**INSTRUCTOR NOTES: CHAPTER 7**

**COST-VOLUME-PROFIT ANALYSIS**

**Learning Objectives**

1. Compute a break-even point using the contribution-margin approach and the equation approach.

2. Compute the contribution-margin ratio and use it to find the break-even point in sales dollars.

3. Prepare a cost-volume-profit (CVP) graph and explain how it is used.

4. Apply CVP analysis to determine the effect on profit of changes in fixed expenses, variable expenses, sales prices, and sales volume.

5. Compute the break-even point and prepare a profit-volume graph for a multiproduct enterprise.

6. List and discuss the key assumptions of CVP analysis.

7. Prepare and interpret a contribution income statement.

8. Explain the role of cost structure and operating leverage in CVP relationships.

9. Understand the implications of activity-based costing for CVP analysis.

1. Be aware of the effects of advanced manufacturing technology on CVP relationships.
2. Understand the effect of income taxes on CVP analysis (appendix).

**Chapter Overview**

1. **Illustration of Cost-Volume-Profit (CVP) Analysis**

A. Importance of cost behavior

**II. The Break-even Point**

A. Contribution-margin approach

B. Contribution-margin ratio

C. Equation approach

III. **Graphing CVP relationships**

A. Interpreting the CVP graph

B Profit-volume graph

**IV. Target Profit**

A. Contribution-margin approach

B. Equation approach

C. Graphical approach

**V. Applying CVP Analysis**

**A. Safety margin**

**B. Changes in fixed expenses**

**C. Changes in unit contribution margin**

**D Predicting profit given expected volume**

**E. Interdependent changes in key variables**

**VI. CVP Analysis with Multiple Products**

1. Sales mix
2. Weighted-average contribution margin

**VII. Assumptions Underlying CVP Analysis**

**VIII. CVP Relationships and the Income Statement**

**A. Traditional income statements**

**B. Contribution income statements**

**IX. Cost Structure and Operating Leverage**

X. CVP Analysis, Activity-Based Costing, and Advanced Manufacturing Systems

1. A move towards JIT and flexible manufacturing

XI. Appendix: Effect of Income Taxes

**Key Concepts**

1. **ILLUSTRATION OF COST-VOLUME-PROFIT (CVP) ANALYSIS**
2. **CVP analysis**, often referred to as break-even analysis, examines the interrelationship of sales activity, prices, costs, and profits in planning and decision-making situations. **CVP analysis**, often referred to as ***break-even analysis***, examines the interrelationship of sales activity, prices, costs, and profits in planning and decision-making situations.

**2. THE BREAK-EVEN POINT**

* The **break-even point** is the point where revenues and expenses are equal.

1. An organization's costs are categorized into variable and fixed components before beginning the analysis.
2. There are **two approaches** to calculating the break-even point for a firm: **the contribution-margin approach and the equation approach**.

* **The contribution-margin approach** is based on the concept of the **contribution margin,** or the amount that each unit contributes toward covering fixed expenses and generating profit.
* Contribution margin = Selling price - Variable expenses per unit

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| **Break-Even Volume (units)** | = | Fixed Costs |
|  |  | Unit Contribution Margin |

* To find the **break-even point in dollars,** simply **multiply the break-even point in units by the selling price.**
* Alternatively, one can use the **contribution margin ratio,** which is the contribution margin expressed as a percentage of the selling price.

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| **Contribution Margin Ratio** | = | Contribution Margin *per unit* |
|  |  | Sales Price *per unit* |

* Thus:

|  |  |  |
| --- | --- | --- |
| **Break-Even Volume (sales dollars)** | = | Fixed Costs |
|  |  | Contribution Margin Ratio |

* The equation approach is based on the net income equation that students already know: Sales – Total variable expenses – Total fixed expenses = Profit.
* **At the break-even point, sales revenues equal the sum of variable and fixed expenses since profit is zero. Thus:**

**Break-even point ($) = Total variable expenses + Total fixed expenses**

**3. GRAPHING CVP RELATIONSHIPS**

1. CVP relationships can be communicated in the form of a **cost-volume-profit graph,** which shows the effects on profit of a change in volume (see Exhibit 7-1 in the text).

* An alternative format, called a **profit-volume graph,** highlights the amount of profit or loss at a given level of activity (see Exhibit 7-3).

**4. TARGET PROFIT**

1. The preceding equations can be modified to determine the level of sales needed to produce a particular **target net profit.**

* *Contribution approach*—Each unit now contributes toward covering fixed expenses *and* generating profit (some amount other than zero). Accordingly, the equation becomes:

**Sales (units) = (Fixed expenses + Target net profit) Contribution margin per unit**

* *Equation approach*—Sales dollars must now be large enough to cover variable expenses and fixed expenses, *and* produce a particular profit. Thus:

**Sales ($) = Total variable expenses + Total fixed expenses + Target net profit**

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| **UNDERSTANDING CVP AND UNDERSTANDING BREAKEVEN ARE IMPORTANT TAKEAWAYS IN THE COURSE, AND WILL BE IMPORTANT IN TESTING SITUATIONS.** |

**Profit Planning—Target Profit**

Knowledge of break-even can be use in planning. A company may want to estimate what sales volume is necessary to achieve a certain **target profit.**

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| **Target Profit (units)** | = | Fixed Costs + Target Profit |
|  |  | Unit Contribution Margin (1) |

1. Unit contribution margin = Sales price per unit – Variable costs per unit

|  |  |  |
| --- | --- | --- |
| **Target Profit (sales dollars)** | = | Fixed Costs + Target Profit |
|  |  | Contribution Margin Ratio |

*NOTICE, THESE FORMULAS ARE A VARIATION OF THE BREAK-EVEN FORMULAS, IN WHICH TARGET PROFIT IS SET AT ZERO.*

**NOTE: these computations are important takeaways from this chapter.**

**5. APPLYING CVP ANALYSIS**

1. The **safety margin,** which shows the amount that sales can fall before a firm starts losing money, is computed as follows:

Safety margin = Budgeted sales - Break-even sales

1. The impact of changes in fixed expenses, variable expenses, selling prices, and volume on profit can be determined by using CVP analysis. Therefore, CVP is a useful tool in answering "what-if" questions (i.e., **sensitivity analysis).**

**6. CVP ANALYSIS WITH MULTIPLE PRODUCTS**

1. Most organizations have more than one product line, and CVP analysis may be adapted for these firms. The same basic equations are used; however, the contribution margin must be weighted by the sales mix.

* The **sales mix** is the number of units sold of a given product relative to the total units sold. For example, if a company sells 8,000 units of product A and 2,000 units of product B, the sales mix is 80% A and 20% B.

1. A **weighted-average unit contribution margin** is calculated by multiplying a product's contribution margin by its sales mix percentage, and then summing the results for individual products.

* The result is divided into fixed expenses (as before) to arrive at the break-even point in "units." These "units" are really a commingled market basket of goods.

1. As a final step, the sales-mix percentages are multiplied by the number of "units" to calculate individual product sales to break even.

* It should be evident that a change in a firm's sales mix will alter the break-even point.

**7. ASSUMPTIONS UNDERLYING CVP ANALYSIS**

1. The **CVP model is based on a number of underlying assumptions**, as follows:

* **The behavior of *total revenue* is linear within the relevant range**.
* **The behavior of *total expenses* is linear within the relevant range**. This assumption dictates that (1) expenses can be categorized as fixed, variable, or semivariable and (2) efficiency and productivity remain as predicted.
* **The *sales mix remains constant* over the relevant range**.
* ***Inventory levels at the beginning and end of the accounting period are the same*.** This assumption implies that during the period, the number of units sold equals the number of units produced.

**8. CVP RELATIONSHIPS AND THE INCOME STATEMENT**

1. The traditional income statement for a manufacturer includes a cost-of-goods-sold figure that combines variable costs and fixed manufacturing overhead. The statement's format does not group costs by behavior but rather by function, thus making CVP analysis difficult.
2. The **contribution income statement** is presented in a format that highlights cost behavior. *This statement is not in accordance with GAAP, but is useful to managers.*

* Variable expenses are subtracted from sales to produce a total contribution margin.
* Next, fixed expenses are subtracted from the contribution margin to yield the period's net income. This format is used for variable costing and is discussed more fully in later chapters.
* The contribution income statement is often preferred by operating managers because it separates fixed and variable expenses, thus enhancing the statement's usefulness and making it consistent with cost-volume-profit analysis.

**9. COST STRUCTURE AND OPERATING LEVERAGE**

1. The **cost structure** of an organization **is the relative proportion of fixed and variable costs**. An automated manufacturing plant has a high proportion of fixed costs while a labor-intensive plant has a high proportion of variable costs.

* Many advanced manufacturing facilities have relatively high break-even points, which could be troublesome during periods of economic recession.
* A firm's cost structure has a significant effect on the way that profits fluctuate in response to changes in sales volume. The greater the proportion of fixed costs, the greater the impact on profit from a given percentage change in sales revenue.

1. *The extent to which an organization uses fixed costs in its cost structure is* called **OPERATING LEVERAGE**.

* *A company with a high proportion of fixed costs and a low proportion of variable costs has high operating leverage* and the ability to greatly increase net income from an increase in sales revenue.
* In other words, after the break-even point has been reached, a larger contribution margin will fall to the bottom line in a high fixed-cost structure when compared against a structure that is heavy in variable costs.
* The risk is also greater because if the break-even point is not reached, losses will be larger in a high-leverage situation.
  + The degree of operating leverage can be measured as follows:

**Operating leverage factor** **=** Contribution margin Net income

This factor, when multiplied by the percentage change in sales revenue, will equal the percentage change in net income.

**10. CVP ANALYSIS, ACTIVITY-BASED COSTING, AND ADVANCED MANUFACTURING SYSTEMS**

1. Cost behavior may change with a shift from a traditional-costing system to an ABC system.

* **The traditional CVP analysis recognizes a single, volume-based cost driver, namely, sales volume.**
* **With the multiple drivers of ABC, some traditional fixed costs are now considered variable.**

1. With the improved accuracy of ABC, a company receives a richer understanding of cost behavior and CVP relationships.
2. As companies move towards JIT and flexible manufacturing systems, many variable costs become fixed costs. For example, setup and inspection costs.

**11. APPENDIX: INCOME TAXES AND CVP ANALYSIS**

1. The target net profit figure discussed in the body of the chapter is stated in terms of before-tax income. The appendix focuses on a target, after-tax figure.
2. A minor adjustment is made to the after-tax income to convert it to a before-tax figure, and the before-tax figure is plugged into the CVP formulas shown earlier. The adjustment is:

Before-tax income = After-tax income (1 - Tax rate)