

Flexible Budgeting and Variance Analysis

GOALS OF THIS CHAPTER

1. Explain the traditional approach to variance analysis in health care organizations.
2. Introduce the concept of a flexible budget and its use for adjusting variances for the impact of changes in patient volume.
3. Define the price, quantity, and volume variances, which are broadly used in industry, and apply them to the health care setting.
4. Define other variances that can provide managers with additional information.
5. Provide both a conceptual framework for variance analysis, and an analytical method for calculating variances.
6. Discuss the issues of whether variances are controllable or noncontrollable.
7. Provide a framework for when to investigate variances.
8. Consider the possible alternative actions to be taken in response to variances.
9. Explain the calculation of revenue variances and the role of market size, market share, patient mix, and price variances.

KEY APPLICATION QUESTIONS

1. How can I determine if my organization is inefficient or simply spending more money than planned for legitimate reasons related to patient care?
2. What is the point of getting a variance report every month for a budget that was created over 4 months ago?
3. How can I use variance analysis to help monitor my managed care contract?

INTRODUCTION

Health care organizations have made tremendous strides in recent years in the area of *budgeting* and *variance* reporting and analysis. Budgeting improves outcomes by forcing the organization to consider alternative approaches and plan ahead for the coming year. Variance analysis is also essential for the management control function. The difference between a budgeted amount and the amount that actually results represents a variance. Managers investigate variances to determine their causes. Actions taken in response to variances can often dramatically improve the future operations of a health care organization.

Some variances are *controllable*. Managers can take actions to correct elements of operations that are out of control. This will help avoid unfavorable variances in the future. The primary focus of variance analysis should not be on assigning blame for overspending. Rather, the goal is to uncover the cause of problems that create overspending, so that the problems can be minimized in the future.

Other variances are not controllable. For example, the cost of an expensive essential supply item may have increased substantially and unexpectedly. Even if the organization cannot avoid the higher expense of the supply, variance information is essential to the overall management and well-being of the organization. It may be necessary to revise plans, for example, reduce costs in areas that are somewhat more discretionary to offset the higher expense for this essential supply item.

Such reductions may not seem fair to managers of the discretionary areas whose expenses are revised downward. However, the overall financial stability of the organization dictates that variances not be ignored. Overspending in some areas without offsetting reductions in others will lead to negative year-end results. Managers must consider the magnitude of the variances and decide whether the organization can sustain such negative results without making midstream changes.

Historically, variance analysis has focused on comparisons of actual results and budgeted ex-

pectations for each line in the budget of each cost center in the health care organization. Such comparisons are generally provided to managers for the current month and cumulatively for the year-to-date.

In the past decade, in an effort to understand variances better and to improve managerial efficiency in correcting the underlying causes of variances, there has been a movement toward a variety of improvements in variance analysis. For example, Kropf provides a method for calculating physician cost variances in an article that is Reading 9-1 in *Issues in Cost Accounting for Health Care Organizations*,¹ the companion to this text. That article looks at each physician's variance attributable to the mix of patients and to the cost of treating those patients. Many health care organizations have started to use such physician variance analyses as a cost control technique. In Reading 9-2 in *Issues in Cost Accounting for Health Care Organizations*,² Holswade and Vogel discuss improvements in variance analysis for pharmacy departments. Finally, Reading 9-3 in *Issues in Cost Accounting for Health Care Organizations*³ introduces the technique of rolling variance reports.

A major recent improvement in health care variance analysis has been the introduction of *flexible budget* variance analysis. This approach places emphasis on the volume of patients actually treated by the health care organization. A budget is created based on an anticipated patient volume. If that volume is not attained, it may be misleading to compare the actual revenues and expenses to the original budget. Flexible budgeting adjusts the budget based on the actual patient volume. Flexible budget variance analysis calculates variances based on the adjusted flexible budget.

This chapter starts with a conceptual discussion of the traditional and flexible budget approaches to variance analysis. It then provides examples of calculations of variances. Next, the chapter focuses on the use of variance analysis for management control. Budgets are simply plans that are carried out by people. It is vital to consider the people in the process and their moti-

vations and incentives. Unless people are willing to make an effort to meet the budget, it has little chance of being an effective management tool.

The final section of this chapter deals with *revenue variances*. Inherently, a cost accounting text is primarily concerned with expenses rather than revenues. Variance analysis traditionally has been used primarily for consideration and control of expenses. However, the tool does have significant potential application for understanding and controlling variations in revenues of health care organizations.

TRADITIONAL VARIANCE ANALYSIS

The traditional health care organization variance report is a line-by-line comparison of budgeted and actual expenses for each department or cost center of the health care organization. The report typically shows monthly activity and year-to-date cumulative results. An example of such a variance report is shown in Table 9-1.

In the table, we can see that a comparison is made for each line of the original budget for this cost center. Managers are held accountable for explaining why variances arose. For example, in Table 9-1, we can see that regular salaries for this general surgery unit were budgeted to be \$38,320, but were actually \$43,082. The unfavorable \$4,762 is 12 percent over the budget. Why did that happen?

There are many possible causes of variances. More staff may have been needed because there were more patients or because the patients were sicker than expected. There may have been an outbreak of the flu, causing much higher than expected sick leave among the staff. Perhaps the variance was attributable to a raise given to staff that was higher than expected. It is possible that an employee resigned and was replaced by a new employee at a higher salary. It is possible, however, that there were inefficiencies. Late arrival and long coffee and lunch breaks translate into more staff hours.

The manager has a difficult job of determining which of these and many other possible factors

were responsible for what portion of the variances. In most cases, variances are not the result of one cause, but rather of many different factors that interplay, sometimes combining to result in a large variance and sometimes offsetting each other, masking true underlying problems.

Variance analysis is not performed by the financial departments for the line departments of health care organizations. Accountants can measure the amount of the variances, but they cannot explain their causes. Such explanation requires investigation by someone knowledgeable about the department. Further, it requires the experience and judgment of a manager who understands the many specific details and factors that affect the spending of each department. Therefore, variances are analyzed and explained by cost center managers.

However, as noted earlier, the focus is not on blame. Organizations that use variance analysis to assign blame for poor outcomes rather than primarily to improve future outcomes risk poor morale, which is likely to have a negative impact on overall long-term cost control. The focus of variance analysis is to allow us to control better those costs that are controllable and to be aware of unexpected increases in noncontrollable costs.

Traditional variance analysis is not an excellent approach to understanding the spending of health care organizations. By providing managers with just the difference between actual and budgeted costs for each line item, even an experienced unit or department manager does not know where to begin investigating. However, mechanical accounting calculations could subdivide the variance into a number of elements. This can help managers to understand and explain the causes of variances.

We can look at the portion of each line-item variance caused by paying a higher price than expected for a resource versus the portion caused by using more of the resource. We can look at whether we used more per patient or had more patients. We can look at whether we used more per patient because the patients were sicker than expected. As we mechanically subdivide the variance, we make the manager's job easier, we tend

Table 9-1 Sample Variance Report: General Surgery Cost Center

Account No./Description	This Month			Year-to-Date		
	Actual	Budget	Variance	Actual	Budget	Variance
311. Revenue						
010 Routine	148,607-	146,843-	1,764	1,310,469-	1,321,584-	11,115-
020 Other	2,459-	2,056-	403	20,277-	18,493-	1,784
(a) Total operating revenue	151,066-	148,899-	2,167	1,330,746-	1,340,077-	9,331-
611. Expenses						
010 Salaries—regular	43,082	38,320	4,762-	341,418	344,886	3,468
020 Salaries—overtime	729	972	243	7,344	8,748	1,404
030 FICA	2,922	2,621	301-	23,252	23,587	335
040 FICA	284	253	31-	2,253	2,276	23
050 Life insurance	91	81	10-	726	733	7
060 Other fringes	141	162	21	1,446	1,461	15
(b) Total employment costs	47,249	42,409	4,840-	376,439	381,691	5,252
300 Pt care supplies	2,012	1,998	14-	16,257	17,981	1,724
400 Office supplies/forms	438	579	141	6,040	5,213	827-
500 Seminars/meetings	135	50	85-	480	447	33-
600 Noncapital equip	250	74	176-	532	666	134
700 Maintenance repair	32	67	35	610	600	10-
800 Miscellaneous	—	48	48	381	432	51
900 Interdepartmental	582	530	52-	4,926	4,770	156-
(c) Total materials & supplies	3,449	3,346	103-	29,226	30,109	883
(d) Total operating costs (d = b + c)	50,698	45,755	4,943-	405,665	411,800	6,135
(e) Contribution from operations (e = a + d)	100,368-	103,144-	2,776-	925,081-	928,277-	3,196-
(f) Contribution % of revenue (f = (e/a) × 100)	66.44%	69.27%	2.83%-	69.52%	69.27%	0.25%

to improve the accuracy of the explanations of the causes of variances, and we improve the organization's ability to control its costs. Flexible budget variance analysis provides the tools to make these subdivisions in each line-item variance.

FLEXIBLE BUDGET VARIANCE ANALYSIS

The traditional approach to variance analysis suffers from a fatal flaw: it fails to account directly for the impact of volume changes on cost. Based on the discussion in earlier chapters, it should be obvious that as the volume of patients rises, variable costs must rise. Just as obviously, if volume falls, we would expect that variable costs will fall.

Suppose that a cost center actually incurs salary costs of \$110,000, but the budget was only \$100,000. There is a \$10,000 unfavorable (U) variance.

Budget	Actual	Variance
\$100,000	\$110,000	\$10,000 U

The cost center spent \$10,000 more for labor than had been budgeted. Are labor costs out of control? Does the cost center manager need to take strong actions to prevent the excessive use of labor hours from continuing in future months?

The difficulty in answering these questions is that the \$10,000 variance has been calculated without consideration of the patient volume. Suppose that 1,000 patients had been anticipated, but there were actually 1,200 patients treated. If some of the labor costs are variable, we would expect to spend substantially more than \$100,000 because the volume has increased by 20 percent. It would be desirable to have a system that automatically segregates the portion of the variance that is simply attributable to changes in volume. The manager would then be able to investigate more easily the causes of the remaining portion of the variance.

Flexible Budgeting

A flexible budget is one that is adjusted for volume. An initial budget is based on an antici-

pated volume of activity. In preparing the budget, one could also prepare alternate budgets based on a range of possible volume outcomes. Thus, we could plan a budget assuming 1,000 patients, but also create alternate budgets showing the expected costs for 800, 900, 1,100, or 1,200 patients. Each of these would be considered to be a flexible budget based on the costs that we would expect to incur at the specified volume.

In preparing flexible budgets, it is essential to bear in mind that fixed costs do not vary with changes in volume, and variable costs do vary with volume. Therefore, the reason for different budgets at different volumes is because variable costs rise or fall with volume. This means that a flexible budget system must develop each budget based on a knowledge of which costs are fixed and which are variable.

A Naive Approach to Flexible Budgeting

Some health care organizations recognize the problems of comparing actual results with the original budget. However, rather than determining the underlying fixed and variable cost relationships, they attempt to solve the problem by treating all costs as if they were variable.

A naive approach to creating flexible budgets would allow all items in a budget to rise by 10 percent if volume is up by 10 percent. The problem with this overly simplistic adjustment is that fixed costs should not be rising at all as volume increases.

Such a budget adjustment is excessively lax. Once managers realize how that system works, they will know that there is substantial slack in their budgets during periods of rising volume. It will not take managers long to find ways to spend that slack, or, if a bonus system is in place, the resulting bonuses will be unduly generous.

On the other hand, what would happen when volume was lower than expected? Unlike the traditional system, which fails to require a manager to generate any cost reduction when volume falls, a naive approach to flexible variance analysis will assume that both variable and fixed costs will fall in proportion to volume reduc-

tions. Therefore, it will call for too much of a cost cutback.

Such naive approaches appear attractive for several reasons. First, they flex the budget with volume changes. Second, the simplicity of increasing or decreasing the budget by the same percentage as the change in volume appears to make sense at first glance. Finally, they do not require accurate breakdowns of which costs are fixed and which are variable. However, such approaches do not provide accurate information to managers.

Workable Flexible Budgets

A workable flexible budget system must first be able to identify which costs are fixed and which are variable. It must then use that information to allow volume changes to affect the variable costs in the budget, while leaving the fixed costs unchanged.

Most health care organizations that use flexible budgeting do not calculate a series of hypothetical flexible budgets at different potential volumes of activity. Instead, they wait until after an accounting period (such as a month) has ended, and then measure the actual volume. Based on that specific actual volume, a flexible budget can be developed.

The difference between the total budget for the line item and the flexible budget is referred to as a *volume variance* because it is attributable to a change in volume. The flexible budget is compared with the actual costs incurred to determine the extent of the remaining variance. If that variance is substantial, managers would need to investigate it and attempt to explain what caused it. Note that the volume variance is part of the total variance for that item, as is seen in Figure 9-1. The total variance has been divided into two parts, referred to as the flexible budget variance and the volume variance.

Determining whether a cost is fixed or variable is not always easy. In health care organizations, a large part of the overall cost is represented by staffing, which may well be neither strictly fixed nor strictly variable. Staffing may be fixed up to a point, and then require an incremental increase.

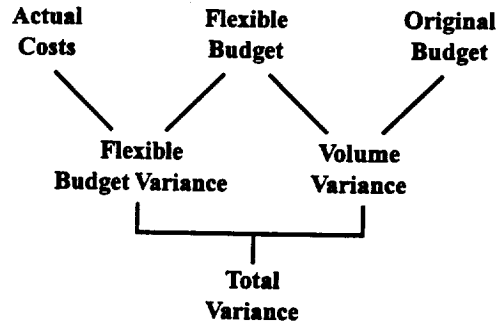


Figure 9-1 The Flexible Budget and Volume Variances

For example, a unit may need seven nurses on a shift unless volume rises or falls by 500 patient days, at which point another nurse must be added or removed. Obviously, trying to build such patterns into a variance analysis system creates substantially increased complexity. As with all elements of cost accounting, you must consider whether the extra benefit of improved information is worth the cost of the higher level of sophistication.

At a minimum, however, one would want to examine each line item of each cost center budget and decide whether the resources represented by that line primarily are fixed or variable in nature. It might be worthwhile to restructure budgets to show staff that is fixed on a separate line from staff that varies with volume. Variable staff need not vary patient by patient. However, unlike managers and supervisors, they would be a category of staff that can be increased or decreased in response to changes in patient volume.

Price and Quantity Variances

The use of a flexible budget allows the organization to calculate mechanically the portion of each line-item variance caused simply by changes in volume and the remaining portion caused by other factors. This still does not bring health care organizations to the level of variance analysis sophistication utilized in most industrial organizations.

Flexible budget variance analysis calls not only for adjusting the variance for volume, but also for dividing that flexible budget variance

into the portion that results from the price of the inputs, as opposed to the portion resulting from the quantity of input used to produce each unit of output. These *price* (or *rate*) and *quantity* (or *use* or *efficiency*) *variances* represent the next level of sophistication. (See Figure 9-2.)

Essentially, we can break down any variance into three main causes: more or fewer units of activity (patients, lab tests, etc.) than expected; higher or lower price paid for resources consumed; or more or fewer resources consumed per unit of activity. The first type of variance is automatically segregated by use of a flexible budget approach, which subdivides the total variance into a volume variance and an additional unexplained portion. In Figure 9-2, the volume variance is the difference between the original budget and the flexible budget. The additional, unexplained portion can also be segregated into a price variance by comparing the actual costs with the actual quantities at the budgeted price, and into a quantity (or use) variance by comparing the actual quantities at the budgeted price with the flexible budget.

A number of health care organizations have begun to move in this direction. The benefit from expanding the level of detailed information is that it is easier to isolate problem areas. Small variances can be quickly disposed of, and managerial attention can focus on the more serious problems. The implications for action differ substantially if it is the purchase price of a supply rather than the amount of the supply used that is creating a supply cost variance. Furthermore, by

having more detailed variances, one quickly can determine whether it is in fact the price of a resource or the quantity consumed that requires investigation.

At times, variances will tend to offset each other. If the volume of patients is declining while the cost per patient is rising, the total line-item cost will show little variance. Adjusting for volume, as discussed above, will remove that problem. However, if the price of inputs is falling while the quantity used per patient is rising, the two effects can offset each other. Even with a volume-adjusted variance, we will not detect the increasing consumption per patient.

By dividing the variance for any line item into the portion attributable to the price of the inputs and the portion due to the quantity of inputs consumed, our ability to detect problems and control them is greatly enhanced. The cost of such information is not substantial, because this form of variance analysis requires only information that is readily available in the health care organization accounting system, and the costs of calculating and reporting the additional variances are minimal.

Overhead Variances

The above discussion of volume, price, and quantity variances generally is applied to direct labor and direct materials. Obviously, actual overhead costs will also vary from budgeted costs on frequent occasions. It is necessary to

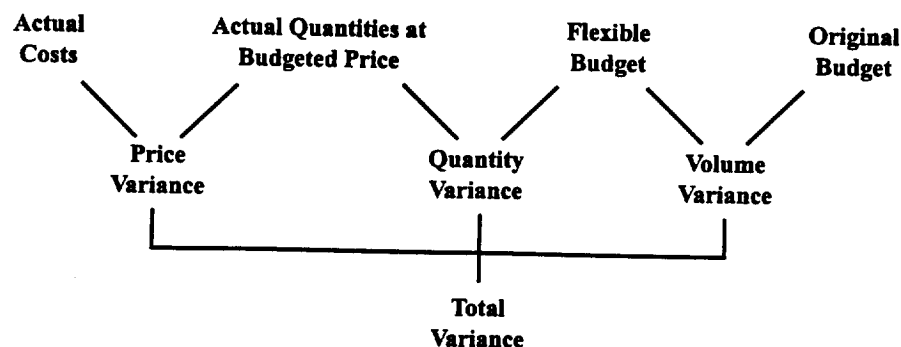


Figure 9-2 The Price, Quantity, and Volume Variances

consider variances related to both variable overhead costs and fixed overhead costs.

Variable overhead costs are similar to direct labor and direct materials in many respects. A volume variance can be calculated. Greater volume would likely result in greater variable overhead costs and, therefore, a volume variance. In some instances, a price and quantity variance can also be calculated. These are often called spending and efficiency variances.

Calculating such variances requires knowledge of the price and quantity of inputs used per unit of output. These are often not known independently. For example, for 1,000 laboratory tests, we might expect to have \$5,000 of variable overhead costs made up of many items. However, by the very nature of indirect costs, we do not know the quantity of each indirect item per unit of output. If we did, we could treat them as direct costs. Therefore, we can often calculate only a volume variance and flexible budget variance for variable overhead costs.

Fixed overhead costs represent a different problem. There can be no volume variance for fixed overhead costs. By definition, fixed costs are fixed; they do not vary with volume. Therefore, for any fixed costs, whether they are overhead costs or direct costs, the expected costs for the actual volume would be identical to the expected costs for the budgeted volume.

In some cases, it may be possible to determine price and quantity variances for fixed overhead costs. For example, if a department expects to have one manager and one supervisor, it must be determined whether variances arise because of a change in the number of managers (a quantity variance) or because of a change in the rate paid to managers (a price or rate variance).

The Acuity Variance

The *acuity variance* represents the amount that spending differed from expectations because the severity of patient illness differed from expectations. If patients are sicker than expected, it will generally require more resources to treat them.

The quantity variance represents all factors that result in consumption of more input per unit of output than budgeted. For example, if we use more hours of nursing care per patient day than the amount budgeted, we will have a quantity variance. What does that variance represent? To some extent, it may represent an inefficient staffing pattern or perhaps inefficient work methods employed by our nursing staff. Perhaps coffee breaks and lunch breaks are gradually becoming longer. On the other hand, it may represent an increase in the average severity of illness, or acuity, of our patients. If the goal of more sophisticated variance analysis is to generate accounting reports that guide and direct managers as to where their variance investigation efforts should go, then it would be extremely useful to be able to quickly identify the degree to which variances are the result of sicker patients as opposed to inadequate managerial supervision and control.

Health care organizations that have functioning patient classification systems can translate patient acuity levels into required hours of patient care. Using that information, the quantity variance can be subdivided further into the portion caused by an unexpectedly high or low average patient acuity level as opposed to the portion caused by other factors. This is shown in Figure 9-3.

In this figure, the price and volume variances are unchanged. However, the quantity variance has been subdivided. Part of it is now isolated as an acuity variance, and the other part is a remaining quantity variance. The key to this calculation is that the flexible budget provides for budgeted quantities of resource inputs at the expected acuity level. It is flexible in that it bases these budgeted resources on the actual volume of output. In contrast, the "actual quantities at budgeted price" category in the figure represent the actual quantities and actual acuity level.

A new category is placed between the actual quantities at budgeted price category and the flexible budget category: the "budgeted inputs for actual acuity." This category maintains the use of budgeted prices, as does the category to

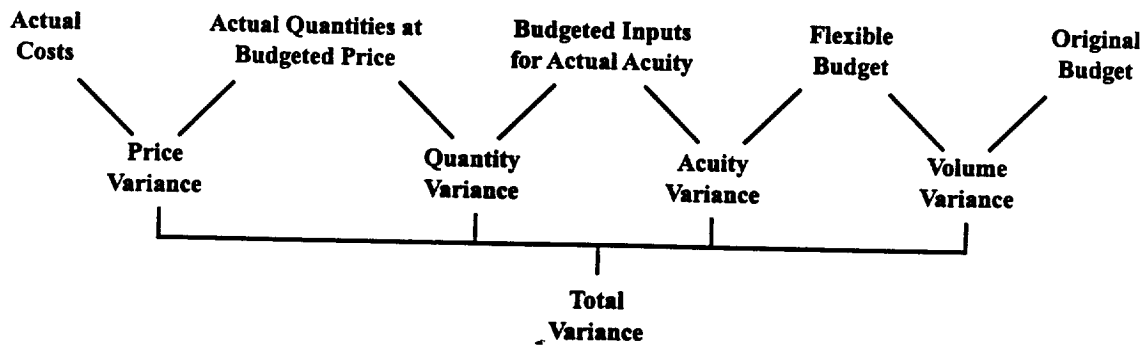


Figure 9-3 The Price, Quantity, Acuity, and Volume Variances

its left. It also maintains the use of the actual output volume, as does the category to its right. This category is differentiated in that it uses the quantity of input that would have been budgeted per unit, had the actual acuity been known.

In a sense, this new category is a type of flexible budget. The flexible budget provides the budget for the actual amount of output. The "budgeted inputs for actual acuity" category provides the budget for the actual amount of output at the actual acuity level. The difference between this category and the flexible budget is called an acuity variance, because the only difference is the use of the budgeted acuity versus the actual acuity. The difference between this category and the actual quantities at budgeted price category is referred to as the quantity variance, because it represents quantity of inputs consumed that is different from what would be expected for the actual volume of output at the actual acuity level.

The Worked vs. Paid Variance

Another issue that creates difficulties in the area of variance interpretation is the fact that not all hours that are paid for are actually worked. In calculating the labor cost budgeted per patient day versus the actual labor cost per patient day, the personnel cost includes the total cost, not just the portion for time worked. This means that a share of sick leave, vacation, holidays, and so forth is included in the cost per unit of activity.

Essentially, when one notes from a quantity variance that we are using more labor per patient,

that could mean more direct care hours, or it could mean more sick leave than expected. Obviously, these two possibilities have very different implications for the organization. The potential diversity of possible causes of quantity variances makes the manager's job of investigation and interpretation of variances more difficult.

For the health care organization as a whole, the proportion of paid versus worked time might be quite predictable. However, for a given department, if one employee breaks his or her leg and goes on disability for two months, substantial department budget variances will be generated. The department will pay for the replacement employee and may also be charged for the sick leave payments to the employee who is out for two months. Such variances will not be explained by volume variance analysis, or by price, or acuity variance analysis. They will reside as an unexplained portion of the quantity variance.

If we further subdivide the quantity variance into two segments, we can isolate the portion of the variance that results from an unexpected level of paid but not worked time. The remaining quantity variance can be more directly considered and investigated for possible out-of-control situations. At that point, it will have been isolated from any portion caused by acuity and from any portion caused by paid but not worked hours. This will enhance the manager's ability to consider both why the paid but not worked portion has varied and why the paid and worked portion has varied.

At the current time, not many health care organizations formally make this calculation. However, as the use of computers at the level of the cost center continues to grow, it is likely that managers will start to make such computations to aid in their analyses of variances.

The Productive vs. Nonproductive Variance

Even having segregated the paid but not worked and acuity components from the quantity variance, it would be theoretically possible to subdivide the quantity variance further. Specifically, we could look at worked hours in terms of whether they are productive or nonproductive hours. By this, we are not referring to inefficiencies, but rather to the fact that employees may attend in-service education programs or for some other reason be away from their clinical or staff position.

If the number of hours spent at work but not "on the job" differs from expectations, that will send us a message different from that if nonproductive time was paid but not worked. It will also send a message different from that if the time was worked on the employees' usual tasks.

For example, in a nursing unit, if we spend fewer hours than expected providing care to each patient, we may have a quality of care concern. On the other hand, if a quantity variance was really caused because we spent fewer hours than expected in in-service education or at conferences, we might feel very different about the variance and about the need to investigate the variance. Data to calculate such a variance may be somewhat harder to obtain than data for the earlier variances, but it should be available within most health care organizations.

The Patient Care Variance

In addition to productive versus nonproductive variance, managers can learn a great deal by considering the extent to which paid, worked, productive time is actually spent in the process of direct patient care. For example, suppose that

a nursing department paid for exactly the expected number of labor hours, and staff worked exactly the expected number of hours and had exactly the expected amount of paid but nonproductive time (such as conferences). There still are questions. Did the patients receive the expected amount of direct care? Was there a higher level of nondirect patient care time and a lower amount of direct patient care time per patient day? (This might be due to poor scheduling, poor employee attitude, or time-consuming patient-chart documentation problems.)

Unlike all of the other variances discussed to this point, there are very considerable data collection obstacles with respect to calculating this variance. As with the other variances discussed above, we are not proposing the determination of new, additional variances. The entire process merely consists of dividing and subdividing the difference between actual and budgeted costs into smaller, more clearly defined segments.

This variance, however, requires that we be able to know how much of any given workday is actually devoted to direct patient care. In some departments, those data might be obtainable. For example, in the operating room, we could track the percentage of hours that each employee is actually in surgery. Although there are clearly important indirect tasks that must be undertaken, it would be valuable to be able to monitor the proportion of direct time and indirect time.

On the other hand, for many departments, such as routine nursing care units, such a determination would involve a tremendous data collection effort. Therefore, it is unlikely that any health care organizations would spend the resources to calculate this *patient care variance*. The cost of doing so would be too high relative to the value of the information obtained.

Capitation Variance

The last variance to be considered relates to monitoring an organization's performance under a capitation arrangement. As discussed in earlier chapters, the decision for a health care provider to work under a capitation arrangement is based

on estimates of the utilization of the insurer's covered lives and the cost to provide the required services.

Suppose a primary care practice had accepted a capitation arrangement that called for payment of \$25 per covered life for a pool of 10,000 patients. The practice had assumed the following:

- 10,000 covered lives
- No additional fixed costs
- Variable costs = \$35 per visit
- Utilization = 6,000 visits (500 per month)

Given the assumptions above, the practice had budgeted costs for the managed care contract of \$17,500 per month (500 visits \times \$35). After the first month however, the practice had incurred costs of \$19,800. Is the unfavorable variance due to higher than anticipated utilization? Is it due to higher than anticipated cost of care?

The variance techniques discussed above can be employed to answer these questions. What if the actual visits for the month totaled 580? The volume variance is the difference between what would have been budgeted for 580 visits and the budgeted amount:

$$\$20,300 - \$17,500 = \$2,800 \text{ Unfavorable}$$

The fact that monthly expenditures were only \$19,800 compared to the volume adjusted budget of \$20,300 tells us that our variable cost per visit was actually lower than anticipated. For the manager of this situation, utilization is the key to bringing this contract back in line with expectations.

With some additional information, the volume variance can be further broken down to a volume variance and an acuity or type of visit variance. The important point is that the concept of flexible variance analysis can be applied to many situations. By breaking down the simple difference between budgeted and actual expenditures, the manager has a useful tool to more effectively manage the organization.

Health care organization budgeting and the control of budget results has changed dramatically in the years since the advent of Medicare.

The advent of diagnosis-related groups (DRGs) and the growth of managed care has pushed the process even further. Many of the variances discussed above are not calculated currently in many health care organizations. They do for the most part, however, represent workable ways to improve managerial capabilities for controlling the organization.

CALCULATION OF VARIANCES

The above discussion provided the conceptual basis for variances based on volume, price, quantity, acuity, not-worked time, and nonproductive time. This section of the chapter extends the discussion by giving a numerical example of the calculations that might be employed to determine the more widely used of those variances.

Assume that Florence Nightingale was the nursing supervisor for the Fourth Floor West Medical/Surgical Unit of The Getuwell Hospital. For the month just ended, she had budgeted for 450 patient days. She had planned to pay for 7 hours of RN nursing care per patient day at a rate of \$20 per hour including benefits. Actual results for the month indicated total spending for nursing salaries for the unit was \$98,700, considerably above the \$63,000 (450 patient days \times 7 hours per day \times \$20 per hour) budgeted. These data are summarized as follows:

The Getuwell Hospital Fourth Floor West Medical/Surgical Unit	
Budgeted patient days	450
Budgeted RN hours per patient day	7
Budgeted RN hourly pay rate	\$ 20
Budgeted total RN cost	\$63,000
Actual total nursing salaries	\$98,700

Why did the unit go so far over budget?

Florence determined that there were actually 500 patient days, and that 4,700 nursing hours were paid for during the month (9.4 hours per patient day on average). She also knew that the raise that went into effect at the beginning of the month would drive all wages up by \$1 per hour, so she was not surprised to find that the average wage rate including benefits was \$21 per hour.

The Getuwell Hospital
Fourth Floor West
Medical/Surgical Unit

Actual patient days	500
Actual RN hours per patient day	9.4
Actual RN hourly pay rate	\$ 21

Actual Amounts

$$aQ_o \times aP_i \times aQ_i = 500 \times \$21 \times 9.4 = \$98,700$$

- Budgeted Amounts

$$- bQ_o \times bP_i \times bQ_i = 450 \times \$20 \times 7.0 = 63,000$$

$$\text{RN Labor Variance} \quad \underline{\underline{\$35,700}}$$

Calculating the Traditional Variance

The traditional variance report might look like this:

	Actual	Budgeted	Variance
RN salaries	\$98,700	\$63,000	\$35,700 U

Typically, year-to-date information would also be provided, but for simplicity's sake we will not report it here.

In order to simplify the calculation of variances, we will introduce arithmetic notation as we proceed. The first items are as follows:

- **bQ_o**: The *budgeted quantity of output* (in this case, patient days).
- **aQ_o**: The *actual quantity of output*.
- **bP_i**: The *budgeted price of input* per unit of input (in this case, nursing rate per hour).
- **aP_i**: The *actual price of input* per unit of input.
- **bQ_i**: The *budgeted quantity of input* per unit of output (in this case, number of nursing hours per patient day).
- **aQ_i**: The *actual quantity of input* per unit of output.

From the information given in the example, we know the following values for these six items:

Budgeted Quantity of Output	⇒ bQ _o = 450 patient days
Budgeted Price of Input	⇒ bP _i = \$20 per hour
Budgeted Quantity of Input	⇒ bQ _i = 7 hours per patient day
Actual Quantity of Output	⇒ aQ _o = 500 patient days
Actual Price of Input	⇒ aP _i = \$21 per hour
Actual Quantity of Input	⇒ aQ _i = 9.4 hours per patient day

The traditional variance simply requires comparison of the budgeted and actual amounts, as follows:

This variance would be referred to as an unfavorable variance because more money was spent than was expected. That does not necessarily mean that the manager or unit performed badly, nor does it mean that the variance was bad for the organization. The extra patients may justify the extra spending. In fact, they might generate enough extra revenue to make this a good event for the organization. However, accountants refer to spending in excess of budget as being an unfavorable variance.

Calculating the Volume Variance

In the past decade, many health care organizations have adjusted their variance reports to allow for the impact of volume changes. It does not make much sense to hold a manager responsible for keeping to a fixed budget when activity levels are increasing. Variable costs will drive up actual expenditures even if the manager does an exceptional job of controlling costs. Similarly, we would not want to reward a manager for exactly achieving a fixed budget if the volume of activity declined. Costs should have declined as well.

If the RN staffing is considered to be a variable cost, then a change in patient days would be expected to change the required amount of nursing care. As a result, the actual amount spent for 500 patient days should differ from the budget for 450 patient days.

One approach taken by many health care organizations is to treat the actual volume as if it were also the budgeted amount. For instance, we would have the calculation below:

Actual Amounts

$$aQ_o \times aP_i \times aQ_i = 500 \times \$21 \times 9.4 = \$98,700$$

- Volume Adjusted Amounts

$$- aQ_o \times bP_i \times bQ_i = 500 \times \$20 \times 7.0 = 70,000$$

$$\text{RN Labor Variance} \quad \underline{\underline{\$28,700}}$$

In this calculation, the budgeted volume is adjusted from the original budget of 450 patient days, to an after-the-fact budget of 500 patient days. That is, once we know that volume actually was 500 patients, that is used as the budget in the variance calculation. The budgeted cost has effectively been revised to \$70,000, and the total variance has declined from \$35,700 to \$28,700. The unit manager is no longer responsible for the portion of the cost increase that is attributable to higher volume.

While that is a step in the right direction, constant changes in the underlying budget are not desirable. If volume decreases, we do not simply want to change the amount available for each department to spend. We also want to flag the fact that volume increased or decreased so that the appropriate manager can focus on that specific issue. If patient days are decreasing while admissions are constant, that may be good. However, if admissions are declining, then revenues will fall as well. We do not want that fact to become buried.

Therefore, a preferable approach for volume changes is to isolate (rather than eliminate) the portion of the variance due to volume of activity changes. The one traditional variance can be subdivided into two parts, as follows:

Volume Variance

Volume Adjusted Budget	
$aQ_o \times bP_i \times bQ_i = 500 \times \$20 \times 7.0 =$	\$70,000
– Original Budget	
$- bQ_o \times bP_i \times bQ_i = 450 \times \$20 \times 7.0 =$	63,000
RN Labor Volume Variance	<u>\$7,000</u>

Variance Other Than Volume

Actual Amounts	
$aQ_o \times aP_i \times aQ_i = 500 \times \$21 \times 9.4 =$	\$98,700
– Volume Adjusted Budget	
$- aQ_o \times bP_i \times bQ_i = 500 \times \$20 \times 7.0 =$	70,000
RN Labor Other Variance	<u>\$28,700</u>
Total Variance for RN labor cost for Fourth Floor West Medical/Surgical Unit	<u><u>\$35,700</u></u>

This approach to variance measurement leaves all of the original information intact, yielding the traditional variance total of \$35,700, but also giving more information for management by subdividing the traditional variance into two pieces.

It should be noted, however, that a volume variance only rises to the extent that costs are variable. That does not mean that costs must be strictly variable—we do not expect to hire nurses by the patient day. However, the cost item being evaluated must vary at least in some rough proportion to the output measure being used as the volume base. To adjust the budget of a fixed cost item as volume changes is just as misleading as failing to adjust the expected cost of a variable cost item as volume changes.

Calculating the Price and Quantity Variances

Once the traditional variance has been subdivided into two pieces, we can move forward in improving the variance information. The next step is to divide the portion of the traditional variance attributable to causes other than volume into its price and quantity subcomponents. This step, used by some but not most health care organizations, is widely used in industry.

As noted above, \$28,700 of the total variance is caused by something other than the increase in patient days from 450 to 500. The two principal components of this \$28,700 variance are related to the price we paid for the inputs and the amount of input used for each unit of output. These subcomponents are referred to as the price or rate variance, and the quantity, use, or efficiency variance.

Using the notation developed above, we could calculate the *price*, *quantity*, and *volume variances*, as follows:

Volume Variance

Volume Adjusted Budget	
$aQ_o \times bP_i \times bQ_i = 500 \times \$20 \times 7.0 =$	\$70,000
– Original Budget	
$- bQ_o \times bP_i \times bQ_i = 450 \times \$20 \times 7.0 =$	63,000
RN Labor Volume Variance	<u>\$7,000</u>

Quantity Variance

Volume & Qi Adjusted Budget	
$aQ_o \times bP_i \times aQ_i = 500 \times \$20 \times 9.4 =$	\$94,000
- Volume Adjusted Budget	
$- aQ_o \times bP_i \times bQ_i = 500 \times \$20 \times 7.0 =$	70,000
RN Labor Quantity Variance	<u>\$24,000</u>

Price Variance

Actual Amounts	
$aQ_o \times aP_i \times aQ_i = 500 \times \$21 \times 9.4 =$	\$98,700
- Volume & Qi Adjusted Budget	
$- aQ_o \times bP_i \times aQ_i = 500 \times \$20 \times 9.4 =$	94,000
RN Labor Price Variance	<u>\$4,700</u>
Total (Traditional) Variance	
(Volume + Quantity + Price)	<u><u>\$35,700</u></u>

Note that the price variance is derived by comparing all actual information to information that contains actual results except for the budgeted price. Thus, the only difference between the top row and bottom row in the price variance calculation is the budgeted versus actual price, yielding a price variance. In the quantity variance calculation, only the quantity of input per unit of output varies.

The level of detail yielded by this industrial model of variance analysis is far superior to the traditional model used in health care, in terms of orienting managers toward problem areas for investigation. However, in health care organizations, a number of different factors may be responsible for the quantity variance.

Calculating the Acuity Variance

One particular concern in health care organizations is that the output is not a standardized product. We can treat exactly the same number of patients or patient days, but if the mix of patients is such that they are more acutely ill, they may require more resources. Therefore, it is quite beneficial to be able to factor out the portion of the quantity variance that results from the level of patient acuity or severity of illness.

In order to proceed, it is necessary to have a patient classification system in place that can reasonably predict the patient care hours staffing requirements at different acuity levels. Most hospitals and many other health care organizations have implemented such systems during the past decade.

Suppose that, in our example, we determined that our actual incurred acuity level would have called for The Getuwell Hospital to pay for 8.6 hours of nursing care per patient day, rather than the originally budgeted 7.0. Thus, we know that at least a part of the quantity variance was attributable to sicker patients, rather than to lax control. How much of the quantity variance is attributable to unexpectedly high patient acuity? In order to do this calculation, we need to add the following additional notation:

- **bQibA**: The *budgeted quantity of input* per unit of output, at the *budgeted acuity level* (budgeted amount of nursing hours per patient day based on a budgeted patient acuity level).
- **bQiaA**: The *budgeted quantity of input* per unit of output, at the *actual acuity level*.

From the information given in the example, we know the following:

Budgeted Quantity of Input at Budgeted Acuity	$\Rightarrow bQ_{ibA} =$	7 hours per patient day
Budgeted Quantity of Input at Actual Acuity	$\Rightarrow bQ_{iaA} =$	8.6 hours per patient day

We can now subdivide the quantity variance into two parts, as follows:

Acuity Variance

Volume & Acuity Adjusted Budget	
$aQ_o \times bP_i \times bQ_{iaA} = 500 \times \$20 \times 8.6 =$	\$86,000
- Volume Adjusted Budget	
$- aQ_o \times bP_i \times bQ_{ibA} = 500 \times \$20 \times 7.0 =$	70,000
RN Labor Acuity Variance	<u>\$16,000</u>

Remaining Quantity Variance**Volume & Qi Adj. Budget**

$$aQ_o \times bP_i \times aQ_i = 500 \times \$20 \times 9.4 = \$94,000$$

- Volume & Acuity Adj. Budget

$$-aQ_o \times bP_i \times bQ_{iaA} = 500 \times \$20 \times 8.6 = 86,000$$

$$\text{RN Labor Quantity Variance} \quad \underline{\$8,000}$$

$$\text{Total Quantity Variance} \quad \underline{\underline{\$24,000}}$$

Apparently, two thirds of the quantity variance in this example was attributable to the unexpectedly high level of patient acuity. Since the patient acuity level is not a factor under the control of unit managers, we would want to separate the variance caused by such acuity changes. The separation generates information that is far easier to interpret than the aggregated information would be.

The framework generated in this section is represented in Exhibit 9-1. Note that the total of the variances shown in Exhibit 9-1 should always equal the original traditional variance for any line item. This process of variance analysis does not create new variances; it merely subdivides a line-item variance into subcomponent parts for superior analysis.

Exhibit 9-1 Formulas for Price, Quantity, Acuity, and Volume Variances

Price Variance

$$aQ_o \times aP_i \times aQ_i$$

$$-aQ_o \times bP_i \times aQ_i$$

Quantity Variance

$$aQ_o \times bP_i \times aQ_i$$

$$-aQ_o \times bP_i \times bQ_{iaA}$$

Acuity Variance

$$aQ_o \times bP_i \times bQ_{iaA}$$

$$-aQ_o \times bP_i \times bQ_{ibA}$$

Volume Variance

$$aQ_o \times bP_i \times bQ_i$$

$$-bQ_o \times bP_i \times bQ_i$$

VARIANCE ANALYSIS AND MANAGEMENT CONTROL

What do variances tell the manager? What do they mean? When and how should managers respond to variances? Once variances have been calculated, managers should use them to control the organization. The relationship between variances and management control is the topic of this section of the chapter.

Generally, one can expect that there are three possible reactions to a variance. One reaction is simply to ignore it. The variance may be deemed to be the result of a random event. One would probably expect to spend a little more or less than the budget each month for many types of expenses. A second reaction would be to adjust the budget or the budgeting process to reflect more accurately what it must cost to carry out a particular task. It may be clear that the budget was in error. The third possible reaction is to take actions necessary to alter performance. The second and third actions can only be taken if the variances are investigated to determine their causes.

Controllable vs. Uncontrollable Variances

Demski breaks down variances into those that are *controllable* and those that are *uncontrollable*.⁴ In his scheme, variances that create a need to correct the budget are the result of either prediction error or modeling error. A prediction error might include unexpectedly high price increases or fewer than expected patient admissions. A modeling error might include a poor estimate of how long it takes to draw blood from each patient.

Variances that require changes in performance would include either implementation or measurement errors. An implementation problem means that the employees of the organization did not carry out the tasks as expected by the organization. This requires working with the employees to change their behavior. A measurement problem means that the amount of cost assigned to an

area was incorrect. For example, the operating room did not use more supplies than expected in a given month, but a purchase of a three-month supply of an expensive item was all charged to the month it was purchased instead of being charged as the supply was used. The cost reported was measured improperly.

According to Demski, uncontrollable variances are the result of random error and should be ignored. For example, if there is unusually high sick leave due to a virus that attacks the health care organization staff, the month's employment costs will be higher than expected. The policy of ignoring such variances would seem to be extreme. One should at least attempt to determine that the variance is in fact not controllable. Gradually rising sick leave might indicate a controllable morale problem.

Basic Control Principles for Variances

Variance reports should be provided to managers on a timely basis in an understandable format and should give managers a perception of fairness.

Some health care organizations still prepare variance reports on a quarterly basis, with the report generated near the end of the subsequent quarter. If a manager received information about January in May or June, there is clearly no sense of urgency and little sense of importance associated with the document. Review of such document in July or August is likely to tell little about what went wrong in January. Whatever went wrong is likely to have repeated itself for half the year. Timeliness of reporting is essential if the process is to be taken seriously and to yield control benefits.

Most variance reports contain a wide range of abbreviations and assumptions. Variance reports tend to be ongoing. Thus, new managers are likely to receive monthly reports that lack definitions and explanations. In an effort to show that they are in fact capable of performing in their new management position, they are unlikely to admit to not understanding a routine report. Therefore, the finance personnel of the organiza-

tion should be sure that all managers have the definitions and explanations needed to read and interpret variance reports adequately.

Health care organizations should have a mechanism for various managers to explain why they feel that charges to their department are unfair. It is difficult to generate the motivation for managers to control costs if they believe that the costs ultimately assigned to them are not fair. If managers are held accountable for costs that are not within their control, they often lose the incentive to attempt to control the costs that are. There should be a formal mechanism to call for comments and to make changes so that ultimately managers feel they are working in a fair environment.

When To Investigate Variances

It is wasteful to have managers unnecessarily investigate variances. Variances should only be investigated when there is something to gain from the investigation. Most often, small variances will occur just due to normal random fluctuations. Sometimes, however, there will be a need to take corrective action. Therefore, the health care organization must decide in what instances the variance warrants an investigation and in what instances the variance should be ignored.

One approach frequently taken is simply to assume that managers know enough to know when to investigate variances. Such an approach assumes that the same causes of variances keep recurring, leading one to wonder why they are not corrected. Further, it does little to help the new manager.

A more helpful approach is to plot variances on a graph over time. This allows the manager to spot unusual trends that might be cause for concern. For example, look at what happens in Figure 9-4. It is not hard to tell that the manager needs to take a close look at this situation. The random ups and downs have been replaced by an upward trend.

Another option is a *control chart* approach. In such an approach, a graph is used with upper and

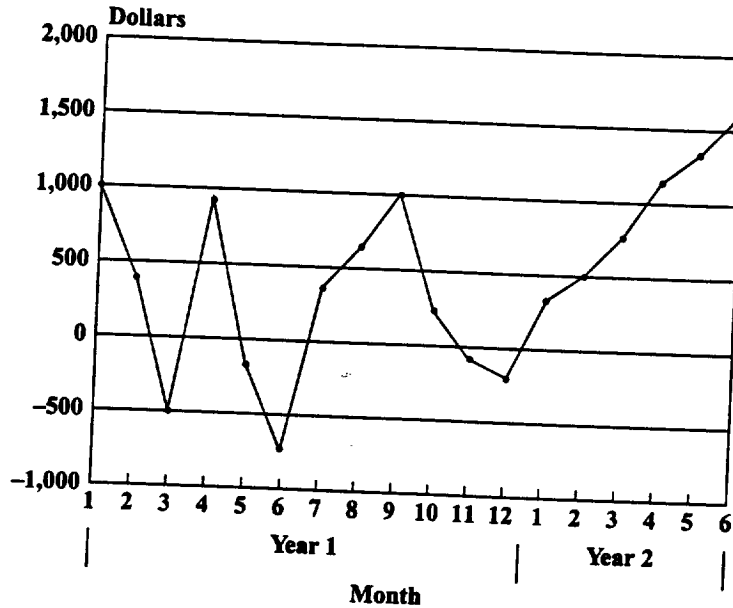


Figure 9-4 Variances over Time. Source: Adapted from *Hospital Cost Management and Accounting*, Vol. 3, No. 3, p. 3, Aspen Publishers, Inc., © 1991.

lower limits. If a variance exceeds the upper or lower *control limits*, the manager should investigate the variance. See, for example, Figure 9-5. In September, the variance was above the control limit, and investigation would be required.

An important issue is where to set the control limits. How high is high? How low is low? To set the limits too far from the budget would allow

correctable variances to continue unnecessarily. To set the limits too close to the budget would cause the manager to spend time needlessly trying to find causes that do not exist.

Some organizations in industry use a formal statistical measure for determining when to investigate variances. One such approach would be to determine a normal expected variation. No

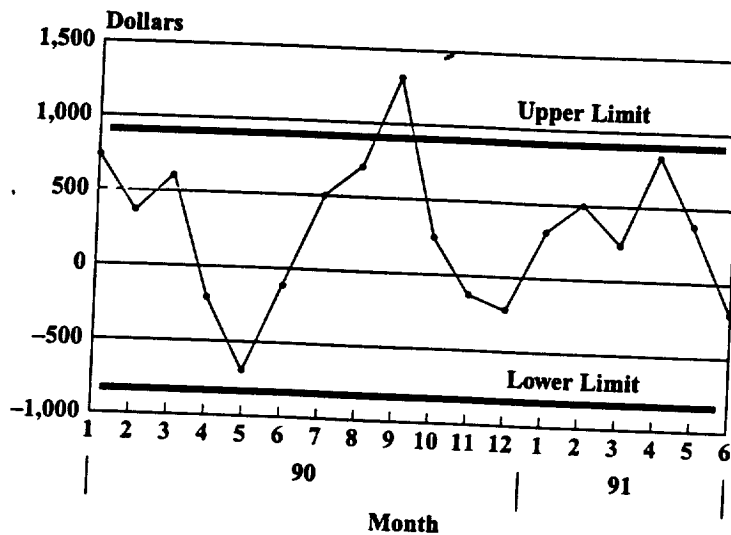


Figure 9-5 Variance Control Limits. Source: Reprinted from *Hospital Cost Management and Accounting*, Vol. 3, No. 3, p. 3, Aspen Publishers, Inc., © 1991.

one expects to come in exactly on budget. Once this variation is determined, a standard deviation can be calculated. A rule often used in industry is to investigate any variance that is more than three standard deviations away from the expected reasonable variation.⁵ Statistical approaches to determining when to investigate variances are discussed further in "Statistical Cost Control: A Tool for Financial Managers," by Skantz. That article is Reading 9-4 in *Issues in Cost Accounting for Health Care Organizations*.⁶

Such arbitrary rules are of questionable value, since they do not measure how costly it is for the manager to investigate the variance, nor how costly it will be for the health care organization if it fails to correct behavior that should be changed. Another problem is caused by the fact that variances may simply be caused by a large random event. Major investigation is not needed if the cause of the variance is simply an outlier. This is discussed further in "Regression-Based Cost Estimation and Variance Analysis: Resolving the Impact of Outliers," Reading 7-1 in *Issues in Cost Accounting for Health Care Organizations*.⁷

Control Limits Based on Cost Analysis

An alternative approach to statistical guidelines such as a set number of standard deviations is to calculate formally the costs of making an investigation and the costs if behavior needs to be corrected. In this approach, if one investigates, there may be no problem (just random events), or there may be a problem. The same holds true if one does not investigate.

Therefore there are four possibilities:

1. Investigate and find a problem.
2. Investigate and find no problem.
3. Do not investigate. It turns out there is no problem.
4. Do not investigate. It turns out there is a problem.

The cost for each of these four possibilities should be estimated. For example, suppose that it would normally take the pharmacy manager one day to investigate a variance fully. Suppose

that the cost to the health care organization of the pharmacy manager is \$400 per day including benefits. Suppose that when there is a problem, on average, it causes the health care organization to lose \$5,000 per month, if it is not uncovered and corrected.

If we investigate, either there is no problem, or there is a problem and it is corrected. In either case, there will be no loss in the coming month, but there will be an investigation cost of \$400. If we do not investigate, there may be no problem, and because we did not investigate, no cost. However, there may be a problem that costs \$5,000. The cost associated with the four possibilities listed above are shown in Figure 9-6. Taking the investigation route is the cautious approach. We avoid the risk of a possible \$5,000 loss. Still, we always spend \$400. Perhaps we should not investigate, and the cost will be \$0.

The decision to investigate depends on how likely it is that there will be a problem. Suppose that there is a 20 percent chance that there is a problem. In that case, on average, there will be a problem one time out of five. Investigating all five times would cost \$2,000. Having an undetected problem one time out of five costs \$5,000. In that case, it pays to investigate.

This can be used to establish the control limits. Suppose that an observed variance of \$5,000 implies that there is a 20 percent chance that there is a problem. The manager should investigate because spending \$2,000 on investigation is cheaper than spending \$5,000 on a problem.

Suppose that a \$3,000 variance implies that there is a 10 percent chance of a problem. In that

	Cost	
	Problem	No Problem
Investigate	\$400	\$400
Do Not Investigate	\$5,000	\$0

Figure 9-6 Payoff Matrix for Variance Investigation

case, if we investigate ten times, we are likely to find a problem once. Ten investigations cost \$4,000 (\$400 per investigation). One problem costs \$5,000. We should investigate a \$3,000 variance.

Suppose that a variance of \$2,000 implies that there is a 5 percent chance that there is a problem. A 5 percent chance means that there would be a problem once in every 20 times that we observed a \$2,000 variance. That means that there would be a cost of \$8,000 to investigate the 20 occurrences. One problem costs \$5,000. It does not pay to investigate. The likely costs of investigation outweigh the likely costs of the problem. Therefore, we would not investigate a \$2,000 variance.

Somewhere between \$2,000 and \$3,000 there is a variance for which the costs of investigation will just offset the costs of an out-of-control situation. That would be used as the control limit. The manager would investigate variances above the limit, but not those below the limit.

This is a rational approach that can be quite helpful to managers. The main weakness of this approach is that the manager must subjectively be able to know, from the size of the variance, how likely there is to be a problem. The advantage is that, ordinarily, even if the manager knows there is a 10 or 20 or 30 percent chance of a problem, that does not indicate whether it is worthwhile to investigate the variance. This approach does.

Reacting to Variances

It is appropriate to assign responsibility for variances to managers. It is less useful to assign blame. People are not perfect. If we allow for imperfections, people will try to correct their errors. When we try to require perfection, the response can be dysfunctional behavior.

For example, if there is extreme pressure to meet the budget, it may well be met, but in a costly manner. Quality of care may suffer, or an expected favorable supply variance may be converted to physical supplies hoarded in the de-

partment against the day when an unfavorable variance might be anticipated.

It is important always to bear in mind that we are dealing with human beings. Any approach to dealing with variances must consider the likely reactions of the various employees of the health care organization.

REVENUE VARIANCES

Product costing has changed the focus of health care organizations from procedures to patient groups. There is less emphasis on departments and increased emphasis on the cost of patients across departments. One goal of the increased emphasis on product costing is to focus on the profitability of different types of patients. This requires an understanding of both the expenses and revenues generated by different groups of patients.

For example, we can use DRG cost information to generate a set of revenue or sales variances. These variances can help managers understand what elements of health care organization activities are causing total health care organization revenues to differ from expectations. Specifically, revenue variances can focus on the total health care organization demand in a given geographic region, a health care organization's share of that total demand, its mix of patients, and the prices for each class of patient. As with the use of variance analysis under capitation discussed earlier in the chapter, calculation of revenue variances is simply a creative application of the techniques demonstrated above. Effective managers should always be looking for useful ways to apply existing managerial tools like variance analysis.

Focus on Contribution Margin

Although the title and topic of this section refers to revenues, all of the variance analysis calculations that follow will focus on *contribution margin*: revenue minus variable cost. The reason

for this is that revenue is not a goal in and of itself. Increasing revenues by having more patients with low or even negative contribution margins will not serve the health care organization well.

We do not want to develop a managerial accounting system that gives wrong signals to health care organization managers. Shifting the mix of patients away from low-revenue patients and toward high-revenue patients may seem positive. However, it is only positive if the variable costs associated with the high revenue are low enough to improve the overall contribution margin.

For example, would you rather have five patients with reimbursement of \$1,000 each and variable costs of \$600 each, or five patients with reimbursement of \$5,000 each, and variable costs of \$4,900 each? Although the revenue in the latter case is \$25,000 in contrast to \$5,000, after deducting the variable costs associated with the patients, we are left with a total contribution of only \$500 in the latter case, whereas we earn \$2,000 of contribution in the former instance.

Use of Budgeted Variable Costs

In calculating the contribution margin (revenue minus variable cost), it is necessary to use some measure of variable costs. As our patient mix changes, some costs (the variable ones) change and others (fixed costs) do not. As product costing systems are being adopted by health care organizations, identification of fixed and variable costs throughout the health care organization is becoming more common.

In the calculation of revenue variances, it is important that the measure of variable cost used be a standard or budgeted cost per unit rather than an actual cost. The budgeted contribution margin is based on budgeted costs. That creates no controversy. One might expect that the actual information used for comparison with the budget would be based on all actual information, including actual variable costs. That, however, will unduly complicate the results and make variance

interpretation unnecessarily difficult. When calculating the actual contribution margin for this variance analysis, we use the actual price but the budgeted variable cost per unit.

Keep in mind the fact that the health care organization will be calculating its usual variances for expenses, as discussed in the earlier sections of this chapter. If actual variable costs differ from budgeted costs, those differences will show up in the expense variance calculations. Here we would like to develop a framework for the calculation of variances arising as a result of revenue factors: the price charged, the mix of patients, and the number of patients. Therefore, to keep the analysis clean, it is appropriate to use the budgeted variable costs for all revenue variance calculations.

This does not mean that the contribution margin (i.e., the price minus the variable cost) will not change in our analysis. It will if prices change. However, since this analysis is for revenues rather than expenses, the contribution margin need not be influenced by underlying changes in the variable cost per unit from the budgeted variable cost level.

We will use an example for the remainder of this section of the chapter. The numbers used will be highly simplified. However, once the model is laid out, it can be applied to a more realistic set of numbers, with the only difference being increased time for computations.

Suppose that the health care organization's contribution margin for the last month was budgeted at \$800,000, but in fact turned out to be \$1,010,000. What is the underlying cause for this \$210,000 favorable variance? What things occurred that led to this variance? Were they within or beyond our control?

There are four key pieces of information that are needed to calculate a complete set of variances. For each of the key elements, both budgeted and actual data are needed. If some of this information is not available, a simpler model that requires less input but yields less information can be developed.

The four key information items are (1) the expected number of patients for the entire commu-

nity, (2) our health care organization's share of those patients, (3) our health care organization's patient mix, and (4) the weighted average price for each type of patient.

The most difficult information to obtain will be that related to the budgeted and actual total number of patients in the community. After the complete model, including that information, is developed, the modifications needed to eliminate that information will be discussed.

The Original Budgeted Contribution Margin

The original budgeted contribution margin of \$800,000 will be referred to as the original static (unchanging) budget. This amount consists of a summation of the budgeted total volume of patients in the community, multiplied by our health care organization's market share, multiplied by the contribution margin for each type of patient, weighted for our case mix.

For example, suppose that we expect all of the health care organizations in our area (based on marketing demand studies) to have a total of 3,200 patients for the month in question. That establishes the budgeted size of the market. Suppose further that we expect to get 10 percent of this market.

In this simplified example, assume that we admit only two types of patients, which we will call DRG 1 and DRG 2. (You could choose some method other than DRGs for identifying your patient mix.) Extending the model from 2 DRGs to 470 would require only a greater number of computations.

In our example, we expect three quarters of our patients to be DRG 1 patients, and one quarter to be DRG 2 patients. We expect the contribution margin of our DRG 1 patients to be \$1,000 each and the contribution margin of our DRG 2 patients to be \$7,000 each.

The budgeted contribution margin for the health care organization consists of the weighted sum of the budgeted contribution margin for each of our types of patients. Assume the following information:

Budgeted total number of patients	3,200
Our budgeted share of market	10%
DRG 1 patients	75%
DRG 2 patients	25%
DRG 1 contribution margin	\$1,000
DRG 2 contribution margin	\$7,000

The budgeted contribution margin would be as follows:

DRG 1:	Budgeted market volume	×	Budgeted share	×	Budgeted DRG 1 proportion	×	Budgeted DRG 1 contribution margin
+ DRG 2:	Budgeted market volume	×	Budgeted share	×	Budgeted DRG 2 proportion	×	Budgeted DRG 2 contribution margin

or,

DRG 1:	3,200 × 10% × 75% × \$1,000 =	\$240,000
+ DRG 2:	3,200 × 10% × 25% × \$7,000 =	560,000
Original budget contribution margin		<u>\$800,000</u>

As noted above, the calculations here consist of the total volume multiplied by our share of the market, multiplied by the proportion in the given DRG, multiplied by the contribution margin for the DRG, and finally summed for all DRGs. As noted above, the actual contribution margin was \$1,010,000. This is \$210,000 more than the original budget contribution margin. We would like to know the underlying causes of this favorable total variance.

The Market Size Variance

The first of the variances that can be calculated is the *market size variance*. This variance will tell us if the reason that our revenues and contribution margin changed was simply due to a greater or smaller number of patients in the community than expected. In order to calculate this variance, we need all of the budgeted information from the original budget contribution margin, and we need to know the actual number of patients admitted to health care organizations for the month.

If that information can be obtained, the calculation is fairly straightforward. We replace the budgeted volume of patients for the community with the actual volume of patients, and calculate a new value for the contribution margin. This new value can be referred to as the *market size* flexible budget. This contribution margin projects a budgeted value for the health care organization, based on the actual size of the market. Suppose that, in our example, the actual number of patients was 4,000 for the community for the month.

The market size flexible budget contribution margin can then be calculated as follows:

$$\begin{array}{r}
 \text{DRG 1:} \quad \text{Actual market volume} \times \text{Budgeted share} \times \text{Budgeted DRG 1 proportion} \times \text{Budgeted DRG 1 contribution margin} \\
 + \text{DRG 2:} \quad \text{Actual market volume} \times \text{Budgeted share} \times \text{Budgeted DRG 2 proportion} \times \text{Budgeted DRG 2 contribution margin}
 \end{array}$$

OR,

$$\begin{array}{r}
 \text{DRG 1:} \quad 4,000 \times 10\% \times 75\% \times \$1,000 = \$300,000 \\
 + \text{DRG 2:} \quad 4,000 \times 10\% \times 25\% \times \$7,000 = \quad 700,000 \\
 \text{Market size flexible budget contribution margin} \quad \underline{\underline{\$1,000,000}}
 \end{array}$$

The difference between the original budget contribution margin of \$800,000 and the market size flexible budget contribution margin of \$1,000,000 is \$200,000 favorable (F):

$$\begin{array}{r}
 \text{Original budget contribution margin} \quad \quad \quad \$ 800,000 \\
 - \text{Market size flexible budget contribution margin} \quad \quad \quad - 1,000,000 \\
 \text{Market size variance} \quad \quad \quad \quad \quad \quad \quad \quad \underline{\underline{\$ 200,000 F}}
 \end{array}$$

This variance is simply the result of more patients admitted to area health care organizations and can be referred to as a market size variance.

The Market Share Variance

The next variance that can be calculated is the *market share variance*. This variance is based on the fact that we may not actually realize the percentage of total community admissions that

we expect. For instance, suppose that we actually achieve only an 8 percent share of the total number of patients admitted. We can calculate a new contribution margin that we will refer to as the market share flexible budget contribution margin. This amount is the expected total health care organization contribution margin, given the actual share of the market realized and the actual market size. We can calculate the market share flexible budget contribution margin as follows:

$$\begin{array}{r}
 \text{DRG 1:} \quad \text{Actual market volume} \times \text{Actual share} \times \text{Budgeted DRG 1 proportion} \times \text{Budgeted DRG 1 contribution margin} \\
 + \text{DRG 2:} \quad \text{Actual market volume} \times \text{Actual share} \times \text{Budgeted DRG 2 proportion} \times \text{Budgeted DRG 2 contribution margin}
 \end{array}$$

OR,

$$\begin{array}{r}
 \text{DRG 1:} \quad 4,000 \times 8\% \times 75\% \times \$1,000 = \$240,000 \\
 + \text{DRG 2:} \quad 4,000 \times 8\% \times 25\% \times \$7,000 = \quad 560,000 \\
 \text{Market share flexible budget contribution margin} \quad \underline{\underline{\$800,000}}
 \end{array}$$

The market share variance can then be calculated by comparing the market size flexible budget contribution margin with the market share flexible budget contribution margin:

$$\begin{array}{r}
 \text{Market size flexible budget contribution margin} \quad \$1,000,000 \\
 - \text{Market share flexible budget contribution margin} \quad \quad \quad - 800,000 \\
 \text{Market share variance} \quad \quad \quad \quad \quad \quad \quad \quad \underline{\underline{\$ 200,000 U}}
 \end{array}$$

Apparently, we had a \$200,000 unfavorable variance because we did not maintain our share of the total community demand for health care organization services.

Note that in this particular example, the total size of the market expanded; thus, the health care organization would be expected to gain patients and profits. However, the share of the market obtained by the health care organization declined. We did achieve our targeted number of patients. Without analysis such as this, it might not become apparent that, although we had the expected number of patients, we did not share in the benefits of the expanding number of patients. Other health care organizations in the commu-

nity captured the entire growth in the number of patients. A clear message for our marketing efforts comes forth from the analysis.

The Patient-Mix Variance

Another element in explaining the overall difference between the expected and actual contribution margin is our mix of patients. We may capture an increasing share of an increasing market, but unless we have a favorable mix of patients, profits may suffer.

In this example, we will assume that in actuality, 68.75 percent of our patients were DRG 1, and that 31.25 percent of our patients were DRG 2. In order to calculate a *patient-mix variance*, it is first necessary to establish a patient-mix flexible budget contribution margin, as follows:

DRG 1:	Actual market volume	×	Actual share	×	Actual DRG 1 proportion	×	Budgeted DRG 1 contribution margin
+ DRG 2:	Actual market volume	×	Actual share	×	Actual DRG 2 proportion	×	Budgeted DRG 2 contribution margin

or,

DRG 1:	4,000	×	8%	×	68.75%	×	\$1,000	=	\$220,000
+ DRG 2:	4,000	×	8%	×	31.25%	×	\$7,000	=	700,000
Patient-mix flexible budget contribution margin									<u>\$920,000</u>

This patient-mix flexible budget contribution margin represents the expected contribution margin, given the actual patient mix, our actual share of the market, and the actual market size.

A patient-mix variance can then be calculated by comparing the market share flexible budget contribution margin with the patient-mix flexible budget contribution margin:

Market share flexible budget contribution margin	\$800,000
- Patient-mix flexible budget contribution margin	- 920,000
Patient-mix variance	<u>\$120,000 F</u>

In this case, the variance is favorable. Why? Our DRG 1 patients yield an expected contribution

margin of \$1,000 each, whereas our DRG 2 patients yield an expected contribution margin of \$7,000 each. Even though we had exactly the same number of patients as expected (the increase in the size of the market was offset by our decreased share), we were better off because we had more of the patients with a higher contribution margin.

The Price Variance

The last of the variances to be calculated relates to the price charged for each patient. Going into a year, we have an expected average reimbursement level for each type of patient. Suppose that the expected price for DRG 1 was \$4,000, and variable costs for DRG 1 were expected to be \$3,000, yielding a contribution margin of \$1,000.

It may be that we expect all DRG 1 patients to pay \$4,000. It is more likely, however, that the \$4,000 represents a weighted average revenue expected to be received from all payers. Private insurers might pay \$5,000, Medicare might pay \$4,000, and an MCO might pay a negotiated \$3,500.

The purpose of these calculations is to yield useful information for managers to use in making decisions. Therefore, the price focus should be based on average expected receipts, not on gross charges. Given the changes possible in our mix of payers and the rates various payers are willing to pay, at least a part of our shift from budget to actual contribution margin will be resulting from shifts in the realized average price for each DRG.

Suppose in our example that the DRG 1 price stays exactly as expected. However, the DRG 2 average price received rises from \$25,000 to \$25,900. DRG 2 has an expected variable cost of \$18,000. Thus, the DRG 2 contribution margin has risen to \$7,900. We can now calculate an actual contribution margin. It should be noted that this actual contribution margin allows for actual prices, actual mix of patients, actual share of total community patients, and actual total commu-

nity volume of patients. However, it is not a true actual contribution margin, as it is based on budgeted variable costs.

In order to calculate a price variance, it is first necessary to calculate the actual contribution margin (using budgeted variable costs) as follows:

$$\begin{array}{l} \text{DRG 1: } \text{Actual market volume} \times \text{Actual share} \times \text{Actual DRG 1 proportion} \times \text{Actual DRG 1 contribution margin} \\ + \text{DRG 2: } \text{Actual market volume} \times \text{Actual share} \times \text{Actual DRG 2 proportion} \times \text{Actual DRG 2 contribution margin} \end{array}$$

or,

$$\begin{array}{l} \text{DRG 1: } 4,000 \times 8\% \times 68.75\% \times \$1,000 = \$ 220,000 \\ + \text{DRG 2: } 4,000 \times 8\% \times 31.25\% \times \$7,900 = \quad 790,000 \\ \hline \text{Actual contribution margin} \quad \quad \quad \underline{\underline{\$1,010,000}} \end{array}$$

A price variance can then be calculated by comparing the patient-mix flexible budget contribution margin with the actual contribution margin:

$$\begin{array}{r} \text{Patient-mix flexible budget contribution margin} \quad \$ 920,000 \\ - \text{Actual contribution margin} \quad \quad \quad \quad \quad - 1,010,000 \\ \hline \text{Price variance} \quad \quad \quad \quad \quad \quad \quad \quad \underline{\underline{\$ 90,000 \text{ F}}} \end{array}$$

The variance is favorable, as we would expect, given the increase in the price and contribution margin for DRG 2 patients.

The Total Variance

As variance analysis becomes more detailed to yield more information for managers, it should not change underlying relationships, but rather should merely provide more useful information concerning them. Originally, we noted that the expected contribution margin was \$800,000, and

the actual contribution margin (calculated using standard or budgeted variable costs) was \$1,010,000, generating a favorable variance to be explained of \$210,000. How does that compare to the detailed variances discussed?

As can be seen from the calculation below, we have merely identified the components of that variance.

Market size variance	\$200,000	F
Market share variance	-200,000	U
Patient-mix variance	+120,000	F
Price variance	+90,000	F
<u>Total variance</u>	<u>\$210,000</u>	<u>F</u>

However, in subdividing the variance, managers can begin to identify strengths and weaknesses and plan for improved actions. Note that the total favorable variance is the sum of the favorable variances, less the unfavorable variance.

No Market Size Data

The piece of information most difficult to obtain is total market size. Even if estimates can be made based on marketing studies of the total likely demand, it is not at all clear that information will be readily available after the fact on what demand actually turned out to be for the entire community.

Only if admission rates are generally available on a timely basis can the market size variance be determined. Furthermore, if we cannot determine market size, we cannot determine a market share variance either.

On the other hand, we can still measure the patient-mix and the price variances. We can also calculate a volume variance. The volume variance represents the part of the difference in total health care organization contribution margin caused by the difference between the expected and actual number of patients. The volume variance essentially is a combination of the share and size variances.

Our formulas would be revised as follows:

Original Budget Contribution Margin

	Budgeted	Budgeted	Budgeted
DRG 1:	patient	× DRG 1	× DRG 1
	volume	proportion	contribution
			margin
+ DRG 2:	Budgeted	Budgeted	Budgeted
	patient	× DRG 2	× DRG 2
	volume	proportion	contribution
			margin

Volume Flexible Budget Contribution Margin

	Actual	Budgeted	Budgeted
DRG 1:	patient	× DRG 1	× DRG 1
	volume	proportion	contribution
			margin
+ DRG 2:	Actual	Budgeted	Budgeted
	patient	× DRG 2	× DRG 2
	volume	proportion	contribution
			margin

Patient-Mix Flexible Budget Contribution Margin

	Actual	Actual	Budgeted
DRG 1:	patient	× DRG 1	× DRG 1
	volume	proportion	contribution
			margin
+ DRG 2:	Actual	Actual	Budgeted
	patient	× DRG 2	× DRG 2
	volume	proportion	contribution
			margin

Actual Contribution Margin

	Actual	Actual	Actual
DRG 1:	patient	× DRG 1	× DRG 1
	volume	proportion	contribution
			margin
+ DRG 2:	Actual	Actual	Actual
	patient	× DRG 2	× DRG 2
	volume	proportion	contribution
			margin

Our calculation of variances would become the following:

The Volume Variance

	Original budget contribution margin
-	Volume flexible budget contribution margin
	<u>Volume variance</u>

The Patient-Mix Variance

	Volume flexible budget contribution margin
-	Patient-mix flexible budget contribution margin
	<u>Patient-mix variance</u>

The Price Variance

	Patient mix flexible budget contribution margin
-	Actual contribution margin
	<u>Price variance</u>

The Total Variance

	Volume variance
+	Patient-mix variance
+	Price variance
	<u>Total variance</u>

These revenue variances can be helpful to managers in marketing, controlling the organization, and making a number of decisions about products and services offered.

NOTES

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