Chapter 2: Cost Concepts, Behaviour, and Estimation

# Chapter Overview

This chapter begins a series of chapters that present a variety of decision-making techniques and methods. Once students have a foundation in cost behaviour in Chapter 2, they use this information to identify relevant costs and develop solutions for cost-volume-profit analysis (Chapter 3), non-routine decisions (Chapter 4), capital budgeting decisions (Chapter 13), and product pricing (Chapter 14) and costing decisions (Chapter 15). Many accounting programs do not include capital budgeting in cost accounting, so this chapter has been moved toward the end of the text. This group of chapters may be taught in the order suggested above for a complete wrap up of the decision making methods used in cost and managerial accounting. (The sell or process further decision is covered in Chapter 9 concurrent with accounting for joint products.)

Chapter 2 is longer than other chapters because the first part of the chapter reviews terms from the introductory management accounting course. For both graduate and undergraduate students, this chapter may require more than one class session. Pages 42 to 50 should be review for many students. Because several months may have elapsed since they learned this material, they will need to review it. In addition, their ability to understand some of the more subtle judgments may have increased with time and experience, so they will be more able to consider the ambiguity in a cost category such as direct labour, which can be either fixed or variable depending on how labour is used in the organization.

This chapter provides many opportunities to discuss the uncertainties involved in predicting costs using a cost function that is based on historical cost and updated for anticipated changes. Students begin to understand that cost prediction is not perfect. Some students feel uncomfortable with uncertainties and want to memorize definitions and the use of cost categories by memorizing problems. If this is their first semester in upper-division coursework, they are easily frustrated when they cannot memorize a method and instead need to apply judgment to make decisions about cost categories. However, students need to understand that uncertainty is an inherent part of the business world, and they need to understand the importance developing the skills to identify and manage information that is uncertain.

Several homework problems from this chapter are expanded upon in Chapter 3. These may be used as part of the class demonstration of material or assigned as homework. Little Beaver Daycare Centres (Problems 2.56 and 3.54) is useful as a group in-class problem that can be done at the end of the class period with students completing it at home. A student or several students can put their answers on the board or an overhead at the start of the next class, and the solution can be used to review and prepare for the next topic.

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# Chapter In Brief

Managers need a basic understanding of the organization's costs if they are to react quickly to change and create successful organizational strategies and operating plans. Managers use classifications and estimation techniques to understand and anticipate future cost behaviour. They can then estimate relevant costs to help them make decisions and plan future operations.

# This Chapter Addresses the Following Learning Objectives:

LO1: Explain the cost concept and cost terms.

LO2: Describe the different types of cost behaviour.

LO3: Describe cost estimation techniques.

LO4: Apply cost estimation techniques to determine future costs.

LO5: Utilize regression analysis in cost estimation.

LO6: Appreciate the uses and limitations of cost estimates.

# Lecture Notes

## LO1: Explain the cost concept and cost terms.

Review the five cost classifications:

Relevance – costs that differentiate between alternatives

Behaviour – how costs change with changes in activity

Traceability – whether a cost can be traced to an identified cost object

Function – manufacturing or non-manufacturing

Controllability – the level of management that has the authority to incur/cut costs

Define a cost object as any thing or activity for which we measure costs

Discuss the concept of relevant range and how it is applied when costs change over the range of activity being analyzed. Exhibit 2.3b can be used to illustrate the occurrence of two relevant ranges within the range of activity being analyzed.



Review the challenges of identifying relevant costs, also noting that not all costs appear in the accounting system.

Introduce the students to direct versus indirect costs and the concepts of opportunity and sunk costs. Self-Study Problem 2-1 presents a scenario to discuss opportunity and relevant costs with the class.

## LO2: Describe the different types of cost behaviour.

Review cost behaviour terminology from introductory classes

Interactive activity: Ask students to define, and then help them refine their definitions for the following:

|  |  |
| --- | --- |
| Variable cost | Opportunity cost |
| Fixed cost | Sunk cost |
| Mixed cost | Discretionary cost |
| Direct cost | Relevant range |
| Indirect cost |  |

**Teaching Note for Undergraduates**

Although undergraduates may have learned these terms in introductory courses, their memories need refreshing. Discretionary and marginal costs are more difficult, so examples are important. It is usually easy for students to find discretionary cost examples in their own lives, such as the money they spend on entertainment. However, it is more difficult for them to realize that marketing and research and development costs can be cut out completely (although eliminating these costs would usually be an unwise decision).

Teaching Note for Undergraduates and Graduates

Direct labour cost and electricity are ambiguous costs for categorization, and worthy of discussion to help students understand the need for judgment in examining cost behaviour. For these two costs, the categorization depends on the business context. For example, students believe that direct labour in a fast food restaurant would be completely variable. However, some students will have worked in this environment and know that there is a set schedule for a core crew, suggesting that it is a mixed cost. In addition, students need to understand that when direct labour employees are guaranteed 40-hour work weeks and the organization is not at capacity, direct labour cost is actually fixed. When the company is at capacity, it becomes variable if the cost object is a particular product within a product mix, because the labour could be used on any one product line. If students ask about overtime, you may want to discuss the different options for recording overtime, that is, as direct labour or as overhead. Alternatively, you may want to defer this discussion until job costing and allocation are introduced (Chapter 5).

**Teaching Note for Graduates**

These terms are new to most graduates, so the chapter should be assigned reading before definitions are discussed.

Introduce the following linear cost function:

TC = F + V\*Q TC is total cost

F is total fixed cost

V is the variable cost per unit of activity

Q is the volume of activity (cost driver)

Discuss the following assumptions of linearity:

Within the relevant range, fixed costs remain fixed and the variable cost per unit remains constant. Discuss the term *Cost Driver*.

**Teaching Note**

A very simple problem, such as the following, generates discussion about the need for judgment in categorizing direct labour and power and light costs. Students will assume that direct labour, telephone, and power and lights are completely variable. These costs can be categorized a number of different ways, depending on the actual business context. You may want to have one group of students develop a cost function assuming that direct labour is fixed, as are power and light. Another group may assume that these two are variable, or that power is mixed if you wish to supply extra information, such as that 40% of power and light is used to heat and cool, and 60% is used for running manufacturing machines.

Scott Manufacturing

Schedule of Costs

Direct materials $500,000

Direct labour 300,000

Rent 25,000

Insurance 15,000

Commissions 200,000

Property tax 20,000

Telephone 10,000

Depreciation 85,000

Power and light 30,000

Administrative salaries 100,000

Total $720,000

Note: 100,000 units were produced and sold.

Introduce linear cost functions that are exceptions to the assumptions as follows:

Stepwise linear Fixed costs change across relevant ranges

Piecewise linear Variable costs change across relevant ranges

Introduce the following nonlinear cost functions:

Economies of scale Average costs decline with volume of production

Learning curve Variable costs decline with experience

No apparent pattern No relationship between cost and a potential cost driver

**Teaching Note (Appendix 2B)**

The learning curve is introduced in Appendix 2B on page 72. It can be defined as the rate at which labour hours decrease as the volume of production or services increases. Students can relate to this in terms of working homework problems – the more problems on a particular topic that they work, the more skilled and faster they become at working the problems.

Cumulative average time learning model is measured as:

Y = αX*r*

where: Y = cumulative average labour hours used for X units

α = time required for the first unit

r = an index for the rate of learning calculated

Use Exercise 2.33 to demonstrate the formula

## LO3: Describe cost estimation techniques.

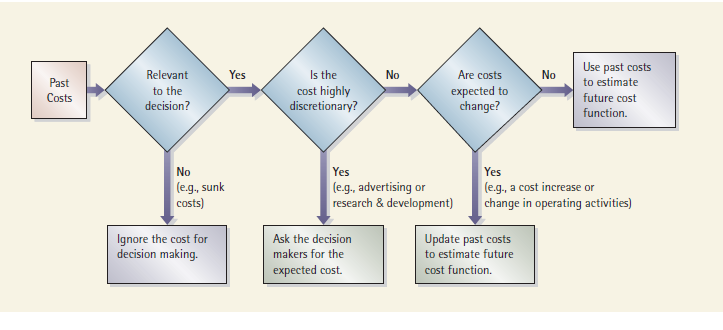
Given: Some purpose for estimating a cost 🡺 Identification of a cost object

**Teaching Note**

Some students fall into the trap of thinking that determining the lowest cost estimate is the purpose for estimating future costs. It is important to stress that the purpose is to provide the

best estimate of the future cost regardless of the magnitude of the cost. Only the best estimate   
is meaningful in the decision-making process.

Procedures:



Discuss why cost estimation methods are needed

### Engineered Estimate of Cost Method

Analyze amount of labour time, materials, and other resources used in each activity. Estimate costs based on resources used.

We suggest focusing primarily on analysis at the account level and the two-point methods. However, Exercise 2.38 could be presented to demonstrate the engineered estimate approach to costing.

### Analysis at the Account Level

Review pattern of past cost recorded in the accounting system; use knowledge of operations to classify cost as variable, fixed, or mixed.

Use all or part of Exercise 2.27 to present analysis at the account level.

The Little Beaver Daycare Centres can be used in both this chapter and Chapter 3 (Mini-Cases 2.56 and 3.54).

###### Teaching Note

Problem 2.46 (Wildcat Lair) can be used to demonstrate a problem-solving approach for this material. In the right hand margin, place two columns titled Fixed and Variable. Then ask students to categorize the costs, discussing the reasons and assumptions behind each cost category. This is a good time to discuss direct labour cost categorization as fixed or variable, depending on the way that labour is used. Students prefer to memorize a single category for direct labour and need to be reminded that if employees work a fixed schedule, the cost is fixed. Sum the fixed costs, and then sum the variable costs and find the variable cost ratio and in turn the contribution margin ratio. This problem solving method is illustrated below for a more complex problem in the Problem Solving Tip Box (following the lecture notes). This box can be posted on a web site for students.

### Scatter Plots

### Refer to data on page 52 and graphs on page 53 as an example of the use of a scatter plot.

### Two-Point and High-Low Methods

##### Description: Two-Point Method

Algebraically calculate a linear mixed cost function using any two data points of the cost and a cost driver.

##### Description: High-Low Method

Specific application of the two-point method using the highest and lowest data points of the cost driver.

Use Exercise 2.29 to introduce high-low, scatter plot, and regression methods. Each section and solution is presented with their learning objectives. Plot past data points for cost against a potential cost driver. First analyze the plot to decide whether the cost approximates a linear function. Then, visually analyze the plot to decide whether the cost might be completely fixed, completely variable, or mixed.

**Teaching Note**

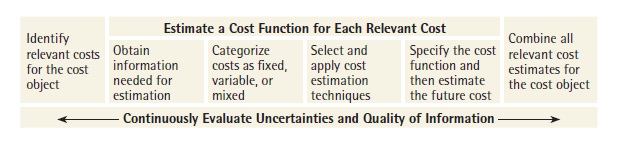
Both undergraduate and graduate students benefit from a demonstration of the key strokes used in Excel to develop scatter plots and to perform regression analysis. Students with laptops should follow the professor’s example and develop a scatter plot and run a regression using data from Problem 2.29 or from one of the other data sets posted on the textbook website. Output from the regression analysis can be projected and the definitions and interpretations of the coefficients and related statistics can be discussed.

Alternatively, if most students are comfortable with the graphing and regression functions in Excel, a simple tutorial using an example from the textbook can be posted on the class website or distributed in hardcopy.

## LO4: Apply cost estimation techniques to determine the future costs.

Estimating the Cost Function

Exhibit 2.11 summarizes activities for estimating a cost function.



An example of how to create a cost function is provided from pages 54 to 57. This is a comprehensive example, the concept is applied to an animal clinic us the high-low method. Student could be asked to review this outside of class and come prepared to discuss in class.

## LO5: Utilize regression analysis in cost estimation.

Description of Regression:

Statistical technique that measures the average change in a dependent variable for every unit change in one or more independent variables. Creates a linear cost function where variable cost is the slope of the regression line and fixed cost is the intercept.

### Simple Regression:

One independent variable

Simple regression analysis then estimates the following equation:

Y = α + βX + ε

where: Y is the dependent variable (total cost)

α (alpha) is the intercept (fixed cost)

β (beta) is the slope coefficient (variable cost per unit of the cost driver)

X is the independent variable (the cost driver)

ε (epsilon) is the error term, also called the residual

You will need to introduce the following terms:

Dependent and independent variables

Coefficients

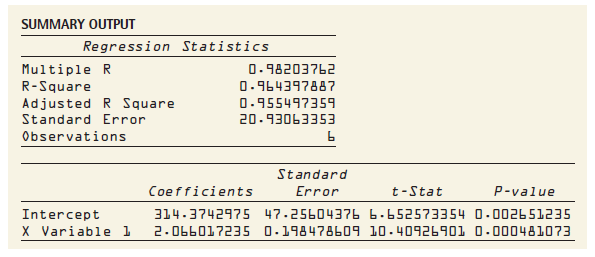
R-square statistic

t-statistic

p-value

### Review the interpretation of regression results, especially with regard to the *R*-square statistic, the *t*-statistic and the *p*-statistic and how they act as indicators for the lever confidence to be derived from the results.

### The following exhibit provides an example of the results of a simple regression analysis.



**Teaching Note**

The comprehensive example provided on pages 60–63 is based on the same animal clinic in the previous example of cost estimation. However, in this example more data points are provided and the process to estimate costs is expanded to use scatter plots, two-point method and simple regression analysis. This example could be used as a basis of in-class discussion for these topics.

### For practice with simple regression analysis use problem 2.42.

### Multiple Regression (Appendix 2A):

Multiple regression analysis estimates the following equation:

Y = α + β1X1 + β2X2 + … + ε

where: Y is the dependent variable (total cost)

α (alpha) is the intercept (fixed cost)

β1, β2, etc. (beta) are the slope coefficients (variable cost per unit of the related cost driver)

X1, X2, etc. are the independent variables (the cost drivers)

ε (epsilon) is the error term, also called the residual

Regression Analysis Assumptions:

* + The dependent variable can be calculated as a linear function of a set of independent variables.
  + The error terms have a normal distribution with a mean of zero.
  + The error terms have a constant variance for all the observations, and they are not correlated with each other.
  + Relatively little correlation occurs among the independent variables.

Additional Regression Analysis Considerations:

Stepwise Linear Fixed Costs

* The importance of analysing costs within a relevant range must be observed when analysing fixed costs.

Piecewise Linear Variable Costs

* Issues such as volume price discounts may impact the behaviour of variable costs. If ignored, regression analysis may generate misleading information.

Data Limitations

Regression analysis is only as accurate as the data fed into the analysis. There are several points to be considered when using regression analysis (highlighted on page 71).

To illustrate multiple regression, use Problem 2.51.

## LO6: Uses and limitations of cost estimates.

### Examples of Reasons to Estimate Future Costs

* Budgeting
* Planning future operations, such as setting employee work schedules, financing activities
* Making specific decisions, such as discontinuing a line of business, renting additional retail store space, or hiring new employees

### What do Managers Need to Consider When Using Estimates of Future Costs?

Uncertainties:

* Actual Future Costs Are Unknown
* Reliability of Cost Estimates is Uncertain Because of Uncertainties About:
  + Cost behaviour classification
  + Cost drivers
  + Changes in cost behaviour over time

In Light of Uncertainties, Need to Evaluate:

* Quality of Cost Information
* Appropriateness of past costs for estimating future costs
* Accounting system information
* Information from outside the accounting system
* Quality of Estimation Techniques
* Reasonableness of Cost Function Assumptions

### Common Errors in Estimating Relevant Costs

* Financial statements, which often average costs, are use as a source of cost information.
* Use of accounting records as a source of data, which tend to reflect purchase behaviour versus the use of resources in production.
* Managers assume incorrectly that variable costs are always avoidable and therefore relevant to all decisions. Or, conversely, that all fixed costs are unavoidable and irrelevant.

# Recommended Homework

Students can replicate the solution to Problem 2.51 if it has been used in class.

Problem 2.50 is a thought-provoking problem that requires students to create scatter plots and run regressions using a data set from the website.

Problem 2.53 requires students to evaluate the appropriateness of two different cost drivers.

Problem 2.52 integrates cost accounting with statistics by asking students to evaluate a lagged variable as a potential cost driver.

Problem 2.45 requires students to estimate learning curve effects and determine the impact of using information from early in the learning process to predict future costs by using a regression analysis.You may wish to give students the following guidance for developing a cost function.

PROBLEM SOLVING TIP: CREATING A COMPLEX COST FUNCTION

Use this guide to create a cost function for problems having several cost categories and data for prior time periods.

1. Create a table listing the relevant cost categories in the left column. Include prior cost data in the following columns, if past information is available. Create three new columns labelled “F” for fixed costs, “V” for variable costs, and “Driver” for the cost driver.

2. Analyze each relevant cost and classify it as fixed, variable, or mixed. For variable and mixed costs, identify at least one cost driver.

3. For each relevant cost: Estimate the cost function. Analyze each cost and write your estimate of value of that cost, updating values as needed for expected changes in cost. Enter your estimates for fixed and variable costs in the appropriate columns. If the cost is mixed, use an estimation technique (for example, high-low or regression) to separate the fixed and variable portions.

4. Add all of the fixed costs. Then add the variable costs for each cost driver.

5. Write the algebraic expression of the cost function. If you have more than one cost driver, you will have more than one variable cost component in the cost function. I emphasize the importance of writing the cost function in business terms so that it is readily understandable to business colleagues using the information.

This is how your schedule would appear for the Small Animal Clinic (Part 2) illustration in Chapter 2:

Costs: 2014 2015 2016 Fixed Variable Driver

Part-time veterinarian $ 24,000 $ 32,800 $ 42,000 $ 0 $12.00 Animal visits

Technicians 71,000 80,000 80,000 80,000

Treatment suppliesa 4,000 4,600 5,200 259 4% Revenues

Rent 8,000 8,500 8,750 8,750

Administrationa 38,000 39,600 41,200 30,000 $3.20 Animal visits

Total $145,000 $165,500 $177,150 $119,009

aMixed cost

**Total cost function: Total Cost = $119,009 + $15.20•Animal Visits + 4%•Revenues**

# Chapter 2 Key Terms Quiz Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 1. A thing or activity for which we measure costs, such as a particular production activity, an individual product, a product line, a projects, an individual or group of customers, a department, and even the entire company.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. Often refers to a pool of production costs other than direct materials and direct labour. May also refer to other types of common costs, such as general and administrative costs.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3. The variation in costs relative to the variation in an organization’s activities.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 4. Cost that is partly fixed and partly variable.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5. Algebraic representation of the total cost of a cost object over a relevant range of activity, represented as TC = F + V × Q.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 6. Some input or activity that causes changes in total cost for a cost object.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 7. Method for estimating a cost function by analyzing and assigning costs to the labour time, materials, and other resources used in each activity.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 8. Algebraic method for estimating a mixed cost function using only the highest and lowest data points of the cost driver.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 9. Arithmetic mean cost, computed as total costs (TC) divided by the quantity (Q) of activity or production.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 10. Cost that is easily traced to a cost object; a clear cause-and-effect relationship generally exists between the cost object and the cost.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 11. Benefit forgone when one alternative is chosen over the next best alternative.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 12. Cost that changes proportionately with changes in volumes or activity levels.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 13. Span of activity for a given cost object where total fixed costs remain constant and variable cost per unit of activity remain constant.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 14. Cost function in which the variable cost per unit changes across relevant ranges of activity.

Chapter 2 Key Terms Quiz (continued)

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 15. Cost that reflects periodic (usually annual) decisions about the maximum amount that will be spent for activities such as advertising, executive travel, or research and development. Amount spent can easily be altered during the period.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 16. Method for estimating a cost function by reviewing the pattern of past costs in the accounting system and using knowledge of operations to classify the cost as variable, fixed, or mixed.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 17. Graphical technique in which data points for past costs are plotted against a potential cost driver.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 18. Statistical technique that measures the average change in a dependent variable for every unit change in one independent variable.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 19. Cost that is not easily traced to a cost object; no clear cause-and-effect relationship exists between the cost object and the cost, or the cost of tracing the cost to the cost object exceeds the benefit.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 20. Expenditures made in the past, which cannot be changed by any future decisions; unavoidable and therefore not relevant to decision making.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 21. Cost that does not change with small changes in activity levels of a cost object.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 22. Incremental cost of an activity, such as producing the next unit of goods or services.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 23. Cost function in which fixed cost changes across relevant ranges of activity.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 24. Rate at which labour hours decrease as the volume of production or services increases.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 25. Algebraic method for estimating a mixed cost function using any two data points of the cost and cost driver, preferably using two representative points.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 26. Statistical technique that measures the average change in a dependent variable for every unit change in two or more independent variables.

# Answers to Key Terms Quiz

1. Cost Object

2. Overhead Cost

3. Cost Behaviour

4. Mixed Cost

5. Cost Function

6. Cost Driver

7. Engineered Estimate of Cost

8. High-Low Method

9. Average Cost

10. Direct Cost

11. Opportunity Cost

12. Variable Cost

13. Relevant Range

14. Piecewise Linear Cost

15. Discretionary Cost

16. Analysis at the Account Level

17. Scatter Plot

18. Simple Regression Analysis

19. Indirect Cost

20. Sunk Cost

21. Fixed Cost

22. Marginal Cost

23. Stepwise Linear Cost

24. Learning Curve

25. Two-Point Method

26. Multiple Regression Analysis