**INSTRUCTOR NOTES: CHAPTER 6**

**ACTIVITY ANALYSIS, COST BEHAVIOR, AND COST ESTIMATION**

**Learning Objectives**

1. Explain the relationships between cost estimation, cost behavior, and cost prediction.

2. Define and describe the behavior of the following types of costs: variable, step-variable, fixed, step-fixed, semivariable (or mixed), and curvilinear.

3. Explain the importance of the relevant range in using a cost behavior pattern for cost prediction.

4. Define and give examples of engineered costs, committed costs, and discretionary costs.

5. Describe and use the following cost-estimation methods: account classification, visual fit, high-low, and least-squares regression.

6. Describe the multiple regression, engineering, and learning-curve approaches to cost estimation.

7. Describe some problems often encountered in collecting data for cost estimation.

8. Perform and interpret a least-squares regression analysis with a single independent variable (appendix).

**Chapter Overview**

I. **Cost Behavior Patterns**

A. **Types of costs**

1. Variable costs

2. Step-variable costs

3. Fixed costs

4. Step-fixed costs

5. Semivariable (mixed) costs

6. Curvilinear cost

 B. **The relevant range**

 C. Using Cost Behavior Patterns to Predict Costs

 D. Cost Categories and Structures

1. Engineered costs
2. Committed costs
3. Discretionary costs

II. **Cost Estimation**

 A. Methods

1. Account-classification
2. Visual-fit
3. **High-low**
4. **Least-squares regression**
5. Regression line
6. Independent and dependent variables
7. Goodness of fit
8. Multiple regression
9. Data Collection Problems
10. Missing data
11. Outliers
12. Mismatched time periods
13. Trade-offs in choosing the time period
14. Allocated and discretionary costs
15. Inflation

III. Effects of Learning on Cost Behavior

A. Learning curves

B. Experience curves

**Key Concepts**

**1. COST BEHAVIOR PATTERNS**

1. Understanding **cost behavior** patterns (i.e., the relationship between cost and activity) is important to managers as they plan, control, and make decisions in the operation of their organizations. (For example, a manager must understand how costs behave across various levels of activity before a budget can be prepared.)
2. **Variable costs** are costs that remain constant on a per-unit basis and fluctuate in total in direct response to cost-driver changes.
* Example: the paper cost of examinations varies with the number of students in a class.
1. **Step-variable costs** are nearly variable, but such costs increase in small steps rather than in direct proportion to cost-driver changes.
* Example: if a class is a bit larger than usual, an additional exam proctor may have to be hired. This increase in part-time hourly help increases by a step as the class size grows.
1. **Fixed costs** stay constant in total but fluctuate on a per-unit basis across ranges of activity.
* Example: a professor's salary is fixed, and more students enrolled in his or her course will not affect salary. However, the salary cost *per student* will vary depending on class size.
1. **Step-fixed costs** are fixed within a wide range of activity but will change outside that range.
* Example: if a course increases by a large number of students, it will be necessary to add another section and hire another instructor. The fixed cost then jumps to another step.
1. A **semivariable cost (mixed cost)** changes in response to a change in a cost driver, but not in direct proportion. Such costs have both variable and fixed elements.
* Example: a printer's fee for brochures may include a fixed set-up cost and a per-copy (i.e., variable) charge for running the total copies needed.
1. A **curvilinear cost** function cannot be represented with a straight line but instead is represented with a curve that reflects either increasing or decreasing marginal costs.
2. The **relevant range** reflects therange of activity within which managers expect a company to operate, allowing the prediction of cost behavior with some certainty.
* Within the relevant range, even curvilinear costs may behave in a linear fashion.
1. An **engineered cost** is one that bears a definite physical relationship to the cost driver.
* Example: the food cost of a restaurant, as it is impossible to serve more meals without incurring additional food cost.
* **Committed costs** result from an organization's ownership or use of facilities and its basic organizational structure. These costs cannot be eliminated without endangering the entity's overall health and existence.
* Examples: property taxes, depreciation on buildings and equipment, top management salaries
* **Discretionary costs** exist as the result of a management decision. In comparison with committed costs, such costs are more easily changed in bad economic times without doing serious long-run harm to the entity.
* Examples: a training program, an advertising campaign, corporate contributions

**2. COST ESTIMATION**

1. The **account-classification method** (also called **account analysis)** requires the study of an account in the general ledger. The experienced analyst uses the account information as well as his or her own judgment to determine future cost behavior.
2. With the **visual-fit method,** an analyst examines a cost by plotting points on a graph (called a **scatter diagram)** and places a line through the points to yield a cost function.
* This method is more objective than the account-classification method, but it is still lacking because two cost analysts could visually fit different lines.
* The visual-fit method is useful because it helps spot nonrepresentative data points, or **outliers.**
1. The **High-Low Method** considers only two points of data, the highest and lowest, for activity within the relevant range. To estimate fixed and variable costs, this method uses data from a representative period of *low activity* and a period of *high activity*. This method is straight-forward and easy to use.

High-Low estimation computes the following:

|  |  |  |
| --- | --- | --- |
| **VARIABLE COSTS PER UNIT** | **=** | **Difference in Total Costs** (for High – Low Activity) |
|  |  | **Difference in Activity** (High – Low Activity) |

**Fixed costs = Total Costs - Variable** **Costs**

* The method first focuses on cost changes, allowing an analyst to determine the presence of any variable cost. Next, fixed costs are determined by subtracting variable cost from the total cost at either of the two data points.
* The high-low method is more objective than the visual-fit method, but it is still a rough approximation because it considers only two points of data.
* The points selected should be representative of normal behavior.

|  |
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| **Use of the high-low method is common in practice and is common in testing situations. It can be used easily to estimate fixed and variable costs** |

1. The **Least-Squares Regression Method** is a statistical approach that is both objective and considers all data points.
* By using mathematical formulas to arrive at the best possible cost line (i.e., the **regression line),** the method is more accurate than the other methods.
* The regression line is in the form Y = a + bX, where X is the **independent variable** and Y is the **dependent variable.**
* The **coefficient of determination, R2,** can be used to judge the line's **goodness of fit,** or how well the line fits the data on which it is based.
* If the goodness of fit is relatively high, a large proportion of the variation in the dependent variable is explained by changes in the independent variable.
* The text's appendix shows how a spreadsheet such as Microsoft® Excel can be used to calculate various parameters related to regression analysis.
1. **Multiple regression** can be used to estimate a cost function when there is more than one independent variable. (For example, the fuel cost for an airline is determined by the number of miles flown and by other variables such as wind speed and load.)
2. The process of collecting appropriate data to use in cost estimation is important, as the best method will fail if it integrates poor data. Common problems include missing data, outliers, mismatched time periods for the dependent and independent variables, and inflation.
3. The previously mentioned estimation methods assume there is an historical pool of data from which to draw. In new environments without such a pool, the **engineering method** of estimation may be used.
* Instead of beginning with past cost, the engineering method begins by asking how much a product *should* cost, given design specs and manufacturing techniques.

**3. Effects of Learning on Cost Behavior**

1. A **learning curve** expresses the relationship between labor time and output. As the labor force becomes more experienced with a new process, workers become more efficient and the per-unit cost falls.
* The learning-curve concept has been broadened to include costs other than direct labor via the **experience curve.**
	+ - * Learning and experience curves have been applied primarily in complex, labor-intensive manufacturing operations. An example of use: cost prediction, particularly the cost of new products and processes.