residents, so we should lose less money.

Source: Hospital vice president of patient services.

For Review:

1. What is the basic equation for the break-even volume of services? Define each term in the equation.
   The basic break-even equation for volume of services is $V = TFC \div (ANR - AVC)$.

2. When determining the break-even volume of services, how do you obtain information on which expenses are fixed and which are variable?
   First, it is important to obtain a copy of the income statement to identify revenues and the various types of expenses. Second, asking experienced managers about fixed and variable expenses may be the best way to obtain the needed information. Plotting the data of expenses at different volumes of services is another method.

3. How is profit included in a break-even analysis?
   Break-even analysis permits identification of values of components of the equation at zero profits. To include profits, consider them to be another contribution that must be made and add the amount as if it were another fixed cost.

Summary & Resources

Chapter Summary

This chapter has presented a framework for analyzing the relationships among volumes, costs, revenues, and profits. Critical to analysis of costs for planning and management purposes is being able to distinguish between fixed costs, variable costs, or some combination of the two. There are fixed costs that are fixed for only a range of volumes of services, which are called semifixed or step-fixed costs. There are variable costs that are variable for only a range of volume of services, with a fixed cost component at minimal levels of services, which are called semivariable costs. Many quick analyses classify all services as being either fixed or variable costs. Detailed analyses may require more careful classification and analytical methods.

To determine whether expenses are fixed or variable, experienced managerial input may be required. Managers often develop an understanding of the care delivery process that enables them to indicate which expenses change with different volumes of service. When managerial input is not available, examination of patterns of total costs and volumes of service over time may yield insights into the cost classification process.

The presence of fixed costs adds to the operational risk of an organization. A larger percentage of fixed costs increases operating leverage. Greater leverage enables higher levels of profits when resources are used at high levels of capacity. Greater leverage also results in greater losses when resources are used at low levels of capacity. There is a risk-return trade-off associated with use of fixed expenses.

With information on fixed and variable costs, as well as expected payment levels and volume of services, healthcare organizations can prepare budgets and project income statements. The ability to forecast financial statements is helpful for planning and managing healthcare organizations.

All of the elements in this chapter led to the development of tools to conduct cost-volume-profit analyses in fee-for-service and capitated environments. CVP analysis is a quick, useful tool for considering the targets that organizations must achieve to break even or reach target levels of profits. The simple equation, volume of services (V) = total fixed costs (TFC) ÷ [average net revenues (ANR) − average variable costs (AVC)] is quite powerful. With knowledge of any three elements, the equation can be used to solve for the fourth. CVP analysis is often used to create target levels of volume of services for planning and management purposes.

The use of cost-volume-profit analysis varies in terms of inputs when working in fee-for-service versus capitated environments. Under fee-for-service payment methods, CVP analysis leads to the creation of *minimum* levels of resident services to achieve target profit levels. More services result in higher profits. Under capitation payment methods, CVP analysis leads to creation of *minimum* levels of resident enrollment to achieve target profit levels, where more enrollees result in higher profits and more services result in lower profits. The use of financial management tools is sensitive to the payment environment in which the organization resides.

Discussion Questions

1. Cost-volume-profit analysis uses some simplifying assumptions to yield the basic break-even equation. Namely, costs are assumed to be fixed or variable, and they may not be perfectly either fixed or variable. With this limitation are break-even analyses still worthwhile?
2. Graphs are often used to explain cost-volume-profit concepts. Is the full cost-volume-profit graph or the volume-profit graph more worthwhile?

Exercises

1. An outpatient clinic has one operating room. The annual cost of rent, heat, and electricity for the operating room and its equipment is $360,000, and the annual salaries of the people who staff this room total $540,000. Each surgery requires the use of $830 worth of medical supplies and drugs. The clinic receives, on average, payment of $2,000 for each operation.
   a. Identify the average net revenue per case and the annual fixed and variable costs for the operating room.
   b. How many operations must the clinic perform each year in order to break even?

2. A medical center rents clinic space to physician-owned practices rendering specialized services. The medical center charged the following costs to a two-physician practice for the year ended June 30, 2013.

Laundry	$25,000
Laboratory	$225,000
Pharmacy	$360,000
Rent	$180,000
Janitorial	$30,000
Billings and collections	$140,000

   During the year, the practice also had staff expenses of $360,000 and received payments that averaged $150 per patient. The practice was very busy with 12,000 patient visits for the year.
   a. What was the break-even number of patients for the year?
   b. If the two physicians each planned to earn $225,000 as income, which is profit to the practice, what was the break-even number of patients for the year?

3. A 109-bed nursing home has average net revenue of $172 per day, average variable costs of $132 per day, and total fixed costs of $1,200,000.
   a. What was the break-even number of resident days for the year?
   b. At the break-even number of resident days per year, what is the occupancy rate of the nursing home? The occupancy rate is defined as the number of residents divided by the number of residents at 100% occupancy.
   c. If the number of resident days per year is estimated to be 32,000 days and the average net revenue is an unknown value, what amount of average net revenue per day is required to break even?

4. A primary care practice is evaluating an opportunity to join an accountable care organization. If they join, the payments for providing care to enrollees will be on a capitation basis. Fixed practice expenses are $900,000 per year, including the salary of the physician. Variable expenses average $150 per enrollee per year. The capitation for primary care services is $25 per member per month, which is $300 per enrollee per year.
   a. What was the break-even number of enrollees for the year?
   b. If fixed practice expenses are $900,000, the number of enrollees per year is 5,800, and the capitation is $300 per enrollee per year, what is the maximum amount of variable expenses per enrollee per year to break even?

Key Terms

break even The point at which the organization makes zero profits for a given combination of volume, total fixed costs, average net resident revenue, and average variable cost.

break-even analysis Another term for cost-volume-profit analysis, which is a calculation of the change in profit associated with a change in cost or volume. When profit is assumed to be zero, cost-volume-profit is a break-even analysis.

contribution margin The difference between net revenue and total variable costs. It is the amount available for fixed costs and profit.

contribution margin per unit The difference between average net revenue and average variable cost. It is the amount per unit that is available for fixed costs and profit.

cost-volume-profit (CVP) analysis A calculation of the change in profit associated with a change in cost or volume. When profit is assumed to be zero, cost-volume-profit is a break-even analysis.

degree of operating leverage A measure of the impact of using fixed cost inputs in the production of resident services, defined as the percentage change in earnings before interest and taxes divided by the percentage change in operating revenues.

economies of scale Lowering average cost per resident at higher volume by more fully utilizing available resources; spreading fixed costs over more residents.

fee-for-service A payment method that provides healthcare organizations with additional payments for each service provided.

fixed costs Costs that remain the same for differing levels of resident services.

health maintenance organization (HMO) A company that provides insurance coverage for services provided by a defined set of providers.

operating leverage The use of fixed cost inputs in the production of resident services.

semifixed costs or step-fixed costs Costs that remain the same within a range of levels of resident services and increase at higher levels of resident service. Semifixed costs are also called step-fixed costs, as the pattern of fixed costs at each level of resident service appears as a stairstep.

semivariable costs Expenses that increase with the number of resident services, with a minimum level of expenses at a low number of resident services.

variable costs Expenses that increase with the number of resident services.

Suggested Websites

- Microsoft has created a template and charts for break-even analysis: http://office.microsoft.com/en-us/templates/break-even-chart-TC101877513.aspx
- Harvard Business School also provides a template for break-even analysis, which requires an agreement for use: hbswk.hbs.edu/archive/docs/breakeven.xls