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|  | **Cost-Volume-Profit Analysis** |
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**Transition Notes**

This chapter contains updated coverage of strategy and strategic uses of cost information. The five-step decision process is applied to CVP decisions. There is a shift to the “essentials” of cost-volume-profit analysis with less focus on the assumptions of CVP analysis. This is in line with the increased focus on the managerial aspects of the text. Discussion of alternative fixed/variable cost structures, multiple product breakeven analysis, and contribution margin versus gross income have been revised and shortened. There are several significant revisions and additions to the problem material at the end of the chapter.

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| **Problem Material** **Correlation Chart** |

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| --- | --- | --- | --- | --- | --- |
|  | **15th** **Edition** | **14th** **Edition** |  | **15th** **Edition** | **14th Edition** |
|  | 16 | 16 Revised |  | 33 | 33 Revised |
|  | 17  | 17  |  | 34 | 34 Revised |
|  | 18 | 18 Revised |  | 35 | 35 Revised |
|  | 19  | 19 Revised |  | 36 | 36 Revised |
|  | 20 | 20 |  | 37  | 37 Revised |
|  | 21  | 21  |  | 38 | 38 Revised |
|  | 22 | 22 Revised |  | 39 | 39 Revised |
|  | 23 | 23 Revised |  | 40  | 40 Revised |
|  | 24  | 24 Revised |  | 41  | 41 Revised |
|  | 25 | 25 Revised |  | 42 | 42 Revised |
|  | 26 | 26 Revised |  | 43 | 43 Revised |
|  | 27 | 27 Revised |  | 44 | 44 |
|  | 28  | 28 Revised |  | 45  | 45 Revised |
|  | 29  | 29 Revised |  | 46 | 46  |
|  | 30 | 30 Revised |  | 47  | 47  |
|  | 31 | 31 |  | 48 | 48 Revised |
|  | 32  | 32 Revised |  | 49 | 49  |

**I. LEARNING OBJECTIVES**

1. Explain the features of cost-volume-profit (CVP) analysis.
2. Determine the breakeven point and output level needed to achieve a target operating income.
3. Understand how income taxes affect CVP analysis.
4. Explain how managers use CVP analysis in decision making.
5. Explain how managers use sensitivity analysis to cope with uncertainty.
6. Use CVP analysis to plan variable and fixed costs.
7. Apply CVP analysis to a company producing multiple products.
8. Apply CVP analysis to service and not-for-profit organizations.
9. Distinguish contribution margin from gross margin.
10. **CHAPTER SYNOPSIS**

This chapter presents the cost-volume-profit (CVP) analysis model and illustrates how managers use that model to help answer important “what-if” business questions. CVP analysis also helps management accountants alert managers to the risks and rewards of decisions they are considering by illustrating how the “bottom-line” is affected by changes in activity levels or key pricing or cost components. CVP analysis is based on several assumptions, one of which is that fixed costs can be distinguished from variable costs. However, whether a cost is variable or fixed depends on the time period for the decision and also the range of activity (relevant range) being considered. Students are also presented with a method for applying CVP analysis to companies with multiple products and to situations where there is more than one cost driver. The applicability of CVP to manufacturers, service organizations, and nonprofits is discussed. Contribution margin is also defined and distinguished from gross margin.

**III. Points of Emphasis**

1. The concepts of contribution margin, contribution margin income statement, breakeven, target operating income, along with other measures are introduced in this chapter. This is a “nuts and bolts” chapter that the student should understand if they are to grasp the material covered in future chapters. Spend time having the students work problems covering the concepts from this chapter.
2. Sensitivity analysis is a valuable tool that students can use to determine the expected outcome from various scenarios.
3. Operating leverage is a concept that will help the students understand why operating income changes as it does. Help the students see the usefulness of DOL.

**IV. CHAPTER OUTLINE**

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| **LEARNING** **OBJECTIVE** | 1 |
| Explain the features of cost-volume-profit (CVP) analysis… how operating income changes with changes in output level, selling prices, variable costs, or fixed costs |
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* 1. **Cost-volume-profit (CVP) analysis** studies the behavior of total revenues, total costs, and operating income as changes occur in the units sold, the selling price, the variable cost per unit, or the fixed costs of a product.
	2. The five-step decision process outlined in Chapter 1 can be utilized in doing CVP analysis. To review, those steps are:
1. Identify the problems and uncertainties.
2. Obtain information.
3. Make predictions about the future.
4. Make decisions by choosing among alternatives.
5. Implement the decision, evaluate performance, and learn.

(The Emma Frost example in the text details each of these steps as faced by a GMAT test preparation salesperson.)

1.3 **Contribution margin** is the difference between total revenues and total variable costs. This is an indication of why operating income changes as the number of units sold changes.

1.4 **Contribution margin per unit** is the difference between selling price and variable cost per unit; that is, contribution margin per unit is the change in operating income for each additional unit sold.

1.5 A **contribution income statement** is an income statement that groups costs into their variable and fixed components. Variable costs are subtracted from revenues to highlight contribution margin. Fixed costs are subtracted from contribution margin to arrive at operating income.

(Exhibit 3-1 illustrates a contribution margin income statement.)

Teaching point. This is a good time to reinforce the definitions of fixed and variable costs and their behavior in total and per unit. Time spent here will help students grasp the differences in how these costs behave.

1.6 The **contribution margin percentage or ratio** equals contribution margin per unit divided by the selling price. This is an indication of the percent of each sales dollar that is available to pay fixed costs and return a profit.

1.7 CVP relationships and the calculation of operating income can be illustrated using three methods:

**Equation Method.** The *equation method* is based on the following formula:

(Selling price × Quantity of units sold) – (Variable cost per unit × Quantity of units sold) – Fixed costs = Operating income

**Contribution Margin Method.** Under this approach fixed costs are divided by the unit contribution margin to give the breakeven point in units.

**Graph Method.** The *graph method* represents total costs and total revenues graphically. When costs and revenues are netted and graphed as one line, this is often referred to as a profit-volume or PV graph.

(Exhibits 3-2 and 3-3 illustrate the graph method with a cost-volume-profit graph and a profit-volume graph.) Go over these, and discuss each line on the graph and its significance.

1.8 **Cost-Volume-Profit Assumptions.** There are a number of assumptions that must be made in conducting CVP analysis. Although these assumptions do not always precisely hold, they can allow meaningful analysis.

* Changes in the levels of revenues and costs arise only because of changes in the number of units sold. Thus, number of units sold is the only revenue and cost driver.
* Total costs can be separated into fixed and variable components.

Teaching point. Emphasize to the students that this is usually possible; the question is: “Do they have the ability to make this division, given the data available and their level of skill?”

* Total revenues and total costs are linear; that is, when graphed they can be represented as a straight line.
* Selling price, variable cost per unit, and total fixed costs are known and constant.

Teaching point. Obviously, these assumptions do not hold over time. Point out that any time one of the factors changes, it changes the dynamics and the analysis must be repeated.

**Refer to Quiz Question 1**

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| **LEARNING** **OBJECTIVE** | 2 |
| Determine the breakeven point and output level needed to achieve a target operating income… compare contribution margin and fixed costs |
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2.1 **Breakeven Point (BEP).** The breakeven point is that quantity of output sold at which total revenues equal total costs. Following is the formula for calculating BEP in units:

Fixed costs

Unit contribution margin

2.2 However, BEP, and therefore zero profit is not what companies should strive for, managers are concerned with how they can achieve their goals for operating profit. **Target operating income** is the level of sales needed to attain a specified dollar amount of operating income. In order to determine TOI, add the desired operating income to fixed cost in the breakeven calculation.



Teaching point. Work with the class in doing various exercises that illustrate the points covered in this learning objective. Contribution margin, CM ratio, and breakeven point are understood much more readily when students see how these are calculated, rather than simply learning a definition of them. Exercises 3-19 and 3-20 illustrate these concepts.

(Exhibits 3-2 and 3-3 graphically illustrate the CVP analysis of breakeven point.)

(Exhibit 3-4 displays the underlying spreadsheet data.)

**Refer to Quiz Questions 2 and 3 Exercises 3-19 and 3-20**

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| **LEARNING** **OBJECTIVE** | 3 |
| Understand how income taxes affect CVP analysis… focus on net income |
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3.1 **Net income** is operating income plus nonoperating revenues (such as interest revenues) minus nonoperating expenses (such as interest expense) minus income taxes.

3.2 To this point, we have ignored the effect of income taxes in our CVP analysis. To make net income evaluations, however, we must state results in terms of target net income rather than target operating income.

3.3 The TOI calculation can be easily adjusted to accommodate this change:

Target NI = TOI – (TOI × Tax rate) or stated another way

Target NI = TOI × (1 – Tax rate)

**Refer to Quiz Questions 4-6 Exercise 3-21**

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| **LEARNING** **OBJECTIVE** | 4 |
| Explain how managers use CVP analysis in decision making… determine the alternative that maximizes operating income  |
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4.1 CVP analysis is useful in numerous situations to evaluate anticipated results from strategic decisions. Decisions such as whether to increase advertising or reduce the selling price can be facilitated with CVP analysis. These types of problems are illustrated in the text.

**Refer to Quiz Questions 7 and 8 Exercise 3-23**

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| **LEARNING** **OBJECTIVE** | 5 |
| Explain how sensitivity analysis helps managers cope with uncertainty… determine the effect on operating income of different assumptions |
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5.1 **Sensitivity analysis** is a technique that managers use to examine the effect of changes in the variables that will affect the outcome of the decision. This is also referred to as “what if” analysis; that is, asking: “What would happen if …?”

Teaching point. Sensitivity analysis is an excellent tool to illustrate the practical usefulness of Excel. By programming the decision data into an Excel spreadsheet, the effect of changes in variables can be instantly seen by changing the value on the spreadsheet.

5.2 The **margin of safety** is another aspect of sensitivity analysis. It may be expressed in units, dollars, or as a percentage. It is defined as the amount by which the current level of sales exceeds the breakeven point; that is, it is a measure of how much sales can decline and have the company remain profitable.

Margin of safety in dollars = Revenues – Breakeven revenues

Margin of safety units = Sales in units – Breakeven units

Margin of safety percentage = Margin of safety in dollars / Revenues

5.3 Sensitivity analysis recognizes **uncertainty,** the possibility that actual amounts of revenue and costs will differ from expected amounts.

**Problem 3-24**

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| **LEARNING** **OBJECTIVE** | 6 |
| Use CVP analysis to plan variable and fixed costs… compare risk of losses versus higher returns |
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6.1 Managers have the ability to choose the levels of fixed and variable costs in their cost structures. This is a strategic decision and can be as simple as choosing between automation and a labor-based manufacturing operation.

6.2 Sensitivity analysis can be utilized in making the decision to substitute fixed costs for variable costs in the cost structure. Exhibit 3-4, lines 6 and 11 illustrate the effects of a choice of fixed over variable in the cost structure.

6.3 **Operating leverage** describes the effects of fixed costs on changes in operating income with changes in contribution margin or volume. It is defined as the percentage change in operating income from a given change in sales and is described as **degree of operating leverage** **(DOL).** For example, a company that has a DOL of 4 will experience a change in operating income four times the change in revenues. If revenues increase 5 percent, operating income would increase 4 × 5 or 20 percent.

6.4 DOL is calculated as follows:



Teaching point. Note that DOL is a two-edged sword, with an increase in revenues. A high DOL accelerates the increase in operating income. However, a decrease in revenues accelerates the decrease in operating income. DOL also changes as revenues change; its value is dependent on the level of sales.

**Refer to Quiz Questions 9 and 10 Problem 3-43**

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| **LEARNING** **OBJECTIVE** | 7 |
| Apply CVP analysis to a company producing multiple products… assume sales mix of products remains constant as total units sold changes |
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7.1 **Sales mix** is the quantities or proportions of various products or services that constitute the total sales of a company. The CVP analysis discussed to this point assumes a single product. This is not reasonable, as most companies sell a large variety of products.

7.2 Recall that one of the assumptions of CVP analysis was that “selling price, variable cost per unit, and total fixed costs are known and constant.” With products having different selling prices and variable costs, how can the sale of multiple products be adapted to fit the CVP model?

7.3 CVP analysis with multiple products is performed by calculating a weighted average contribution margin based upon a constant sales mix percentage. This is illustrated in the text in Problem 3-46.

**Refer to Quiz Questions 11 Exercise 3-28; Problem 3-46**

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| **LEARNING** **OBJECTIVE** | 8 |
| Apply CVP analysis in service and not-for-profit organizations |
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8.1 **CVP** analysis for service and not-for-profit organizations differs from other organizations. CVP need to focus on measuring their output which is different from the tangible units sold by manufacturing and merchandising companies.

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| **LEARNING** **OBJECTIVE** | 9 |
| Distinguish contribution margin from gross margin |
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9.1 **Gross margin** measures how much a company can charge for its products over and above the cost of acquiring or producing its products. **Contribution margin** indicates how much of a company’s revenues are available to cover fixed costs.

**APPENDIX**

A.1 Business decisions are made in a world of **uncertainty**. A decision model helps managers deal with uncertainty through a five-step process.

A.2 Step one is to **identify a choice criterion**—an objective that can be quantified.

A.3 Step two identifies the **set of alternative actions that can be taken**.

A.4 In step three, managers **identify the set of events that can occur.** An **event** is a possible relevant occurrence. These events should be mutually exclusive.

Teaching Point. Rolling a die is an event with six possible outcomes, each of which is mutually exclusive.

A.5 Managers **assign a** **probability** to each event that can occur in step four. A **probability distribution** describes the likelihood that each of the mutually exclusive events will occur. These probabilities will equal 1.0.

A.6 Step five is to identify the set of possible **outcomes**—the predicted economic results of the possible combinations of actions and events. These outcomes are summarized in a **decision table.**

A.7 The **expected value** is the weighted average of the outcomes with the probability of each outcome serving as the weight. When measured in monetary terms, this is called the **expected monetary value.**

**V. OTHER RESOURCES**

To download these and other resources, visit the Instructor’s Resource Center [*www.pearsonhighered.com*](http://www.pearsonhighered.com/).

The following exhibits were mentioned in this chapter of the Instructor’s Manual, and have been included in the **PowerPoint Lecture presentation** created specifically for this chapter. You may use the PowerPoint Lecture presentations “as is”, or modify them to suit your individual needs.

Exhibit 3-1 illustrates a contribution margin income statement.

Exhibits 3-2 and 3-3 illustrate the graph method with a cost-volume-profit graph and a profit-volume graph. Go over these, and discuss each line on the graph and its significance.

Exhibit 3-4 displays the underlying spreadsheet data.

**CHAPTER 3 QUIZ**

1. Which of the following is *not* a factor in cost-volume-profit analysis?
2. Units sold
3. Selling price
4. Total variable costs
5. Fixed costs of a product
6. Which of the following is *not* an assumption of cost-volume-profit analysis?
7. The time value of money is incorporated in the analysis.
8. Costs can be classified into variable and fixed components.
9. The behavior of revenues and expenses is accurately portrayed as linear over the relevant range.
10. The number of output units is the only driver.
11. Contribution margin is calculated as
12. total revenue – total fixed costs.
13. total revenue – total manufacturing costs (CGS).
14. total revenue – total variable costs.
15. operating income + total variable costs.

**Questions 4 through 6 are based on the following data.**

Tee Times, Inc. produces and sells the finest quality golf clubs in all of Clay County. The company expects the following revenues and costs in 2004 for its Elite Quality golf club sets:

Revenues (400 sets sold @ $600 per set) $240,000

Variable costs 160,000

Fixed costs 50,000

1. How many sets of clubs must be sold for Tee Times, Inc. to reach their breakeven point?

a. 400

b. 250

c. 200

d. 150

1. How many sets of clubs must be sold to earn a target operating income of $90,000?

a. 700

b. 500

c. 400

d. 300

1. What amount of sales must Tee Times, Inc. have to earn a target net income of $63,000 if they have a tax rate of 30 percent?

a. $489,000

b. $429,000

c. $420,000

d. $300,000

1. One way for managers to cope with uncertainty in profit planning is to
2. use CVP analysis because it assumes certainty.
3. recommend management hire a futurist whose work is to predict business trends.
4. wait to see what does happen and prepare a report based on actual amounts.
5. use sensitivity analysis to explore various what-if scenarios in order to analyze changes in revenues or costs or quantities.
6. The Beta Mu Omega Chi (BMOC) fraternity is looking to contract with a local band to perform at its annual mixer. If BMOC expects to sell 250 tickets to the mixer at $10 each, which of the following arrangements with the band will be in the best interest of the fraternity?
7. $2500 fixed fee
8. $1000 fixed fee plus $5 per person attending
9. $10 per person attending
10. $25 per couple attending

**Use the following information for questions 9 and 10.**

LSB Company has the following income statement:

Revenues $100,000

Variable Costs 40,000

Contribution Margin 60,000

Fixed Costs 30,000

Operating Income 30,000

9. What is LSB’s DOL?

1. 3.33
2. 2.00
3. 0.50
4. 1.00

10. If LSB’s sales increase by $20,000, what will be the company’s operating profit?

1. $42,000
2. $12,000
3. $50,000
4. $30,000

11.Valley Company sells two products. Product M sells for $12 and has variable costs per unit of $7. Product Q’s selling price and variable costs are $15 and $10, respectively. If fixed costs are $60,000 and Valley sells twice as many units of Product M as Product Q, what is the BEP in units for Product M?

a. 4,000

b. 6,000

c. 12,000

d. 8,000

**CHAPTER 3 QUIZ SOLUTIONS**

# 1. c

# 2. a

# 3. c

# 4. b

# 5. a

6. c

# 7. d

# 8. b

# 9. b

# 10. b

11. d

**Quiz Question Calculations**

4. Variable costs per unit = $160,000/400 units sold = $400

Contribution Margin = $600 – 400 = $200 per unit

Breakeven point = $50,000/$200 = 250 units

5. TOI = $50,000 + $90,000/$200 = 700 units

6. TNI = $50,000 + $63,000/(1 – 0.30)/$200 = 700 units × $600 = $420,000

8. Cost of option a: $2,500 Profit = 0

Cost of option b: $1,000 + 5(250) = $2,250 Profit = $250

Cost of option c: $10 (250) = $2,500 Profit = 0

Cost of option d: $25 (125) = $3,125 Loss ($625)

9. DOL = $60,000/$30,000 = 2.0

1. $20,000 / $100,000 = 20%

20% × 2 = 40%

40% × $30,000 = $12,000 increase

1. Product M contribution margin (12-7) = 5 x sales mix of 2 = 10

Product Q contribution margin (10-5) = 5 x sales mix of 1 = 5

Total contribution margin of both products = 12

FC/CM = BEP – package

$60,000/14 = 4,000 packages

BEP – units of Product M = BEP – packages x sales mix of 2 = 8,000 units