

Forecasting

As part of the planning and budgeting processes that precede each new fiscal year, human service agencies are confronted with a series of questions: What will the agency caseload be? Will the caseload go up, go down, or remain the same? What does the revenue situation look like? Will revenues increase, stay the same, or decline? What about expenses? In light of changes in caseload and revenues, can the current pattern of expenses be maintained? Should expenses be reduced? Without some estimate of how many clients a human service agency will serve in the coming fiscal year and what the revenue and expense picture will look like, it is difficult to prepare a realistic line-item operating budget for a human service agency.

There are essentially two ways human service administrators can estimate future case loads, revenues, and expenses: by educated guessing or by one or more of a variety of generally accepted forecasting techniques. As a general rule, the use of one or more generally recognized forecasting techniques is preferable to simply guessing. While an educated guess can sometimes turn out to be quite accurate, it is hard to defend during the budget process.

Forecasting can be defined as techniques that predict the future based on historical data (Lee & Shim, 1990:442). One of the interesting discoveries that researchers have made about forecasting is that simple techniques perform (produce estimates) that are frequently just as accurate as complex forecasting techniques (Cirincione, Gurrieri, & Van de Sande, 1999). Consequently, one doesn't have to be an expert in math or statistics to use many of the commonly recognized forecasting techniques. This chapter presents four commonly recognized time series forecasting techniques: (1) simple moving averages, (2) weighted moving averages, (3) exponential smoothing, and (4) time series regression. The first three of these forecasting techniques are relatively simple and the calculations can be done by hand. Time series regression is a more complex forecasting technique that requires the use of a computer and a basic understanding of some statistical concepts. Today, a variety of low-cost computer programs can perform not only time series forecasting, but moving averages, weighted moving averages, exponential smoothing, and assorted other techniques that are not covered in this chapter.

Before proceeding directly to the discussion of the four forecasting techniques, a few basic forecasting rules of thumb are presented.

Some Basic Forecasting Rules of Thumb

Several rules of thumb can be used as guides in conducting forecasts and interpreting the results.

Rule 1. Examine the data for the presence or absence of a trend. Revenues and expenses and, to a lesser extent, caseload, tend to change incrementally. Consequently, either an upward or downward trend may be present in the data. Looking at Table 9.1, an upward trend is clearly evident in the caseload data. The caseload has been trending upward for the past four fiscal years. On the other hand, the donation data do not demonstrate a trend, but rather vary (increase and decrease) from year to year. In the absence of any other data or any other contextual information about the nature of the human service agency, the type of service involved, the client population, the community, the local economy, and so on, we would expect that the trend in the caseload data would continue for fiscal year 20X5. We are less sure about the forecast for donations because of the absence of a trend.

Rule 2. The farther out the forecast, the less reliable the forecast. A forecast that looks ahead one fiscal year will generally be more reliable (more accurate) than a forecast that looks ahead three fiscal years. The reason is simple: Things change! A good example of the problem with forecasts that look too far ahead is provided by the U.S. space program. When the United States put a man on the moon in 1969, all kinds of forecasts about the future of space exploration were made based on how long it took us to reach the moon. According to many of these forecasts, we should already have a space colony on Mars. But we don't. Why? Because things change! In the case of the space program, government funding for space exploration was cut back and our space exploration policy changed from using manned spacecraft to using unmanned spacecraft.

Rule 3. Older data are less important than more recent data. Table 9.1 could include donation data for fiscal years 1999, 1998, 1997, and so on. But we know that a problem in forecasting is that things change. So, the older the data included in a forecast, the more opportunity for things to change and, consequently, the less reliable the forecast is likely to be.

Rule 4. The last actual value of the forecast variable is the single most important piece of information. In Table 9.1, the caseload and donation forecasts are to be made for fiscal year 20X5; the last actual value for the caseload is 1,450 and the last actual value for donations is \$25,000. In the absence of any other data, the single best predictor of the future is the last value of the forecast variable. The reason is that the last actual value is the single piece of datum that is temporarily closest to the forecast. For example, if the only datum we had in Table 9.1 was the last actual value for caseload (1,450) for fiscal year 20X4, our best forecast for 20X5 would be 1,450. The last actual

TABLE 9.1 The Palmdale Human Service Agency

Fiscal Year	Caseload	Donations
20X1	1,200	\$25,000
20X2	1,300	22,000
20X3	1,400	27,000
20X4	1,450	25,000
20X5	?	?

value also provides a reality check for a forecast. For any forecast, the question should be asked, Does the forecast seem reasonable given the last actual data?

Rule 5. The more one knows about the data, the better one can interpret the forecast. One can forecast anything. The real gut issue is how to interpret the results of the forecast. In Table 9.1, any one of a number of forecasting techniques could be used to forecast the caseload for fiscal year 20X5. But the critical issue is, What are the data trying to tell us? A trend in the caseload data is clearly evident over the past four fiscal years. The caseload was 1,200 in FY 20X1 and increased 100 cases per year for fiscal year 20X2 and 20X3. But then something happened to the trend. In FY 20X4, the caseload increased by only 50. Why? What is going on? Unfortunately, we don't know anything about the Palmdale Human Service Agency, the type of service involved, the client population, the community, the local economy, and numerous other factors that could help provide us with a context in which to interpret the forecast. If we had contextual information, we would be better able to understand what the data are trying to tell us and we would be better able to interpret the forecast. Something may be occurring with the agency, the service, or the community that might explain the caseload data for fiscal year 20X4 and thus help to interpret the forecast for 20X5.

With this brief discussion of some forecasting rules of thumb completed, we can proceed to a discussion of our four forecasting techniques.

Simple Moving Averages

The forecasting technique called *simple moving averages* involves taking historical data on the forecast variable for a series of time periods and computing a simple arithmetic (mean) average. The forecaster must decide how many time periods of the forecast variable to include in the moving average. For example, in Table 9.1, we have historical values of the forecast variables of caseload and donations for four fiscal years. Rule 3 comes into play here: Older data are less important than more recent data. Following this guideline, we might decide to use only three years of historical data on the caseload and donations to make our forecasts. Table 9.2 takes this approach to forecasting caseload and donation data for fiscal year 20X5 using simple moving averages.

TABLE 9.2 Palmdale Human Service Agency

Caseload and Donations Forecasts Using Simple Moving Averages		
Fiscal Year	Caseload	Donations
20X2	1,300	\$22,000
20X3	1,400	27,000
20X4	1,450	25,000
20X2–X4	4,150	74,000
20X5	$\frac{4,150}{3} = 1,383$	$\frac{74,000}{3} = \$24,667$

Using simple moving averages, the caseload forecast for fiscal year 20X5 is 1,383, whereas the donations forecast is \$24,667. The caseload forecast is derived by adding the caseload data for the three time periods and dividing by the number of time periods. The same procedure is used to forecast donations. At this point we are reminded of Rule 1 relating to the presence or absence of a trend. We know that an upward trend exists in the caseload data, but that no trend appears to exist in the donations data. Thus, we should anticipate that the caseload forecast will show a continuation of the trend, whereas the donations forecast will continue to fluctuate.

Our expectations are satisfied with respect to the donations forecast, but not for the caseload forecast. The donations forecast for fiscal year 20X5 is 24,667, which is less than the last actual data for fiscal year 20X4. The donations forecast continues to jump around. Our expectation is not satisfied for the caseload forecast. The caseload forecast for fiscal year 20X5 is 1,383, which is again less than the actual data for fiscal year 20X4. But we should expect, based on the observed trend in the caseload data, a forecast that is greater than the actual caseload for fiscal year 20X4.

What is the problem with the simple moving averages forecast of caseload for fiscal year 20X5? Rules 3 and 4 provide some guidance. Rule 3 tells us that older data are less important than more recent data. All the data in the two simple moving averages forecasts are weighted the same. Actually, no weights are used, which has the effect of treating all data as though they were weighted equally. Rule 4 suggests that the last actual value of the forecast variable is more important than the other data and should perhaps be given greater weight in the forecast.

The point needs to be made that the *moving* in *simple moving averages* means that for fiscal year 20X6, the forecast would be comprised of the actual caseload and donations data for fiscal years 20X3, 20X4, and 20X5. The actual caseload and donations data for 20X5 would be added to the moving averages and the caseload and donations data for 20X2 would be deleted. This process keeps the simple moving average's base of three fiscal years.

Weighted Moving Averages

The second of our four forecasting techniques, *weighted moving averages*, attempts to improve on simple moving averages by assigning weights to the data that comprise the forecast. In keeping with Rules 3 and 4, the idea is to place more weight on the last actual value of the forecast variable and decreasing weights on the older data. For example, a common practice in weighted moving averages is to assign a weight of “1” to the oldest datum to be used in the forecast and then assign increasing weights to more recent data so that the last actual value receives the greatest weight. Following this approach, Table 9.3 shows the results of a weighted moving average forecast for caseload and donations for fiscal year 20X5.

Using weighted moving averages, the caseload forecast for fiscal year 20X5 is 1,408 and the donations forecast is \$25,167. The caseload forecast is arrived at by multiplying the caseload data for each year by its weight, adding the results together, and dividing by the total number of weights. The forecast for donations is obtained using the same approach. The caseload forecast of 1,408 appears more realistic than the simple moving averages forecast of 1,383, but it is still less than the last actual caseload data of 1,450 for fiscal year 20X4. Again, we are confronted with the problem that we cannot put a lot of confidence in a forecast of 1,408 unless we have some contextual information that explains why we should accept a caseload forecast that does not demonstrate a continuation of the identified trend. The

TABLE 9.3 Palmdale Human Service Agency

Forecasts Using Weighted Moving Averages			
Caseload			
Fiscal Year	Caseload	Weight	Weighted Score
20X2	1,300	1	1,300
20X3	1,400	2	2,800
20X4	1,450	3	4,350
20X5	8,450/6 = 1,408	6	8,450
Donations			
Fiscal Year	Donations	Weight	Weighted Score
20X2	\$22,000	1	\$ 22,000
20X3	27,000	2	54,000
20X4	25,000	3	75,000
20X5	\$151,000/6 = \$25,167	6	151,000

donations forecast of \$25,167 appears reasonable given the historical way in which donations have tended to fluctuate.

Exponential Smoothing

In order to perform a forecast using either simple moving averages or weighted moving averages, the forecaster must collect and save data for several historical time periods. *Exponential smoothing* is a forecasting technique that requires only two pieces of information: (a) the last actual value of the forecast variable and (b) the last actual forecast. With these two pieces of information and the use of a simple formula, we can forecast caseload, revenues, expenses, or any other variable. One might say that exponential smoothing takes to heart Rule 4 that the last actual value of the forecast variable is the single most important piece of information. The forecasting formula used in exponential smoothing is

$$NF = LF + \alpha (LD - LF) \quad \text{where} \quad \begin{array}{l} NF = \text{New forecast} \\ LF = \text{Last forecast} \\ \alpha = 0 \text{ to } 1 \\ LD = \text{Last data} \end{array}$$

The formula is relatively straightforward with the exception of the alpha (α). Alpha is a value between 1 and 0 that is selected by the forecaster. The alpha determines how much weight in the new forecast will be placed on the last data (the last value of the forecast variable) and, conversely, how much weight will be placed on the last forecast. An alpha of 1 means that 100 percent of the new forecast will be based on the last data and 0 per cent on the last forecast. An exponential smoothing forecast using an alpha of 1 would result in a number that would be exactly the same as the last actual value of the forecast variable. An alpha of zero means that 0 percent of the new forecast will be based on the last data and 100 percent on the last forecast. An exponential smoothing forecast using an alpha of 0 would result in a number that is exactly the same as the last forecast. An alpha of .5 means that 50 percent of the new forecast will be based on the last actual data and 50 percent on the last forecast.

When using exponential smoothing, the alpha selected is determined by the accuracy of the last forecast. For example, if the caseload forecast for fiscal year 20X4 was 1,700 and the actual caseload was 1,450, then the forecast was not very accurate. In such a situation, the forecaster would want to select for the next forecast (fiscal year 20X5) a high alpha (.7 to .9) that places more weight on the last data and less weight on the last forecast. If, however, the caseload forecast for fiscal year 20X4 was 1,460 and the actual caseload for fiscal year 20X4 was 1,450, then the forecast was quite accurate. In such a situation, the forecaster would want to select for the next forecast (fiscal year 20X5) a low alpha (.2 to .3) that places more weight on the last forecast and less weight on the last data. A small alpha (.2 to .4) has the same effect as if data for several time periods were included

TABLE 9.4 Palmdale Human Service Agency**Caseload and Donations Forecasts
Using Exponential Smoothing****Caseload**

$$\begin{aligned}
 \text{NF} &= \text{LF} + \alpha(\text{LD} - \text{LF}) \\
 &= 1,500 + .2(1,450 - 1,500) \\
 &= 1,500 + .2(-50) \\
 &= 1,500 + (-10) \\
 &= 1,490
 \end{aligned}$$

Donations

$$\begin{aligned}
 \text{NF} &= \text{LF} + \alpha(\text{LD} - \text{LF}) \\
 &= \$26,000 + .5(\$25,000 - \$26,000) \\
 &= \$26,000 + .5(-\$1,000) \\
 &= \$26,000 + (-\$500) \\
 &= \$25,500
 \end{aligned}$$

in the forecast. In other words, a small alpha “smooths” the forecast, hence the name *exponential smoothing*.

Let’s assume that the caseload forecast for fiscal year 20X4 was 1,500 and that the donations forecast was \$26,000. We know that the actual caseload and donations data for fiscal year 20X4 were, respectively, 1,450 and \$25,000. Because the caseload forecast was quite accurate, we will select an alpha of .2 for use in our forecast of caseload for 20X5. Because the forecast for donations was somewhat less accurate, we will select a higher alpha (.5) that will place equal emphasis on both the last forecast and the last data. This information can now be entered into the exponential smoothing formula (Table 9.4) and a fiscal year 20X5 forecast can be made for both caseload and donations.

The exponential smoothing caseload forecast is 1,490 for 20X5. This forecast appears to be realistic because the upward trend evidenced over the last four fiscal years is continued and because the new forecast is greater than the actual caseload data of 1,450 for fiscal year 20X4. Similarly, the exponential smoothing forecast for donations of \$25,500 for fiscal year 20X5 appears reasonable, but we are less sure of this forecast because of the tendency of the donations data to fluctuate.

Time Series Regression

Time series regression is the last of the four generally recognized forecasting techniques to be discussed in this chapter and the only one that requires the use of a computer. Time series regression is more sophisticated than the other forecasting

techniques considered, but it also more powerful and provides more insights into the data and the forecast. Time series regression forecasting also yields an estimate of how much confidence one should have in the forecast. These features make it one of the most commonly used forecasting techniques (Forester, 1993). Time series regression forecasting can be performed using any computer software package that contains a simple linear regression program.

Time series regression is an application of what is called the ordinary least squares regression model. Time series regression forecasting attempts to find a linear relationship between time (the independent variable) and the forecast variable (the dependent variable). A linear relationship can be thought of as a trend. In other words, time series regression analyzes the data looking for a trend. The time series regression model looks for (a) a positive linear relationship (or trend) between time and the forecast variable, (b) a negative linear relationship (or trend) between time and the value of the forecast variable, or (c) no linear relationship (or trend). A positive linear relationship (or trend) means that over time the values of the forecast variable are increasing. A negative linear relationship (or trend) means that over time the values of the forecast variable are decreasing. If the time series regression model finds a moderate to strong positive or negative linear relationship (or trend), the computer output can be used to make a forecast using the formula

$$Y = A + BX \text{ where } Y \text{ is the forecast (an unknown quantity)}$$

A is the base or constant
 B is the unit value change in the forecast variable
 X is the increment of time to be forecasted

The use of an example should help make the discussion of time series regression forecasting more understandable. Table 9.5 demonstrates how time series regression can be used to conduct a caseload forecast using the caseload data we have used in the other forecasts. In conducting a caseload forecast using time series regression, we are going to use all four years of available caseload data. Using older data here does not violate Rule 3, because (a) a time series regression forecast needs at least four (some would say five) data points to function properly and (b) the analysis is able to differentiate between changes attributable to time (the trend) and changes attributable to other factors.

The first part of Table 9.5 shows how the data for a time series regression forecast are entered into a computer program. Time is always treated as the independent variable (IV), whereas the forecast variable (e.g., caseload or donations) is always treated as the dependent variable (DV). When the data are inputted into the computer program, it is important not to reverse these variables. Time must always be the independent variable or the computer output will be meaningless. When inputting data into a time series regression, the time periods are transformed into consecutive numbers. For example, we have four years of caseload data (the time period) so fiscal year 20X1 = 1, 20X2 = 2, 20X3 = 3, and 20X4 = 4. The oldest time period is always designated 1.

TABLE 9.5 Caseload Forecast Using Time Series Regression

Computer Input					
	Time (IV)	Caseload (DV)			
	1	1,200			
	2	1,300			
	3	1,400			
	4	1,450			
Computer Output					
Coefficients					
Unstandardized Coefficients			Standardized Coefficients		
Model	B	Std. Error	BETA	t	Sig.
Constant	1125	23.717		47.434	.000
Var 1	85	8.660	.990	9.815	.010
Model Summary					
Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate	
1	.990	.980	.969	19.3649	

The second part of Table 9.5 shows the resulting computer output, specifically the “coefficients” and the “model summary” sections. Computer programs such as Statistical Packages for the Social Sciences (SPSS) provide a lot of output that is not essential to the purposes of conducting and interpreting the results of a time series regression forecast. For forecasting purposes, one needs to know the value of R-square, the value of *A* (the constant), and the value of *B* (Var1). In SPSS, the value of R-square is usually found as part of the model summary output, while values of the *A* (constant) and the *B* (Var1) are usually found as part of the coefficients output.

The R-square tells us how much confidence we should have in the forecast. R-square can vary between 0 and 1. R-square can also be thought of as a measure of the strength of a trend (either positive or negative) in the values of the forecast variable over time. If the R-square is greater than .7, a strong trend exists. An R-square between .5 and .7 indicates a moderate trend; R-square less than .5 indicates a weak trend. Looking at the model summary portion of the computer output (Table 9.5), we can see that the R-square for the time series regression is .980, which is significantly greater than .7. In terms of interpretation, we can say that we can

have a high degree of confidence in the result of a time series regression forecast. Another interpretation is that the time series regression analysis has found a strong trend in the caseload data. This strong trend can be used for forecasting purposes.

In order to perform a time series regression forecast, we must substitute the relevant values into the formula $Y = A + BX$ (Table 9.6). To the base value of A (a constant), we add B (Var1) multiplied by X (the time period to be forecasted). Since we are using four years of caseload data in the time series regression and we are performing a forecast for the next fiscal year, $X = 5$. The result is a caseload forecast of 1,550. This caseload forecast looks good because it is a continuation of the observed trend in the caseload data and because it is greater than the last actual caseload data for fiscal year 20X4.

Why does the time series caseload forecast perform so much better than the other forecasting techniques? The answer is that time series regression is particularly sensitive to, and performs best, when a strong trend is present. The three other forecasting techniques discussed in this chapter are not as sensitive to trends.

At this point it is probably advisable to pause for a moment and explain exactly what the values of the A (constant) and the B (Var1 or variable 1) mean in a time series regression. When conducting a time series regression, many computer programs provide for the optional generation of a graph of the linear relationship between time and the forecast variable. Figure 9.1 is such a graph. The independent variable (time) is shown on the x -axis and the dependent variable (caseload) is shown on the y -axis. In the middle of the graph are four data points. The first data point represents the caseload data (1,200) for fiscal year 20X1 (year 1). The second data point represents the caseload data (1,300) for fiscal year 20X2 (year 2). The third data point represents the caseload data (1,400) for fiscal year 20X3 (year 3). And finally, the fourth data point represents the caseload data (1,450) for 20X4 (year 4).

The line in the center of the graph is the *regression line*. The regression line can be thought of as “the best line” that expresses the linear relationship (the trend) between time and the forecast variable. The line begins at 1,125. This point is called A (constant) because it is the fixed point at which the regression line begins. This point is also called the *y-intercept* because it is the point at which the regression line crosses the y -axis. The slope of the regression line then goes up 85 (B or Var1) for each time period (year). In performing the actual time series regression forecast, the regression line is simply extended out to the time period being forecasted. In

TABLE 9.6 Caseload Forecast Using Time Series Regression

$$\begin{aligned}
 Y &= A + BX \\
 &= 1125 + 85(5) \\
 &= 1125 + 425 \\
 &= 1550
 \end{aligned}$$

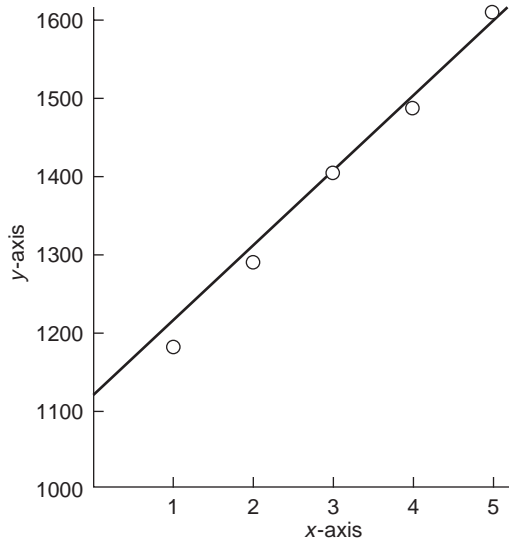


FIGURE 9.1 Graph of Time and Caseload with Regression Line

this example, caseload is being forecasted for the fifth year. The mathematics of the forecast are simply to begin with the value of A (constant) and then to add the value of B (Var1) for each time period (year) up to the forecast time period (year):

$$1,125 + 85 (\text{year 1}) + 85 (\text{year 2}) + 85 (\text{year 3}) + 85 (\text{year 4}) + 85 (\text{year 5}) = 1,550$$

Now let's do a time series regression forecast for donations. The top portion of Table 9.7 shows how the data are entered into the computer program; the lower portion shows the computer output. In the "coefficients" section of the output, we see that the value of A (constant) is 23,500 and the value of B (Var1) is 500. In the model summary section, we see that the R-square is .098. The R-square is extremely low, which means that we can have little confidence in any forecast made using time series regression. Another way of interpreting the low R-Square is that the computer could not find a trend in the data. Knowing that we can have no confidence in the results, let's go ahead anyway and do a time series regression forecast using the formula $Y = A + BX$ (see Table 9.8) The resulting forecast for donations is \$27,000 in fiscal year 20X5, but we know that we can have absolutely no confidence in this forecast.

The two time series regression forecasts for caseload and for donations demonstrate the strengths and limitations of this forecasting technique. Time series regression forecasting works well when a strong (R-square = .7 or greater) trend exists, works less well when a moderate (R-square = .4 to .7) trend exist, and does not work well at all when a weak (R-square = less than .4) exists.

TABLE 9.7 Donations Using Time Series Regression

Computer Input					
	Time (IV)	Caseload (DV)			
	1	\$25,000			
	2	22,000			
	3	27,000			
	4	25,000			
Computer Output					
<i>Coefficients</i>					
<i>Unstandardized Coefficients</i>			<i>Standardized Coefficients</i>		
Model	B	Std. Error	BETA	t	Sig.
Constant	23,500	2936.835		8.002	.015
Var 1	500	1702.381	.313	.466	.687
<i>Model Summary</i>					
Model	R	R-Square	Adjusted R-Square	Standard Error of the Estimate	
1	.313	.098	-.353	2397.9165	

TABLE 9.8 Donations Using Time Series Regression

$$\begin{aligned}
 Y &= A + BX \\
 &= \$23,500 + \$500(5) \\
 &= \$23,500 + \$2,500 \\
 &= \$27,000
 \end{aligned}$$

When to Use Which Forecasting Technique

The preceding discussion of the four generally recognized forecasting techniques (in particular, the discussion of time series regression) allows three more rules of thumb to be offered:

Rule 6. When a strong trend (R-square = .7 or greater) is present in the data, use time series regression.

Rule 7. When a moderate trend (R-square = .4 to .7) is present in the data, use moving averages or weighted moving averages.

Rule 8. When a weak trend (R-square = less than .4) or no trend is present in the data, use exponential smoothing with the choice of alpha dependent upon the accuracy of the last forecast.

Following Rule 6, for any given forecast, a forecaster should first use time series regression and determine if a trend is present in the data and the strength of any such trend.

Summary

This chapter presented four generally recognized forecasting techniques: (1) simple moving averages, (2) weighted moving averages, (3) exponential smoothing, and (4) time series regression. The advantages and disadvantages of each forecasting technique were identified and several rules of thumb were provided to guide human services administrators in the selection of the most appropriate forecasting technique and in interpreting the results of forecasts.

EXERCISES

Exercise 9.1

The following data represent total personnel expenses for the Palmdale Human Service Agency for past four fiscal years:

20X1	\$5,250,000
20X2	\$5,500,000
20X3	\$6,000,000
20X4	\$6,750,000

Forecast personnel expenses for fiscal year 20X5 using moving averages, weighted moving averages, exponential smoothing, and time series regression. For moving averages and weighted moving averages, use only the data for the past three fiscal years. For weighted moving averages, assign a value of 1 to the data for 20X2, a value of 2 to the data for 20X3, and a value of 3 to the data for 20X4. For exponential smoothing, assume that the last forecast for fiscal year 20X4 was \$6,300,000. You decide on the alpha to be used for exponential smoothing. For time series regression, use the data for all four fiscal years. Which forecast will you use? Why?

Exercise 9.2

The following data represent total “person trips” (service outputs or units of service) provided by the Palmdale Human Service Agency’s specialized transportation program for the past four fiscal years:

20X1	12,000
20X2	15,000
20X3	13,500
20X4	14,250

Forecast person trips for fiscal year 20X5 using moving averages, weighted moving averages, exponential smoothing, and time series regression. For moving averages and weighted moving averages, use only the data for the past three fiscal years. For weighted moving averages, assign a value of 1 to the data for 20X2, a value of 2 to the data for 20X3, and a value of 3 to the data for 20X4. For exponential smoothing, assume that the last forecast for fiscal year 20X4 was 15,000. You decide on the alpha to be used for exponential smoothing. For time series regression, use the data for all four fiscal years. Which forecast will you use? Why?

Exercise 9.3

The following data represent total revenues (from all sources) for the Palmdale Human Service Agency for the past four fiscal years:

20X1	\$15,000,000
20X2	\$14,250,000
20X3	\$14,000,000
20X4	\$13,500,000

Forecast total revenues for fiscal year 20X5 using moving averages, weighted moving averages, exponential smoothing, and time series regression. For moving averages and weighted moving averages, use only the data for the past three fiscal years. For weighted moving averages, assign a value of 1 to the data for 20X2, a value of 2 to the data for 20X3, and a value of 3 to the data for 20X4. For exponential smoothing, assume that the last forecast for fiscal year 20X4 was \$13,000,000. You decide on the alpha to be used for exponential smoothing. For time series regression, use the data for all four fiscal years. Which forecast will you use? Why?