PUBLIC HEALTH FINANCE TUTORIAL SERIES
Module II

ESTIMATING COSTS AND MARGINS

MODULE THEME:
TANGELO COUNTY HEALTH DEPARTMENT ADULT INFLUENZA IMMUNIZATION PROGRAM

Each year about 48,000 adults die from vaccine preventable diseases in the United States. The purpose of immunization programs is to prevent illness and death from diseases such as influenza, pneumococcal disease, hepatitis B, diphtheria, tetanus, measles, mumps, and rubella. The public health objectives established by Healthy People 2010 include a goal of achieving 90% immunization coverage of those over 65 for annual influenza vaccination and one-time pneumococcal disease vaccination. Unfortunately, current levels fall far short of this goal. For example, annual influenza vaccination rates for the elderly are only in the 60-70 percent range.

The costs associated with vaccine-preventable diseases are enormous. It is estimated that the costs associated with such diseases in the United States are about $10 billion a year. Influenza related diseases alone are estimated to cause 36,000 deaths annually and result in over 200,000 hospitalizations. In fact, influenza causes more mortality and morbidity than all other vaccine preventable diseases combined. Like most health departments, the Tangelo County Health Department (TCHD) provides a full range of immunization services, with a goal of reducing and eventually eliminating as many vaccine preventable diseases as possible. One important program is foreign travel immunizations. Such immunizations typically are not offered in doctor's offices or walk-in clinics because volume is low and the vaccines are relatively expensive with short shelf lives. Because of these factors. some smaller surrounding area health departments send their clients to TCHD for foreign travel immunizations.

The largest immunization program offered by TCHD is for school and childcare attendance. This program is offered free of charge to children from birth through 18 years of age through the federal Vaccines for Children [VFC] program. Last year, TCHD administered a total of 30,854 childhood vaccines through this program. In addition to the children's program, TCHD provided roughly 24,300 influenza immunizations to adults. To fund its adult flu immunization program, TCHD receives payment from various insurers, including Medicaid and Medicare. In addition, uninsured immunization recipients are charged a fee unless they meet established poverty guidelines. On average, it is estimated that the adult flu program collects $25 per immunization. As part of the overall evaluation of services offered, TCHD routinely assesses the financial impact of its programs. The assessment is part of the overall budgeting and financial analysis system developed by the Budget and Finance Section of the Administrative Services Department. By the end of this module, you will understand the financial concepts and tools used to evaluate public health programs such as TCHD's Adult Influenza Immunization Program.

Learning Objectives

After studying this module, you should be able to do the following:

- Explain how costs are classified according to (1) their relationship with volume and (2) their relationship to the unit being analyzed.
- Answer why proper cost allocation is important to public health organizations.
- Explain the direct method of allocating overhead costs among public health programs.
- Describe the two most widely used approaches to setting prices (fees).
- Conduct analyses to learn the impact of volume changes on profitability and to determine breakeven points.

INTRODUCTION

Public health managers have many responsibilities. The more important ones include planning for the future, establishing policies that control the operations of the organization, and overseeing the day-to-day activities of the organization's employees. One of the key steps in the planning process is to estimate the future demand (volume) for programs and services and see to it that the organization has the facilities, staff, and supplies necessary to meet the forecasted demand. This task is accomplished primarily with budgets that use forecasted future volume to estimate the resources needed to meet expected community needs. As the future unfolds, managers must monitor operations to see if the volume estimates were correct. If not, supplies and staffing requirements must be adjusted to reflect variations from forecasts. Finally, public health managers must constantly review the resources used to ensure that they are being acquired at the lowest possible costs.

In general, public health program success is based on outcomes, but the ability to create good outcomes is tied to the availability of financial resources. Some programs generate financial resources while others consume external financial resources. The ability to identify those programs that are financial "givers" and those that are financial "takers" is an important factor in program assessment.

All of these planning activities require information, a great deal of it. Furthermore, this information has to be presented in a format that facilitates analysis, interpretation, and decision making. Without timely and relevant information, public health managers would be making decisions in the dark. Of course, accurate information does not ensure good decision making, but without it the chances of making good decisions are almost nil.

The foundation of a good information system is the ability to estimate costs with confidence. This is not an easy task. You may be able to estimate the cost of operating a car with some confidence—just add up the costs of fuel, wear and tear, servicing, and so on. However, what about the costs of running a public health organization or one of its departments or programs? The overall (total) costs of an organization can be measured with some confidence, but what about the costs of running the dental department, or the costs associated with Medicare patients, or the costs of treating HIV patients? Estimating these costs with confidence is essential to sound management, yet it's a fact of life that estimating the costs associated with departments within an organization or the costs of specific programs or services is not easy.

THE BASICS OF MANAGERIAL ACCOUNTING

When we think about costs, we think about using accounting data to provide the needed information. Accounting is split into two primary areas: managerial accounting and financial accounting. Whereas financial accounting (which is discussed in Module V) focuses on the reporting of operational and financial results to outsiders, *managerial accounting* focuses on the development of information used internally for managerial decision making.

Key Concept: Managerial Accounting

The accounting function within businesses is broken down into two major areas: managerial accounting and financial accounting. Financial accounting, which is covered in Module V, involves the creation of statements that report what has occurred in the past. Managerial accounting concerns the creation and use of data to manage current operations, with a focus on specific programs and services.

Managerial accounting information is used for routine budgeting processes, allocation of financial resources, and pricing and service decisions, all of which deal primarily with sub-units (programs and services) of an organization. In addition, managerial accounting data can be compiled for special purposes, such as determining how much a particular program or service will cost.

Managers are more concerned with what will happen in the future than with what has happened in the past, so managerial accounting is for the most part forward-looking. Because most of the future is unknown, managerial accounting information requires many assumptions. For example, as public health managers create budgets, they often must make assumptions regarding governmental funding amounts, volumes by individual service, reimbursement amounts, and costs.

A critical part of managerial accounting is the measurement of costs. Unfortunately, there is no single definition of the term *cost*. Rather, different costs exist for different purposes. As a general rule, a cost involves a resource use associated with providing, or supporting, a specific service. However, the cost-per-service identified for pricing purposes can differ from the cost-per-service used for management control purposes. Also, the cost-per-service used for long-range planning purposes may differ from the cost-per-service defined for short-term purposes. Thus, when dealing with costs, public health managers have to understand the context so that the correct cost is identified.

Self-Test Questions

1. What is the primary purpose of managerial accounting information?

2. What is meant by the term *cost*?

FIXED VERSUS VARIABLE COSTS

Costs are classified in two primary ways: by their relationship to the volume (amount) of services provided and by their relationship to the unit (i.e., department or program) being analyzed. We will begin our discussion of cost classifications by focusing on their relationship to the amount of services provided, often referred to as *volume* or *utilization*. Future volume—the number of patient visits, immunizations, and so on—is almost always uncertain.

Volume may be forecast in a number of ways. One way is to review historical trends, say, over the past five years, because in many situations, the past is a reasonable predictor of the future. If this is thought to be the case, then the historical data can be reviewed and analyzed to predict future volumes. If past data are not available or if significant changes in the operating environment are taking place, volume forecasting becomes more difficult. Now, it is necessary to evaluate population and disease trends in the service area, actions of other organizations that offer similar services, pricing (fee) strategies, and a whole host of additional factors that may influence future volume.

If a volume forecast is off, the consequences can be severe. First, if the actual volume for any particular service is greater than anticipated and planned for, then the organization will not be able to meet the community's needs. On the other hand, if projections are overly optimistic, the organization could end up with excess equipment, supplies, and staff, and hence costs that are higher than necessary. Costs that are higher than necessary in one program siphon off financial resources from other programs that might benefit from additional resources.

In spite of the difficulties in forecasting volume, managers typically have some idea of the potential range of volumes for particular programs. For example, the administrator of the Tangelo County Health Department (TCHD) might estimate that the total number of immunizations for next year's Adult Influenza Immunization Program could range from 22,000 to 26,000. If utilization is not likely to fall outside of these bounds, then the range of 22,000 to 26,000 immunizations defines the *relevant range* for this program. Note that the relevant range pertains to a particular time period—in this case, for the coming year. For other time periods, the relevant range might differ from this estimate.

Fixed Costs

Some costs, called *fixed costs*, are more or less known with certainty, regardless of the level of volume **within the relevant range**. For example, TCHD has a labor force of well-trained permanent clinical and administrative employees that would be increased or decreased only under unusual circumstances. Thus, as long as the volume of influenza immunizations falls within the relevant range of 22,000 to 26,000, labor costs for the program are fixed for the immunization period. The actual number of immunizations might turn out to be 23,352 or 25,877, but program labor costs will remain at their forecasted level as long as volume falls within the relevant range. Other examples of fixed costs include expenditures on facilities (e.g., rent, maintenance, housekeeping, and utilities), diagnostic equipment, and information systems. After an organization has acquired these assets, it typically is locked into them for some period of time regardless of volume fluctuations, so these costs are known and predictable beforehand. In essence, organizations plan for some maximum volume of services and insure that they have the capability to provide these services. Only when volumes are significantly higher than anticipated would new facilities, equipment, and labor resources have to be added.

Of course, no costs are fixed over the long run or over large volume changes. At some point of increasing volume, public health organizations or programs must incur additional fixed costs for new property and equipment, additional staffing, and so on. Likewise, if volume decreases by a substantial amount, an organization or program likely would reduce fixed costs by shedding part of its facilities and labor base.

Variable Costs

Whereas some costs are fixed regardless of volume (within the relevant range), other resources are more or less consumed as volume dictates. Costs that are related to (depend on) volume are called *variable costs*. For example, the costs of the clinical supplies (e.g., rubber gloves, vaccines, and hypodermics) used in the adult influenza immunization program would be classified as variable costs. So would the cost of administrative supplies that are tied to volume (each individual that is vaccinated must sign a consent form as well as receive a card explaining possible side effects). Examples of generic variable costs include diagnostic equipment that is leased on a per use basis (a fixed payment each time the equipment is used), which converts the cost of the equipment from a fixed cost to a variable cost. Also, some employees may be paid on the basis of the amount of work performed, which would convert labor costs from fixed to variable. The bottom line here is that fixed costs are independent of the volume of services delivered (within the relevant range), while variable costs depend on volume.

> Key Concept: Fixed Versus Variable Costs
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> One way of classifying costs is by their relationship to volume. Fixed costs are known and predictable regardless of volume (within some relevant range). Think facilities and labor costs. Conversely, variable costs depend on the volume of services supplied. For example, rubber gloves and vaccines.

Underlying Cost Structure

Public health managers are vitally interested in how costs are affected by changes in the amount of services supplied (volume). The relationship between costs and volume, called *underlying cost structure*, is used by managers in planning, control, and decision making. The primary reason for defining an organization's underlying cost structure is to provide managers with a tool for forecasting costs (and ultimately margins) at different volume levels.

> Key Concept: Underlying Cost Structure
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> The nature of the costs of an organization, program, or service, often expressed as an equation. The most basic form of cost structure is:
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> Total costs = Fixed costs + Total variable costs.

To illustrate the underlying cost structure concept, consider the hypothetical cost data presented in Exhibit 1 for a state public health regional clinical laboratory. The underlying cost structure consists of both fixed and variable costs—that is, some of the costs are expected to be volume sensitive and some are not. This structure of both fixed and variable costs is typical in public health organizations as well as most other organizations. For illustrative purposes, let's assume that the relevant range is from zero to 20,000 tests. (Of course, the actual relevant range might be from 15,000 to 20,000 tests.)

Assume that the laboratory has $150,000 in fixed costs that consist primarily of labor, facilities, and equipment costs. (These costs clearly are too small—we are keeping the numbers small for ease of illustration.) The $150,000 in fixed costs will occur even if the laboratory does not perform one test, assuming it is kept open. In addition to the fixed costs, each test, on average, requires $10 in laboratory supplies, such as glass slides and reagents.

The per unit (per test, in this example) variable cost of $10 is defined as the *variable cost rate*. If laboratory volume doubles—for example, from 500 to 1,000 tests—*total variable costs* will double from $5,000 to $10,000. However, the variable cost rate of $10 per test remains the same whether the test is the first, the hundredth, or the thousandth. **Total variable costs**, therefore, increase or decrease proportionately as volume changes, but the **variable cost rate** remains constant.

Fixed costs, in contrast to total variable costs, remain unchanged as the volume varies. When volume doubles from 10,000 to 20,000 tests, fixed costs remain at $150,000. Because all costs in this example are either fixed or variable, *total costs* are merely the sum of the two. For example, at 10,000 tests, total costs are Fixed costs + Total variable costs = $150,000 + (10,000 × $10) = $150,000 + $100,000 = $250,000. Because variable costs are tied to volume, total variable costs, and hence total costs, increase as the volume increases even though fixed costs remain constant.

EXHIBIT 1 Cost Behavior Illustration

Fixed Costs per Year: $150,000
Variable Costs per Test: $10

Volume	Fixed Costs	Total Variable Costs	Total Costs	Average Cost per Test
0	$150,000	$ 0	$150,000	---
1	150,000	10	150,010	$150,010.00
100	150,000	1,000	151,000	1,510.00
1,000	150,000	10,000	160,000	160.00
10,000	150,000	100,000	250,000	25.00
15,000	150,000	150,000	300,000	20.00
20,000	150,000	200,000	350,000	17.50

The rightmost column in Exhibit 1 contains *average cost* per unit of volume, which in this example is average cost per test. It is calculated by dividing total costs by volume. For example, at 10,000 tests, with total costs of $250,000, the average cost per test is $250,000 ÷10,000 = $25. Because fixed costs are spread over more tests as volume increases, the average cost per test declines as volume increases. For example, when volume doubles from 10,000 to 20,000 tests, fixed costs remain at $150,000, but fixed cost per test declines from $150,000 ÷ 10,000 = $15 to $150,000 ÷ 20,000 = $7.50.

With fixed cost per test declining from $15 to $7.50, the average cost per test goes down from $15 + $10 = $25 to $7.50 + $10 = $17.50. The fact that higher volume reduces average fixed cost and average cost per unit of volume has important implications on the effect of volume changes on the ability of a program to pay for itself. This point will be made clear in a later section. (In economics, the situation of declining average cost as volume increases is called *economies of scale*.)

Before we leave this illustration of underlying cost structure, we should mention that fixed and variable costs represent two ends of the volume classification spectrum. Here, within the relevant range, the costs are either independent of volume (fixed) or directly related to volume (variable). A third classification, *semi-fixed costs*, falls in between the two extremes. To illustrate, assume that the actual relevant range of volume for the clinical laboratory is 15,000 to 20,000 tests. However, the laboratory's current workforce can only handle up to 17,500 tests per year, so an additional technician, at an annual cost of $35,000, would be required if volume exceeds that level. Now, labor costs are fixed from 15,000 to 17,500 tests and then again fixed at a higher level from 17,500 to 20,000 tests, but they are not fixed at the same level throughout the entire relevant range of 15,000 to 20,000 tests. Semi-fixed costs are fixed within ranges of volume, but there are multiple ranges of semi-fixed costs within the relevant range. To keep things manageable, we will not include semi-fixed costs in our examples in this tutorial.

Self-Test Questions

1. Define relevant range.

2. Explain the features and provide examples of fixed and variable costs.

3. How does time period affect the definition of fixed costs?

4. What is meant by underlying cost structure?

5. What are semi-fixed costs?

DIRECT VERSUS INDIRECT (OVERHEAD) COSTS

The second major cost classification is the relationship of the cost to the unit (i.e., organization, program, or service) being analyzed. Some costs are unique to the reporting sub-unit and hence usually can be identified with relative certainty. To illustrate, think in terms of a local health department's dental clinic. Certain costs are unique to the clinic; for example, the salaries and benefits for the dentists, hygienists, and assistants who work there and the costs of the equipment and supplies used to provide dental services. These costs, which would **not** occur if the dental clinic was closed, are classified as the *direct costs* of the dental clinic.

Key Concept: Direct Versus Indirect Costs

In addition to their relationship to volume, costs can be classified by their relationship to the unit being analyzed. Those costs that are unique to a particular program, and hence would disappear if the program were abolished, are called *direct costs*. Costs incurred from the use of resources shared across the organization are classified as *indirect (overhead) costs*. For example, the costs of the supplies used in the Healthy Start program are direct costs; they would disappear if the program were abolished. But, the costs of facilities (the space used) remain, so they represent overhead costs to the program.

Unfortunately, direct costs constitute only a portion of the dental clinic's total costs. The remaining resources used to provide dental services are **not** unique to the dental clinic, but rather represent resources that are shared by all programs and services provided by the local health department. For example, the dental clinic shares the health department's physical space as well as its infrastructure, which includes information systems, utilities, housekeeping, maintenance, medical and dental records, finance and billing, and general administration. The costs not borne solely (directly) by the dental clinic but shared across the entire organization are called *indirect (overhead) costs*.

Indirect costs, in contrast to direct costs, are much more difficult to measure because they arise from shared resources—that is, if the dental clinic were closed, the indirect costs would **not** disappear. Perhaps some indirect costs could be reduced, but the health department still requires a basic infrastructure to provide its remaining services. Note that the direct/indirect classification has relevance only at the sub-unit (program or service) level. When the entire organization is considered, all costs are direct.

The two cost classifications (fixed/variable and direct/indirect) overlay one another. That is, fixed costs typically include both direct and indirect costs, while variable costs generally include only direct costs. For example, the fixed costs of the dental clinic include both labor (a direct cost) and facilities (an overhead cost) costs, but the variable costs (primarily dental supplies) are all direct costs. Conversely, direct costs usually include fixed and variable costs, while indirect costs typically include only fixed costs. Although this mixing of cost classifications can give anyone a headache, the good news is that the classifications typically are used independent of one another.

Self-Test Questions

1. What is the difference between direct and indirect costs?

2. Give some examples of each type of cost for an immunization program.

COST ALLOCATION

A critical part of cost measurement at the program or service level is the assignment, or allocation, of overhead costs. *Cost allocation* is a process within organizations whereby managers allocate the costs of one activity (say, housekeeping services) to another activity (say, the dental clinic). What costs within a public health organization must be allocated? Typically, the costs associated with the facilities and support personnel of the organization, such as administrators, financial staffs, and housekeeping and maintenance personnel, must be allocated to those programs and services that are directly related to the organization's mission (generally, community services activities). The allocation of support costs to community services activities is necessary because there would be no need for such costs in the absence of mission-related activities. Thus, decisions regarding service offerings and fees (for those services that create revenues) must be based on the *total (full) costs* associated with each service, including both direct and overhead costs. Clearly, the proper allocation of overhead costs is essential to good decision making within public health organizations.

The goal of cost allocation is to assign all of the costs of an organization to the activities that cause them to be incurred. Ideally, public health managers would like to track and assign costs by program, service provided, individual patient, reimbursement contract, and so on. With complete cost data available in the organization's managerial accounting system, managers can make better decisions regarding how to control costs, what programs and services should be offered, and how the services with charges should be priced (if at all). Of course, the more data needed, the higher the costs of developing, implementing, and operating the accounting system. Furthermore, the data required to develop costs along many dimensions (program, services, patient, payer, and so on) can be substantial. The benefits associated with developing more cost data as well as more accurate data must be weighed against the costs required to develop such data.

Cost Pools

To allocate costs, the first step is to identify the cost pools and drivers. Typically, a *cost pool* consists of all the direct costs of one **support activity**. However, if the services of a single support activity differ substantially (in the sense that the mission services activities use different relative amounts), the costs of that support department may need to be separated into multiple pools.

> Key Concept: Cost Pool
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> A cost pool is a group of overhead costs to be allocated to the mission services activities. Typically, a cost pool consists of all of the direct costs of one overhead department (activity). For example, the costs associated with housekeeping might constitute a cost pool.

For example, suppose a large public health organization has a Financial Services department that provides two significantly different services: billing (for fee-based services such as septic tank licensing) and managerial budgeting. Furthermore, assume that the Environmental Health department uses proportionally more patient billing services than does the Child and Adolescent Health (CAH) department, but the CAH department uses more budgeting services than does Environmental Health. In this situation, it would be best to create two cost pools for the Financial Services department. To do this, the total costs of Financial Services must be divided into a billing pool and a budgeting pool. Then, cost drivers must be chosen for each pool and the costs allocated to the patient services departments as described in the following sections.

Cost Drivers

One of the most important steps in the cost allocation process is the identification of proper *cost drivers*. The theoretical basis for identifying cost drivers is the extent to which the costs from a pool actually vary as the value of the driver changes. For example, consider housekeeping services. Does a program using 1,000 square feet of space use twice the amount of housekeeping services as a program with only 500 square feet of space? The closer the relationship (correlation) between actual overhead resource expenditures on each program or service and the value of the cost driver, the better the cost driver and hence the better the resulting cost allocations.

> Key Concept: Cost Driver
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> A cost driver is the basis on which overhead costs are allocated to sub-units (programs and services). For example, housekeeping costs might be allocated to a dental clinic on the basis of square footage or Medicaid billing costs might be allocated on the basis of the number of bills processed.

Good cost drivers possess two characteristics. The first is *fairness*—that is, does the cost driver chosen result in an allocation that is equitable to the mission services activities? The second, and perhaps more important, characteristic is *cost reduction*—that is, does the cost driver chosen create incentives for the managers of the mission services activities to use less overhead services? For example, the dental clinic director can do little to influence overhead cost allocations for administrative support if the cost driver is the number of clinic visits. In fact, the action needed to reduce the overhead allocation—reduction in patient visits—would not only be detrimental to the mission, it likely would lead to negative financial consequences for the organization. A good cost driver will encourage program and service managers to take overhead cost reduction actions that do not have negative implications for the organization.

The Allocation Process

The steps involved in allocating overhead costs are summarized in Exhibit 2, while the discussion that follows illustrates how the Tangelo County Health Department (TCHD) allocates its housekeeping costs to the Dental Clinic. The allocation can be *retrospective* (based on last year's data) or *prospective* (based on next year's forecasted budget data).

EXHIBIT 2 Allocation of Overhead Costs

Step One: Determine the amount of the cost pool.

Step Two: Determine the best cost driver.

Step Three: Identify the recipients of the overhead service and the amount of service provided.

Step Four: Calculate the allocation rate.

Step Five: Determine the allocation amount.

First, the cost pool must be established. In this illustration, TCHD is allocating housekeeping costs, so the cost pool is the total costs of housekeeping services, $100,000.

Second, the best cost driver must be identified. After considerable investigation, TCHD's managers concluded that the best cost driver for housekeeping costs is labor hours—that is, the number of hours of service required by each activity at the Health Department that housekeeping serves is the measure most closely related to the actual cost of providing those services. The intent here, of course, is to pick the cost driver that provides the most accurate cause-and-effect relationship between the use of housekeeping services and the cost of providing those services.

Third, the recipients of housekeeping services must be identified. Depending on the method used to allocate overhead costs, the recipients could include **all** activities that receive housekeeping services (including other overhead activities such as general administration) or **only** those activities that are mission related (provide community services), while ignoring other overhead activities. In our illustration, it is assumed that the relevant activities are expected to use 6,000 hours of housekeeping services.

> Key Concept: Allocation Rate
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> The allocation rate is the amount of the cost pool to be allocated to each unit of overhead services consumed. For example, if $500,000 of general administration overhead is being allocated across 250,000 units of mission-related services (visit, immunization, inspection, and so on), the allocation rate is Cost pool ÷ Total amount of cost driver units = $500,000 ÷ 250,000 = $2.00 per unit of mission-related service.

Next, the *allocation rate* must be calculated. TCHD's managers estimate that housekeeping services will provide (or has provided, if this is a retrospective allocation) 6,000 hours of service **to those activities that will receive the allocation**. Now that the cost pool and cost driver have been defined and measured, the allocation rate is established by dividing total overhead costs (the cost pool) by the total volume of the cost driver. In this example, the amount in the housekeeping cost pool is $100,000 and the total volume of the cost driver used is 6,000 hours. Thus, the allocation rate is $100,000 ÷ 6,000 hours = $16.67 per hour of services provided. Again, note that different allocation methods can identify different activities to receive the allocation. In the example here, the relevant activities (the community services activities) receive 6,000 hours of housekeeping services. If we had included overhead activities (general administration, financial services, and so on) in the allocation, the volume of housekeeping services allocated would be greater than 6,000 hours, say, 8,000 hours.

Finally, the dollar allocation must be made to each activity. To illustrate, consider the dental clinic, one of TCHD's community service activities. The clinic is expected to use 250 hours of housekeeping services (one hour per day), so the dollar amount of housekeeping overhead allocated is Allocation rate × Amount of overhead services used = $16.67 × 250 = $4,168.

Other activities within TCHD will also use housekeeping services, and their allocations would be made in a similar manner. The $16.67 allocation rate per hour of service used is multiplied by the amount of each activity's utilization of housekeeping services to obtain the dollar allocation. When all mission-related activities are considered, the entire organization is projected to use 6,000 hours of housekeeping services, so the total amount allocated must be $16.67 × 6,000 = $100,000, which is the amount in the cost pool. For any individual activity, the amount allocated depends on both the allocation rate, which represents the per unit cost (transfer price) of the overhead service, and the amount of overhead services utilized.

Cost Allocation Methods

> Key Concept: Direct Allocation Method
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> The direct method of cost allocation allocates overhead costs directly (only) to mission-related activities. Overhead support provided by one support activity to other overhead activities is not recognized in the direct method.

Mathematically, cost allocation can be accomplished in a variety of ways, and the method used is somewhat discretionary. No matter what method is chosen, all overhead costs eventually must be allocated to the activities (primarily mission-related services) that create the need for those costs. The key differences among the methods are how the services provided by one overhead activity are allocated to **other** overhead activities.

The *direct method* is the simplest to understand and easiest to implement. Under this method, each overhead activity's costs are allocated only (directly) to the organization's mission-related activities. Thus, the key feature of the direct method, and the feature that makes it relatively simple to apply, is that

none of the costs of providing overhead services is allocated to other support activities. In effect, under the direct method, only the direct costs of the support activities are allocated to mission-related activities because no indirect costs have been created by intra-support activity allocations.

There are two other methods commonly used in cost allocation. The *reciprocal method* recognizes overhead activity interdependencies, and hence this method generally is considered to be more accurate and objective than the direct method. The reciprocal method derives its name from the fact that it recognizes all services that overhead activities provide to and receive from each other. The good news is that this method captures all of the intra-support activity relationships, so no information is ignored and no biases are introduced into the cost allocation process. The bad news is that the reciprocal method is relatively complex, which makes explaining it to program heads difficult and implementing it costly.

The *step-down method* represents a compromise between the simplicity of the direct method and the complexity of the reciprocal method. It recognizes some of the intra-support activity effects that the direct method ignores, but it does **not** recognize the full range of interdependencies as does the reciprocal method. The step-down method derives its name from the sequential, stair-step pattern of the allocation process, which requires that the allocation takes place in a specific sequence.

Although most organizations use one of the more complicated allocation methods, all methods have the same goal: to distribute the overhead costs of an organization to those activities that created the original need for the organization. An understanding of the direct method will give you a good feel for what cost allocation is all about.

Self-Test Questions

1. What is the goal of cost allocation?

2. Under what conditions should a single overhead department be divided into multiple cost pools?

3. On what theoretical basis are cost drivers chosen?

4. What two characteristics make a good cost driver?

5. What are the five steps in the cost allocation process?

6. What are the three primary methods of cost allocation? How do they differ?

PROFIT (MARGIN) ANALYSIS

Profit, or margin, analysis is a technique used to analyze the effects of volume changes on profit. (Accountants often refer to this technique as *cost-volume-profit [CVP] analysis.*) In public health settings, where the promotion of health and well-being is paramount, it is often considered inappropriate to worry about profits. However, any organization, whether in the public health community or not, must maintain the financial ability to accomplish its mission. Thus, even public health organizations must consider the financial implications of decisions regarding program and service offerings.

Furthermore, some mission-related services, such as environmental health services (primarily inspections) and some immunization programs, are provided on a fee basis. Such fees should be designed to cover the total costs of providing the service, so that governmental funding can be used exclusively to cover services for the needy. Profit analysis can be used to ensure that fee-based programs are full self-supporting. Furthermore, the ability of some services to cover total costs and generate profits creates additional financial resources that can be redeployed to other mission-related services that would otherwise be unfunded.

The value of profit analysis is that it uses estimates of costs, volume, and prices (fees) to estimate the profitability of individual departments (such as the dental clinic), programs (such as an immunization program), and services. Profit analysis is important in planning for the future. In essence, it is used to conduct “what if” analyses: What if volume is

greater than expected? What if the fees collected are less than anticipated? What if costs are higher than forecasted? The answers to these, and similar, questions provide public health managers with insights into the financial impact of the organization's programs and services. By ensuring a sound financial condition, managers can be confident that their organizations will be able to best serve the public interest.

Basic Data

Exhibit 3 summarizes the financial and other relevant data estimated for TCHD's Adult Influenza Immunization Program, hereafter called the AIIP. Our focus here is on forecasting the financial consequences of running the program next year, although the same type of analysis can also be performed on historical (last year's) data. The AIIP is administered at three locations: the main TCHD site and two satellite clinics. The best estimate for next year's volume is 25,000 doses, and the average fee (revenue) collected is estimated to be $25.

EXHIBIT 3 TCHD Adult Influenza Immunization Program (AIIP) Data

Volume	25,000 doses
Per immunization revenue	$ 25.00
Fixed direct costs:	
Labor:	
Program director	$ 30,000
Clinical personnel	$160,000
Total labor	$190,000
Variable direct costs:	
Vaccine	$ 12.50 per dose
Administrative supplies	$ 0.50 per dose
Total variable costs	$ 13.00 per dose
Indirect (overhead) costs:	
Administrative overhead	$ 82,400

The first category of costs is labor, which is a direct fixed cost to the overall immunization program. In addition to the adult flu program, the overall program includes roughly 40,000 children's immunizations and 10,000 foreign travel immunizations, for a total 75,000. The labor costs associated with the overall immunization program are allocated to the individual programs and services on the basis of the number of immunizations. Because the adult influenza immunization program represents about one-third of the overall immunization program, one-third of the director and clinical personnel (registered nurse [RN] and nurse/medical assistant) costs are charged to the AIIP. The overall immunization program has thee RNs and six assistants assigned with total payroll costs (salary and fringe benefits) of $480,000. One-third of this amount, or $160,000, is allocated to the AIIP. In total, the estimated labor costs for the AIIP are $190,000.

In addition to fixed direct (more-or-less) costs, the AIIP also has variable direct costs. The immunizations consist of both syringe and nasal spray forms and, on average, the cost of per dose is estimated at $12.50. With an expected volume of 25,000 doses, the expected total vaccine cost is 25,000 × $12.50 = $312,500. The cost of administrative supplies, consisting primarily of consent forms, side effect notification forms, and copying of insurance information (when needed) is estimated at $0.50 per vaccination, for a total of $12,500. Thus, the variable cost per dose (variable cost rate) is $12.50 + $0.50 = $13.00 and total variable costs are estimated to be 25,000 × $13.00 = $325,000.

In addition to the direct costs, the AIIP requires Administrative Services support, which is an overhead cost that must be allocated to the program. Administrative support consists of processing the immunization information into the state registry; billing, recording, and handling of fees collected; human resources support; and general administration. Unfortunately, it is difficult to allocate such costs, and hence TCHD does not have a good method for doing so. Overall, administrative costs constitute roughly 14 percent of TCHD's total expenditures, so if $14 of each $100 of costs is for administrative support, then $14/$86 or roughly 16¢ is needed for each dollar of non-administrative expense. With an expected $190,000 in labor costs and $325,000 in supplies costs, the AIIP is expected to require

$190,000 + $325,000 = $515,000 in non-administrative costs. At an allocate rate of $0.16 per dollar, the administrative support cost allocation is 0.16 × $515,000 = $82,400. TCHD's management recognizes that this allocation is not very precise and it plans to embark on a major study to (1) divide administrative overhead into multiple cost pools and (2) assign cost drivers that better reflect that actual utilization of administrative services.

Focusing solely on total costs does not provide much information regarding potential alternative financial outcomes of the AIIP. Total cost information is necessary and useful, but the detailed breakdown in Exhibit 3 gives us more insight into the possible financial outcomes of the program than is possible with a total cost focus. With the information given, we can break the costs down into fixed and variable components. Fixed costs, which are independent of volume, consist of labor and overhead costs and total $190,000 + $82,400 = $272,400. Variable costs, which are tied directly to volume, consist of vaccine and administrative supplies costs, for a total per dose cost of $12.50 + $0.50 = $13.00. Thus, the variable cost rate is $13.00. With volume estimated at 25,000 doses, total variable costs are estimated at 25,000 × $13 = $325,000.

In summary, the program's expected total costs (assuming 25,000 doses) have been broken down into two components: fixed costs and total variable costs, which when added together total $272,400 + $325,000 = $597,400. It should be obvious that these cost amounts are fundamentally different. The total fixed costs of $272,400 must be borne regardless of actual volume, as long as it stays within the relevant range of 24,000–26,000 doses. (If volume trends indicate a total below 24,000 doses, it is likely that the labor and overhead allocations will be cut back. Similarly, if volume trends indicate more than 26,000, these amounts would likely be increased.) Note, however, that total variable costs of $325,000 apply only to a volume of 25,000 doses. If the actual number of doses realized by the program is less than or greater than 25,000, total variable costs will be less than or greater than $325,000. (Of course, this is the primary reason that costs are classified as fixed and variable in the first place.)

To conduct a profit analysis, it is necessary to express total costs in equation form. For any volume within the relevant range, the total costs of the AIIP can be expressed as:

$$\begin{aligned} \text{Total costs} &= \text{Fixed costs} + \text{Total variable costs} \\ &= \$272{,}400 + (\$13 \times \text{Number of doses}). \end{aligned}$$

This equation, the program's underlying cost structure, explicitly shows that total costs depend on volume. To illustrate how this equation is used, consider three potential volumes for the program: 24,000; 25,000; and 26,000 doses:

Volume = 24,000:

$$\begin{aligned} \text{Total costs} &= \$272{,}400 + (\$13 \times 24{,}000) \\ &= \$272{,}400 + \$312{,}000 = \$584{,}400. \end{aligned}$$

Average cost per dose = $24.35.

Volume = 25,000:

$$\begin{aligned} \text{Total costs} &= \$272{,}400 + (\$13 \times 25{,}000) \\ &= \$272{,}400 + \$325{,}000 = \$597{,}400. \end{aligned}$$

Average cost per dose = $23.90.

Volume = 26,000:

$$\begin{aligned} \text{Total costs} &= \$272{,}400 + (\$13 \times 26{,}000) \\ &= \$272{,}400 + \$338{,}000 = \$610{,}400. \end{aligned}$$

Average cost per dose = $23.48.

When costs are expressed in this way, it is easy to see that higher volume leads to higher total costs. Each 1,000 increase in the number of immunizations increases total costs by $13,000. However, we have also calculated the average cost per immunization (per dose). For example, at 25,000 doses, the average cost is Total costs ÷ Number of doses = $597,400 ÷ 25,000 = $23.90. Because the program has a fixed cost component, higher volume leads to lower average costs.

In the next section, we are going to illustrate how the addition of revenues to the underlying cost structure allows managers to conduct profit analyses. However, before we do, we should note that the underlying cost structure alone provides valuable information about the AIIP. For example, suppose that the program was intended to serve the very poorest segment of the county's population, and hence the immunizations would be free. To help defray the cost of the program, TCHD plans to obtain local business sponsors (or a government grant). How much should be charged for sponsorship? Of course, the amount depends on the expected volume. If the expected volume is 25,000 doses, then the sponsorship amount should be set at roughly $597,000. If TCHD wanted to ensure that costs were covered should the program actually provide 26,000 immunizations, the amount should be set at roughly $610,000. Of course, the total amount could be broken down into smaller increments, and multiple sponsorships solicited.

Projected P&L Statement

To use the underlying cost structure as the basis for a profit analysis, it is necessary to add a revenue component. The program is expected, on average, to generate revenues of $25 per immunization. With this information, it is possible to create a profit forecast for the program. Profit forecasts are usually created using a statement called a *profit and loss (P&L) statement*. P&L statements, as with all managerial accounting data, are developed for specific purposes and hence can be formatted to best fit the situation at hand.

Typically, a profit analysis begins using the best available estimates for costs, volume, and prices (fees). These estimates can be thought of as the most likely, or "best guess," values, and the result is called the *base case*. The AIIP's base case projected P&L statement is shown in Exhibit 4. The bottom line projects the program's profit using base case (most likely estimate) values for costs, volume, and prices. Note that the format of a P&L statement for profit analysis purposes distinguishes between variable and fixed costs, whereas P&L statements for other purposes may not make this distinction.

EXHIBIT 4 Program Base Case Projected P&L Statement (based on 25,000 doses)

Total revenues ($25 × 25,000)	$625,000
Less: total variable costs ($13 × 25,000)	325,000
Less: fixed costs	272,400
Profit (loss)	$ 27,600

The projected P&L statement used in profit analysis contains four variables; three of the variables are assumed and the fourth is calculated. In Exhibit 4, the assumed variables are expected volume (25,000 doses), expected price ($25 per dose), and expected cost (as defined by the program's cost structure). Profit, the fourth variable, is calculated on the basis of the three assumed variables. In the base case situation, the expected profit is a positive $27,600. (A negative profit would indicate a loss.) Profitability is often expressed in percentage terms, or margin, which is defined as Profit ÷ Total revenues = $27,600 ÷ $625,000 = 0.044 = 4.4 percent. The 4.4 percent margin is telling us that each dollar of revenue, after expenses are taken out, results in 4.4¢ of profit.

At this point, you may be thinking "Wait a minute, the mission of TCHD is to promote health and safety, not to make money." You are right about the mission, but don't forget that in order to accomplish that mission TCHD has to have sufficient financial resources. The purpose of our analysis of the AIIP is to determine whether or not it is self-sustaining financially. If it is not, the program must be supported by financial resources obtained from external funding or from other programs that are profitable. If the program is profitable, then the excess can be used to support other worthy programs at TCHD.

The base case projected P&L statement in Exhibit 4 represents only one potential outcome: the profit that would result if all of the base case input values actually occur. That is, at the end of the program, there were exactly 25,000 doses administered, a $25 fee (on average) was collected on all 25,000 doses, fixed costs were exactly $272,400, and the variable cost rate was $13. What is the probability of that result being realized? We would say "quite low," very close

to zero, because the estimates used in the base case are just that—estimates—and there is a strong chance that the estimates are wrong. Another way of saying this is that the estimates are *uncertain*.

> Key Concept: P&L Statement
>
> A profit and loss (P&L) statement is a listing of revenues, expenses, and profit (revenues less expenses) for an organization, program, or service. There are several alternative formats that can be used, depending on the purpose of the statement. P&L statements can contain historical data, which report what has happed in the past, or forecasted data, which express expectations about the future.

At this point, we have examined only one possible scenario—the base case. A thorough analysis will consider alternative outcomes. But, before we do, it is useful to introduce another accounting concept, the *contribution margin*, which is defined as the difference between per unit price (revenue) and per unit variable cost (the variable cost rate). In this illustration, the per dose price is $25 and the variable cost rate is $13, so the contribution margin is $25 - $13 = $12. What is the inherent meaning of this contribution margin value of $12? The contribution margin has the look and feel of profit because it is calculated as revenue minus cost. However, because none of the fixed costs of providing the immunizations have been included in the cost amount used in the calculation, it is **not** profit. Rather, because only variable costs have been considered, the contribution margin is the dollar amount per dose available to cover the program's fixed costs. Only after fixed costs are fully covered does the contribution margin begin to contribute to profit.

With a contribution margin of $12 on each of the program's 25,000 immunizations, the projected base case *total contribution margin* is $12 × 25,000 = $300,000, which is sufficient to cover the program's fixed costs of $272,400 and then provide a $300,000 - $272,400 = $27,600 profit. After fixed costs have been covered, any additional doses contribute to the program's profit at a rate of $12 per dose. We will use the contribution margin concept again as our discussion of profit analysis continues.

Self-Test Questions

1. Construct a simple P&L statement like the one in Exhibit 4, and discuss its elements.

2. What is meant by *underlying cost structure*?

3. Define and explain the use of *contribution margin*.

BREAKEVEN ANALYSIS

> Key Concept: Breakeven Analysis
>
> Breakeven analysis has many applications in public health finance. In the context of profit analysis, breakeven analysis involves finding the value of an input variable that produces zero profit (or some profit target). For example, a dental clinic might break even when it has 1,000 patient visits. Breakeven analysis is also applied to variables other than volume. For example, a home health program might break even if its per visit costs are $70 or less.

Breakeven analysis is applied in many different situations. Generically, breakeven analyses are used to determine the value of a given input variable, such as volume, cost, or price, that produces some minimum desired result (typically some profit amount). For example, a laboratory might break even (make zero profit) on a particular type of blood test if the reimbursement (price) for that test is $23. Or, given a reimbursement amount, the laboratory might break even if it conducts 1,050 tests. For now, we will use breakeven analysis to estimate the minimum volume at which the AIIP becomes financially self-sufficient.

As mentioned in the previous section, the P&L statement format used for profit analysis is a four-variable model. When the focus is profit, the three assumed variables are cost, volume, and price, while profit is calculated. When the focus is volume breakeven, the same four variables are used, but profit is now assumed to be known while volume is the unknown (calculated) value.

To illustrate volume breakeven, the base case P&L statement presented in Exhibit 4 can be expressed in equation form as shown here:

Total revenues	- Total variable costs	- Total Fixed costs	= Profit
($25 × Volume)	- ($13 × Volume)	- $272,400	= Profit.

At breakeven the program's profit equals zero, so the breakeven equation can be rewritten this way:

$$(\$25 \times \text{Volume}) - (\$13 \times \text{Volume}) - \$272{,}400 = \$0.$$

Rearranging the terms so that only the terms related to volume appear on the left side produces this equation:

$$(\$25 \times \text{Volume}) - (\$13 \times \text{Volume}) = \$272{,}400.$$

Using basic algebra, the two terms on the left side can be combined because volume appears in both. The end result is this:

$$\begin{aligned} (\$25 - \$13) \times \text{Volume} &= \$272{,}400 \\ \$12 \times \text{Volume} &= \$272{,}400 \\ \text{Contribution margin} \times \text{Volume} &= \$272{,}400 \\ \text{Breakeven volume} = \$272{,}400 &\div \$12 = 22{,}700. \end{aligned}$$

Note that the left side of the breakeven equation contains the contribution margin, $12, multiplied by volume. Thus, the program will break even when the total contribution margin ($12 × Volume) equals fixed costs. Solving the equation for volume results in a breakeven point of 22,700 doses. Any volume greater than 22,700 doses produces a profit for the program, while any volume less than 22,700 results in a loss.

The logic behind the breakeven point is this: Each immunization, on average, brings in $25, of which $13 is the variable cost to administer the dose. This leaves a $12 contribution margin from each immunization. If TCHD sets the contribution margin aside for the first 22,700 immunizations, it would have $272,400, which is the amount needed to cover the program's fixed costs. Once breakeven volume is achieved, each additional dose's contribution margin flows directly to profit. If the program achieves its base case volume estimate of 25,000 immunizations, the 2,300 doses above the breakeven point result in a total profit of 2,300 × $12 = $27,600, which matches the profit shown on the program's projected base case P&L statement in Exhibit 4.

This breakeven analysis contains three important assumptions:

1. The average revenue per immunization is independent of volume. In other words, volume increases are not attained by lowering the price, and price increases are not met with volume declines.
2. Costs can be reasonably subdivided into fixed and variable components.
3. Breakeven falls within the relevant range, so the underlying cost structure holds at the breakeven volume.

Breakeven analysis is often performed in an iterative manner. After the breakeven volume is calculated, managers must determine whether the resulting volume can realistically be achieved at the price assumed in the analysis. If the fee (price) appears to be unreasonable for the breakeven volume, a new price has to be estimated and the breakeven analysis repeated. Likewise, if the cost structure used for the calculation appears to be unrealistic at the breakeven volume, operational and cost assumptions should be changed and the analysis repeated again.

Self-Test Questions

1. What is the purpose of breakeven analysis?

2. What is the equation for volume breakeven?

3. Why is breakeven analysis often conducted in an iterative manner?

SCENARIO ANALYSIS

We mentioned earlier that uncertainty is present whenever we are forecasting the future. In the situation of the AIIP analysis, there are several assumptions that need to be questioned. One excellent method for recognizing uncertainty is *scenario analysis*, which examines results under alternative assumptions about the values used in a profit analysis. This technique of changing the value of an assumed input variable to see the effect on some output variable, profit in this case, is also called *sensitivity analysis*. Typically, such analyses focus on those values that public health managers believe to be the most uncertain. In other words, the inputs that are the most difficult to forecast with any confidence. In our illustration, those variables are volume and price.

> Key Concept: Scenario (Sensitivity) Analysis
>
> In scenario analysis, in addition to base case values, best and worst case values are chosen for the input variables (such as volume) that are considered to be most uncertain. Then, these input values are used to create the best and worst case profit estimates. The range of output values (profit) in a scenario analysis gives managers an idea of the overall financial uncertainty (risk) of the service being analyzed.

Volume

In almost all health services settings, volume is one of the most uncertain variables. We assumed a relevant range of 24,000 to 26,000 doses, so the underlying cost structure is assumed to be valid within that range. Another way of saying this is that we expect fixed costs to be $272,400 and the variable cost rate to be $13 regardless of volume as long as it falls between 24,000 and 26,000 doses. In a scenario analysis, we assume a worst case, a most likely (expected or base) case, and a best case. Then use the estimates for volume for each case. Here, we assume that the worst possible volume outcome is 24,000 immunizations, the base case forecast is 25,000, and the best case volume is 26,000. Here is the expected profit in each scenario, recognizing that profit can be calculated using the contribution margin concept as follows:

(Contribution margin × Volume) - Fixed costs = Profit
($12 × Volume) - $272,400 = Profit.

Worst Case: Volume = 24,000

($12 × 24,000) - $272,400 = $15,600.

Base Case: Volume = 25,000

($12 × 25,000) - $272,400 = $27,600.

Best Case: Volume =2 6,000

($12 × 26,000) - $272,400 = $39,600.

Note that worst case expected profit is $15,600, the base case expected profit is $27,600 (which should be no surprise), while the best case profit estimate is $39,600. This scenario analysis, which focuses on volume, tells us that the profitability of the program is highly sensitive to volume. In fact, a 1,000 change in volume results in a $12,000 change in profitability, which validates the contribution margin concept that tells us that each single dose change in volume will impact profit by the contribution margin, $12.

Price

Another variable of interest is the average revenue received for each immunization. What would happen if we were able to charge $30 per dose? Or, perhaps a drug store chain is offering immunizations at $25 a piece, so to better serve the community, TCHD decides to offer immunizations at only $20 per dose. Here are the results of this scenario analysis:

([Price - Variable cost rate] × 25,000) - Fixed costs = Profit.
([Price - $13] × 25,000) - $272,400 = Profit.

.

Worst Case: Price = $20

($7 × 25,000) - $272,400 = ($97,400).

Base Case: Price = $25

($12 × 25,000) - $ 272,400 = $27,600.

Best Case: Price = $30

($17 × 25,000) - $272,400 = $152,600.

Again, the base case expected profit is $27,600, while the best case profit estimate is $152,600 and the worst case estimate is a $97,400 loss. (The parentheses indicate a negative profit, or loss.) It is obvious that the profitability of the immunization program is even more sensitive to price (fee charged) than it is to volume. Here, a $5 change in price leads to a $125,000 change in profitability, which means that each dollar change in price impacts profit by $25,000. Of course, this results stems from the fact that our analysis assumes a volume of 25,000 immunizations. (To perform a better comparison of the sensitivities to volume and price, we should really compare the same percentage change in both inputs. For example, what happens to profit when volume or price falls by one percent. Thus, we would compare a 250 drop in volume with a $0.25 drop in price.) Why don't you do this and see what happens.

Before we move to the next section, a few words about pricing might be appropriate. There are two primary approaches to setting prices on those services that are fee based. *Full cost pricing* recognizes that to remain financially viable in the long run, a program or service must be priced to recover all costs associated with operating that activity. Thus, the price that is set must include the following costs: (1) the direct variable costs of providing the program or service, (2) the direct fixed costs, and (3) the appropriate share of the overhead expenses of the organization.

Key Concept: Full versus Marginal Cost Pricing

Prices can be set using two primary methods. In full cost pricing, the price is set to recover all costs associated with a program or service, including fixed and variable and direct and indirect. In marginal cost pricing, the price is set to recover only the marginal cost (the cost of the next unit of output). Typically, the marginal cost of providing one additional unit of output is the variable cost. Obviously, a price based on full costs is typically higher, sometimes much higher, than one based on marginal costs.

Because of the difficulties inherent in allocating overhead costs, the full cost of an individual program or service is difficult to measure with precision and hence has to be viewed with some skepticism. Nevertheless, in the aggregate, total revenues must cover all direct and indirect (overhead) costs, and hence revenue producing programs plus government and grant revenues must cover all costs of an organization.

The second approach to setting prices is *marginal cost pricing*. In economics, the *marginal cost* of an item is the cost of providing one additional unit of output. For example, the AIIP is expected to provide 25,000 immunizations. Its marginal cost, based on dose as the unit of output, is the cost of providing the 25,001st dose. In this situation, the fixed costs, both direct and overhead, have already been covered by fees collected from the first 25,000 doses, so the marginal cost that must be covered consists solely of the variable cost associated with an additional one dose. The marginal cost, therefore, is the variable cost rate, which consists of the $13 in expenses required for the vaccine and administrative supplies. Obviously, the marginal cost associated with one additional dose ($13) is far less than the full cost ($23.90 at a volume of 25,000 doses), which includes all direct and indirect costs.

Many proponents of government programs such as Medicare and Medicaid argue that payments to non-governmental providers should be made on the basis of marginal rather than full costs. The argument here is that some price above marginal cost is all that is required for the provider to "make money" on government-sponsored patients. By implication, nongovernmental payers would cover all base costs. However, what would happen if all payers for a particular program or service set reimbursement rates based on marginal costs? If such a situation occurred, the organization would not recover its total costs, including both direct and overhead, and hence would ultimately fail.

Should any prices be set on the basis of marginal costs? In **theory**, the answer is no. For prices to be equitable, all payers should pay their fair share in covering a program's or service's total costs. Furthermore, if *marginal cost pricing* should be adopted, which payer(s) should receive its benefits by being charged lower prices? Should it be the government because it is taxpayer funded, or should it be the last payer to contract with the provider? There are no good answers to these questions, so the easy way out, at least conceptually, is to require all payers to pay full costs and hence equitably share the burden of the organization's total costs.

However, as a practical matter, it may make sense for public health organizations to occasionally use marginal cost pricing to provide needed programs or services to a patient clientele that is unable to pay full costs. To remain financially secure in the long run, however, public health organizations must realize revenues that cover their full costs. Thus, either marginal cost pricing must be a temporary measure or the organization must employ *cross-subsidization* (*price shifting*). In such situations, some patients or covered populations are overcharged for services, as compared to full costs, while others are undercharged. In public health, the cross-subsidization most commonly occurs when government funding covers the full cost of programs or services while the individuals receiving the benefit are paying less than full cost or even nothing.

Other Single Variables

Of course, we could perform many more scenario analyses. For example, fixed costs could turn out be more or less than indicated by the base case analysis. Or perhaps the cost of administrative supplies could be as low as $0.25 or as high as $1.00 per immunization. Each of these uncertainties could be examined in using scenario analysis. However, in analyses like our AIIP example, it is all too easy to develop too much information, and managers must be careful that "data overload" does not make the decision process more difficult rather than easier. Furthermore, scenario analyses should focus on those variables that are most uncertain; that is, the variables that are most difficult to estimate.

Two Variable Scenario Analyses

Thus far, we have conducted two scenario analyses focusing on a single variable: volume or price. We can combine the two (or even more) uncertain variables into a single analysis as follows:

$$([\text{Price} - \$13] \times \text{Volume}) - \$272{,}400 = \text{Profit}.$$

.

Worst Case: Price = $20, Volume = 24,000

$$(\$7 \times 24{,}000) - \$272{,}400 = (\$104{,}400).$$

Base Case Price = $25, Volume = 25,000

$$(\$12 \times 25{,}000) - \$\ 272{,}400 = \$\ 27{,}600.$$

Best Case Price = $30, Volume = 26,000

$$(\$17 \times 26{,}000) - \$272{,}400 = \$169{,}600.$$

We see here that when two (or more) variables are considered to be uncertain, the overall profitability uncertainty increases. The range of uncertainty when only volume is considered is Best case profit - Worst case profit = $39,600 - $15,600 = $14,000; the range when only price is considered is $152,600 - (-$97,400) = $250,000; and the range when both are considered is $169,600 - (-$104,400) = $274,000. In essence, the more input variables that are uncertain, the greater the overall uncertainty in profitability.

Self-Test Questions

1. Briefly describe the mechanics of a scenario analysis.

2. What is the purpose of a scenario analysis?

3. Explain the difference between full cost and marginal cost pricing.

4. What is cross-subsidization? Does it occur in public health settings?

MARGINAL ANALYSIS

Marginal analysis involves analyzing the impact of new volume to an existing program. To illustrate, assume a large employer in Tangelo County wants to contract with the Health Department to provide immunizations to 200 of its employees. The shots would be given at one of the AIIP locations during regularly scheduled hours. Specific times would be established for this group, which would not interfere with access available to other program participants.

The assumption here is that the 500 immunizations would be new, or *incremental* or *marginal*, as opposed to part of the 25,000 immunizations considered in the base case volume estimate. That's the good news. The bad news is that the employer would pay only $18 per immunization, compared to the $25 fee charged to walk-ins. What would be the impact of accepting the employer's offer?

To begin the analysis, let's first remember that the average cost per immunization based on 25,000 doses is $23.90. This was calculated earlier when total costs and average costs were estimated for volumes of 24,000, 25,000, and 26,000. Thus, at first blush, the employer's proposal appears to be unacceptable. First and foremost, $18 is less than the full cost of providing service and the program would lose roughly $23.90 - $18 = $5.90 per dose. (This is only a rough estimate because the average cost per dose decreases as the number of doses increase.) However, before TCHD's managers reject the proposal, they must examine it in more detail.

Key Concept: Marginal Analysis

Marginal analysis is used to analyze the impact of adding volume to an existing base. If the added volume does not cause total volume to exceed the relevant range, the proposal can be assessed quickly by comparing the price to the marginal cost, typically the variable cost rate.

Although each new (marginal) dose is expected to bring in only $18, compared with $25 on the program's other patients, the *marginal cost* is the variable cost rate of $13. (As discussed previously, the marginal cost is the cost of the next unit sold.) The program's $272,400 in fixed costs will be incurred whether the offer is accepted or rejected, so these costs are not relevant to the decision. Because the contribution margin on the proposal is $18 - $13 = $5 per dose (a positive amount), each immunization will contribute to the program's recovery of fixed costs and ultimately flow to profit. In this situation, because fixed costs are already covered by the existing 25,000 immunizations, the $5 contribution margin of each marginal dose (the marginal contribution margin) will flow directly to profit. Thus, from a financial perspective, the offer must be seriously considered.

Note that this conclusion is based on the assumption that the relevant range of volumes is from 24,000 to 26,000 immunizations, and hence the current level of fixed costs can support the added volume of 500 doses. If the proposal were expected to add 5,000 doses instead of 500, then perhaps new (marginal) fixed costs would have to be incurred. In this situation, the marginal cost of each new visit would be $13 plus some additional per dose fixed cost, which would change the numbers used in the analysis.

EXHIBIT 5 AIIP Marginal Analysis Projected P&L Statement (based on a total of 25,500 doses)

Base case revenues ($25 × 25,000)	$625,000
Plus: marginal revenues ($18 × 500)	9,000
Total revenues	$634,000
Less: total variable costs ($13 × 25,500)	331,500
Less: total fixed costs	272,400
Profit (loss)	$ 30,100

To verify the positive impact of the proposal, consider the P&L statement in Exhibit 5. Here, we have combined the existing 25,000 base case volume with the additional 500 doses, for a total of 25,500. The revenues had to be split between the old and new groups because of the price difference. However, the cost structure is assumed to hold, so it is the same, except for the fact that 25,500 doses are now expected. The end result is that the program's profit is now expected to be $30,100 instead of the $27,600 shown in Exhibit 4 for the base case (25,000 immunizations).

Note that the additional profit expected from the proposal is $30,100 - $27,600 = $2,500. We could have arrived at this result more easily by merely noting that each of the 500 new immunizations has a contribution margin of $5, so the total marginal contribution margin is expected to be 500 × $5 = $2,500. Because the existing 25,000 immunizations are more than sufficient to cover fixed costs, the entire amount of the additional contribution margin flows to profit.

Self-Test Questions

1. What is the impact of new volume on fixed costs, the variable cost rate, and total variable costs?

2. Describe marginal analysis.

KEY CONCEPTS

A critical part of managerial accounting information is the measurement and allocation of costs. In addition, with an estimate of the costs associated with a particular program or service, public health managers can examine whether or not a program is self-sustaining financially or must use resources generated from other activities. Here are the key concepts:

- Costs can be classified by their relationship to the *amount of services provided*. *Variable costs* are costs that are expected to increase and decrease with volume (patient days, number of visits, and so on), while *fixed costs* are costs that are expected to remain constant regardless of volume (within some *relevant range*).

- The relationship between cost and activity (volume), typically expressed as an equation, is called *underlying cost structure*.

- Costs can also be classified according to their relationship to the *unit being analyzed*. *Direct costs* are the unique (exclusive) resources used only by one unit of an organization, such as a department, and therefore are fairly easy to measure. *Indirect (overhead) costs*, in contrast, are inherently difficult to measure because they constitute a shared resource of the organization, such as administrative costs.

- *Cost allocation* is a critical part of the costing process because it addresses the issue of how to assign the costs of support activities to the revenue-producing (patient services) departments. The *goal* of cost allocation is to assign all costs of an organization to the activities that cause them to be incurred.

- A *cost pool* is a dollar amount of overhead services to be allocated. In general, a cost pool consists of the total costs of one support department. However, under some circumstances, it may be better to divide the costs of a single support department into multiple cost pools.

- A *cost driver* is the basis for making allocations from a cost pool. Cost drivers are chosen on the basis of their positive *correlation* with the amount of overhead services used by the patient services departments.

- A good cost driver will be perceived by department heads as being *fair* and will promote *cost reduction* within the organization.

- There are three primary *methods for cost allocation*: direct, reciprocal, and step down. Regardless of the allocation method, all costs eventually end up in the patient services departments.

- The *direct method* recognizes no intrasupport department services. Thus, support department costs are allocated exclusively to patient services departments.

- The *reciprocal method* recognizes all intrasupport department services. However, the reciprocal method is the most difficult to understand and to implement.

- The *step-down method* represents a compromise between the direct and reciprocal methods that recognizes some of the intrasupport department services.

- *Profit analysis*, often called *cost-volume-profit (CVP) analysis*, is an analytical technique used to analyze the effects of volume changes on revenues, costs, and profit.

- In a profit analysis context, a *projected profit and loss (P&L) statement* is a profit projection that uses assumed (estimated) values for volume, price, and costs.

- *Contribution margin* is the difference between unit price and the *variable cost rate*, or per unit revenue minus per unit variable cost. Hence, contribution margin is the per unit dollar amount available to first cover a program's fixed costs and then to contribute to profits.

- *Breakeven analysis* is used to estimate the volume needed (or the value of some other variable) for a program or service to break even in profitability.

- *Scenario (sensitivity) analysis* is used to determine the impact of input value uncertainty on program or service profitability.

- There are two primary bases for setting prices on services that charge fees. In *full cost pricing*, prices are set to cover all (direct and indirect) costs, while under *marginal cost pricing*, prices are set to cover only marginal costs (typically only variable costs).

- In *marginal analysis*, the focus is on the incremental (marginal) profitability associated with increasing or decreasing volume.

This tutorial contains a great deal of detail, but the most important concept to remember is that good cost estimates and profit analyses are critical to good managerial decision making. These techniques allow public health managers to determine those programs and services that are self-supporting and contribute to the financial resources of the organization as opposed to those are require external financial support. This knowledge allows managers to better allocate resources within the organization and hence supports mission accomplishment.

This module was prepared by Louis C. Gapenski, PhD, Department of Health Services Research, Management and Policy, University of Florida. It was supported by a grant from the Robert Wood Johnson Foundation.