

CHAPTER 4 UNDERSTANDING COSTS

As managers work on the preparation of plans, one of the critical requirements is a good understanding of costs. The better managers understand costs, the more accurate their plans will be. Furthermore, a solid understanding of costs will improve a manager's ability to make effective decisions.

Costs, however, are complicated. Many cost terms are widely used but are not well understood. Direct costs, indirect costs, average costs, fixed costs, variable costs, and marginal costs are concepts that managers should understand. This chapter provides definitions of these and other key terms.

After defining costs, this chapter considers how costs change as volume changes. The relationship between costs and volume has a dramatic impact on the profits or losses incurred by an organization. An understanding of this relationship can be instrumental in decision-making. As part of the planning process, organizations must decide whether it makes sense to expand or contract volume or whether to add or eliminate services. Issues such as these require sophisticated thinking to optimize the results for both the organization and its clientele. Managers must learn which costs are relevant for evaluating these decisions.

Learning Objectives

The learning objectives of this chapter are to

- define cost terms, including direct costs, indirect costs, average costs, fixed costs, variable costs, marginal costs, relevant range, mixed costs, and step-fixed costs;
- discuss the behavior of costs with a focus on the impact of changes in the volume of services provided;
- discuss outsourcing decisions using marginal cost analysis;
- explain break-even analysis and provide an example of the technique;
- extend the use of break-even analysis to situations with multiple products or services;
- discuss the managerial implications of break-even analysis;
- define and discuss the concept of margin of safety;
- introduce the concept of cost measurement;
- discuss cost allocation, including the selection of the base for allocation, approaches for allocation from mission centers to service centers, and allocation to units of service; and
- introduce and explain activity-based costing.

The chapter then examines a decision method called break-even analysis, a technique that assists the manager in determining what volume of activity is required for a program or service to become financially self-sufficient. Although many not-for-profit organizations are willing to undertake projects

that lose money, the organization's survival depends on managers knowing when that will happen and how much money projects will probably make or lose. An awareness of likely losses will give managers critical information. They can then respond by finding other profitable activities that will make up for the losses or by trying to obtain grants or donations to subsidize specific services.

The chapter concludes with a discussion of cost measurement. The measurement of costs is complicated by the fact that some responsibility centers provide services to other centers. To determine the costs of products or services provided by the organization, it is necessary to allocate all the costs of the organization to the centers that produce the organization's products or services. In addition to addressing cost allocation, this section also discusses activity-based costing, a technique designed to improve the accuracy of cost measurements.

BASIC CONCEPTS AND DEFINITIONS

Cost measurement is more complex than one might expect. When someone asks what something costs, accountants usually respond that "it depends." The reason for this apparently evasive answer is that the appropriate measure of cost depends substantially on the intended use for the cost information. For Steve Netzer, chief operating officer of the Hospital for Ordinary Surgery (HOS), to find out what it cost to treat each patient in the hospital the previous year is different from calculating what it might cost to treat one more patient the following year. The cost per patient when 100 patients are treated may be different from the cost per patient when 500 patients are treated.

Cost is measured based on the amount that must be paid to obtain or use resources, including human resources, for the organization's desired use. The amount paid for resources is their value, and the consumption of those resources are an organization's expenses. Specific measurement of that amount is sometimes difficult. To make sense in this complicated area, managers rely on a set of definitions. These definitions provide the basis of a common language so that when the Millbridge town controller and Dwight Ives, the town manager, have a discussion, both managers can interpret that information in the same way and effectively communicate with each other. Communication about costs should begin by identifying the **cost objective**:

Cost objective: Anything for which a measurement of cost is desired. This could be a unit of service, program, department, or organization.

For example, one might be interested in the cost of plowing snow from the roads of the town of Millbridge.

The cost objective must be defined clearly. Suppose that Dwight Ives asks the Public Works Department manager how much the latest snowfall cost the town. In Ives's mind, he may be wondering about the cost of plowing the snow. In the mind of the Public Works manager, the cost of the snowfall includes both plowing and subsequently filling the potholes caused by the snow and plows. If the Public Works Department reports a cost to Ives that includes pothole repair, there will be a miscommunication. Ives may compare the cost with that reported by other towns and wonder why Millbridge's costs are so high. It may turn out the other towns are reporting only the cost to plow the roads, whereas Millbridge also includes the cost of road repair. The most basic point in costing is to clearly define and communicate the cost objective. Communication is critical, and data become useful information only if they are communicated in a way that everyone understands.

Costs are often measured both in total and per some unit of measurement. Millbridge may want to know the total cost of plowing snow and also the cost per unit. However, the units could be miles

plowed, inches of snow, or labor hours. The town may want to know the cost per mile, cost per inch of snow, or cost per labor hour. The total cost is also referred to as the **full cost**:

Full cost: The total of all costs associated with a cost objective. This includes direct and indirect costs.

The terms **direct costs** and **indirect costs** often cause some confusion. They are defined here as follows:

Direct costs are

- a. costs that are incurred within the organizational unit for which the manager has responsibility,
- or
- b. costs of resources that are used for the direct production of a good or service.

Indirect costs are

- a. costs that are assigned to an organizational unit from elsewhere in the organization, or
- b. costs of resources that are not used for direct production of a good or service.

Direct and indirect costs are particularly difficult to understand because their definitions relate to the object of the analysis. If one is interested in the direct cost of the Public Works Department, it is appropriate to include department supervisory personnel in that cost. By contrast, if one is interested in the direct cost per mile of road plowed, that would include the plow, the driver, and the cost of the salt spread on the road but not the cost of supervisory personnel. In that example, the supervisors are direct costs of the Public Works Department (i.e., what it costs to operate the Public Works Department) but indirect costs of plowing the road (i.e., what it costs to plow the roads). The scheduling and other administrative activities carried out by supervisory personnel are essential to running the department, but they are not a direct cost of plowing snow. If part of the cost of the town manager's salary is allocated to each department, including the roads department, that cost would be an indirect cost of both the department and each mile of road plowed. Direct and indirect costs, when added together, make up the full costs of the cost objective.

Thus, the full cost of plowing the road includes all the costs that the organization incurs, including indirect costs. Indirect costs are often referred to as overhead. In general, the terms "indirect cost" and "overhead" are used interchangeably. However, one should always determine the meaning of technical terms in specific situations. The Public Works manager may consider the plow driver to be a direct cost of plowing roads, the administrative assistant to be an indirect cost, and a share of Dwight Ives's salary to be an overhead cost. In other words, the department manager considers indirect costs within the department to be different than overhead costs.

Think of this distinction another way. A department has the direct costs of providing some specific service (e.g., the plow driver). There may also be indirect costs incurred within the department that are needed to run the department but are not directly related to the service (e.g., an administrative assistant). Indirect costs that are needed to run the organization may also be incurred outside the department (e.g., the town manager's salary or the costs of the Payroll Department).

In some instances, only the indirect costs generated outside the department are considered to be overhead. In other cases, all indirect costs may be referred to as overhead. This is often the result of different people defining the cost objective differently. If one person believes that determining the direct cost of plowing the road is the cost objective, the administrative assistant and Payroll Department

may both be indirect costs and, therefore, overhead. If another person views the costs of running the Public Works Department as being the cost objective, then both the plow driver and administrative assistant are considered to be direct costs, and only the Payroll Department is an indirect cost, or overhead.

The variability in the use of terms can cause confusion. The confusion generally is the result of miscommunication. Managers should explicitly define the cost objective, the types of costs being treated as direct, and those being treated as indirect.

Suppose that all town workers, including snowplow drivers, wear a uniform that is cleaned by the town in its own laundry. What type of cost is the worker who does the laundry? Well, it is an indirect cost of plowing the roads. It is also an indirect cost of the Public Works Department, so it is an indirect cost.

To the Laundry Department, however, the worker doing the laundry is a direct cost. So a specific cost can be measured as both a direct cost and an indirect cost for the same organization! The classification depends on the cost objective. If one is interested in the cost of doing laundry for the town, it is a direct cost. If one is interested in the cost of plowing snow off roads, it is an indirect cost.

Average cost: The full cost of any cost objective divided by the number of units of output provided.

If all the costs of plowing snow, both direct and indirect, are added, and the total is divided by the number of units of output, the result is the cost per unit or the **average cost**. The total cost could be divided by the number of miles to find the cost per mile plowed, for instance. Often managers require information on the cost per mile, cost per patient, cost per meal, and so on. Each unit of a good or service provided (e.g., a plowed mile of road, a patient treated, or a meal served) is considered output or volume. Here, output and **volume** are used interchangeably.

Fixed costs: Costs that do not vary as the volume of output changes over a relevant range of activity.

Variable costs: Costs that vary directly with changes in the volume of output over a relevant range of activity.

Once Meals for the Homeless (Meals) rents space for a soup kitchen, the rent will not change from day to day even if the number of meals provided varies by a substantial amount. Perhaps Meals is serving 300 people a day at a given soup kitchen. If Meals were to feed another person, the rent would stay the same. Therefore, rent is a fixed cost. By contrast, the food that Meals purchases is a variable cost. If more people are served, Meals will need more food. If cost and output are directly related, as they are in the case of any variable cost, each additional unit of output results in an increase in total cost. It is important to remember that with additional output, it is the total variable cost that increases if there are variable costs. The per-unit variable cost does not change unless there are unique circumstances, as described here.

Relevant range: The normal range of expected activity for the cost center or organization.

Fixed costs are fixed over the **relevant range** of activity. Suppose that Meals expects that each of its soup kitchens will serve between 250 and 500 people. Within that normal expected range, costs that are fixed will remain fixed. Rent would not change regardless of whether 250, 300, or 500 are people served. However, what if the demand suddenly jumped to 1,200 people? That might be more than Meals could physically handle at one location. It might be necessary to lease additional space, which would increase the cost of rent. Thus, fixed costs are fixed only within the relevant range for an activity. However, most managers can accurately predict the likely range of activity for a coming year and plan their fixed and variable resources accordingly.

As in the case of activity, fixed costs are fixed only over a relevant period. Rent that is a fixed cost today, this month, or this year can change when the lease expires. Salary costs for a manager may be fixed for a period of one year. After that, the manager may earn a raise in salary. Thus, fixed costs remain fixed only within the relevant range of activity and within a relevant period. Different fixed costs have different periods over which they remain fixed: Rent may be fixed over a five-year lease period; managers' salaries might change once a year.

Marginal costs: The additional costs incurred as a result of providing one more unit of output (such as one more meal served or one more patient treated).

At first, **marginal costs** appear to be identical to variable costs. In both cases, if there is one more unit of activity there will be an increase in total cost due only to the variable costs. Marginal costs, however, more broadly look at all costs that might change as a result of a decision. Suppose that HOS has a staff of surgeons who are paid salaries and can perform 5,000 surgeries per year. Assuming HOS expects to do 3,000 surgeries, the cost of surgeons' salaries is a fixed cost. But what if HOS is already doing 5,000 surgeries? What is the cost of doing one more surgery?

If HOS must hire another surgeon to do the 5,001st surgery, then on the margin—that is, from the 5,000th surgery to the 5,001st—the increase in total cost of the additional patient is the variable cost of one more patient plus the cost of hiring another surgeon. It would be reasonable to argue that instead of hiring another surgeon, HOS should try to push the existing surgeons a little farther. And that might be done. But at some point, whether it is at patient 5,001 or 5,002 or 5,500 or 6,000, the hospital will have to hire another surgeon. The cost for that marginal patient would include both the variable costs for that patient and the increase in fixed costs. In other words, marginal cost is equal to variable cost unless the relevant range of an existing fixed resource is exceeded, in which case marginal cost is equal to variable cost plus new fixed costs.

Mixed costs: Costs that contain both fixed and variable cost elements.

Some costs are both fixed and variable. For example, electricity is a **mixed cost**. Meals uses electricity to provide general lighting for its soup kitchens and offices and to run its ovens. Because the lights are on every day, the electricity consumed for that purpose is a fixed cost. But the more meals it cooks, the longer the ovens are on, and the more electricity it uses.

Mixed costs create some problems for managers. If the number of meals served by Meals is expected to increase by 20% next year, how much should Leanna Schwartz, the executive director, budget for electricity? Electricity use will clearly rise as a result of cooking the extra meals. But lighting costs will probably not change. So costs will rise but by less than 20%. Regression analysis can be used to separate the mixed cost into its fixed and variable cost components. That approach is described in statistics and advanced financial management texts and is beyond the scope of the discussion here.

Step-fixed costs or step-variable costs: Costs that are fixed over ranges of activity that are less than the relevant range.

Often organizations require a fixed number of employees for a range of activity. Within that range, the personnel costs will remain fixed. However, if the volume increases by a large enough number, additional personnel will be needed. That personnel level will then be fixed for a new, higher range of activity. The key to understanding step costs is that they are fixed over volume intervals but do vary within the relevant range.

COST BEHAVIOR

One of the most critical cost issues relates to **cost behavior**. Cost behavior is the way that costs change in response to changes in volume. If the volume of activity rises by 5%, what do costs do? What if volume falls? How can one predict whether total costs will exceed revenues or remain at a level less than revenues?

Cost behavior depends on the specific elements of cost in any organization and its cost centers. A **cost center** is any unit or department in an organization for which a manager is assigned responsibility for costs. Some types of costs are stable, changing little, if at all, even in response to significant changes in the volume of services provided. Other costs are highly changeable, reacting directly to changes in volume. The goal of this section is to lay out a framework for understanding cost behavior.

Fixed versus Variable Costs

As discussed, the total costs of running an organization, program, or department are generally divided into those costs that are fixed and those that are variable. Graphs help clarify the concepts of cost behavior. [Figure 4-1](#) provides an example of a fixed cost. Specifically, the graph shows the \$80,000 annual salary for a gastrointestinal (GI) endoscopy lab manager for the coming year.

That salary is a fixed cost for HOS. The salary paid to a lab manager is not dependent on the number of lab procedures. In [Figure 4-1](#) the vertical axis shows the cost to the institution. As one moves up this axis, costs increase. On the horizontal axis are the number of lab procedures. The farther to the right one moves, the more procedures the lab has done. Regardless of the volume, the \$80,000 salary for the lab manager will remain the same. Therefore, the cost is the same for 400, 700, or 1,000 procedures.

Variable costs, as noted earlier, vary with the volume of activity or output. Suppose that each procedure in the GI lab at HOS uses a disposable set of supplies. The cost of those supplies would increase in proportion with the number of procedures. Assuming each set of supplies costs \$500, the expected supply cost would be \$500 multiplied by the number of procedures.

Consider [Figure 4-2](#). This graph plots the cost for disposable supplies as they vary with patient volume. As in [Figure 4-1](#), the vertical axis represents the cost to HOS, and the horizontal axis represents the procedure volume. Unlike [Figure 4-1](#), which showed some positive cost even at a volume of zero, this graph shows zero cost at a volume of zero because zero procedures implies that none of these supplies will be used.

In [Figure 4-3](#) dashed lines have been inserted to show the total cost when there are 500 and 800 procedures. As can be seen, there is \$80,000 of fixed cost regardless of volume. At 500 procedures, the total cost is the \$80,000 fixed cost plus \$500 variable cost per procedure for 500 procedures (\$500 $\times$

500 = \$250,000). The total cost is \$330,000. At 800 procedures the variable cost is \$400,000 ($\$500 \times 800$), and the total is \$480,000. Note that the total costs start at \$80,000, even at a volume of zero, due to the fixed costs of the manager's salary.

Cost Graphs and the Relevant Range

In [Figures 4-1](#) and [4-2](#) it is assumed that fixed costs are fixed throughout the entire range of the graph and that variable costs vary in direct proportion throughout the entire range of the graph. This is likely an oversimplification.

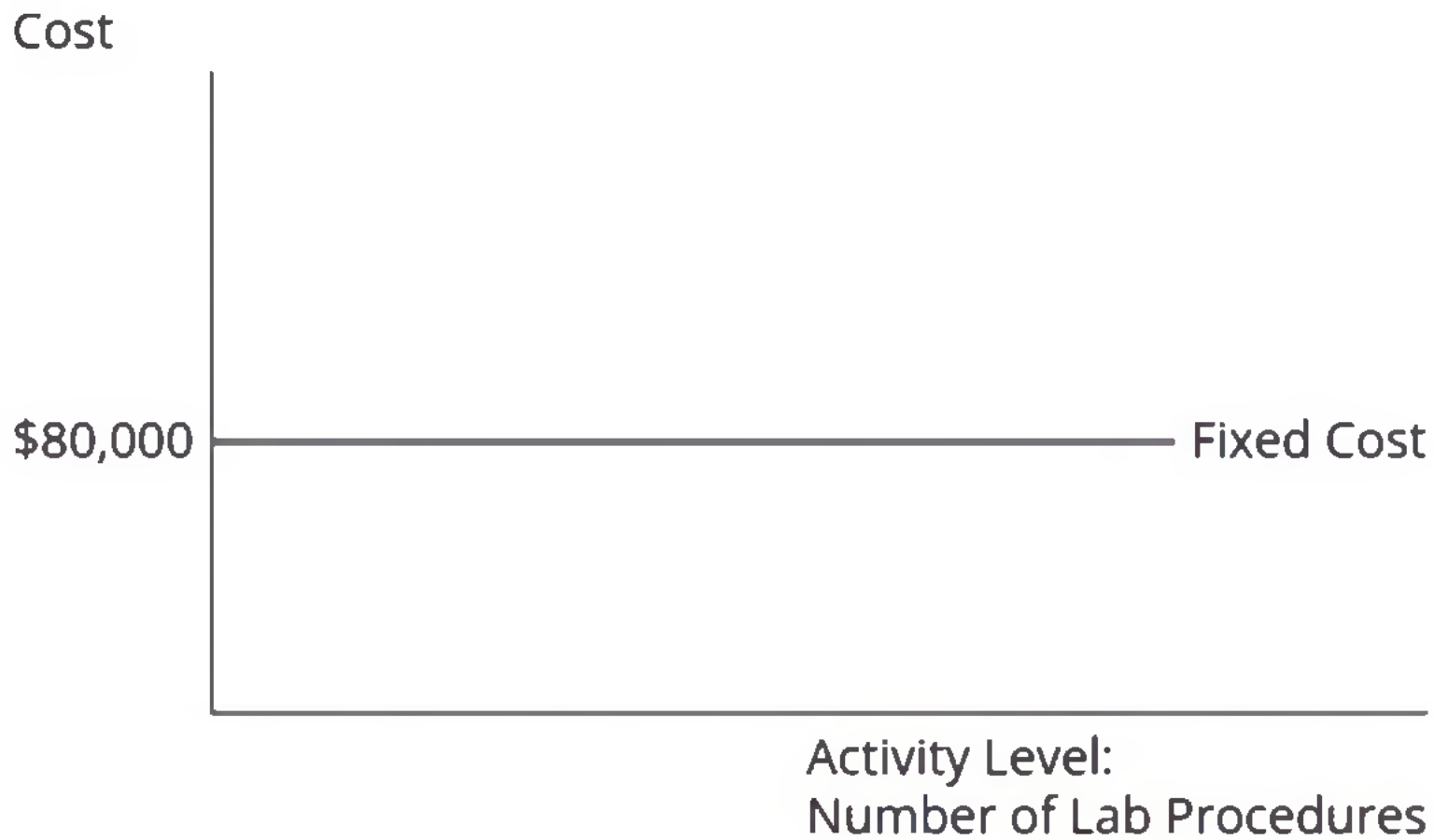


Figure 4-1 Graph of Fixed Cost

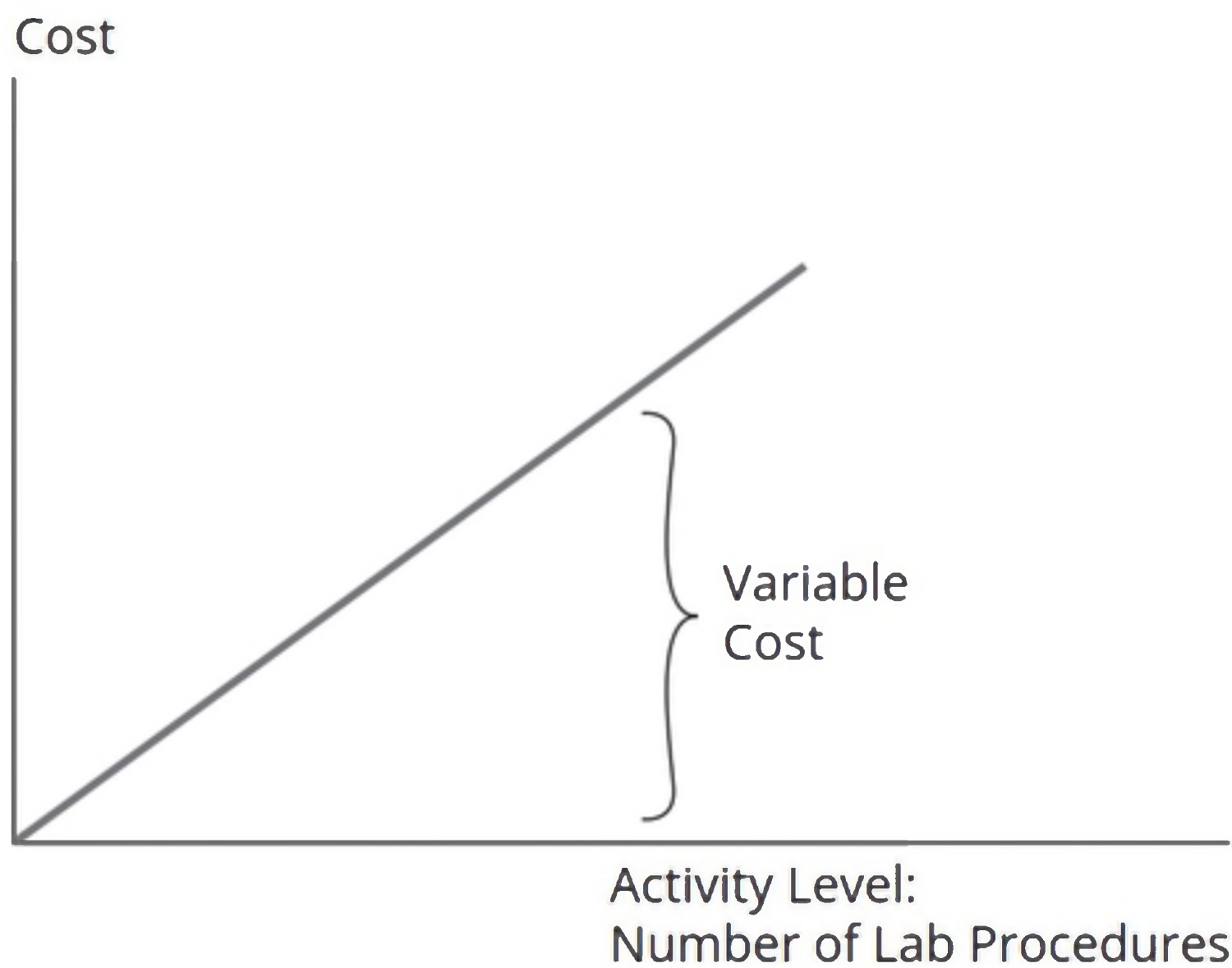
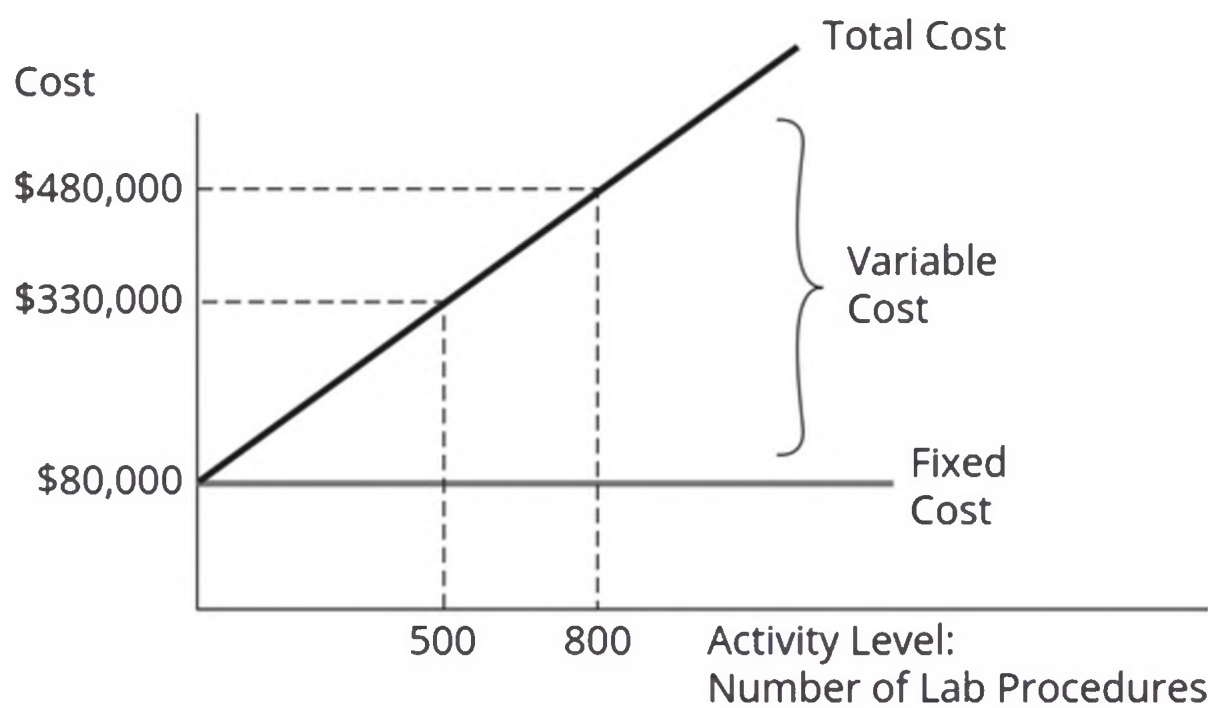


Figure 4-2 Graph of Variable Costs



[Description](#)

Figure 4-3 Graph of the Total Cost

If volumes were extremely low, it is unlikely that the lab would be kept open. The manager would be let go, and the fixed cost would be eliminated. If volume were extremely high, an assistant manager might have to be hired, thus causing a jump in fixed costs. For many analyses done by managers, however, the true expected range of changes in volume is relatively small. If the organization currently does 500 procedures a year, next year it might do 400 or 600, but it is unlikely that volume would fall to 50 or rise to 2,000. Within typical volume swings, fixed costs are generally likely to remain fixed.

Variable costs increase proportionately over the relevant range. However, if the volume of a lab fell from 500 to 50, the organization might have to pay more per unit for supplies because it is no longer purchasing a reasonably high volume. By contrast, if volume were to rise to 5,000, the organization might get a lower price for each unit of supplies. Therefore, the cost of supplies does not vary exactly proportionately (doubling the cost with each doubling of volume) over any range of activity.

Again, however, such wide swings in activity are unusual, and it is reasonable for most managerial analyses to assume that, within the relevant range, variable costs will vary proportionately. But it is important to be aware that fixed costs are fixed and variable costs are directly variable only over a reasonable relevant range of activity.

Many costs are **step-fixed** (or sometimes referred to as **step-variable**) and vary within the relevant range but not smoothly. This is common with personnel. The GI lab in the example might need the following staff in addition to the managers (see [Table 4-1](#)).

Staff	Activity Level
One technologist	Up to 250 procedures per year
Two technologists	251–500 procedures per year
Three technologists	501–750 procedures per year
Four technologists	751–1,000 procedures per year



If somewhere between 400 and 600 procedures are expected, then there will be a need for at least two technologists and perhaps three. The cost behavior pattern for these step-fixed costs is shown in [Figure 4-4](#).

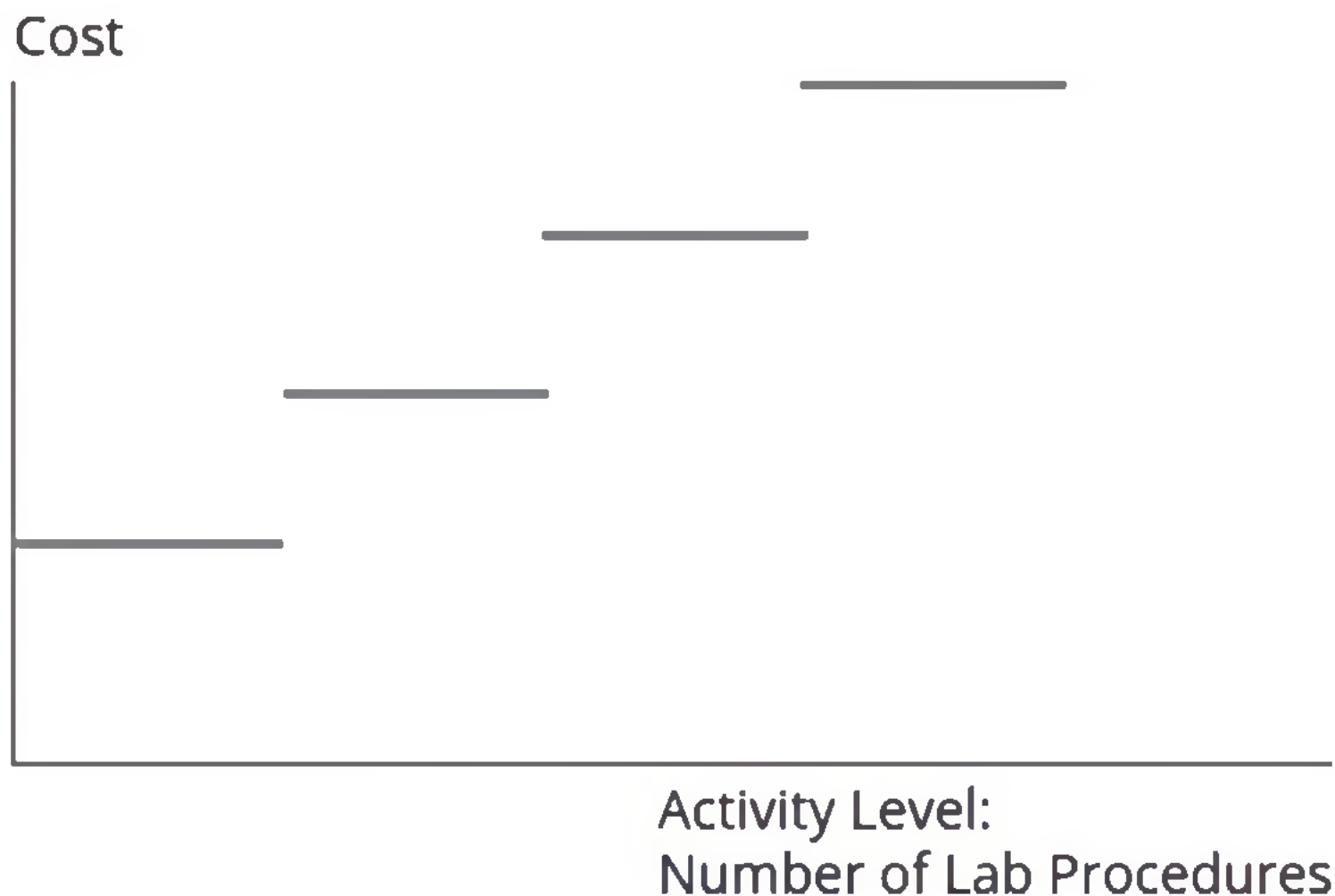


Figure 4-4 Graph of Step-fixed Costs

The Impact of Volume on Cost per Unit of Activity

If the GI lab manager were to ask what it costs to do each procedure in the lab, accountants would probably answer that it depends, as noted earlier. Costs are not always the same. The cost to treat a patient depends on several critical factors. One of these is the volume of procedures or, more generally for any organization, the overall volume of activity. The cost per meal at Meals depends on how many meals it serves. The cost per person arrested by the Millbridge Police Department depends on the total number arrested. The cost per patient procedure at HOS depends on the number of procedures.

Suppose that the Millbridge School System has annual fixed costs of \$15 million and variable costs of \$3,000 per student.¹ Using these hypothetical data, what is the average cost per student per year? If there are 3,000 students for the year, the total costs will be the fixed cost of \$15 million plus \$3,000 per student for each of the 3,000 students. The variable costs would be \$9 million (i.e., \$3,000 per student $\times$ 3,000 students). The total cost would be \$24 million (i.e., \$15 million fixed cost + \$9 million of variable cost). The cost per student would be \$8,000 (i.e., \$24 million total cost $\div$ 3,000 students).

However, what if there were only 2,500 students? Then the variable costs, at \$3,000 per student, would be \$7.5 million, and the total cost would be \$22.5 million. In that case, the cost per student would be \$9,000. The cost is higher because there are fewer students sharing the fixed costs. Each student causes the Millbridge School System to spend another \$3,000 of variable costs. The \$15 million fixed cost remains the same regardless of the number of students. If there are more students, each one shares less of the \$15 million fixed cost. If there are fewer students, the fixed cost assigned to each increases. [Table 4-1](#) calculates the fixed, variable, total, and average cost per student at a variety of student volumes.

[Figure 4-5](#) shows the average cost at different student volumes. The cost declines as the volume of students increases because more students are sharing the fixed costs. The impact of sharing fixed costs over increasing levels of volume is referred to in economics as short-run economies of scale. Suppose there are only 1,500 students. The total variable costs of \$3,000 per student would be \$4.5 million,

and the total cost would be \$19.5 million. The cost per student would be \$13,000—substantially more than the cost per student with 2,500 or 3,000 students.

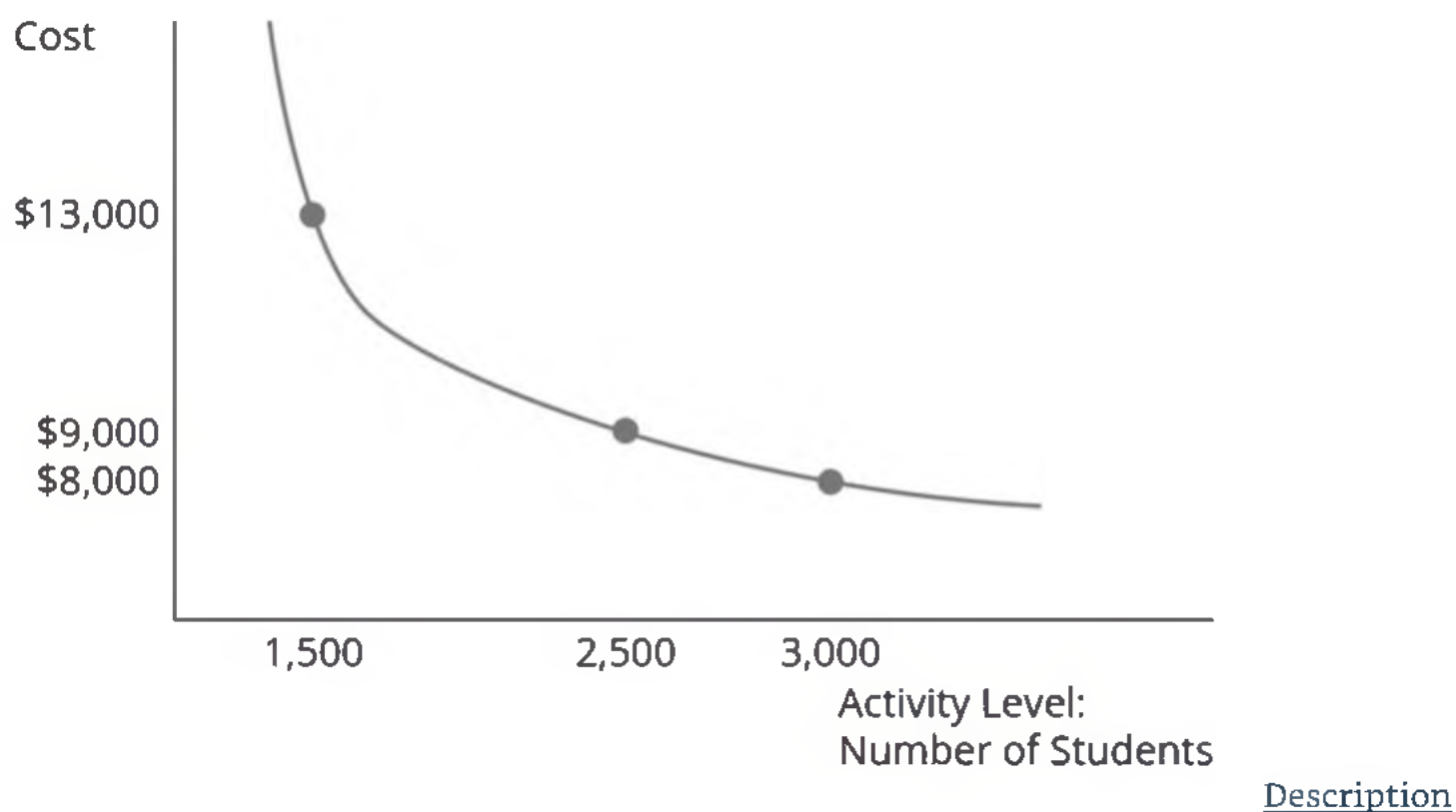


Figure 4-5 Average Cost per Student

In trying to understand costs, it is essential to grasp this concept: because fixed costs do not change in total, the cost per student does change as volume changes. The school superintendent receives a set salary, it costs a fixed amount to maintain the school buildings and athletic facilities, and so on. The greater the number of students who share those fixed costs, the lower the cost per student. There is no unique answer to the question, “What is the cost per student?” That question can be answered only by giving the cost per student assuming a specific volume of students. The volume is critical.

One implication of this result is that many organizations generally are better off with higher rather than lower volume. As volume increases, the average cost per unit of service declines. If prices can be maintained at the original level for an organization that charges for its services, the declining cost will result in lower losses or higher profits.

Outsourcing and Marginal Cost Analysis

Often public service organizations must decide whether to provide services themselves or to purchase them from an outside consultant or other provider. When an organization decides to have activities performed by an outside provider rather than doing them itself, it is said to be **outsourcing** that service or activity. An example is a government’s decision to collect garbage itself or to outsource that activity to a private company. This is sometimes referred to as a **make-or-buy decision**. In the late twentieth century, outsourcing became popular. The range of activities being outsourced increased, and the use of private organizations to provide services soared.

One form of outsourcing is hiring workers from a temp agency on a long-term basis in lieu of hiring full-time employees. The workers do the same work as if they had been hired as full-time employees, but the organization receives two major benefits for hiring them. First, even though there is an agency fee and typically a higher hourly wage for a temp worker than for a full-time employee, the organization does not have to pay as much for benefits such as health care and retirement for temp workers. Second, the organization retains flexibility. It is much easier to reduce staff by simply discontinuing an agency temp worker as opposed to firing an employee.

The other major form of outsourcing is one in which an activity is taken over by an outside firm that specializes in that activity. For example, we have long seen private laundry companies that provide laundry services to multiple hospitals. But in recent years the range of activities being outsourced has grown dramatically. Information systems, training, payroll, billing, receivables collections, public relations, insurance claims processing, technical assistance, and customer service are some examples of outsourcing activities.

A laundry service that provides laundry to ten hospitals in a large city may be much more efficient than ten individual laundry departments. That efficiency can result in a profit for the laundry company and reduced costs for each of the ten hospitals. However, in recent years a great deal of outsourcing has resulted in activities being done in other countries (outsourcing overseas is referred to as offshoring), where workers earn lower wages. More often, organizations are scanning documents and then sending them electronically to other countries, where data from the documents are entered in databases for processing or analysis.

A full discussion of the political and economic implications of outsourcing is beyond the scope of this text. In short, the trend toward outsourcing has grown over the past several decades, but more recently opposition has also grown because of the potential domestic job loss that it creates. An organization first needs to assess the financial implications of a make-or-buy decision. Once it understands whether a specific outsourcing proposal makes financial sense, it can then consider the social and political implications of the decision and take them into account as well.

From a financial perspective, the decision of whether to outsource is one that is best addressed using an approach called **marginal cost analysis**. This approach is sometimes referred to as **incremental analysis** or **out-of-pocket analysis**. The essence of the approach is that decisions such as whether to provide a service or to change the volume of a service should be based on marginal rather than average costs.

As discussed in the previous section, the cost per pupil will depend on the number of pupils in the school system. The measurement of cost also depends on what the measurement will be used for. If the question is one of historical curiosity, the average cost is an adequate response. However, if the information will be used for decision-making, that response may well be incorrect.

Suppose that the town has recently had a large influx of families with young children. Dwight Ives realizes that in a few years the population in the Millbridge School System will start to grow dramatically. The town can hire additional staff and accommodate the additional students with the existing buildings. Alternatively, an adjacent town has offered to educate Millbridge students for \$7,000 per student. Although this would be somewhat unusual, it is not unheard of. And if the neighboring town has excess capacity, why should Millbridge add more classes? This is an example of a make-or-buy or outsourcing decision: Educate the students in the township or purchase the services.

Suppose that the township currently has 2,500 students and believes that the new influx will cause the size of the town's student body to rise to 3,000. Looking at [Table 4-2](#), the immediate reaction would be to accept the offer. The \$7,000 price offered would be less than the \$8,000 average cost per pupil within the town at a volume of 3,000 students. It looks like a good deal. However, [Table 4-2](#) shows the average cost rather than the marginal cost.

The marginal cost is the additional cost that results from a decision. If one more student is added, the marginal cost would be the cost of that one additional student. If 500 more students are added, the marginal cost would be the cost incurred because of those 500 additional students. Clearly, the marginal cost includes variable costs. If new schools must be built for the additional students, the cost of those schools (depreciation, maintenance, etc.) would also be included in the marginal costs. But if the fixed costs can remain the same, then they would not be included.

Volume (A)	Fixed Cost (B)	Variable Cost (C = \$3,000 × A)	Total Cost (D = B + C)	Average Cost (E = D ÷ A)
1,500	\$15,000,000	\$4,500,000	\$19,500,000	\$13,000
2,500	15,000,000	7,500,000	22,500,000	9,000
3,000	15,000,000	9,000,000	24,000,000	8,000



Assuming the fixed costs would not change going from 2,500 to 3,000 students, what is the marginal cost? It is the amount that costs increase as a result of the additional students. In this example, the marginal costs would be \$3,000 per student. That is substantially less than the offer from the other town.

If the decision is made to purchase the services, the town will pay \$7,000 additional for each of the extra students in addition to what it is paying currently for its students. If the additional students are educated within the town, the cost will be \$3,000 per student in addition to current costs.

Another way to view this is to consider the total costs of the school system. From [Table 4-2](#), with the current student population of 2,500, the total cost of the system is \$22.5 million. If 3,000 students are educated within the town, the total cost rises by \$1.5 million to \$24 million. However, if Millbridge were to pay the adjoining town \$7,000 for each of 500 students, the total costs would rise \$3.5 million ($\$7,000 \times 500$ students) to \$26 million ($\$22.5$ million + $\$3.5$ million). It clearly is less expensive for the town to educate the students itself.

These same principles apply any time an organization must decide whether to add or eliminate a service or expand or contract volume of an existing service. The decision always requires the organization to consider how much additional cost it will incur if it makes one choice versus another. In some cases, revenues will also change, and the change in revenue must be considered as well. It is, however, the change in revenues and costs that is the key measurement when one is considering making a change.

In recent years, many government, not-for-profit, and health-care organizations have focused on the issues of outsourcing and privatization. However, if an organization is considering eliminating a current service, caution is necessary. Often, an outside vendor can offer a price that is less than the average cost. The organization, however, must assess the marginal costs and marginal revenues. If a hospital can eliminate many fixed costs of running its laundry, there may be a cost savings from outsourcing. However, what if most of the fixed costs of running the laundry will be incurred anyway? In that case, it may not pay to shift to the outside supplier. The organization must consider its likely reduction in internal spending versus the price that it will be charged by the outside provider.

Marginal cost analysis is sometimes referred to as **relevant costing**. This is because all decisions should be made based on those costs that are relevant to the decision. The simplest way to think about this concept is to consider costs before and after a change. The relevant costs are those that change as a result of the decision. The approach applies equally to revenues.

In the Millbridge School System example, the many fixed costs were not relevant. This is because they would not change as a result of adding the extra students. If the town would have had to build an additional school, the new fixed costs of that school would have been relevant costs. It would have had to consider those fixed costs in determining whether the total costs to the town would be higher or lower if it kept the students versus sending them to the next town for their classes.

BREAK-EVEN ANALYSIS

Many health, not-for-profit, and public organizations are moving toward adding new projects and ventures as a way of improving the financial stability and results of the organization or to address new needs. Profitable new ventures are seen as a way to subsidize other activities of the organization that lose money. However, managers must determine whether a new venture will indeed be profitable or whether it will require additional subsidization. **Break-even analysis** is a useful tool for determining whether a program will be profitable or not when there is a specific price associated with the service. The price may result from a charge for the service (i.e., an exchange transaction) or perhaps from a **cost reimbursement** (such as a public contract).

At first blush, this would seem to be a fairly transparent exercise. First, find out the likely price or reimbursement that can be earned for each unit of the new service—that is, for each unit of output. Then determine the cost per unit for the service. If the price is greater than the cost, a profit will be made. If the price is less than the cost, the new activity will lose money. The only problem is that when one tries to determine the cost per unit, the result is, “It depends.”

The cost per unit depends on volume, as discussed earlier in this chapter. At low volumes, the cost per unit will be higher than it is at high volumes. It is possible that at low volumes the cost per unit will exceed the average price that can be earned for the service.

At higher volumes, the service may become profitable. The goal of break-even analysis is to determine the volume at which the activity moves from losing money to making money. Understanding whether a particular unit or output will lose money, make money, or break even is useful for the evaluation of both new and continuing projects and services.

The profitability of an activity is determined by whether its revenues are greater than its expenses. If revenues exceed expenses, the organization earns a profit. If revenues are less than expenses, the organization incurs a loss. Only when revenues are *exactly* equal to expenses does the activity or organization break even. An activity's or organization's revenues are the average price collected multiplied by the number of units of service. The equation is

(4-1)

$$\text{Total Revenues} = P \times Q$$

where P is the price and Q represents the volume. The price, P , is not the amount we charge but rather the average amount that we can expect to collect. There are situations in which we will collect less than our official price. For instance, in the health-care context, the revenue received by a provider for a service is not the same as the price for that service if there is a third-party payer, such as a private health insurer. Therefore, the revenue per unit of service is sometimes shown as variable revenue, or VR . The expenses of the organization are the sum of the fixed and variable costs:

(4-2)

$$\text{Total expenses} = (VC \times Q) + FC$$

where VC is the variable cost per unit, Q is the volume or quantity of output, and FC is the total fixed cost. At the volume at which we precisely break even, we refer to Q as the BEQ (for break-even quantity). Because the organization will break even only when the total revenues equal total expenses, the volume needed to break even can be found by solving the following equation for BEQ :

(4-3)

$$(P \times BEQ) = (VC \times BEQ) + FC$$

Next, subtract $(VC \times BEQ)$ from both sides of the equation (see Equation 4-4), factor out the BEQ from all items on the left side of the equation (see Equation 4-5), and divide both sides of the equation by $(P - VC)$ (see Equation 4-6), as follows:

(4-4)

$$(P \times BEQ) - (VC \times BEQ) = FC$$

(4-5)

$$BEQ \times (P - VC) = FC$$

(4-6)

$$BEQ = FC / (P - VC)$$

This results in a formula for the quantity, BEQ , that is needed to break even.

Break-even Analysis Example

Suppose that the hypothetical Feed-a-Child Foundation is contemplating starting a new program in South America. It does not currently have any operations on that continent and does not have sufficient funds to provide a subsidy to a new program. The program would have to be completely self-sufficient.

The proposal is to generate donations of \$50 per donor to feed each child. There would be new fixed costs of \$10,000 for a special mailing (postage and printing) to solicit funds for the program and new variable costs of \$30 per child. In the unlikely event that there are no donors, then no children would be fed because there would be no revenue, but there would still be fixed costs of \$10,000, resulting in a \$10,000 loss. If there are 100 donors at \$50 each, there would be \$5,000 of revenue ($\$50 \times 100$ donors), \$10,000 of fixed costs, and \$3,000 of variable costs ($\$30 \times 100$ children). Total costs would be \$13,000 (\$10,000 of fixed cost + \$3,000 of variable cost), revenues would be \$5,000, and the loss \$8,000.

How many donors would the Feed-a-Child Foundation need for the program to break even? Each additional donor contributes \$50 of support but causes the foundation to spend an additional \$30. The difference between the \$50 donation and the \$30 variable cost is called the **contribution margin**; it is the amount available to contribute to paying fixed costs and, if all fixed costs are covered, to contribute to profits.

When the contribution margin is negative, the organization can never expect to break even. Instead, the organization's price per unit does not cover variable cost per unit, implying that there is no marginal profit (marginal revenues in excess of marginal costs) that can be used to pay fixed costs. It is a common misunderstanding that an organization can make up for a negative contribution margin by

increasing volume. In reality, when the contribution margin is negative, higher volume results only in a greater loss. In the for-profit sector, some products—like video game consoles—are sold at a negative contribution margin and are known as **loss leaders**. If the companies producing loss leaders are to stay in business, the loss leaders must be counterbalanced by products that have positive contribution margins. In the case of video game consoles, it is the software that consumers use on those consoles that has a positive contribution margin. Loss leaders are much more common in the for-profit sector than in the public and not-for-profit sectors.

If the contribution margin is positive, it means that each additional unit of activity makes the organization better off by the amount of the contribution. In that case, the organization will break even if the volume is high enough that the contribution margins from all donors add up to enough to cover the fixed costs. In cases where the contribution margin is positive, an organization can turn a loss into a profit by increasing volume.

For the Feed-a-Child Foundation, when there are 100 donors, there is a total contribution margin of \$2,000 ($100 \times \$20$). Note that the loss with zero donors is shown previously to be \$10,000; it is only \$8,000 when there are 100 donors. The loss decreased by \$2,000, exactly the amount of the total contribution margin for those 100 donors.

How many donors at \$50 each would the foundation need for the new program to break even? The answer is 500. If each additional donor generates \$20 of contribution margin, then 500 donors would generate \$10,000 of contribution margin ($500 \text{ donors} \times \$20 = \$10,000$), exactly enough to cover the fixed costs of \$10,000.

This can be calculated directly using the formula from Equation 4-6, derived earlier:

$$BEQ = FCP / VC$$

BEQ is the break-even quantity. It is the volume at which the organization, program, or service precisely breaks even. In the Feed-a-Child Foundation example,

$$BEQ = \$10,000 / \$50 - \$30 = \$10,000 / \$20 = 500$$

Note that the price less the variable cost, $P - VC$, is the contribution margin.

The concept of break-even analysis is illustrated in [Figure 4-6](#). The total cost line starts at a level of \$10,000 because of the fixed costs. The total support or revenue line starts at zero because there is no money coming in if there are no donors. Where the revenue line and the cost line intersect, they are equal, and the foundation precisely breaks even. Note that at quantities of donors below the break-even point (i.e., to the left of *BEQ* on the graph), the total cost line is higher than the total revenue line. The program is then losing money, or operating in the red. At quantities of donors higher than the break-even point (to the right of the intersection), the organization is making money, or operating in the black. At the intersection point, it breaks even.

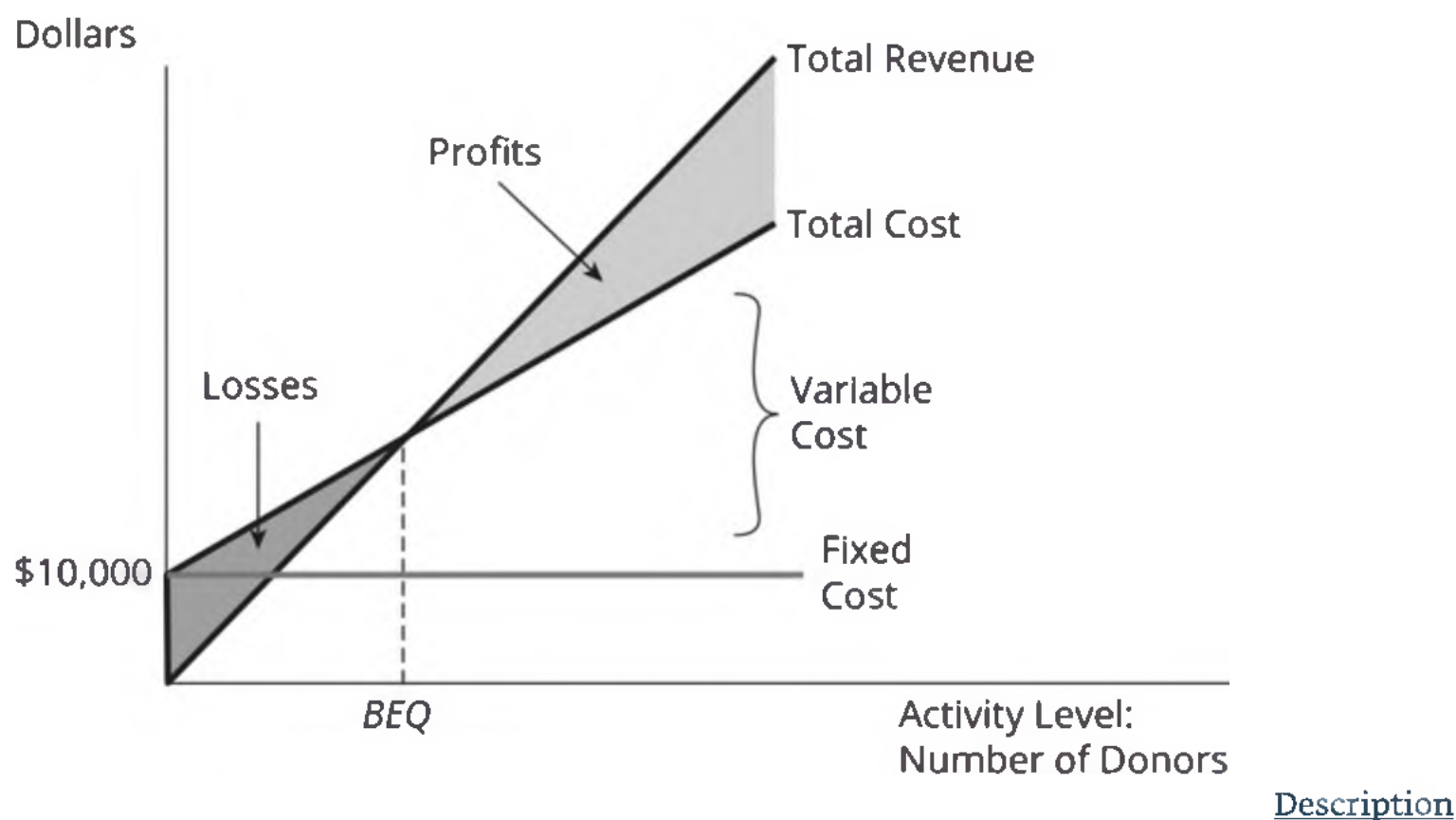


Figure 4-6 Break-even Graph

The intuition of break-even analysis is expressed by the break-even formula: It is a ratio of fixed costs to the contribution margin. The higher the ratio, the more volume or output that is required to cover the fixed costs. And of course, the lower the ratio, the less volume or output that is required. Once the fixed costs are covered, an organization can profit.

Break-even with Multiple Products

When there are different types of services or products, break-even analysis becomes somewhat more complicated. The formula for break-even requires assuming that there is only one price and one variable cost and, therefore, one contribution margin. If there are different prices and different variable costs for differing services, which price or variable cost should be used? It is necessary to use all of them; to get the correct result, it is necessary to find a weighted average contribution margin. That weighted average can be divided into the fixed costs to find the break-even volume in total.

For example, suppose that the Feed-a-Child Foundation is interested in knowing the total number of donors needed for the entire foundation to break even for the coming year. The foundation has current programs for feeding children in Africa and Asia. The African program solicits \$36 per donor under a campaign that 10 cents will feed an African child for a day (10 cents $\times$ 365 days per year is approximately \$36). Its variable costs are \$32. Although the contribution margin is much lower than the proposed South American program, there are many donors for the long-standing African program. The Asian program solicits donations of \$40, and the variable costs for this program are \$29. The contribution margin for each program can be calculated by subtracting the variable cost from the price, as shown in [Table 4-2](#).

The crucial piece of information for calculating the break-even point is the relative proportion of donors to each program. Management of the foundation expects that 70% of all donations will be to the African program, 25% will be to the Asian program, and 5% will be to the new South American program. This information can be used to determine a weighted average contribution margin. This is done by multiplying each program's contribution margin from [Table 4-3](#) by the percentage of total donors who donate to that program. The results are summed to arrive at an overall weighted contribution margin, as shown in [Table 4-4](#).

This \$6.55 weighted contribution margin represents the average contribution margin for all types of donations. It can be used to calculate the break-even quantity. Assume that fixed costs for the entire organization, including all three programs, are \$100,000 per year. The break-even quantity of donors can be calculated using the basic formula but using the weighted average contribution margin instead of the individual contribution margins:

$$BEQ = FCP - VC$$

or

$$BEQ = FCCM$$

where *CM* is the contribution margin.

	Donation (A)	Variable Cost (B)	Contribution Margin (C = A – B)
Africa	\$36	\$32	\$ 4
Asia	40	29	11
South America	50	30	20



Program	Percentage of Donations		Contribution Margin		Weighted Average Contribution Margin
Africa	70%	×	\$ 4	=	\$2.80
Asia	25	×	11	=	2.75
South America	5	×	20	=	<u>1.00</u>
Total	<u>100%</u>				<u>\$6.55</u>



$$BEQ = \$100,000 / \$6.55 = 15,267$$

The Feed-a-Child Foundation will need to receive 15,267 donations over the next year to cover all its costs. Of that total, 70% would be \$36 donations to the African program, 25% would be \$40 donations to the Asian program, and 5% would be \$50 donations to the South American program.

This method works for three different programs. What if there are more than three kinds? The same weighted average approach can be used to find the break-even volume whether there are three different types of programs or hundreds of programs. It would simply make the arithmetic more time-consuming. This is a good reason to use computer spreadsheets for financial management calculations.

Additional Break-even Applications

Break-even analysis is a powerful method to help managers make decisions. In addition to determining the volume of services that are required to achieve a financial break-even situation, it can answer other questions as well.

For example, organizations are not always able to provide an unlimited amount of service. An ambulance service may be limited in the number of trips it can make because it has a limited number of vehicles. A soup kitchen may have a limited capacity for cooking meals. A city golf course may have a limited number of tee-off times. Break-even analysis can be used to determine the price that would have to be charged in situations in which capacity is constrained so that the organization could still break even. The manager would then have to assess whether there would be sufficient demand at that price to reach the capacity constraint.

Sometimes the total revenue is constrained. For example, a charity may have received a donation to be used to provide a specific service. The donation is the total amount of revenue available. Break-even analysis can be used to determine the maximum number of units of service that could be provided without losing money.

In some cases, an organization may know both its price and production volume. Break-even analysis can be used to determine the maximum costs that can be incurred without losing money.

Another use of break-even analysis would be if the organization receives a grant allowing it to lower the charge for a particular service. The analysis can be used to determine how much the price can be lowered without losing money.

In each of these situations, one must consider the elements of Equation 4-6:

$$BEQ = FCP - VC$$

Because the elements of this equation are varied, the equation can be solved for any one missing element.

Solving for Price, Fixed Cost, and Variable Cost

The break-even formula can be used to find the fixed cost, price, or variable cost that will allow an activity, program, or organization to break even at a particular volume level. For example, suppose that we know that the HOS has a clinic with fixed costs of \$250,000, average collected revenue of \$95 per patient, variable costs of \$80 and that it operates at its maximum capacity of 12,000 patient visits per year. Unfortunately, the clinic is losing money. How much would it have to collect per patient, on average, to break even at its 12,000 maximum capacity volume?

$$\begin{aligned} BEQ &= FCP - VC \\ 12,000 &= \$250,000P - \$80 \times 12,000 \\ 12,000 &= \$250,000P - \$960,000 \\ 12,000P &= \$250,000 + \$960,000 \\ 12,000P &= \$1,210,000 \\ P &= \$100.83 \end{aligned}$$

If HOS could collect \$100.83 per patient visit, it would break even. Solving for the break-even price (BEP) is quite common in financial management. Here is the general formula:

(4-7)

$$\text{BEP} = \text{FC} / Q + \text{VC}$$

Note that the BEP is the fixed cost per unit plus the variable cost per unit. In other words, the price at which an activity, program, or organization breaks even is that at which the fixed and variable costs are covered by the charge.

Suppose, however, that studies have shown the clinic that if it were to raise prices to a point where it collects more than \$95 per visit, the price increase would dramatically lower demand. There would be far fewer than 12,000 visits, and the loss would be even greater. Suppose the clinic keeps the average collection per patient at \$95, keeps its variable costs at \$80 per visit, and retains its volume of 12,000 visits: What is the most that it could spend on fixed costs and still break even?

$$\text{BEQ} = \text{FCP} - \text{VC} \quad 12,000 = \text{FC} / (\$95 - \$80) \quad 12,000 \times (\$95 - \$80) = \text{FC} \quad \text{FC} = 12,000 \times (\$95 - \$80) \quad \text{FC} = 12,000 \times \$15 \quad \text{FC} = \$180,000$$

The clinic would break even if it lowered its fixed costs to \$180,000. After further study, the clinic determines that it can cut its fixed costs to \$200,000 but no lower. If the clinic keeps the average revenue collected per patient at \$95, maintains patient volume at 12,000 visits, and lowers fixed costs to \$200,000, what is the most it could spend per visit on variable costs and still break even?

$$\begin{aligned} \text{BEQ} &= \text{FCP} - \text{VC} \quad 12,000 = \$200,000 / \$95 - \text{VC} \quad 12,000 \times (\$95 - \text{VC}) = \$200,000 \\ 12,000 \times \$95 - 12,000 \text{ VC} &= \$200,000 \quad \$1,140,000 - \$200,000 = 12,000 \text{ VC} \quad \$940,000 = 12,000 \text{ VC} \\ \text{VC} &= \$940,000 / 12,000 \quad \text{VC} = \$78.33 \end{aligned}$$

At a variable cost of \$78.33, the clinic would break even.

Break-Even and Fixed Revenues

Sometimes organizations have both variable and fixed revenues. For example, not-for-profit Eye Care Services earns an average of \$100 per patient visit and also receives an annual donation of \$50,000 from a health-care foundation. If Eye Care Services has fixed costs of \$250,000 and variable costs of \$80 per visit, what is the break-even quantity of visits? Fixed revenues (FR) serve to offset some of the fixed costs of the organization. We can restate the break-even formula as follows:

$$\text{BEQ} = \text{FC} - \text{FR} / P - \text{VC} \quad \text{or} \quad \text{BEQ} = \text{FC} - \text{FR} / Q + \text{VC}$$

Solving for the BEQ, taking the FR into account,

$$\text{BEQ} = \$250,000 - \$50,000 / \$100 - \$80 = 10,000 \text{ visits}$$

The intuition of break-even analysis remains the same. For break-even quantity, the formula is a ratio of fixed costs to the contribution margin. Once the fixed costs are covered, an organization can profit. For the break-even price, the formula is the summation of the average of the fixed costs and the variable cost per unit. An organization can profit once these costs are covered. In both cases, fixed costs are offset by fixed revenues.

Margin of Safety

The **margin of safety** is a useful managerial tool related to break-even analysis. The margin of safety is the amount by which expected volume or revenues exceed the volume level or revenues required to break even. For example, suppose that HOS is considering a new outpatient mental health clinic. Its

managers believe that the clinic will have 12,000 visits per year and will collect an average of \$100 per visit, generating total revenue of \$1.2 million (12,000 visits $\times$ \$100 per visit). However, what if they are wrong? What if the number of visits falls short of expectations?

The margin of safety compares the expectations with the break-even point. Assume that HOS expects to collect \$100 per patient on average, have variable costs of \$70 per patient, and have fixed costs per year of \$300,000. The break-even volume is 10,000 patient visits per year, as follows:

$$\text{BEQ} = \text{FCP} \div \text{VC} \quad \text{BEQ} = \$300,000 \div \$100 - \$70 = 10,000 \text{ patient visits}$$

At that level the revenue would be \$1 million per year (10,000 visits $\times$ \$100 per patient). Because HOS expects 12,000 visits and the break-even point is 10,000, there is a margin of safety of 2,000 visits. In their planning HOS managers know that even if the number of visits falls as much as 2,000 visits below expectations, there will not be a loss on the new clinic. Alternatively, focusing on the total revenues, if a decline in the number of visits causes revenues to fall by \$200,000, HOS will still break even.

Managerial Implications of Break-even Analysis

If a particular program, service, or activity is expected to have a volume of activity well in excess of the break-even point, managers have a clear-cut decision to start or continue the service. If the volume is too low to break even, the activity may not be feasible. However, sometimes changes in the activity can be made to achieve a break-even status.

One approach is to lower the volume needed to break even. The required break-even level can be reduced in three ways. One can lower the fixed costs by getting by with less-expensive or fewer fixed resources. That may or may not be possible, depending on the specific circumstances. A second way to lower the break-even point is to increase prices. Price increases would increase the contribution margin per unit. That would have the effect of lowering the break-even point. However, price increases might reduce the expected volume for many activities or services.² In that case, the price increases may be defeating their purpose. Also, prices are sometimes regulated and beyond the control of the organization. Finally, one could try to reduce the variable cost per unit. This might be accomplished by increased efforts toward improved efficiency.

If it is not feasible to change the fixed costs, price, or variable costs, an organization can try to increase the number of units of activity. In the Feed-a-Child Foundation example presented, what type of donor would be desirable? The most desirable type is the one with the highest contribution margin. Every donation to the South American program provides a contribution margin of \$20 (see [Table 4-3](#)). Although this type of donation provides the highest support or revenue, it is not the revenue but rather the contribution margin that is important. If an organization has a service with high revenue, and also very high variable cost and low contribution margin, it would not be as financially attractive as another with a higher contribution margin.

Break-even Analysis Cautions

A few words of caution are advisable when working with break-even analysis. First, once a break-even point is calculated, one must decide whether it is likely that the actual volume will be sufficient to meet or exceed that point. That will require managers to predict the volume that will occur. If the forecast of volume is incorrect, the decision to go ahead with a new service may turn out to be a bad one even if the break-even analysis is otherwise done correctly. Also, correct classification of costs as being either fixed or variable is critical to the analysis.

Another potential problem is that break-even analysis assumes that prices and costs are constant. If it can be reasonably expected that prices will fall over time, then a higher volume would be needed to keep a service viable, unless variable or fixed costs would be falling as well. When a new service is first offered, the price may be high because only one organization provides that service. It has the ability to set prices based on a temporary monopoly situation. If competitors start offering the product, prices may fall. By contrast, if prices are expected to rise faster than costs, then a marginal service today may become profitable over time, even without an increase in volume.

Finally, a technical note of caution: Doing break-even analysis in the real world requires working with messy data. Some variables may be in weekly units of time, whereas others are in monthly or annual units of time. Some variables may be totals, whereas others are averages. A straightforward way to ensure one arrives at the correct solution is to express the fixed costs and revenues per unit of time and the variable costs and revenues per unit of quantity/volume and per unit of time. For instance, if one were calculating the monthly break-even quantity or price for a job training program, fixed costs and revenues should be monthly, and variable costs and revenues should be per participant per month.

As with all budgeting tools, judgment is essential. Based on experience, insight, and thought, the manager must examine the assumptions of any modeling technique and consider the reasonableness of the results. If a result does not seem to make sense, often that is because it does not make sense. Break-even analysis is a tool that can help give a manager a firm starting point in understanding whether a project or service is likely to be financially viable.

COST MEASUREMENT

Up to this point, the focus of the chapter has been on understanding costs for planning. Another important concern is the measurement of costs that have been incurred. One might expect that cost measurement would be a relatively straightforward process of tracking the amount spent. How much did Meals spend on labor? How much did it spend to acquire food? In practice, cost measurement is more complicated.

For example, suppose that a government agency agrees to reimburse Meals for all its costs related to providing meals in its soup kitchens. However, the agency has made clear that it is against its policy to reimburse any of the costs for the counseling services that Meals provides. Suppose that Meals is organized into departments, two of which are Soup Kitchens Department and the Counseling Department. The government agency is willing to reimburse all the costs incurred by the Soup Kitchens Department but none of the costs of the Counseling Department.

Some of the costs that Meals incurs are clearly direct costs of the Soup Kitchens Department. For example, the amount paid to buy food and the wages of the workers who serve the food would be direct costs. Those direct costs would be included in the calculation of cost for reimbursement by the agency. However, Meals also incurs a number of indirect costs.

Indirect costs are more difficult to deal with. Suppose that one manager supervises both the Soup Kitchens and Counseling Departments. How much of that manager's salary should be treated as part of the cost of the Soup Kitchens Department? The part of the manager's salary that is assigned to the soup kitchen operations will be reimbursed by the agency. So the decision concerning how to assign the manager's salary is an important one. The process of assigning indirect costs is generally referred to as **cost allocation**.

Cost Allocation

Cost allocation refers to taking costs from one area or cost objective and allocating them to other areas or cost objectives. Indirect costs must be allocated to arrive at an accurate measurement of the cost of running a department or providing products or services. For example, a portion of the cost of heating and lighting the Soup Kitchens Department should be included in that department's costs.

Often this involves allocating indirect costs from some departments or cost centers to other departments or cost centers. For example, suppose that Meals has a Purchasing Department that is responsible for everything that Meals buys. This includes not only food and kitchen equipment but also administrative and counseling equipment and supplies. The Soup Kitchens Department could not function without the services provided by Purchasing. Meals should allocate part of the cost of the Purchasing Department to the Soup Kitchens Department.

To assign costs from one area to another, it is necessary that there be a **cost pool** and a **cost base**. A cost pool is any grouping of costs to be allocated. A cost base is the criterion on which the allocation is to be made. For example, costs could be allocated based on the number of purchase orders processed. The cost pool in this example would be the costs of operating the Purchasing Department, and the cost base would be the number of purchase orders (POs) processed.

If the base is divided into the cost pool, an **overhead rate** can be calculated. For example, suppose that it costs Meals \$25,000 in direct costs to run the Purchasing Department for the year, and the department processes 5,000 POs for the year. The \$25,000 cost of the Purchasing Department is the cost pool. The 5,000 POs processed is the base.

$$\$25,000 / 5,000 \text{ orders} = \$5 \text{ per PO processed}$$

The overhead rate is therefore \$5 per PO processed. Suppose that 3,000 of the POs were to acquire items for the Soup Kitchens Department. Then Meals would allocate \$15,000 (\$5 per order × 3,000 orders) to the Soup Kitchens Department. That would become part of the cost of providing meals by the soup kitchen. From the perspective of the Soup Kitchens Department, this \$15,000 is an indirect cost, but it is part of the total cost of the department.

Selecting the Base for Overhead Rates

Selecting the base to use for the allocation is an important issue. It is critical to use a base that makes sense. If a department or cost center can vary the amount of services it consumes from other departments or cost centers, then the base should relate to use.

Suppose that the Soup Kitchens Department could request that canned food be ordered daily, weekly, or monthly. The more frequently the orders are made, the more Purchasing spends to process the orders. In that case, the number of POs processed is a good base. The Soup Kitchens Department will be charged more if it causes Purchasing to spend more money processing orders. The Soup Kitchens Department knows that by ordering something once a month, it will be assigned \$5 of cost (\$5 per PO × 1 order per month), whereas if it ordered that item daily, it would be charged approximately \$150 of cost (\$5 per PO × 30 orders per month). This causes the Soup Kitchens Department to act in a responsible manner in deciding how frequently to order.

By contrast, some organizations select arbitrary bases, such as the number of square feet that a cost center occupies. Suppose that the soup kitchen occupied half of Meals's space and the counseling service occupied the other half. Suppose that Counseling orders almost nothing each year, whereas

the Soup Kitchens Department processes many, many orders. In this simple scenario, Counseling would be charged for half of the Purchasing costs even though it did not cause much of those costs to be incurred. The result is inequitable to the Counseling Department and also does not cause the Soup Kitchen Department to realize the impact of placing frequent orders on the costs of running the Purchasing Department.

However, it is simpler to track how many square feet are in each cost center than it is to track which cost center was responsible for each PO processed. Managers must always consider whether the benefits of improved information justify the cost incurred to obtain that information.

Allocation from Support Centers to Mission Centers

If Meals consisted only of Soup Kitchens, Counseling, and Purchasing Departments, the preceding discussion of cost allocation might suffice. However, most organizations have more than one cost center or department providing direct services to clients and also have more than one cost center generating indirect costs. For example, a hospital might charge patients for services from the pharmacy, the lab, radiology, the operating room, and so on. And indirect or overhead costs would likely be incurred in housekeeping, maintenance, security, purchasing, and many other areas. The existence of many different departments complicates the cost allocation process.

The first thing that must be done is to classify each cost center as being either a **mission center** or a **support center**. A mission center is simply one that produces the final product or service provided by the organization. For some organizations such as health-care providers, mission centers are referred to as **revenue centers**. Revenue centers often charge customers for the services they provide. Support centers are those departments or cost centers that are not mission centers. Health-care providers frequently refer to support centers as **nonrevenue centers**.

All support center costs must be allocated to mission centers. That way, when the costs of providing all the organization's products or services are tallied, the full costs of running the organization will be measured. Consider a highly simplified example: Assume that Meals has four cost centers. Two of these cost centers are mission centers: Soup Kitchens and Counseling. The other two are support centers: Purchasing and Administration. Further assume that the government has agreed to reimburse Meals for all costs of providing meals but not for counseling. Meals must determine which of its costs appropriately belong in each mission center. Once the total costs (direct and indirect) of running the Soup Kitchens Department are determined, Meals will know how much reimbursement it can request.

To make that determination, Meals must allocate all the costs of Purchasing and Administration to the Soup Kitchens and Counseling Departments. [Figure 4-7](#) provides a simplified image of what this allocation attempts to do. As the arrows indicate, all the costs of the support centers must be transferred to the mission centers.

[Table 4-4](#) provides a simplified numerical example. As in [Figure 4-7](#), Purchasing and Administration Departments are support centers, and the Soup Kitchens and Counseling Departments are mission centers. The Direct Cost column in the table shows the direct costs that were incurred in each of the four centers. The next two columns show the allocation base chosen and the proportion of the base related to each department.

Purchasing will be allocated on the basis of the number of POs, and Administration will be allocated based on the number of personnel. The use of POs as a base was discussed earlier. Meals considers the primary role of administration to be supervision of employees. Therefore, the number of personnel

in each department is the basis used for allocating administrative costs. Other organizations might choose a different base for allocating administrative costs.

Table 4-5 shows the percentage of all POs originating from each cost center and the percentage of all employees working in each cost center. The POs originating from the Purchasing Department and the number of people working in the Administration Department cost center are excluded because no support cost center allocates its own costs to itself. If it did, it would not achieve the goal of allocating all support center costs to the mission centers because each support center would be allocating some of its costs back to its own cost center.

Table 4-5 shows that 95% of all purchase orders originate in Administration, 1% originate in Soup Kitchens, and 4% in Counseling. It would appear in this scenario that Administration is probably handling most of the ordering of food and other supplies used in the soup kitchens. The table also shows that 2%, 92%, and 6% of the Administrative cost is to be allocated to Purchasing, Soup Kitchens, and Counseling, respectively, based on the number of personnel they employ.

Several approaches can be used to allocate the costs of the support centers to the mission centers: the **direct distribution** approach, the **step-down method**, and a group of more-sophisticated **multiple distribution** techniques.

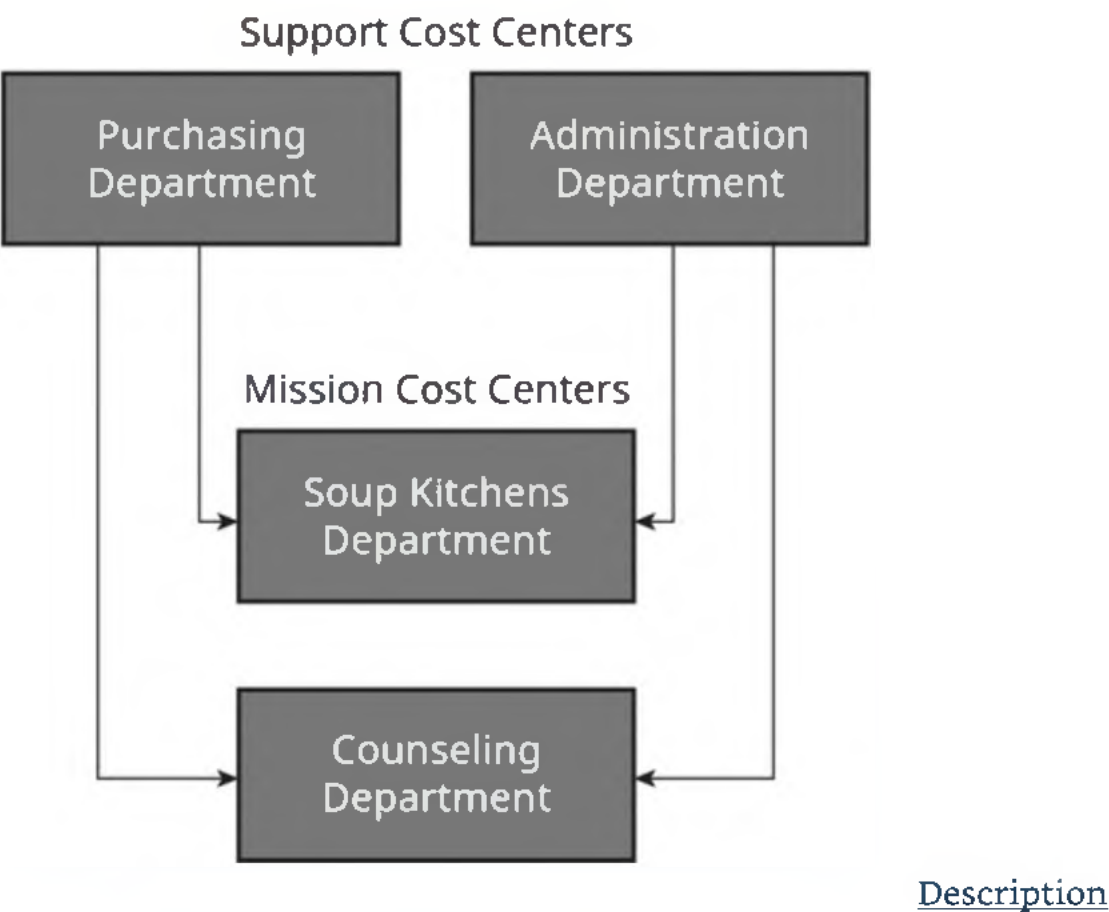


Figure 4-7 Direct Distribution Allocation of Support Centers

	Allocation Statistics		
Cost Centers	Direct Cost (\$)	Purchasing: Purchase Orders (%)	Administration: Personnel (%)
Support			

Purchasing	25,000	—	2
Administra- tion	280,000	95	—
Mission			
Soup Kitchens	500,000	1	92
Counseling	<u>50,000</u>	<u>4</u>	<u>6</u>
Total Cost	<u>855,000</u>	<u>100</u>	<u>100</u>



Cost Centers	Direct Cost (\$)	Purchasing	Subtotal	Administration	Total
Support					
Purchasing	25,000	(25,000)	0		
Administra- tion	280,000	23,750	303,750	(303,750)	0
Mission					
Soup Kitchens	500,000	250	500,250	285,153	785,403
Counseling	<u>50,000</u>	<u>1,000</u>	<u>51,000</u>	<u>18,597</u>	<u>69,597</u>
Total Cost	<u>855,000</u>	<u>0</u>	<u>855,000</u>	<u>0</u>	<u>855,000</u>



Purchasing column: \$5,000 = \$25,000 × [1/(1 + 4)]; \$20,000 = \$25,000 × [4/(1 + 4)]

Administration column: \$262,857 = \$280,000 × [92/(92 + 6)]; \$17,143 = \$280,000 × [6/(92 + 6)]

Direct Distribution

[Table 4-6](#) shows an allocation of the direct costs to the mission centers. The allocation in this table is called a direct distribution. In the direct distribution method, support center costs are allocated only to mission centers because that is where all the costs must ultimately wind up. However, a problem arises in trying to make the allocation. [Table 4-5](#) shows 95% of all POs being done for Administration, which is a support center. That leaves only 5% of POs done directly for mission centers (1% of POs for the Soup Kitchens + 4% for Counseling). If only 5% of Purchasing costs are allocated, most of the costs of that cost center will not wind up in the mission centers.

This problem is resolved by allocating to the mission centers based on the relative proportion of POs processed for each mission center. Because 5% of the POs are in all the mission centers combined (1% Soup Kitchens + 4% Counseling), the 1% in the Soup Kitchens divided by the 5% total for the mission centers gives the proportion of the Purchasing cost allocated to the Soup Kitchens. Similarly, the 4% in Counseling divided by 5% gives the portion of the Purchasing cost allocated to Counseling; 1% divided by 5% ($1/5$ or 20%) is multiplied by the \$25,000 direct Purchasing Department cost. This results in \$5,000 of cost being allocated to Soup Kitchens. Four percent divided by 5% ($4/5$ or 80%) is multiplied by the \$25,000 direct Purchasing Department cost. This results in \$20,000 being allocated to Counseling. Note in [Table 4-6](#) that the Purchasing cost is reduced by \$25,000 on the Purchasing line and the allocation increases by \$5,000 and \$20,000 on the mission center lines in the Purchasing column.

Administration costs are allocated to mission centers in a similar fashion. Also notice that when the allocation is done, there is no cost remaining in the Purchasing or Administration cost center lines (see the Total column), and the total cost in the Soup Kitchens and Counseling cost centers (\$767,857 and \$87,143, respectively) equals the \$855,000 that was the original direct cost for all four cost centers. In other words, after the cost allocation has been completed, we would say that the full costs of operating the Soup Kitchens Department is \$767,857, and the full cost of operating the Counseling Department is \$87,143. These full costs include an allocation of overhead.

The direct distribution approach fails to take into account that some support cost centers provide service to other support centers. Purchasing has primarily processed POs requested by Administration. If all Purchasing costs are allocated directly to mission centers, none would be allocated to Administration, and a distortion in costs might occur.

For example, note that Purchasing is primarily processing POs for Administration (95% of POs, from [Table 4-5](#)). Suppose that most of the purchases by Administration are for food used by the Soup Kitchens Department. It would be logical for most of the Purchasing cost to be allocated to Administration and then most of Administration cost be allocated to the Soup Kitchens. However, because direct distribution does not allocate costs from some support centers to other support centers, Purchasing did not allocate to Administration, and only \$5,000 of the Purchasing cost was allocated to the Soup Kitchens. The bulk of the Purchasing costs, \$20,000, was allocated to Counseling, which used only 4% of Purchasing's services. This is not a reasonable result. The potential distortions of direct distribution are so great that the method is not generally used.

The Step-Down Method

Instead of direct distribution, a cost allocation approach called the step-down method is commonly used. This approach is shown in [Figure 4-8](#). The step-down method requires the organization to allocate all the cost of a support cost center to all other cost centers (both mission and support). First, one support center's costs are allocated to every other cost center. Then, another support center is allo-

cated. As each center is allocated, its cost balance becomes zero, and it is no longer part of the process. In other words, no costs can be allocated to a support center once it has allocated its costs.

Note in [Figure 4-8](#) that Purchasing would allocate costs to Administration, Soup Kitchens, and Counseling in the first step of the allocation (solid lines). In the second step, Administration allocates costs to Soup Kitchens and Counseling only (dashed lines). Therefore, some amount of distortion still remains in the allocation process because Administration does not allocate any of its costs to Purchasing even though Purchasing probably uses some services provided by Administration. If Administration and Purchasing provide services to the mission centers in different proportions, this creates a somewhat inaccurate allocation of costs.

[Table 4-7](#) provides the results of the allocation using the step-down method. First, the \$25,000 of purchasing costs are removed from Purchasing and placed in the other cost centers using the allocation statistics from [Table 4-5](#) that is, 95% of the \$25,000 goes into Administration, 1% into Soup Kitchens, and 4% into Counseling (all in the Purchasing column). The total in the Purchasing column is now zero because all the Purchasing costs have been allocated to the other three cost centers.

Next, a Subtotal column is added, showing the remaining cost in each cost center. Note that the Administration costs in this Subtotal column are higher than when they started because they include both the \$280,000 direct costs of Administration and \$23,750 of the Purchasing costs. This makes sense because Administration requested most of the POs. The total of the Subtotal column is the full \$855,000 of cost that was incurred originally as direct costs in the four cost centers combined.

The next step in the step-down is to allocate the \$303,750 of Administration costs to the remaining cost centers. None of the cost will be allocated to Purchasing because that support center has already allocated its costs. The \$303,750 must therefore be allocated in a manner similar to that used in the direct distribution method. From [Table 4-5](#), 92% of all Administration costs should be assigned to the Soup Kitchens and 6% to the Counseling cost center. A proportion is used, with 92 out of a total of 98 going to Soup Kitchens ($\$303,750 \times 92/98 = \$285,153$) and 6 out of a total of 98 going to Counseling ($\$303,750 \times 6/98 = \$18,597$). After this allocation, the total in the Administration column is zero. No costs are left in that cost center.

By adding the Subtotal column together with the values in the Administration column, the total costs for each cost center can be determined. The total costs in the Soup Kitchens and Counseling rows (\$785,403 and \$69,597, respectively) equal the full \$855,000 that Meals has spent. Notice that the result differs substantially from the direct distribution results in [Table 4-6](#). For example, the Soup Kitchens cost found in the step-down allocation is \$785,403, whereas [Table 4-6](#) showed it as \$767,857. If Meals is being reimbursed the cost of Soup Kitchens and is not being reimbursed the cost of Counseling, the total reimbursement to be received will be approximately \$17,500 higher under the more-accurate step-down cost allocation.

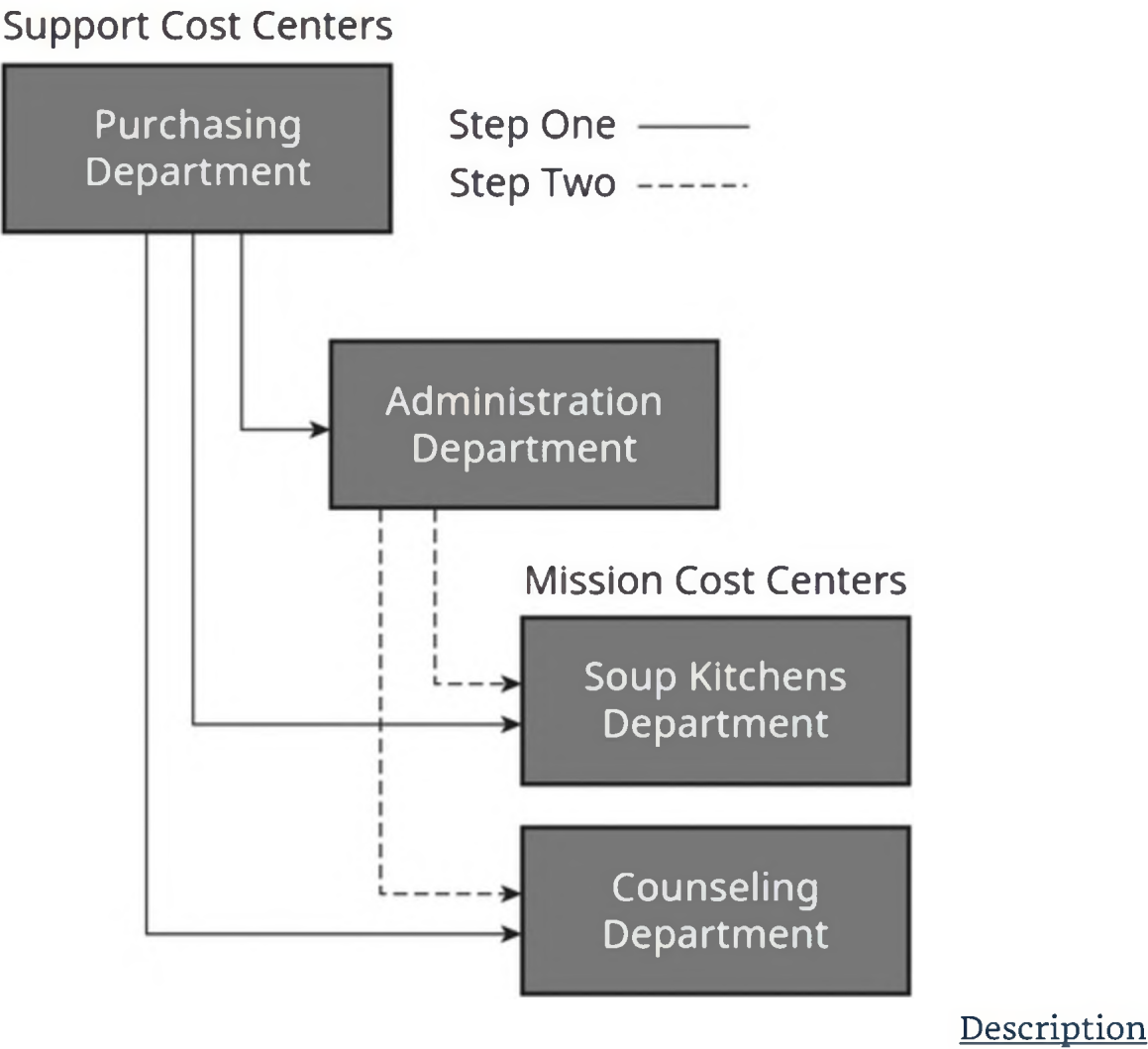


Figure 4-8 Step-down Allocation of Support Centers

The use of step-down does create another problem: Should Purchasing Department costs be allocated before or after Administration Department costs? The order of the allocation may affect the ultimate outcome. [Table 4-8](#) changes the order of allocation. Administration is allocated in that table before Purchasing.

The results from [Table 4-8](#) differ substantially from [Table 4-7](#). For example, in [Table 4-8](#) the costs of the Counseling Department are \$91,280; they were only \$69,597 in [Table 4-7](#). Suppose that Meals did not have an arrangement to get the costs of meals reimbursed but did have an arrangement to get reimbursement from a foundation for all costs related to providing counseling services. It would be in Meals's interest to use the allocation in [Table 4-8](#) rather than the allocation in [Table 4-7](#) because the Counseling Department costs are calculated as being more than \$20,000 higher. Therefore, Meals would receive a much higher reimbursement from the foundation if it used the step-down order shown in [Table 4-8](#) rather than the order shown in [Table 4-7](#).

However, [Table 4-7](#) gives a more-accurate result. Recall that most of the POs were processed for Administration and that Administration's efforts go largely to the Soup Kitchens cost center. [Table 4-7](#) shows that \$23,750 of the Purchasing costs are allocated to Administration in the first step. Those costs later are allocated primarily to Soup Kitchens in the second step. However, in [Table 4-8](#) only \$6,120 is being allocated from Purchasing to Soup Kitchens. The resulting Soup Kitchens total cost of \$763,720 is not as accurate as the cost measured in [Table 4-7](#).

Cost Centers	Direct Cost (\$)	Purchasing	Subtotal	Administration	Total
Support					



Purchasing	25,000	(25,000)	0		
Administra- tion	280,000	23,750	303,750	(303,750)	0
Mission					
Soup Kitchens	500,000	250	500,250	285,153	785,403
Counseling	<u>50,000</u>	<u>1000</u>	<u>51,000</u>	<u>18,597</u>	<u>69,597</u>
Total Cost	<u>855,000</u>	<u>0</u>	<u>855,000</u>	<u>0</u>	<u>855,000</u>



Cost Centers	Direct Cost (\$)	Purchasing	Subtotal	Administration	Total
Support					
Administra- tion	280,000	(280,000)	0		
Purchasing	25,000	5,600	30,600	(30,600)	\$0
Mission					
Soup Kitchens	500,000	257,600	757,600	6,120	763,720
Counseling	<u>50,000</u>	<u>16,800</u>	<u>66,800</u>	<u>24,480</u>	<u>91,280</u>
Total Cost	<u>855,000</u>	<u>0</u>	<u>855,000</u>	<u>0</u>	<u>855,000</u>



Multiple Distribution Techniques

Other allocation approaches, referred to as multiple distribution techniques, eliminate most or all of the cost distortion. Most common are the double distribution and the algebraic approaches. The latter

is sometimes referred to as the reciprocal or matrix distribution approach. These rely on each support center distributing its costs to all centers, including both mission and support centers. These approaches greatly reduce not only distortion but also the ability to manipulate the resulting costs.

If every support center distributes costs to every other cost center, at the end of the allocation there will still be some costs remaining in the support centers. For example, suppose that Purchasing allocated its costs to Administration, Soup Kitchens, and Counseling. At that point there is no cost in the Purchasing Department. Then Administration allocates its costs to Purchasing, Soup Kitchens, and Counseling. Now all support centers have allocated their costs, but Purchasing now has some costs that were allocated to it from Administration. This process did not achieve the goal of getting all support center costs into mission centers. Therefore, at least one more distribution must take place. The distribution process must be repeated until no costs remain in the support centers—hence the name multiple distribution. The double distribution method distributes all support center costs to all other cost centers in the first allocation. It then uses the step-down approach for its second and final allocation of costs. There is less distortion, but using the step-down method in the second pass still leaves some distortion and some room for manipulation of the results.

The algebraic or reciprocal approach is based on solving a set of simultaneous equations. This generates the same result as an infinite number of distributions. Under this method, the percentage relationships are set up as equations. The equations can be solved simultaneously using matrix algebra and inverting the matrix of the equations. Although the allocation that results from this method is more accurate, it is more complicated to understand and implement. Step-down allocation is generally considered to be sufficient despite its inherent limitations.

Allocating Costs to Units of Service

Up to this point the discussion has focused on allocating all costs of the organization into the cost centers that are mission centers. The next part of the cost measurement process is to assign each mission center's costs to the units of service that it provides. For example, Meals could take the total costs of the Soup Kitchens Department and divide it by the number of meals served to find the cost per meal. Counseling could take its total costs and divide them by the number of persons counseled to find the cost per person.

Activity-based Costing and Activity-based Management

Activity-based costing (ABC) is a process-based approach for allocating indirect or overhead costs to determine the cost of products or services. It attempts to model the production process in an effort to measure costs more accurately. ABC attempts to determine the underlying activities that cause an organization to incur costs and then to assign costs based on the amount of each activity undertaken rather than using an arbitrary allocation base. Activity-based management refers to using ABC information when making decisions.

To measure the costs of a product or service, an organization must know the direct and indirect costs of providing that product or service. Direct costs are generally considered to be easy to assign. For example, if the organization consumes identifiable supplies to produce a specific product or service, it would directly assign the cost of those supplies to that product or service. Managers try to trace or track the costs of the organization to the output it is producing.

For example, suppose that the Millbridge School System is interested in knowing the distinct costs of elementary, middle, and high school education. A third-grade classroom teacher is clearly a direct cost of the elementary school. So are the textbooks used by students in that teacher's class. In the school

system's accounting records, someone would track those costs directly to the category of elementary school education.

By contrast, indirect costs are generally not product or service specific and cannot easily be directly assigned to products or services. A school system superintendent is an indirect cost of elementary school education. What part of the superintendent is devoted to elementary versus middle versus high school education? That is a difficult question to answer. Without an ABC system, indirect costs are allocated based on some general measure such as units or labor hours. For example, one might find the total number of students in the Millbridge School System at all levels and allocate the superintendent to the school levels based on the number of students in each level. If 30% of the students are in the elementary school, then 30% of the superintendent's salary would be assigned to the elementary school.

Whether a cost is direct or indirect often depends on the unit of analysis and the cost objective. Consider all government costs, and assume that school costs are part of overall government costs. Even though the superintendent is an indirect cost of elementary school education, they are a direct cost of the school system as a whole.

Consider another example. The HOS has a housekeeping staff to empty wastebaskets, wash floors, and so on. Is the cost of a housekeeper a direct or an indirect cost? From the perspective of the Housekeeping Department, a housekeeping staff member is a direct cost of providing housekeeping services, as the third-grade teacher is a direct cost of elementary school education. In contrast, if a manager is trying to find the cost of providing patient care, housekeeping staff costs are indirect. The housekeeping cost might be allocated to each patient-care department based on the number of square feet that the department occupies. If there are 100,000 square feet in total and the Radiology Department occupied 10,000 square feet, then it would be allocated 10% of the cost of housekeeping ($10,000/100,000 = 0.10$, or 10%). In turn, if the Radiology Department performed 1,000 X-rays, a patient receiving ten X-rays would be assigned a cost that would include 1% of the housekeeping costs that had been charged to radiology ($10 \text{ X-rays}/1,000 \text{ X-rays} = 0.01$, or 1%).

In recent years it has become apparent that the traditional approach used to allocate indirect costs may cause distortions in determining the cost of specific products or services. Suppose that the superintendent spends 90% of their time dealing with problems related to the high school. The simplistic allocation based on the number of students may not generate useful information. The ABC approach aims at improving the overhead allocation process so that product and service costs are measured more accurately.

The problem with the traditional approaches to cost allocation is that many indirect costs do not vary in direct proportion with the allocation base used. For example, as noted earlier square feet would be a poor allocation base for Purchasing Department costs. The number of POs would be a better base. ABC takes this one step farther. ABC questions whether the costs of the Purchasing Department vary based on the number of POs. Perhaps the costs of the Purchasing cost center vary as the result of some specific types of activities carried out by that cost center. The things that cause us to undertake those activities are referred to as **cost drivers**.

From the ABC perspective, the production of goods and services requires a set of activities. If we focus on the activities, we can seek to minimize the cost of, and even completely eliminate, activities that do not enhance the final product or service.

Consider an example. Suppose that a Purchasing Department spends \$25,000 to process 5,000 POs. The simple way to allocate the cost of the Purchasing Department to other areas of the organization is to divide the \$25,000 cost by the 5,000 POs volume and assign the resulting overhead rate of \$5 for each PO. For example, suppose that Millbridge's Purchasing Department issued 200 POs to acquire

supplies and equipment for the Public Works Department. Public Works would receive an overhead allocation of \$1,000 as follows:

$$200 \text{ POs} \times \$5 \text{ per PO} = \$1,000$$

However, ABC argues that it is not simply the volume of POs that accounts for the costs of running the Purchasing Department but rather the activities involved in issuing POs. Perhaps routine orders require a certain simple process of taking the purchase request, filling out a form, and mailing it. We can refer to that process as Activity A. Rush orders require Activity A, but they are also disruptive because the Purchasing Department has to drop everything to process them. After processing the rush order, purchasing clerks lose time as they find the place where they were when the rush order arrived and resume normal processing. We can call the activities related to dropping everything and then picking up where you left off Activity B. So a rush order requires one unit of Activity A and one unit of Activity B.

Rush orders also require that items be shipped by an overnight express service. In the pre-ABC approach, these express costs might be lumped in with all other costs and in this example would be included in the \$5 per PO for all POs. However, the amount paid for express shipping can be treated as a direct cost and charged directly to each order that is shipped overnight in the exact amount that it cost for that order to be shipped.

Orders over a certain dollar amount might require competitive bids. Soliciting and processing competitive bids is extremely time-consuming and costly. Those activities can be referred to as Activity C. All orders over the dollar limit for competitive bids would require one unit of Activity A and one unit of Activity C.

ABC would advocate undertaking a special study to determine the costs related to each activity. Suppose we found that Activity A consumes resources that cost \$2. Assume that 4,000 POs are routine. The study found that Activity B imposes \$1 of cost each time it occurs. Assume that 800 POs require Activity B. The study finds that Activity C, soliciting competitive bids, costs \$56 because of the extensive process involved in getting competitive bids. Assume this occurs 200 times. In addition, the study might find that \$3,000 of freight costs are incurred specifically for overnight shipment of rush orders, charged to Millbridge at the rate of \$8 per pound. Purchasing cost center costs would then consist of the following (see [Table 4-9](#)):

Activity A	5,000	×	\$2.00	=	\$10,000
Activity B	800	×	1.00	=	800
Activity C	200	×	56.00	=	11,200
Express Shipping					<u>3,000</u>
Total					<u>\$25,000</u>

Recall that without an ABC system the Purchasing Department would allocate \$5 per PO. Public Works would be charged \$1,000 for their 200 POs. Under ABC, however, we would examine the activities generated by Public Works a bit more closely. Suppose that the POs generated as a result of Public Works Department activity consisted of a hundred routine orders, sixty rush orders, and forty orders that had to go out for competitive bidding. The Public Works rush orders had a total weight of 100 pounds. Under ABC, Public Works would be assigned \$3,500 of purchasing cost as follows (see [Table 4-10](#)):

Purchasing Department Costs Allocated to the Public Works Department						
Activity	Cost Driver	Cost Driver Volume		Cost per Unit of Activity (\$)		Public Works Purchasing Cost (\$)
A	All orders	200	×	2.00	=	400
B	Rush orders	60	×	1.00	=	60
C	Competitive bids	40	×	56.00	=	2,240
	Weight	100	×	8.00	=	<u>800</u>
Total						<u>3,500</u>



Each of the 200 POs generated for Public Works requires the normal processing that makes up Activity A. Additionally there are sixty rush orders, so we must include the extra Activity B cost related to a rush purchase. Furthermore, forty of the orders require the extra Activity C for orders requiring a competitive bid. Finally, Public Works is being charged for the cost of express shipment on their rush orders at a rate of \$8 per pound.

The resulting \$3,500 charge is much more than the \$1,000 charge under the pre-ABC system. This would indicate that Public Works orders are more likely to be rush orders or require competitive bids than the average purchase processed for all departments. This more-accurate costing creates greater equity across departments. Until now, other departments were being assigned some of the costs resulting from Public Works orders. Additionally, the \$3,500 allocation allows the Public Works manager to better understand the impact the Public Works Department has on overall spending. This is where activity-based management comes into play. Perhaps upon seeing the extra \$60 of Activity B costs and \$800 of FedEx costs, Public Works will try to reduce the number of rush orders it requests. If managers perceive that a rush order costs the same \$5 as any other order, there does not seem to be much need to plan in advance. If the same managers find out that the sixty rush orders added an extra \$860 to the costs of running the department, they might plan more carefully so that fewer rush orders are needed. In other words, ABC not only improves the accuracy of cost measurement, which is useful

for decision-making and external reporting, but it also provides information to help managers manage better.

Public Works can now assign all its costs, including the Purchasing Department allocation, to its own services to generate a more accurate measure of the cost of each of its services, such as snow removal, pothole repair, and garbage collection. In turn, activity-based management uses that improved information from the ABC measurement process to make improved decisions for the organization.

Reflections on ABC

ABC is primarily viewed as a superior method for allocating overhead or indirect costs. However, it is worth examining this view a bit closer. When a product or service is produced, direct and indirect costs are incurred. Direct costs have a cause-and-effect relationship with the product or service an organization provides. In other words, generating a product or service causes the organization to incur certain costs. If it did not offer the product, it would not incur the cost. Those are direct costs. The organization also incurs other costs that are not due to producing the specific product or service. Those are indirect costs.

Consider a simple example. When Millbridge's Public Works Department plows snow, it pays the plow driver. Assume the driver is paid on an hourly basis and would not have been paid anything if it hadn't snowed. Clearly, the driver is a cost of plowing the streets. Millbridge can assign the cost of the driver directly to snow removal on a cause-and-effect basis. Even though the Public Works Department plows snow, fills potholes, and collects garbage, managers do not have to use a cost allocation methodology to determine the portion of the driver that related to snow removal. It is a direct cost.

In contrast, the mayor's salary is an indirect cost of snow removal. The salary of the mayor does not change in any way if it snows. If Millbridge wanted to allocate the mayor's salary to the functions of the city, it could allocate some of it to plowing the streets. However, the allocation of the mayor's salary is not the key focus of ABC because it is a true indirect cost. The mayor works for the general good of the town, and there may be no way to identify activities that will allow Millbridge to assign the mayor's time in any but an arbitrary manner to Public Works or other departments because there is no discernible cause-and-effect relationship.

The key focus of ABC should be less on true indirect costs and more on direct costs that are treated as if they were indirect. Many organizations, in their attempt to become more efficient, have streamlined their accounting systems. Rather than measuring every direct cost as a direct cost, they take shortcuts that wind up treating direct costs as if they were indirect costs.

For example, suppose that City Hall orders ten boxes of paper clips for \$2. The cost is 20 cents per box. The paper clips are then consumed by the mayor's office, the tax assessor's office, the city engineer's office, and so on. Does it make sense to try to measure exactly how many paper clips were used by each office? No. That measurement would cost a lot more than the paper clips. Often, we allow costs that are directly associated with a department or product or service to be allocated *as if* they were indirect costs. A pro rata share of the paper clip cost can be assigned to each department without examining how many clips were used by each department. Will this accurately assign the costs to the departments that use them? Probably not. Probably some departments use more paper clips, and others use fewer. But what if we counted every single paper clip used by each department and assigned the cost directly based on the exact number of paper clips used? It would cost a lot to do that and would probably improve accuracy by only a little bit.

However, it is not always best to treat a direct cost as indirect. The salt that Millbridge spreads on the streets to melt snow and ice is a direct cost of the Public Works Department. It is also a direct cost of

clearing the streets of snow and ice. But it has nothing to do with garbage collection. Many government, not-for-profit, and health-care organizations extend the paper clip philosophy to a variety of direct costs. It is a slippery slope. Once one justifies treating a low-cost direct item such as paper clips as if they were an indirect cost, the next step is to treat more-costly direct costs as if they were overhead items.

Why would anyone do this? Because it is easier. Millbridge's Public Works Department may not bother tracking any of its supplies to any of their services. It uses salt to melt snow and ice. It uses blacktop to fill potholes. It uses trash bags in city garbage cans. All these supplies may be lumped together as if they were paper clips. Rather than trying to track the salt to the function of clearing the streets of snow and ice, it is easier to simply allocate the cost of Public Works supplies on some arbitrary basis—for example, one-third to snow, one-third to potholes, and one-third to garbage removal.

Is this any worse than paper clip allocations? It depends. How much is Public Works spending on supplies? Suppose that it spends \$5 million a year on salt, \$2 million on pothole filler, and \$500,000 on garbage bags. The total spending on supplies is therefore \$7.5 million. If those costs are treated as if they were indirect, the department would allocate \$2.5 million of cost to each area simply by dividing supply costs by three. However, the salt is a direct cost of snow removal. Snow removal should be charged \$5 million rather than \$2.5 million if we are concerned about accuracy. By contrast, the supply costs for garbage collection are allocated as \$2.5 million even though the trash bags cost only \$500,000. Treating direct costs as if they were indirect, and then allocating those costs, results in inaccurate measurement of cost. The town might decide to privatize garbage collection to save money because it thinks that it costs \$2 million more to collect garbage each year than it really does. This might well be the wrong decision. More-accurate cost information would help the organization avoid making costly errors.

The problem is created by treating direct costs as if they were indirect because it is easier to collect cost information if we treat the costs as if they were indirect. However, cost measurement will be most accurate if we assign direct costs directly on a cause-and-effect basis. But that is costly. ABC provides a middle ground. It says, "If you are not willing to assign all direct costs on a direct assignment basis, at least allocate these so-called indirect costs based on the activities that cause them to be incurred." This approach may be less costly than treating all direct costs on a direct basis. However, do not be fooled into thinking that ABC is easy. Determining the activities that drive costs, then measuring the amount of the activity, and ultimately allocating costs based on activities are steps that are both time-consuming and expensive.

The Theory of Constraints

Sometimes organizations have bottlenecks that affect the efficiency with which they produce products or services. The **theory of constraints** (TOC) has been developed to minimize the financial impact of such bottlenecks. Organizations use costly resources, and bottlenecks can result in use of more resources than are necessary.

For example, suppose that a blood bank collects blood donations by sending a crew to various locations, such as a large employer's factory. Assume that the crew includes two people who interview potential donors to ensure their suitability for donation (e.g., they are not currently sick or on medications that would disqualify them) and six people who collect blood from donors. Over the past decade the interview process has become more detailed and time-consuming to better protect our blood supply. However, assume that the ratio of one interviewer for three technicians (techs) has not changed over time. It is possible that the techs may be waiting for donors, while donors are waiting to be interviewed. In that case, there is a bottleneck at the point where donors are interviewed. Be-

cause the techs that collect the blood are being paid an hourly wage while they are waiting for donors, clearly resources are being wasted.

The TOC focuses our attention on how to best address this bottleneck issue. Three main factors are taken into account: **throughput contribution**, **investment**, and **operating costs**. Throughput contribution represents the revenues less the costs of direct materials related to output. Investment represents the costs of buildings, equipment, and materials. Operating costs are the costs other than materials (e.g., labor, rent, and utilities). The TOC attempts to increase throughput contribution while decreasing investment and operating costs. Unlike ABC, which takes a long-term perspective on cost management, TOC assumes that most operating costs are fixed, and therefore TOC is more focused on short-term solutions.

In the blood bank example, the throughput contribution depends on the amount the blood bank charges for blood and the cost of the materials used to draw and store the blood. The investment includes not only the materials to draw and store the blood but also the tables that donors lie on while blood is drawn and the mobile blood center van. The operating costs would include the salaries of both the interviewers and the techs.

TOC requires that the organization first be aware that bottlenecks can cost money. Then it must investigate to determine what bottlenecks exist. Finally, everything possible must be done to ensure that the production at the bottleneck is continuous because delays at that point are costly in other areas of production. Finally, it must implement changes to improve the efficiency or the capacity at the point of the bottleneck.

Applying TOC in the blood bank example would require a thorough review of the process of blood donation. If a line of donors is waiting to donate, but the techs are standing around without donors, it is quickly apparent that a bottleneck exists. There are many possible ways to improve results. First, there should be no idle time at the point of the bottleneck itself. If donors are waiting in line, the donors should be efficiently moved into the interview area as soon as the interviewer is free. Interviewers should not be waiting for donors if donors are available to be interviewed.

Next, we should find ways to reduce processing time at the bottleneck. For example, we might find that donors ask a lot of questions during the interview, slowing things down. An FAQ (frequently asked questions) sheet could be distributed to donors when they first get in line so that they have the answers to most questions by the time they reach the interview.

If possible, the bottleneck should be bypassed, or only the elements at the bottleneck that are essential should be processed. For example, suppose that new donors have to answer far more questions than those who have donated blood frequently in the past. As a result, an interviewer can process a new donor in ten minutes but a repeat donor in four minutes. Perhaps whenever techs are idle an express line can be formed for frequent donors. Another approach would be to cross-train one of the techs to perform interviews. When the bottleneck causes blood techs to wait for their next donor, the cross-trained tech can become a third interviewer until enough donors have been interviewed so that all technicians are operating at capacity. If all else fails, the interview crew could be expanded from two individuals to three.

What would be the ultimate benefit of these bottleneck changes? As a result of improved efficiency, the same number of donors can be processed with the entire team at the site for a shorter time. Or it may be that fewer potential donors will see a long line and decide not to donate. So there may be more donations of blood.

SUMMARY

For public service organizations, an understanding of costs is essential. The better managers understand costs, the more accurate their plans will be, and the better they will be able to control spending. A solid understanding of costs improves the manager's ability to make effective decisions.

As the reader has seen in this chapter, however, costs are complicated. One focus of this chapter is on providing the reader with a solid grasp of the definitions of widely used terms such as "direct costs," "indirect costs," "average costs," "fixed costs," "variable costs," and "marginal costs." Another focus is on understanding how costs change as volume changes. The relationship between costs and volume has a dramatic impact on the profits or losses incurred by an organization and is critical to effective decision making.

Managers who understand the relationship between costs and volume can apply the break-even analysis technique, a tool that assists in determining the required volume level for a program or service to be financially self-sufficient.

The chapter concludes with a discussion of cost measurement. To determine the costs of products or services provided by the organization, it is necessary to allocate costs. Some responsibility center costs are allocated to other centers, and the costs of a specific responsibility center are allocated to units of service or products within that center. Methods of cost allocation, including step-down allocation and activity-based costing, are discussed.

KEY TERMS FROM THIS CHAPTER

activity-based costing (ABC)

average cost

break-even analysis

contribution margin

cost allocation

cost base

cost behavior

cost center

cost drivers

cost objective

cost pool

cost reimbursement

direct costs

direct distribution

full cost

incremental analysis

indirect costs

investment

loss leaders

make-or-buy decision

margin of safety

marginal cost analysis

marginal costs

mission center

mixed costs

multiple distribution

nonrevenue centers

operating costs

out-of-pocket analysis

outsourcing

overhead rate

relevant costing

relevant range

revenue centers

step-down method

step-fixed costs

step-variable costs

support center

theory of constraints

throughput contribution

volume

QUESTIONS FOR DISCUSSION

4-1. York County, New Jersey decided in late 2020 that it would set up county COVID-19 vaccination sites in large vacant mall stores (Sears, Kmart). These sites were opened at the beginning of 2021 to provide vaccine shots to county residents. It was expected that some funding for the shots would be received from insurance companies and from the State, but aside from that the County decided to provide the shots for free to everyone to encourage vaccinations to prevent the spread of COVID-19. What costs should the county have considered?

4-2. What is a cost objective?

4-3. Distinguish among full, direct, and indirect costs.

4-4. Distinguish among average, fixed, and variable costs.

4-5. What are marginal costs?

4-6. What are several reasons that a financial manager says, "It depends," rather than directly answering a question about how much something costs?

4-7. What are some direct and indirect costs of elementary school education? Clearly specify your cost objective.

4-8. Why is the relevant range the key to the difference between variable and marginal costs?

4-9. What is an allocation base, and how is it used in setting allocation rates?

4-10. What is the focus of activity-based costing (ABC)?

4-11. What approach should be taken in evaluating make-or-buy decisions? That is, should an organization provide a service itself or outsource it to another organization?

4-12. What can a manager do if a break-even analysis indicates that a venture will lose money?

MULTIPLE CHOICE AND FILL-IN-THE-BLANK QUESTIONS

4-13. When determining costs, which of the following factors will not be taken into account?

- a. the cost objective
- b. the relevant range of time
- c. the relevant range of volume
- d. who is measuring the cost
- e. whether the person asking the question is inside or outside the organization

4-14. Relevant costs are those that change because of the action being considered or undertaken by an organization. Which of the following factors should be considered when determining which costs are relevant in a decision to expand an after-school reading program for neighborhood children?

- a. the mission of the organization
- b. the number of children that will be added to the program
- c. the impact of adding the children on the quality of the program
- d. the impact of adding the children to the existing facility
- e. all of the above

4-15. Marginal costs are not equal to variable costs when (indicate all that apply)

- a. the time frame for a decision is more than 1 year.
- b. there is a change in fixed costs.
- c. there is excess capacity.
- d. some costs are outside an organizational unit making the decision.

4-16. Consider the cost of service delivery for a public service organization. Match the correct term with its definition below.

- a. average cost
- b. full cost
- c. marginal cost

1. The direct cost and the indirect cost of service delivery equals its _____.
2. The total cost of service delivery divided by the total units of service delivered equals its _____.
3. The cost of the last unit of service delivered equals its _____.

4-17. Select the best available answer to fill the blank.

1. We Give Gifts Foundation's accounting manager prepares reports about the foundation's grant making, investments, and general administrative activities. The cost of their salary and fringe benefits would be included as part of the _____ of its investment management activity.
 - a. direct cost
 - b. indirect cost
 - c. variable cost

2. We Give Gifts Foundation pays Beta Capital Management a fee for managing a portion of its \$83 million investment in stocks and bonds. The cost of this fee would be included as part of the _____ of its investment management activity.

- a. direct cost
- b. indirect cost
- c. variable cost

4-18. Select the best choice from the following to answer Questions 1 and 2.

1. An increase in service volume will have the following effects:

- a. Increase unit variable cost and decrease unit fixed cost.
- b. Unit variable cost remains constant and unit fixed cost remains constant.
- c. Decrease unit variable cost and unit fixed cost remains constant.
- d. Unit variable cost remains constant and unit fixed costs decrease.

2. Which one of the following is a name for the range of service volume over which an organization expects to operate?

- a. mixed range
- b. fixed range
- c. variable range
- d. relevant range

4-19. To break even, an organization's _____ must equal its _____.

- a. total revenues, fixed costs
- b. total revenues, variable costs
- c. total revenues, total costs
- d. total revenues, total support

4-20. Answer the following questions about break-even analysis.

1. Break-even is defined as the point at which _____ equals _____.

2. The contribution margin is equal to _____ minus _____.

3. The Local Town Concert Band has fixed costs of \$500 per concert and variable costs of \$2.00 per person who attends the concert. If they raise their ticket price from \$2.25 to \$2.50, their break-even level

- a. increases.

- b. decreases.
 - c. stays the same.
4. The marginal contribution or contribution margin is the difference between _____ and _____.
5. The Committee for Fair Elections expects to have \$5,000 in fixed costs. If its fixed costs do not change in non-presidential election years, but the amount of money each marcher raises through pledges (price/unit) declines from \$75 to \$60 and the variable cost/unit increases from \$40 to \$50, the break-even quantity will
- a. increase.
 - b. decrease.
 - c. stay the same.
6. If all other factors remain unchanged, an increase in the variable cost per unit of service will
- a. reduce the break-even volume of service.
 - b. reduce the contribution margin per unit of service.
 - c. increase total fixed costs.
7. The difference between marginal revenue and marginal cost is called the _____.
8. If an organization sells ten fewer tickets to its annual gala than are needed to break even, the gala will produce
- a. a loss or deficit.
 - b. break-even results.
 - c. a profit or surplus.
- 4-21. Answer the following questions about costs.
1. Whether a cost is considered to be a direct or indirect cost depends on (select the best choice)
- a. the cost objective.
 - b. who is doing the analysis.
 - c. the time frame for the analysis.
 - d. whether costs are inside or outside an organizational unit.
 - e. the expected range of volume.
2. If you are trying to determine the cost of the third-grade classes in an elementary school, the principal's salary is
- a. direct and fixed.

- b. indirect and fixed.
- c. direct and variable.
- d. indirect and variable.

4-22. Answer the following questions about break-even analysis.

1. Break-even analysis for multiple products requires a _____ approach.
2. The contribution margin must be a positive number for the organization to have any chance of having a _____.
3. The NYU Concert Band has fixed costs of \$200 per concert and variable costs of \$1.00 per person who attends the concert. If they raise their ticket price from \$1.25 to \$1.50, their break-even level
 - a. increases.
 - b. decreases.
 - c. stays the same.

4-23. Doctors Without Borders (DWB) operates health programs around the world. It has a central staff of 100 people who administer its worldwide programs. DWB's central operation buys and distributes all the supplies used in its various country operations. DWB's country director for Afghanistan and the staff run twenty clinics around the country. At the clinic level, doctors and nurses hired under two-year fixed contracts administer medical treatment free of charge to the local population using supplies shipped to them by DWB's central staff.

1. From the perspective of the program director for Afghanistan, which of the program's expenses are
 - a. direct,
 - b. indirect,
 - c. fixed, and
 - d. variable?
2. Which of the direct expenses for Afghanistan would be classified as indirect from the perspective of a clinic director?

4-24. Mike Shiau is the finance director for faculty research at Big and Prestigious University (BPU). The research division has an administrative staff that is responsible for managing the administrative aspects of all BPU's research grants. Faculty research is carried out in a dedicated research building that is divided into twenty specialized laboratories. Grants are expected to pay for a share of the building expenses as well as the cost of the portion of the laboratory they use. When a grant is awarded, a faculty researcher is paid to manage the project, and they hire graduate assistants to work on the grant. Faculty researchers and research assistants are paid fixed amounts for their work on a grant. In general, carrying out the research funded by a grant also requires the use of supplies.

If Mike is measuring the costs associated with one specific grant, which of the grant expenses would be considered

- a. direct,
- b. indirect,
- c. fixed, and
- d. variable?

4-25. If the contribution margin for Independent Lab (IL) stays constant and its fixed costs increase from \$8,000 to \$12,000, then IL's break-even quantity

- a. increases.
- b. decreases.
- c. stays the same.

PROBLEMS

4-26. Review Father Purtell's Special Purpose Budget in [Chapter 2](#). Determine which costs are fixed and which are variable. Assume that a \$10,000 subsidy is available from the two parishes. How many teens are needed for the trip to break even? What is the contribution margin per teen above that break-even point? What complicating issues exist?

4-27. Camp Hole-in-the-Wall provides children who have chronic medical conditions with one-week summer vacations. The camp owns a 500-acre facility in the Berkshire mountains, where it brings the kids. The annual depreciation expense for the camp is \$100,000. The camp hires one counselor for every ten campers. It also employs a full-time doctor, a nurse, two cooks, and a camp director. It costs \$75 per week to feed each camper and an additional \$30 round-trip to transport them to and from the camp. Which of the camp's expenses are

- a. fixed,
- b. step-fixed or semi-variable costs,
- c. variable, and
- d. not included in the camp's cash budget.

4-28. Answer the following questions about the break-even analysis.

1. New City Day-care Center (NCDC) operates from Monday to Friday. It has fixed expenses of \$5,000 per week and charges each child who attends the program \$15 per day. It costs NCDC \$5 per day for supplies and snacks for each child. How many children must come to NCDC each day for it to break even?
2. If NCDC gets a contribution of \$1,000 per week, its break-even point (choose the correct answer)

- a. increases.
- b. decreases.
- c. stays the same.

4-29. Youth for America had annual total costs of \$800,000 at a volume of 2,000 volunteers. The fixed costs for the year were \$400,000.

1. What are the total variable costs for the year?
2. What would the total costs be if the volume increased by 10%?

4-30. The Center for Shaker Crafts (CSC) is thinking about bringing a new exhibit to CSC. It will cost CSC \$30,000 to bring the exhibit to town, an additional \$12,000 for lighting and security equipment, and \$5,500 for an insurance policy. The manager of CSC thinks they can charge \$12 per person to see the exhibit; they estimate that 350 people per day will come to see the exhibit. If the total costs for additional security guards, power, and added custodial services are \$1,500 per day, how many days will the exhibit need to be at CSC to cover the costs?

4-31. Millbridge Memorial Hospital (MMH) provides comprehensive physical exams. The charge per exam is \$100, whereas the variable cost per exam is \$65. Thirty percent of the patients who come in for exams are private pay. They must pay the full charge. Seventy percent of the patients are covered by an insurance company that has an agreement with MMH that reduces the charge by 20%. MMH has \$210,000 in fixed costs per year. How many exams must MMH provide to break even?

4-32. The fixed costs of running a fundraising dinner for Meals for the Homeless (Meals) are \$10,000 and the variable costs are \$75 per attendee. The facility where the event is being held can accommodate 500 people. Answer the following questions about the event.

1. If Meals charged \$275 per ticket, how many people would have to attend the gala for the organization to break even on the event?
2. If Meals charged \$300 per ticket, what would be the contribution margin from each ticket sold?
3. If 500 people attend the event, how much does the organization have to charge each attendee to earn a profit of \$100,000? (Assume costs from original problem are still in effect.)

4-33. A Greener World expects to have \$15,000 in fixed costs. If its fixed costs do not change but the amount each marcher raises through pledges declines from \$55 to \$50 and its variable cost per unit increases from \$25 to \$30, how much will its break-even quantity increase?

4-34. The Helensville Symphony (HS) incurs \$3 million of fixed costs each year. The variable cost for each person attending one of the orchestra's performances is \$24. If the average charge for a ticket to attend a performance of the HS is \$100, how many tickets must it sell each year to break even?

4-35. Millbridge Family Services (MFS) currently operates a foster care program that is fully funded by the state. Changing government priorities are expected to result in a 20% reduction in its state foster care funding for the upcoming fiscal year. MFS's management is considering eliminating the foster care program in the next fiscal year in light of these anticipated funding cuts.

The total foster care program expenses for the upcoming fiscal year are \$120,000. The foster care program's budgeted expenses include \$25,000 of salaries and occupancy costs that are allocated to its program budget from MFS's central administration. These allocated expenses of \$25,000 are unavoidable even if the foster care program is eliminated. What is the total relevant cost that should be considered in making this decision?

4-36. Hudson University (HU) has received a proposal from Speak and Tell (S&T), a New York public relations firm. Under the terms of the proposal, S&T has offered to meet all HU's external media relations needs at a fixed cost of \$750,000 per year. These activities are currently performed by HU staff. The expenses associated with the media relations department during the current year were as follows:

Staff salaries: \$650,000 including a senior staff member who is paid \$80,000 and who will remain on staff to oversee HU's interests in dealings with the public relations firm. All other staff would be let go. HU incurs additional costs for health care and other benefits at a rate of 30% of staff salaries.

Fixed equipment: The computers and media equipment in the department were purchased four years ago. They cannot be used by any other department at HU and cannot be sold. Depreciation expenses from the equipment are \$20,000 per year. The net book value of the equipment is \$60,000.

Printing costs: If HU contracts out, it will no longer have to print external media documents, which cost \$150,000 this year.

1. Which of the costs listed should be included in HU's consideration of the proposal? Why should they be included?
2. Based solely on financial considerations, should HU accept the contract? Why?

4-37. Millbridge Animal Protective Services (MAPS) is planning its spring awards dinner as a fundraising event. It is planning to charge each attendee \$150. Feast Hall, the site of the dinner, will charge MAPS \$5,000 for the use of its posh VIP Room and \$50 per plate for food. The VIP Room has a capacity of 180 people. Rocky Mount and the Tar Heels (one band) will provide the entertainment for their standard performance fee of \$1,000 per night.

4-38. How many people would need to attend for MAPS to break even?

1. If MAPS sells 100 tickets for the dinner, what is the average cost to MAPS for each person with a ticket?

4-39. The Children's Museum of Millbridge (CMM) is considering catering birthday parties for members as a way to generate additional revenue. The costs associated with each party are in the following table:

Staff	\$90
Cake and Food	\$60



Decorations	\$30
In addition, party favors are \$5 per child.	

1. Find the break-even price per child, assuming that twelve children attend each party.
 2. CMM expects to make a profit of \$300 on every party. Find the price per child to break even and produce the \$300 profit on every party (again, assume that twelve children attend each party).
- 4-40. The Millbridge Fine Arts Museum (MFAM) is thinking about bringing a Van Gogh exhibit to Millbridge for thirty days. MFAM expects 2,000 people per day to visit the exhibit, each paying the \$10 entrance fee. Daily costs for security, extra power, and added custodial services will be \$1,000. What is the maximum amount that MFAM can afford to spend on fixed costs, such as organizing and bringing the exhibit to town, and still break even? Hint: Break-even quantity in this problem is measured in days.
- 4-41. Answer the following questions about break-even analysis:
1. Millbridge Day-care Center (MDCC) operates from Monday to Friday. It has fixed expenses of \$18,000 per week and charges each child who attends the program \$300 per week. It costs the MDCC \$30 per week for supplies and snacks for each child. How many children have to come to MDCC each day for it to break even?
 2. If MDCC gets a rent increase of \$1,000 per week, its break-even point (choose the correct answer)
 - a. increases.
 - b. decreases.
 - c. stays the same.
- 4-42. Kids Early Start (KES) operates from Monday to Friday. KES provides child care and educational services for inner-city kids between the ages of three months and five years. It has fixed expenses of \$35,000 per week and charges parents \$15 per day for each child who attends the program. A city contract pays the KES \$25,000 per week. It costs KES \$5 per day for supplies and snacks for each child. KES also offers an optional early reading program for children over the age of three. Parents pay an additional \$3 per day to enroll a child in the reading program. It costs KES an additional \$4 per day for each child in the program. Thirty percent of the children attending KES are enrolled in the reading program.
1. How many children have to come to KES each week for it to break even?
 2. If the percentage of children in the reading program rises from 30% to 35%, the break-even level
 - a. increases.
 - b. decreases.

c. stays the same.

4-43. The Walk for Kids (WfK) is an annual fundraising event that raises money for research on children's blood disorders. WfK costs \$120,000 to stage even if nobody shows up. To encourage people to participate, each walker is given a T-shirt that costs WfK \$8 and refreshments that cost an average of \$10 per person. This year, the organizers of the walk got a \$20,000 grant from the City Foundation to offset part of the costs associated with staging the walk. WfK raises money by asking each walker to pay \$10 to register and requires each walker to solicit sponsors who agree to pay \$0.75 (75 cents) per mile for each of the ten miles that the walker completes. In the past, all the walkers completed the ten-mile course and had an average of twenty sponsors.

1. How many walkers have to participate for the event to at least break even?
2. If the cost of refreshments per walker increases from \$10 to \$11, the break-even number of walkers will
 - a. increase.
 - b. decrease.
 - c. stay the same.

4-44. PPO of Millbridge Township (PPOMT) sells health benefit plans to local employers. PPOMT charges its clients (local employers) \$50 for each office visit provided to a covered employee. PPOMT contracts with individual physicians to provide the office visits to its health plan beneficiaries. PPOMT pays its contracted physicians a fee of \$40 for each new patient visit and \$30 for each follow-up office visit. Twenty percent of all office visits are new patient visits. PPOMT maintains an office building where all routine office visits are conducted and pays \$6,000 in occupancy expenses each month for the building. PPOMT also incurs monthly staffing costs of \$12,000 for maintenance and administrative staff at its facility.

1. How many office visits must PPOMT deliver to break even?
2. Assuming that PPOMT's facility is open twenty-one days in a typical month, how much profit will it earn if each of its five contracted physicians sees an average of twelve patients each day?

4-45. The Millbridge High School Student Association (MHSSA) is planning a fundraising event for the spring semester. The MHSSA is planning to hire the Dizzy Gillespie Heritage Band as entertainment for a fee of \$750. The Fine Arts Museum was selected as the site for the event. The museum will charge the MHSSA \$600 for the use of its banquet room. Good Eats Restaurant was selected to cater the event. Good Eats will charge the MHSSA a flat fee of \$400 and a \$20 per meal charge.

1. The MHSSA expects 250 students and alumni to attend its spring fundraising event. What is the minimum (break-even) ticket price for the event?
2. The MHSSA is considering two ticket prices: a \$25 price for students and a \$75 price for alumni. If three students are expected to attend the event for each alumnus, how many students and alumni must attend the spring fundraising event if it is to break even?

4-46. You are given the following information about We-Save-Um Animal Rescue (WSU):

Number of dogs rescued and placed by WSU—600

Average length of stay for a dog—10 days

Daily cost of feeding one dog—\$0.90

Number of veterinary visits per dog—1.2

Cost per veterinary visit—\$35

Cost of spay/neuter and transportation per dog rescued—\$45

Cost of the kennel and related equipment—\$300,000

Useful life of the kennel and related equipment—20 years

WSU uses straight-line depreciation.

Salvage value of the kennel and related equipment—\$0

WSU has three full-time employees—an executive director who earns \$40,000 per year, an evaluator/trainer who earns \$30,000 per year, and a kennel manager who earns \$25,000 per year. Fringe benefits equal 25% of each employee's annual salary.

WSU expects to place all the dogs that it takes into the program by the last day of the fiscal year. It charges an adoption fee of \$225 per dog. Experience has shown that 15% of people elect to make an additional donation to WSU at the time of adoption. Historically, these extra donations have averaged \$200. In addition, WSU has an active fundraising program and expects to raise \$40,000 in donations during the fiscal year.

The executive director wants to know how many dogs the organization needs to place next year to break even. Calculate WSU's break-even.

4-47. The Stick-em-Quick Inoculations Center (SQIC) provides early childhood checkups and vaccinations for children in the South Bronx. It pays annual rent of \$25,000 and has a permanent staff consisting of a nurse practitioner and an administrative assistant, who are paid \$125,000 in total per year. SQIC hires doctors on a per diem basis to provide exams and uses \$15 worth of supplies for each exam, not including vaccines. Inoculation appointments are scheduled in advance, and SQIC needs one per diem doctor for every 100 children it has scheduled on any given day. It also spends \$7.50 per child for the vaccines used in its inoculations program. Which of SQIC's expenses are

- a. fixed,
- b. step-fixed or semi-variable costs, and
- c. variable?

4-48. James Town Clinic (JTC) had the following fixed and variable costs:

Variable Costs (VC) per Patient		Fixed Costs per Year	
Personnel	\$ 150	Rent	\$100,000
Supplies	20	Administration	120,000
Laundry	30	Other	80,000
Other	<u>50</u>		
Total VC/Patient	<u>\$250</u>	Total Fixed	<u>\$300,000</u>



1. What are the fixed, variable, total, and average costs per patient for volumes of 100, 500, 1,500, 2,500, and 3,000?
 2. Draw a graph of the average cost per patient. Plot cost on the vertical axis and the number of patients on the horizontal axis.
 3. An outside organization, such as a health maintenance organization, offers to send JTC 500 patients per year but offers to pay only \$300 for each one. Should JTC agree to this arrangement? It currently has 2,500 patients per year and can easily handle 3,000.
- 4-49. Millbridge Township provides a variety of summer recreation alternatives. You can belong to the town pool, play tennis, or play golf. Summer passes allowing residents to use these facilities are sold each year. Twenty-five percent of the season passes that are purchased are golf passes, 35% are for tennis, and the rest are for the pool. The golf passes are \$30, the tennis passes are \$50, and the pool passes are \$70. The cost of providing these services is mostly fixed, with a \$3 variable cost per pass, regardless of type. The fixed cost of operating the summer recreation program is \$250,000. How many people must buy recreation passes for the town to break even? How many passes would be sold for the pool at that break-even volume?
- 4-50. Calabrese City allocates some indirect or overhead costs to each of its police stations. The city charges each station for common services such as the city food service and for administrative services such as payroll. For the coming year, the Washington Square Police Station (WSPS) will have a total budget allocation of \$1.4 million. That will be its only revenue. All direct and indirect charges have to be paid from that budgeted amount.
- Each police station must pay \$100,000 for processing its payroll. In addition, once arrests are made, the prisoners spend a day or two in the local police station, where the city must feed them. On average, the city food service charges each police station \$40 for meal service for each arrest.
- WSPS would like to maximize its number of arrests to reduce the number of criminals on the street. However, more arrests require not only more food but also more police officers.

The personnel employed by WSPS are supervisors, desk clerks, and police officers. The minimum staffing levels based on total budgeted arrests are as follows:

Annual Number of Arrests	Police Officers	Desk Clerks	Supervisors
0–1,000	11	6	2
1,001–2,000	12	6	2
2,001–3,000	12	7	2
3,001–4,000	13	8	3

Annual salaries for each class of employee are supervising officers, \$68,500; desk clerks, \$59,000; and police officers, \$54,000. Note that this police station cannot process more than 4,000 arrests per year.

Calculate the maximum number of arrests that WSPS can budget and still expect to break even for the coming year.

4-51. The New City Subway has 40,000 passengers every day. However, they are fairly price sensitive. If the current price of \$2 were to increase to \$2.50, it is likely that there would be only 30,000 passengers each day. In contrast, if the price were to drop to \$1.50, the ridership would increase to 50,000. The variable costs are 8 cents per passenger. The fixed costs of operating the subway are \$70,000 per day. How many passengers are needed each day to break even at the current \$2 price?

Prepare a flexible budget for the subway system at prices of \$1.50, \$2.00, and \$2.50. (Refer to [Chapter 3](#) for a discussion of flexible budgets.) Considering only the financial implications, what should be done? Why? How can you reconcile the results of the flexible budget with the results of the break-even calculation?

4-52. Millbridge Ambulance Service (MAS) has been considering consolidating its three locations into two. The location MAS is considering closing currently costs \$155,000 to operate. If the location is closed, the ambulances from that location would be moved to the other two locations. The savings from the closure would be partially offset by increased expenses at the two remaining locations. MAS will lose \$40,000 of state subsidy if it closes the location. MAS wants to close the location only if the closure results in an overall financial improvement. The current costs of the location are as follows:

Salaries of Staff	\$80,000
Rent	20,000

Repairs and Maintenance	10,000
General and Administrative	20,000
Supplies	<u>25,000</u>
Total	<u>\$155,000</u>



The general and administrative expenses of \$20,000 are an allocation of costs from the central office. The costs of the central office are not affected by the existence of the specific locations. If the location is closed, the staff will be transferred to the other two locations, and the lease will be canceled, so there will be no rent or repairs and maintenance. Although it will not purchase supplies for this location, the supply cost of the other two locations will rise by \$20,000. What should MAS do?

4-53. The Millbridge tax collector’s office spent \$32,000 in the first quarter of the year, during which it processed 8,000 tax bills. It took a total of 1,000 hours of clerical time to process the tax bills. What are two possible allocation bases and rates?

4-54. Mr. Robbins’s detailed medical records indicated that a total of twenty labor hours were directly used in providing his care. The cost of the labor was \$380. It was expected before the beginning of the year that a total of 90,000 direct labor hours would be consumed by the health-care organization’s patients at a cost of \$1,350,000. The total overhead to be allocated to patients was expected to be \$810,000.

Determine the overhead to be assigned to Robbins based on the data given. Solve this problem in two ways: First, assign overhead on the basis of direct labor hours, and second, assign overhead on the basis of direct labor cost. Why might your results differ?

		Allocation Statistics	
Cost Centers	Direct Cost (\$)	Purchasing: Purchase Orders (%)	Administration: Total Salaries (%)
Support			
Purchasing	80,000	—	5
Administra- tion	40,000	15	—



Mission			
Soup Kitchens	900,000	40	90
Counseling	<u>300,000</u>	<u>45</u>	<u>5</u>
Total Cost	<u>1,320,000</u>	<u>100</u>	<u>100</u>



4-55. Use the information in the previous table to allocate costs to the mission centers using the direct distribution method.

4-56. Using the information from Problem 4-53, allocate the costs using the step-down method. Compare the results with Problem 4-53. Do they differ?

4-57. Using the information from Problem 4-54, allocate the costs using the step-down method, but change the order of step-down from that used when you solved Problem 4-54. Do your results differ from those you found in Problem 4-54?

4-58. Jump Hospital currently allocates all Maintenance Department costs based on departmental square feet. However, the manager of the Pharmacy Department has suggested that an ABC approach be used for the portion of the Maintenance Department costs that relate to repairing equipment. Her contention is that the pharmacy has relatively little equipment that breaks. However, it must subsidize many high-tech departments that require expensive equipment repairs. Using the data in the following tables, calculate the maintenance cost assigned to the pharmacy using the existing method and using an ABC approach.

	Maintenance Costs		
	Routine Maintenance	Repairs	Total
Volume (Square Feet)	100,000	800	
Labor Hours	10,000	4,000	14,000
Labor Cost/Hour	\$12.00	\$18.00	\$13.71
Supplies	\$20,000	\$80,000	\$100,000
Administration			\$15,000



	Department Information		
	Pharmacy	All Other Departments	Total
Square Feet	2,000	98,000	100,000
Volume of Repairs	3	797	800
Hours of Repairs	6	3,994	4,000
Supplies Used for Repairs	\$200	\$79,800	\$80,000



4-59. Madison's House runs three programs for victims of domestic violence: 1) a shelter, 2) food assistance; and 3) a medical clinic. The organization is led by a CEO, a purchasing manager who processes orders for all the departments, and three program directors (one for each of program). Here are additional data on the departments:

	<u>Shelter</u>	<u>Food Assistance</u>	<u>Medical Clinic</u>	<u>Total</u>
Employees	4	9	3	16
Sq. Feet Occupied	7,500	2,500	500	10,500
Annual # Purchase Orders	12	52	26	90



Use this information to answer the next three questions.

1. Which of the following might be considered an indirect cost to the food assistance program?
2. If the CEO were to allocate his or her salary on a traditional cost basis to the medical clinic, by what might the salary be multiplied?
3. If the CEO were to allocate his or her salary using activity-based costing (ABC) to the shelter, by what might the salary be multiplied?

4-60. CodeLearn is a not-for-profit tech bootcamp that will offer classes in computer coding to elementary and middle school students year-round. Each class will convene for a month (i.e. there will be twelve classes a year). As executive director of this startup, you have been tasked

with ensuring CodeLearn earns a profit of \$1,000 per month so that those profits can be invested in the organization. In FY 2026, beginning January 1:

1. CodeLearn expects to earn a seed grant of \$120,000 on January 1.
2. CodeLearn will charge \$125 tuition per student for each month-long class.
3. CodeLearn will pay \$2,000 per month in rent for its building.
4. CodeLearn will take out a \$90,000 loan on January 1 to buy computers the same day. The loan will have an annual interest rate of 6%. CodeLearn will not make any principal repayments on the loan in FY 2026.
5. Each of CodeLearn's sixty computers will cost \$1,500, will have no salvage value, and will have a useful life of three years.
6. CodeLearn will use \$1,000 in electricity and water utilities each month.
7. CodeLearn's annual staff budget will be \$150,000 in salaries plus benefits valued at 35% of payroll.
8. CodeLearn expects all students to bring their own supplies. (Hint: What does this imply about variable cost?)

How many students must CodeLearn enroll per month for it to achieve its target profit?

APPENDIX 4-A: ADDITIONAL BREAK-EVEN ANALYSIS ISSUES

This appendix addresses the issue of break-even for multiple products with multiple prices, raises the issue of target profit analysis, and considers two-tier pricing models.

BREAK-EVEN WITH MULTIPLE PRODUCTS EXTENDED

In this chapter the problem of break-even analysis for multiple products was considered. An example for the Feed-a-Child Foundation was given in which there were three different programs. It was necessary to calculate a weighted average contribution margin (see [Table 4-4](#)) and use that weighted average contribution margin when solving for the break-even point. In many cases, there are not only multiple products but also different prices and/or variable costs for each product. How can that problem be addressed?

Reconsider the problem of the Feed-a-Child Foundation. Still assume that there are three programs: Africa, Asia, and South America. However, now assume that there is more than one level of donation for each program. Although the program appeals are based on feeding one child for one year for a set amount, some people may make larger or smaller donations. The method would still work in the same way. It would be possible to list each donation amount for each program as a separate item, estimate the percentage of donations in that amount, and calculate a weighted average.

For example, assume no change in the South American and Asian programs, but assume that 50% of all African program donations are in the amount of \$36, 30% in the amount of \$50, and 20% in the

amount of \$100. The contribution margin by program and donation size is shown in [Table 4-A-1](#). Note that there are five different classes of donation, shown as a, b, c, d, and e.

To use the individual contribution margins from [Table 4-A-1](#) to calculate an overall weighted average contribution margin, it is necessary to know the percentage of total contributions that each donation makes up. The African program is expected to receive 70% of all donations to the foundation. It is also known that 30% of the African donations are Type b donations for \$50. Then 21% of the donations to the foundation are to the African program in the amount of \$50 ($70\% \times 30\% = 21\%$). [Table 4-A-2](#) shows this calculation for each type of donation. The resulting percentages in the right-hand column can then be used in [Table 4-A-3](#) to calculate the weighted average contribution margin.

The weighted average contribution margin of \$18.45 ([Table 4-A-3](#)) can be used to determine the number of donations needed to break even:

$$\text{BEQ} = \text{FCCM} / \text{BEQ} = \$100,000 / \$18.45 = 5,420$$

If the revenues, expenses, and relative proportion of donations by type can be projected, it does not matter how many products, services, or programs an organization has or the number of different prices for each program or service. The weighted average approach can be used to determine the activity level needed to break even.

TARGET PROFIT ANALYSIS

At times, an organization will decide that it wants to undertake a new program or project only if it will earn some minimum amount of profit. This might be because there are losses in other parts of the organization that must be subsidized. Another reason is that organizations desire to have a safety cushion in case everything does not work out as expected. To find the volume for the activity that is required to not only break even, but also earn some minimal required profit level, the required profit is treated as a fixed cost. Equation 4-6 then becomes

	Donation (A)	Variable Cost (B)	Contribution Margin (C = A – B)
a. Africa	\$36	\$32	\$4
b. Africa	50	32	18
c. Africa	100	32	68
d. Asia	40	29	11
e. South America	50	30	20



Program	Donation Size	Program's Percentage of Foundation Donations		Portion of All Donations to This Program Based on Size		Percentage of All Donations to the Foundation
a. Africa	\$36	70%	×	50%	=	35%
b. Africa	50	70	×	30	=	21
c. Africa	100	70	×	20	=	14
d. Asia	40	25	×	100	=	25
e. South America	50	5	×	100	=	<u>5</u>
						<u>100%</u>



Program	Donation Size	(From Table 4-A-2) Percentage of Donations		(From Table 4-A-1) Contribution Margin		Weighted Average Contribution Margin
a. Africa	\$36	35%	×	\$4	=	\$1.40
b. Africa	50	21	×	18	=	3.78
c. Africa	100	14	×	68	=	9.52
d. Asia	40	25	×	11	=	2.75
e. South America	50	<u>5</u>	×	20	=	<u>1.00</u>
		<u>100%</u>				<u>\$18.45</u>



(4-A-1)

$$TPQ = FC + TPP - VC$$

where TP is the target profit and TPQ is the volume required to achieve the target profit. Target profits have the same effect as if fixed costs had increased.

TWO-TIER PRICING MODELS AND BREAK-EVEN ANALYSIS

Many not-for-profit and government organizations occasionally find themselves in a situation in which there is not one unique price for their services. Consider, for example, a charitable organization with an endowment. The income from the endowment is used to subsidize the services provided to its clients. This subsidy might take place in several ways. For example, the endowment income could be used to offset fixed costs. Alternatively, it could be used to provide a price subsidy.

Suppose that the Leetch Blood Bank normally charges \$100 per pint of blood. The variable costs of processing blood are \$80 and the fixed costs of running the organization are \$80,000. The break-even point would be as follows:

$$BEQ = FCP - VC = \$80,000 / \$100 - \$80 = 4,000 \text{ units of blood}$$

Suppose further that Leetch is expected to generate \$20,000 in endowment income. How would that affect the break-even point? That income would be fixed revenue that is independent from volume. That income could be treated as a source to offset part of the fixed costs of running the blood bank, as follows:

$$BEQ = FC - \text{Endowment Income} / P - VC = \$80,000 - \$20,000 / \$100 - \$80 = 3,000 \text{ units of blood}$$

Alternatively, the bank could decide that it will charge the regular price to those who can pay the full amount and will charge a subsidized price to those who are poor. Assuming that the bank believes it will provide 5,000 units of blood, and 40% of the units will have to be subsidized, what is the lowest subsidized price the blood bank can charge and still break even?

This can be solved in a fashion similar to break-even analysis with multiple products. The break-even formula can incorporate the endowment income as a reduction of fixed costs and then can be solved for the subsidized price. Here, 60% of the clients pay \$100 and have variable costs of \$80, for a contribution margin of \$20. The remaining 40% pay the lower, unknown price. Because there is only one unknown variable in the equation, it can be solved for S , the subsidized price, as follows:

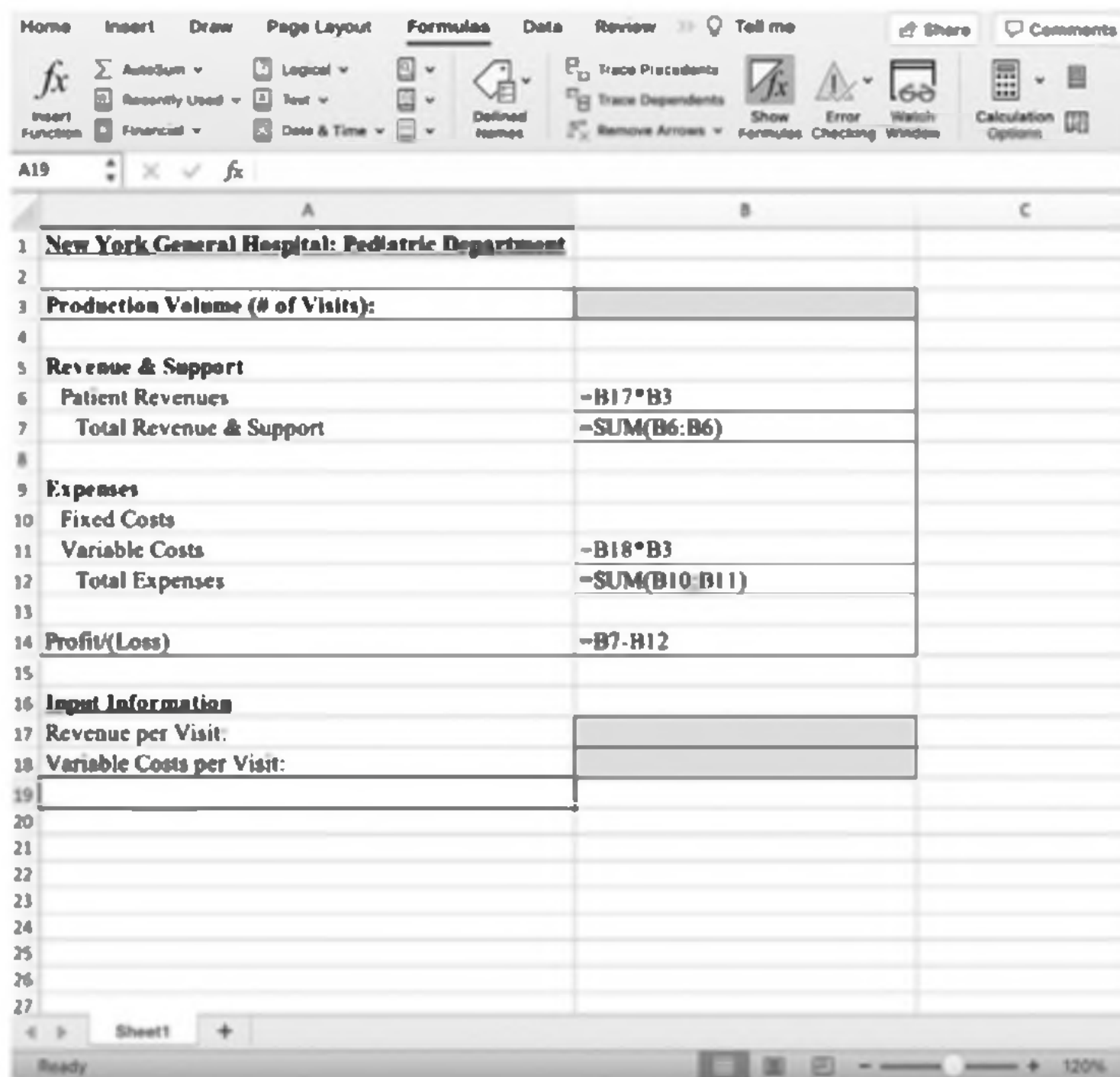
$$\begin{aligned} BEQ &= FC - \text{Endowment Income} / P - VC \\ 5,000 &= \$80,000 - \$20,000 / [(60\% \times \$100) + (40\% \times \$S)] - \$80 \\ \$805,000 &= \$60,000 [\$60 + \$.4S] - \$805,000 = \$60,000 \$.4S - \$205,000 \times (\$.4S - \$20) = \$60,000 \$2,000S - \\ \$100,000 &= \$60,000 \$2,000S = \$160,000S = \$80 \end{aligned}$$

If the blood bank charges \$80 to the 40% of the clients who are subsidized, it will still break even. Thus, break-even analysis can be helpful in determining prices that are needed in two-tier pricing systems.

APPENDIX 4-B: USING EXCEL TO SOLVE BREAK-EVEN PROBLEMS

This appendix introduces the use of spreadsheet programs to solve break-even analyses. Suppose New York General Hospital's Pediatric Department runs an outpatient clinic that has the following cost structure: total fixed costs are \$500,000, variable costs are \$15 per patient visit, and revenue per patient visit is \$75. The department wants to determine how many visits it must provide to breakeven.

The first step to using Excel is to set up the problem and spreadsheet as shown in [Figure 4-B-1](#).



Description

Figure 4.B-1

The key to this setup is to recognize which revenues and expenses are fixed and which are variable. Those that are variable, such as patient revenues under “Revenue & Support” and variable costs under “Expenses,” should be set up so that the variable cost or revenue is multiplied by the production volume. Thus, the variable cost cell (B11) will be calculated by multiplying the variable cost per patient visit (i.e., \$15) by the number of visits (cell B3, which is currently blank). Similarly, cell B6—patient service revenue—is set up as cell B17 (i.e., \$75) multiplied by the number of patient visits (cell B3). In this example, the cells that are shaded gray are where we will enter our input values that will determine the total patient revenues and total variable costs.

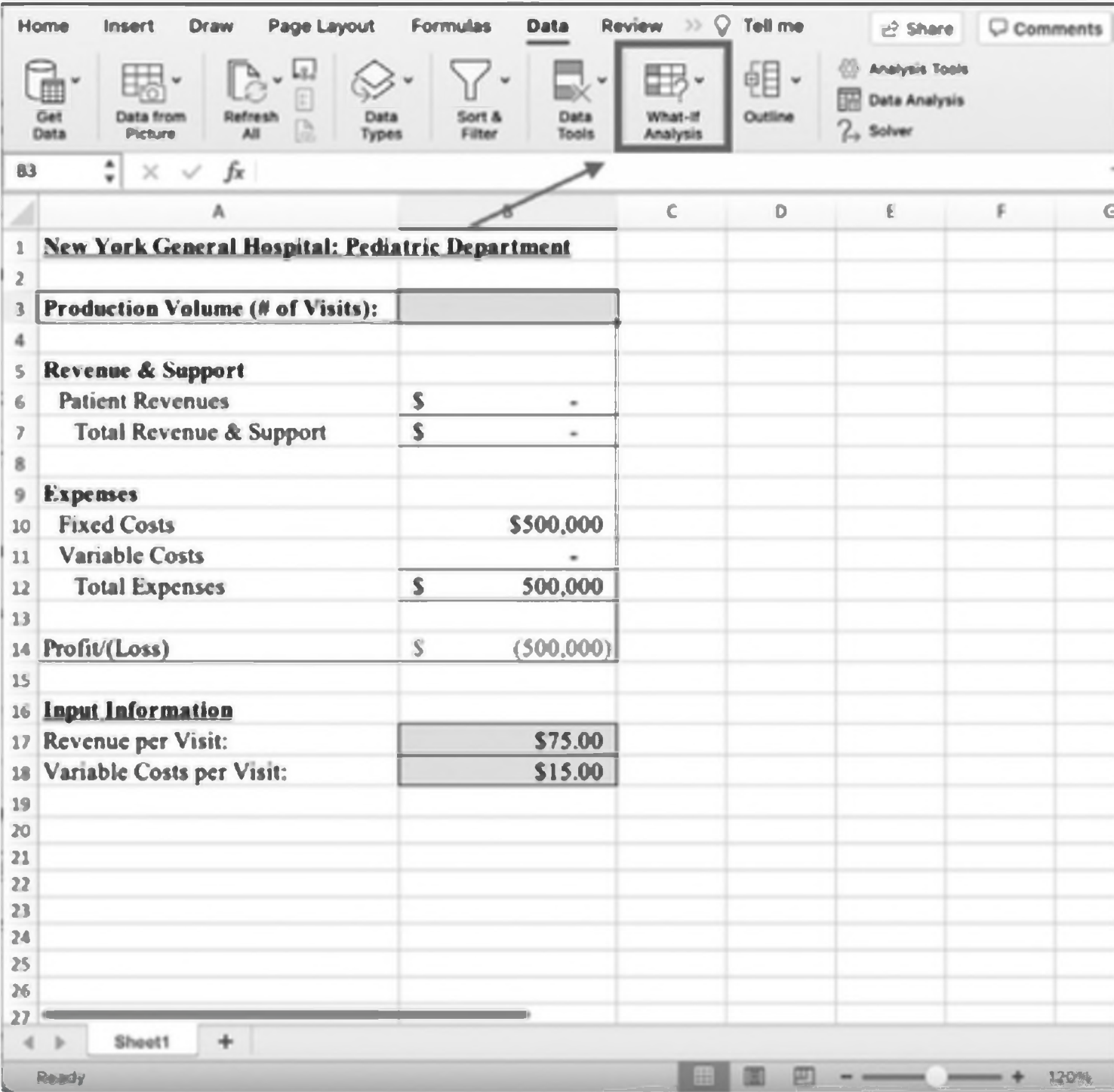
The problem tells us that the revenue per visit is \$75 and the variable cost per visit is \$15. We will assume in this problem that the revenue and variable costs are an average across patients and payers. Some insurers will pay more than \$75, and others less. Some patients will consume more than \$15 of variable cost and others less. We can enter that data in cells B17 and B18. Enter the fixed costs of \$500,000 in cell B10. For now, let’s suppose New York General Hospital expects to have 8,000 pediatric outpatient visits; enter “8,000” in cell B3. Once you enter that, the spreadsheet will calculate the variable revenues and costs for the problem because the spreadsheet is set up to do so, as shown in [Figure 4-B-2](#).

	A	B	C	D	E	F	G
1	New York General Hospital: Pediatric Department						
2							
3	Production Volume (# of Visits):	8,000					
4							
5	Revenue & Support						
6	Patient Revenues	\$ 600,000					
7	Total Revenue & Support	\$ 600,000					
8							
9	Expenses						
10	Fixed Costs	\$500,000					
11	Variable Costs	120,000					
12	Total Expenses	\$ 620,000					
13							
14	Profit/(Loss)	\$ (20,000)					
15							
16	Input Information						
17	Revenue per Visit:	\$75.00					
18	Variable Costs per Visit:	\$15.00					
19							
20							
21							
22							
23							
24							
25							
26							
27							

Description

Figure 4.B-2

We can see that the pediatric clinic would be expected to lose \$20,000 in this case. How can we determine the break-even point for this problem? Now we can use the built-in goal seek function in Excel to determine the break-even number of visits needed. First, delete the “8,000” in cell B3. Then, click on “Data” in the menu on the top of the Excel screen, and your screen should appear as shown in [Figure 4-B-3](#):

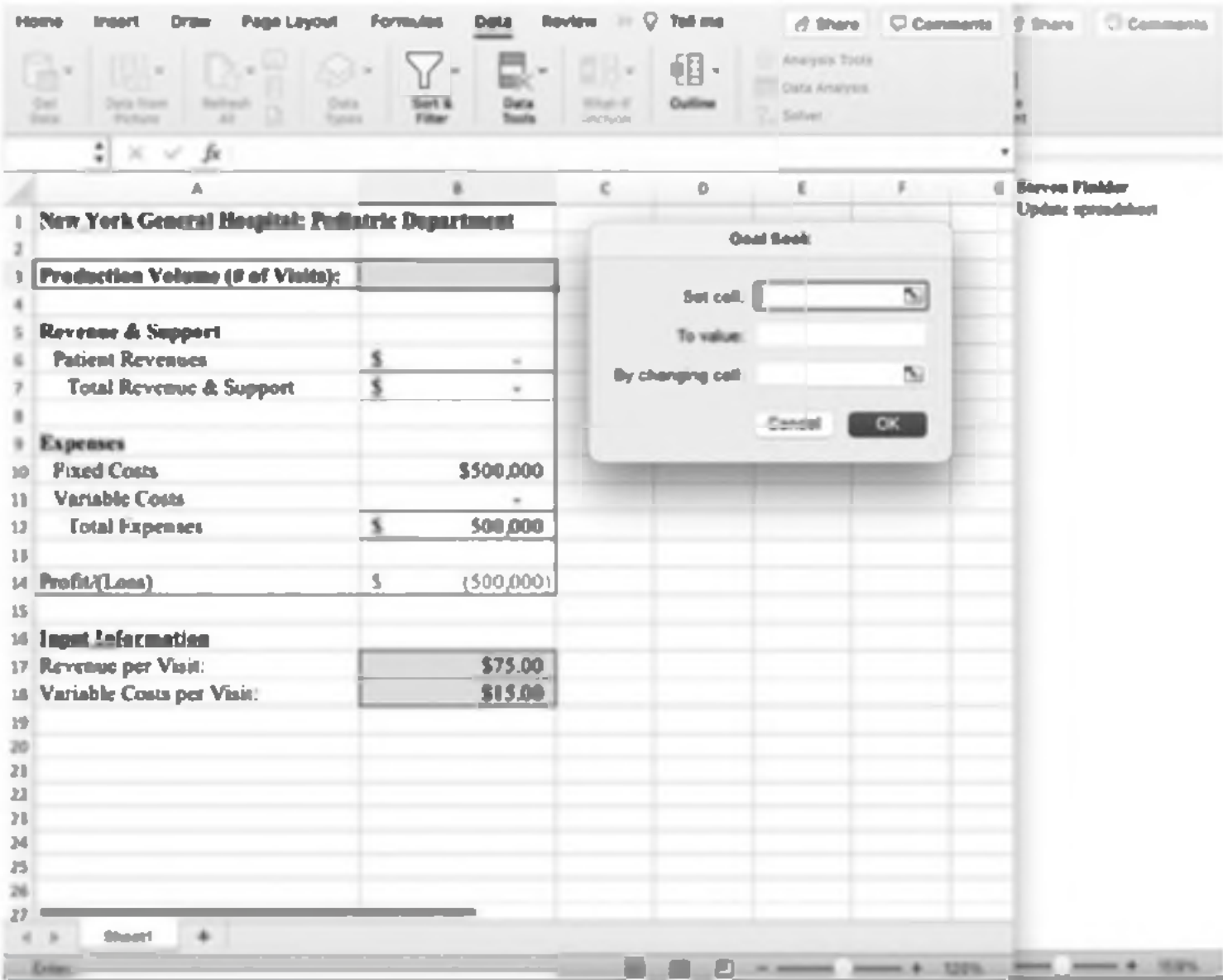


Description

Figure 4.B-3

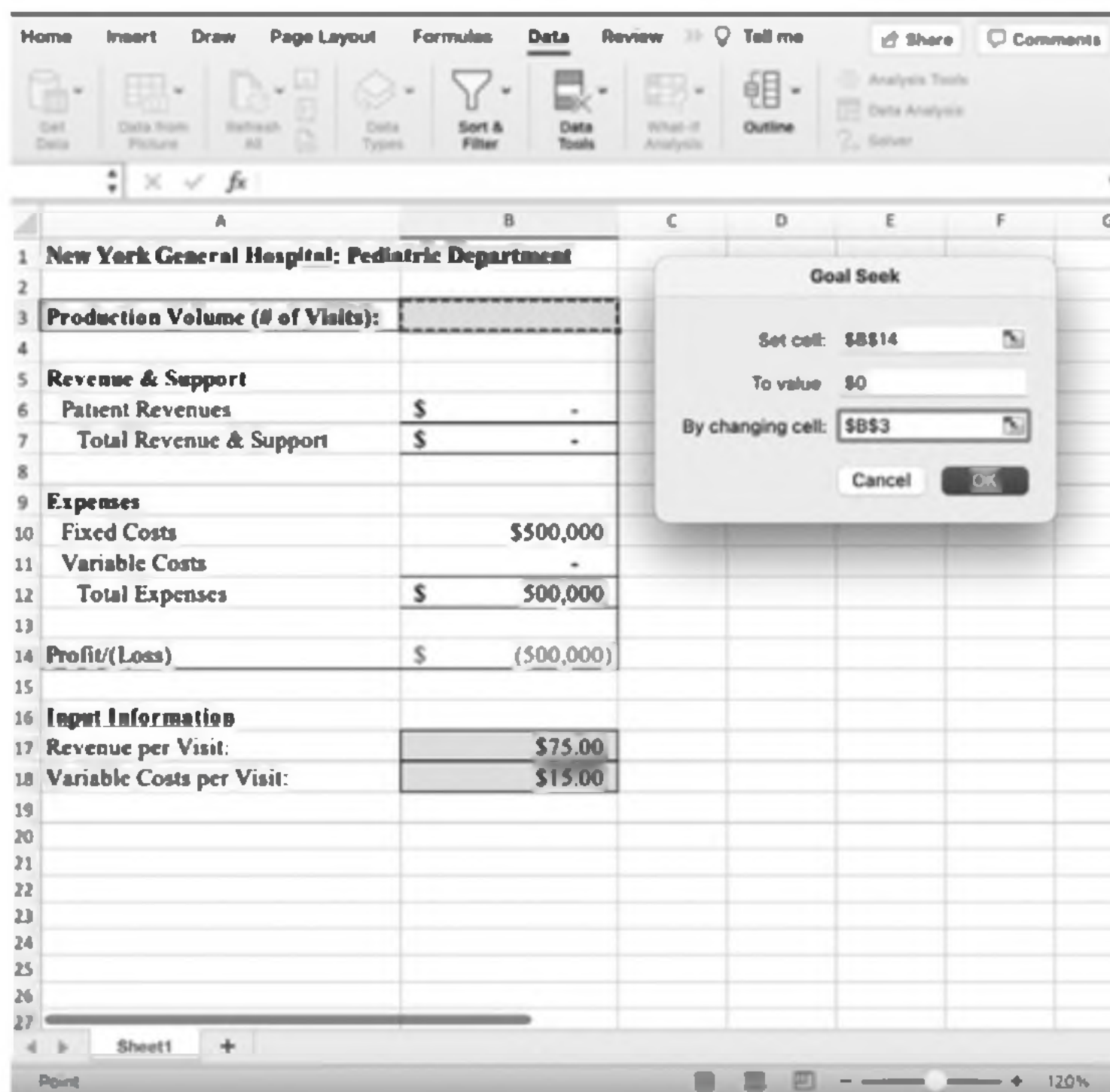
Then click on the “What-If Analysis” button toward the right side. Then click the “Goal Seek ...” option from the drop-down menu that will appear when you click on What-If Analysis. The screen should look as shown in [Figure 4-B-4](#) at this point:

The “Set cell” field is the cell that you want to calculate for some value, such as the break-even quantity. That value is then entered into the “To value” field. In this case, we want to calculate the break-even quantity, so we want to enter B14 in the field to the right of “Set cell.” We set the “To value” variable to 0 to show that the profit or loss should be 0 at the break-even volume being computed by the Goal Seek function. Next, we tell Excel that we want to accomplish \$0 profit/loss “By changing cell” B3, which is the volume cell (or, the Q in the break-even formula). Therefore, in the field “By changing cell,” we enter B3. These values have been put into the Goal Seek window in [Figure 4-B-5](#).



Description

Figure 4.B-4



Description

Figure 4.B-5

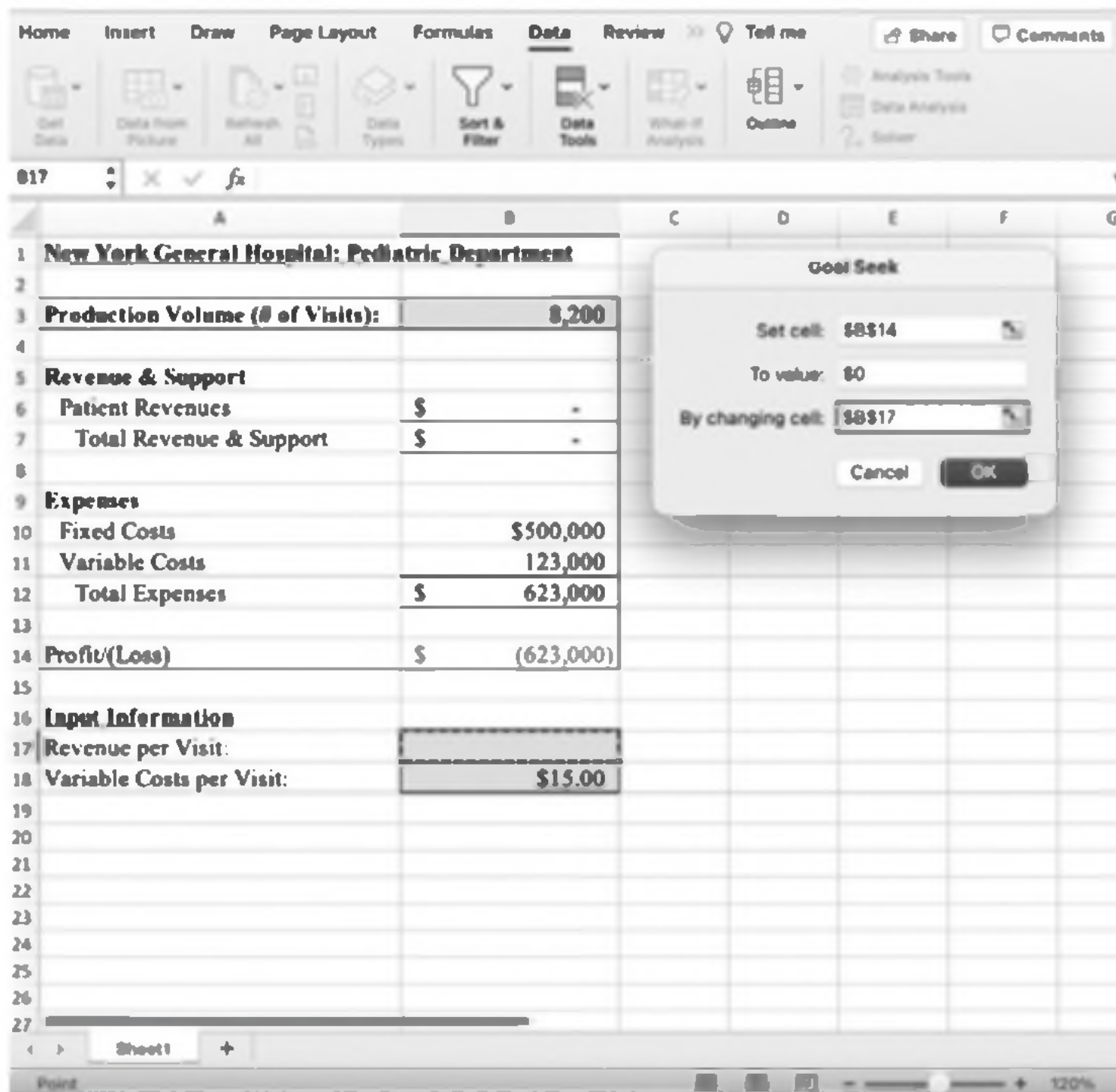
When we hit "OK," Excel calculates the volume needed for the clinic to generate \$0 of profit (break-even). That volume is 8,333. You will then see that Excel also determines the variable revenue and expense lines that are dependent upon the volume. See [Figure 4-B-6](#).

Once you understand how to use the basic functions of Goal Seek, you can expand its use. For example, rather than setting the profit/loss to \$0, you might target some expected profit amount. You simply change the "To value" field to that number. Or you can determine the variable revenue or cost necessary for any specific volume. For example, suppose we know that the clinic is expected to bill for only 8,200 visits; what average revenue per visit must the clinic earn to break even? Rather than setting the profit/loss ("Set cell") to \$0 ("To value") by changing volume ("By changing cell"), you can set the "By changing cell" to the Revenue per Visit (Cell B17) after entering 8,200 visits in cell B3. See [Figure 4-B-7](#).

	A	B	C	D	E	F	G
1	New York General Hospital: Pediatric Department						
2							
3	Production Volume (# of Visits):	8,333					
4							
5	Revenue & Support						
6	Patient Revenues	\$ 625,000					
7	Total Revenue & Support	\$ 625,000					
8							
9	Expenses						
10	Fixed Costs	\$500,000					
11	Variable Costs	125,000					
12	Total Expenses	\$ 625,000					
13							
14	Profit/(Loss)	\$ -					
15							
16	Input Information						
17	Revenue per Visit:	\$75.00					
18	Variable Costs per Visit:	\$15.00					
19							
20							
21							
22							
23							
24							
25							
26							
27							

[Description](#)

Figure 4.B-6



Description

Figure 4.B-7

When you press the “OK” button, cell B17 will calculate \$75.98. This means the pediatric clinic would have to plan to earn \$75.98 per visit on average to break even with 8,200 clinic visits. You could use a similar method to find the maximum variable cost per visit based on some number of visits.

NOTES

1. The existence of high fixed costs, relative to variable costs, is not uncommon. For example, a school system may have many tenured faculty members. Salary requirements for those faculty will not vary with the number of pupils. Similarly, administrative costs (e.g., principals, vice principals, administrative assistants) and maintenance costs (e.g., electric, heat, custodial services) may not vary substantially with volume changes.

2. Based on economic theory, price and quantity are related. Price increases are likely to reduce quantity. However, the extent to which this occurs depends on the shape of the demand curve and the elasticity of demand. In some cases, minor price changes can have dramatic impacts on quantity (high elasticity), but in other cases it is possible that substantial price changes have only minor impacts on quantity.

Descriptions of Images and Figures

[Back to Figure](#)

The x-axis represents the 'Activity Level: Number of Lab Procedures', ranging from 0 to 800 in varying increments (500 and 800 are marked). The y-axis represents 'Cost' in dollars, ranging from 0 to 480,000 in varying increments: 80,000 dollars, 330,000 dollars, and 480,000 dollars are labeled. A positive slope extends across 80,000 dollars.

Three cost components are shown:

1. Fixed Cost: Represented by a horizontal line at 80,000 dollar.
2. Variable Cost: Shown as the space between the Fixed Cost line and the Total Cost line.
3. Total Cost: Represented by an upward sloping line starting at 80,000 dollars (the fixed cost) and rising to over 480,000 dollars.

Key data points:

At 0 procedures, Total Cost equals Fixed Cost at 80,000 dollars.

At 500 procedures, Total Cost is approximately 330,000 dollars.

At 800 procedures, Total Cost reaches 480,000 dollars.

[Back to Figure](#)

The horizontal axis, labeled 'Activity Level: Number of Students', extends from 1,500 to 3,000 in varying increments. The vertical axis represents 'Cost' and ranges from 8,000 dollars to 13,000 dollars.

The line on the graph starts high on the left and curves downward as it moves to the right, indicating an inverse relationship between the number of students and cost. There are three data points marked on the line:

1. At 1,500 students, the cost is approximately 13,000 dollars.
2. At 2,500 students, the cost decreases to about 9,000 dollars.
3. At 3,000 students, the cost further reduces to around 8,000 dollars.

[Back to Figure](#)

The x-axis is labeled 'Activity Level: Number of Donors' and the y-axis represents 'Dollars'. The graph contains several key elements:

1. Fixed Cost: A horizontal line at 10000 dollars.
2. Total Cost: An upward sloping line starting from the fixed cost line, representing the sum of fixed and variable costs as the number of donors increases.
3. Total Revenue: An upward sloping line starting from the origin, representing the income generated as the number of donors increases.
4. Break-even Quantity (BEQ): The point where the Total Revenue line intersects with the Total Cost line.
5. Profits and Losses: The area above the break-even point between the Total Revenue and Total Cost lines is labeled as 'Profits'. The area below the break-even point between these lines is labeled as 'Losses'.

6. Variable Cost: The space between the Fixed Cost line and the Total Cost line represents the variable costs that increase with the number of donors.

[Back to Figure](#)

The support cost centers include Purchasing Department and Administration Department. These are connected to the mission cost centers, that include Soup Kitchens Department and Counseling Department.

[Back to Figure](#)

The Support Cost Centers include Purchasing Department and Administration Department. Mission cost centers include soup kitchens department and counseling departments. Step One links the Purchasing Department to the Administration, Soup Kitchens, and Counseling Departments in separate pathways. Step Two connects the Administration Department to both the Soup Kitchens and Counseling Departments through separate pathways.

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas (selected), data, review, and tell me tabs. The options under formulas are displayed.

The table consists of three columns: Column A, Column B and Column C. It reads as follows: Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type).

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: equals B 17 times B 3.

Row 7. Total Revenue and Support: equals sum open parenthesis B6 colon B6 close parenthesis.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: (empty).

Row 11. Variable Costs: equals B 18 times B3.

Row 12. Total Expenses: equals SUM open parenthesis B10 colon B11 close parenthesis. Row 13. (empty).

Row 14. Profit/(Loss): equals B7 minus B12.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: (blank cell selected).

Row 18. Variable Costs per Visit: (blank cell selected).

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas (selected), data, review, and tell me tabs. The options under formulas are displayed.

The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows: Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): 8,000.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: 600,000 dollars.

Row 7. Total Revenue and Support: 600,000 dollars.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: 120,000.

Row 12. Total Expenses: 620,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): 20,000 dollars.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: 75.00 dollars.

Row 18. Variable Costs per Visit: 15.00 dollars.

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas, data (selected), review, and tell me tabs. The options under data are displayed, out of which What-If analysis option is selected. An arrow from the title of the table (displayed in row 1) points to this option.

The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows: Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): blank.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: dollar nil.

Row 7. Total Revenue and Support: dollar nil.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: nil.

Row 12. Total Expenses: 500,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): 500,000 dollars.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: 75.00 dollars.

Row 18. Variable Costs per Visit: 15.00 dollars.

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas, data (selected), review, and tell me tabs. Three options under data are displayed: sort and filter, data tools, and outline.

The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows: Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): blank.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: dollar nil.

Row 7. Total Revenue and Support: dollar nil.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: nil.

Row 12. Total Expenses: 500,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): 500,000 dollars.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: 75.00 dollars.

Row 18. Variable Costs per Visit: 15.00 dollars.

The pop-up box titled Goal seek has three fields: set cell (blank); to value (blank); by changing cell (blank). Cancel and Ok buttons are at the right bottom. OK button is selected.

Text Steven Finkler, update spreadsheet is visible in the partially visible folder underneath.

Back to Figure

The top ribbon displays the home, insert, draw, page layout, formulas, data (selected), review, and tell me tabs. Three options under data are displayed: sort and filter, data tools, and outline.

The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows:

Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): blank.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: dollar nil.

Row 7. Total Revenue and Support: dollar nil.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: nil.

Row 12. Total Expenses: 500,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): 500,000 dollars.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: 75.00 dollars.

Row 18. Variable Costs per Visit: 15.00 dollars.

The pop-up box titled Goal seek has three fields: set cell: dollar B dollar 14; to value: 0 dollar; by changing cell: dollar B dollar 3. Cancel and Ok buttons are at the right bottom. OK button is selected.

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas, data (selected), review, and tell me tabs. All options under data are displayed. The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows:

Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): 8,333.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: 625,000 dollars.

Row 7. Total Revenue and Support: 625,000 dollars.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: 125,000.

Row 12. Total Expenses: 625,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): dollars nil.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: 75.00 dollars.

Row 18. Variable Costs per Visit: 15.00 dollars.

The number 833.333333333333 is displayed in the formula bar (cell B3).

[Back to Figure](#)

The top ribbon displays the home, insert, draw, page layout, formulas, data (selected), review, and tell me tabs. Three options under data are displayed: sort and filter, data tools, and outline.

The table consists of seven columns: A, B, C, D, E, F, and G. It reads as follows:

Row 1. New York General Hospital: Pediatric Department (bold type and underlined).

Row 2. (empty).

Row 3. Production Volume (number of Visits): (bold type): 8,200.

Row 4. (empty).

Row 5. Revenue and Support (bold type).

Row 6. Patient Revenues: dollar nil.

Row 7. Total Revenue and Support: dollar nil.

Row 8. (empty).

Row 9. Expenses (bold type).

Row 10. Fixed Costs: 500,000 dollars.

Row 11. Variable Costs: 123,000.

Row 12. Total Expenses: 623,000 dollars.

Row 13: empty.

Row 14. Profit/(Loss): 623,000 dollars.

Row 15. (empty).

Row 16. Input Information (bold type).

Row 17. Revenue per Visit: blank (dashed line outline).

Row 18. Variable Costs per Visit: 15.00 dollars.

The pop-up box titled Goal seek has three fields: set cell: dollar B dollar 14; to value: 0 dollar; by changing cell: dollar B dollar 17. Cancel and OK buttons are at the right bottom. OK button is selected.