CHAPTER 3
COST–VOLUME–PROFIT ANALYSIS

NOTATION USED IN CHAPTER 3 SOLUTIONS

SP: Selling price
VCU: Variable cost per unit
CMU: Contribution margin per unit
FC: Fixed costs
TOI: Target operating income

3-1 Define cost–volume–profit analysis.

Cost-volume-profit (CVP) analysis examines the behavior of total revenues, total costs, and operating income as changes occur in the units sold, selling price, variable cost per unit, or fixed costs of a product.

3-2 Describe the assumptions underlying CVP analysis.

The assumptions underlying the CVP analysis outlined in Chapter 3 are

1. Changes in the level of revenues and costs arise only because of changes in the number of product (or service) units sold.
2. Total costs can be separated into a fixed component that does not vary with the units sold and a variable component that changes with the number of units sold.
3. When represented graphically, the behaviors of total revenues and total costs are linear (represented as a straight line) in relation to number of units sold within a relevant range and time period.
4. The selling price, variable cost per unit, and fixed costs are known and constant.

3-3 Distinguish between operating income and net income.

Operating income is total revenues from operations for the accounting period minus cost of goods sold and operating costs (excluding income taxes):

Operating income = Total revenues from operations – Costs of goods sold and operating, costs (excluding income taxes)

Net income is operating income plus nonoperating revenues (such as interest revenue) minus nonoperating costs (such as interest cost) minus income taxes. Chapter 3 assumes nonoperating revenues and nonoperating costs are zero. Thus, Chapter 3 computes net income as:

Net income = Operating income – Income taxes

3-4 Define contribution margin, contribution margin per unit, and contribution margin percentage.

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Contribution margin is the difference between total revenues and total variable costs. Contribution margin per unit is the difference between selling price and variable cost per unit. Contribution-margin percentage is the contribution margin per unit divided by selling price.

3-5 Describe three methods that managers can use to express CVP relationships.

Three methods to express CVP relationships are the equation method, the contribution margin method, and the graph method. The first two methods are most useful for analyzing operating income at a few specific levels of sales. The graph method is useful for visualizing the effect of sales on operating income over a wide range of quantities sold.

3-6 Differentiate between breakeven analysis and CVP analysis.

Breakeven analysis is about determining the value or the volume of sale at which the total revenues equal total costs, while CVP analysis goes beyond the breakeven analysis and explains the overall relationship between cost, volume, and profit, and their behaviors in relation to each other.

3-7 With regard to making decisions, what do you think are the main limitations of CVP analysis? Explain.

The CVP analysis is based on a simple assumption that focuses only on two factors: revenue and cost. It assumes that the relationship between revenue and cost is linear. CVP analysis is applicable within a relevant range of activity and it is assumed that productivity and efficiency of operations will remain constant. CVP analysis also assumes that costs can be accurately divided into fixed and variable categories and selling price and variable cost per unit remain constant while these assumptions may not be true. CVP is limited in terms of the details and the amount of information that it can provide, especially in a multi-product operation.

3-8 How does an increase in the income tax rate affect the breakeven point?

An increase in the income tax rate does not affect the breakeven point. Operating income at the breakeven point is zero, and no income taxes are paid at this point.

3-9 Describe sensitivity analysis. How has the advent of the electronic spreadsheet affected the use of sensitivity analysis?

Sensitivity analysis is a "what-if" technique that managers use to examine how an outcome will change if the original predicted data are not achieved or if an underlying assumption changes. The advent of the electronic spreadsheet has greatly increased the ability to explore the effect of alternative assumptions at minimal cost. CVP is one of the most widely used software applications in the management accounting area.

3-10 Is CVP analysis more focused on the short or the long term? Explain.

The CVP analysis is more focused on the short run because the variables cannot be influenced (fixed costs, selling price, and variable costs per unit). So the only variable that can be altered is the production and sales volume.

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3-11 Is it possible to calculate the breakeven point for a company that produces and sells more than one type of product? Explain.

Yes. You can use the assumption of a constant sales mix of the products. You cannot calculate the BEP in products, but you can calculate the BEP in dollars revenue.

3-12 What is operating leverage? How is knowing the degree of operating leverage helpful to managers?

Operating leverage describes the effects that fixed costs have on changes in operating income as changes occur in units sold, and hence, in contribution margin. Knowing the degree of operating leverage at a given level of sales helps managers calculate the effect of fluctuations in sales on operating incomes.

3-13 CVP analysis assumes that costs can be accurately divided into fixed and variable categories. Do you agree? Explain.

CVP analysis is always performed within a relevant range of activity and for a specified time horizon. What we consider to be a fixed cost in CVP analysis can be true when we are focusing on a specific short horizon, but it may not be true when it sufficient time is provided. In other words, a fixed cost in a short horizon can be considered as unfixed in a long-term horizon. Furthermore, there are some costs that are semi-fixed and some that are semi-variable, depending on the relevant range of activities.

So the time periods and the relevant range of activities are two main bases for sort costs into the fixed and variable categories.

3-14 Give an example each of how a manager can decrease variable costs while increasing fixed costs and increase variable costs while decreasing fixed costs.

Examples of decreasing variable costs and increasing fixed costs include:
Manufacturing—substituting a robotic machine for hourly wage workers
Marketing—changing a sales force compensation plan from a percent of sales dollars to a fixed salary
Customer service—hiring a subcontractor to do customer repair visits on an annual retainer basis rather than a per-visit basis

Examples of decreasing fixed costs and increasing variable costs include:
Manufacturing—subcontracting a component to a supplier on a per-unit basis to avoid purchasing a machine with a high fixed depreciation cost
Marketing—changing a sales compensation plan from a fixed salary to percent of sales dollars basis
Customer service—hiring a subcontractor to do customer service on a per-visit basis rather than an annual retainer basis

3-15 What is the main difference between gross margin and contribution margin? Which one is the main focus of CVP analysis? Explain briefly.

The gross margin focuses on full cost, but the contribution margin focuses only on variable cost to measures how much a company is making for its products above the costs of acquiring or producing them. The contribution margin is the main focus of CVP analysis.

3-16 Jack's Jax has total fixed costs of $25,000. If the company's contribution margin is 60%, the income tax rate is 25% and the selling price of a box of Jax is $20, how many boxes of Jax would the company need to sell to produce a net income of $15,000?

a. 5,625 **b.** 4,445
c. 3,750 **d.** 3,333

SOLUTION

Choice "c" is correct. The number of boxes needed to be sold is calculated as follows:
Selling Price per box: $20 per box
Contribution % = 60%
Contribution margin per box: 60% × $20 = $12 per box
Fixed costs: $25,000
Income after tax: $15,000
Tax rate: 25%
Operating income before tax: $15,000 ÷ (1 – 0.25) = $15,000 ÷ 0.75 = $20,000
Total fixed costs $25,000 + target operating income, $20,000 = $45,000
Boxes necessary to produce target operating income: $45,000 / $12 per box = 3,750 boxes
Choice "a" is incorrect. The contribution margin of 60% means that variable costs are 40% of the sale price, not 60% of the sales price.
Choice "b" is incorrect. The contribution margin needs to cover the fixed costs of $25,000 and the operating income before tax of $20,000. Fixed costs are not subject to the income tax rate in the calculation.
Choice "d" is incorrect. Net income of $15,000 is after deducting the income tax expense. Operating income before tax of $20,000 must be generated in order to produce net income of $15,000.

3-17 During the current year, XYZ Company increased its variable SG&A expenses while keeping fixed SG&A expenses the same. As a result, XYZ's:

a. Contribution margin and gross margin will be lower.
b. Contribution margin will be higher, while its gross margin will remain the same.
c. Operating income will be the same under both the financial accounting income statement and contribution income statement.
d. Inventory amounts booked under the financial accounting income statement will be lower than under the contribution income statement.

SOLUTION

Choice "c" is correct. Operating income is the bottom line figure under both the financial accounting income approach and the contribution margin approach. Both methods take SG&A (fixed and variable) into account, which means both will produce the same bottom line figure.
Choice "a" is incorrect. The contribution margin will be lower due to an increase in variable SG&A expenses, but the gross margin (as calculated under the financial accounting income approach) will not be affected because fixed and variable SG&A expenses are deducted after calculating gross income.
Choice "b" is incorrect. The gross margin will remain the same, as SG&A expenses do not factor into the gross margin calculation. The contribution margin will be lower (not higher) due to higher variable SG&A expenses.
Choice "d" is incorrect. Inventory amounts will be the same under both methods, as SG&A expenses are period costs and will not affect inventory calculations.

3-18 Under the contribution income statement, a company's contribution margin will be:

a. Higher if fixed SG&A costs decrease.
b. Higher if variable SG&A costs increase.
c. Lower if fixed manufacturing overhead costs decrease.
d. Lower if variable manufacturing overhead costs increase.

SOLUTION

Choice "d" is correct. An increase in any variable costs will cause the contribution margin to be lower, as the contribution margin is calculated by taking sales and subtracting variable cost of goods sold (which includes variable overhead costs) and variable SG&A costs.
Choice "a" is incorrect. Fixed SG&A costs do not factor into the contribution margin calculation.
Choice "b" is incorrect. An increase in variable SG&A costs will decrease (rather than increase) the contribution margin.
Choice "c" is incorrect. Fixed overhead costs do not factor into the contribution margin calculation.

3-19 A company needs to sell 10,000 units of its only product in order to break even. Fixed costs are $110,000, and the per unit selling price and variable costs are $20 and $9, respectively. If total sales are $220,000, the company's margin of safety will be equal to:

a. $0 **b.** $20,000
c. $110,000 **d.** $200,000

SOLUTION

Choice "b" is correct. The margin of safety is equal to total actual sales − breakeven sales dollars. Since the breakeven number of unit sales is 10,000, and the sale price is $20, breakeven sales dollars equals $200,000 ($20 per unit × 10,000 units). The margin of safety is therefore $220,000 − $200,000 = $20,000.
Choice "a" is incorrect. There is no margin of safety when total sales are equal to breakeven sales, which would be the case here if total sales were equal to $200,000.
Choice "c" is incorrect. The margin of safety is incorrectly calculated here as total sales − fixed costs.

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Choice "d" is incorrect. This answer choice is equal to breakeven sales dollars, not the margin of safety.

3-20 Once a company exceeds its breakeven level, operating income can be calculated by multiplying:

a. The sales price by unit sales in excess of breakeven units.
b. Unit sales by the difference between the sales price and fixed cost per unit.
c. The contribution margin ratio by the difference between unit sales and breakeven sales.
d. The contribution margin per unit by the difference between unit sales and breakeven sales.

SOLUTION

Choice "d" is correct. The contribution margin per unit represents the difference between sales price and variable cost per unit. Once breakeven has been met, a company has recovered its fixed and variable costs. Any sales in excess of breakeven sales will result in operating income equal to the contribution margin per unit multiplied by the excess in unit sales above breakeven sales.
Choice "a" is incorrect. This equation does not take into account the variable costs per unit that will still be incurred with additional sales above breakeven.
Choice "b" is incorrect. This will not eqaul the operating income earned when sales are in excess of breakeven.
Choice "c" is incorrect. The contribution margin per unit (rather than the ratio) must be multiplied by the difference between unit sales and breakeven sales in order to calculate the profit.

3-21 CVP computations. Fill in the blanks for each of the following independent cases.

Case	Revenues	Variable Costs	Fixed Costs	Total Costs	Operating Income	Contribution Margin	Operating Income %	Contribution Margin %
a.	$4,250			$3,500			30.00	60.00
b.				$6,000		$3,000	25.00	
c.	$6,600	$3,500			$2,200			
d.		$2,400	$1,800		$3,200			

SOLUTION

(10 min.) **CVP computations.**

		Variable	Fixed	Total	Operating	Contribution	Operating	Contribution
	Revenues	**Costs**	**Costs**	**Costs**	**Income**	**Margin**	**Income %**	**Margin %**
a.	$4,250	**$1,700**	**$1,800**	$3,500	**$1,275**	**$2,550**	30.00%	60.00%
b.	**8,000**	**5,000**	**1,000**	6,000	**2,000**	3,000	25.00%	**37.50%**
c.	6600	3500	**900**	**4400**	2200	**3,100**	**33.33%**	**46.97%**
d.	**7,400**	2,400	1800	**4,200**	3,200	**5,000**	**43.24%**	**67.57%**

3-22 CVP computations. Simplex Inc. sells its product at $80 per unit with a contribution margin of 40%. During 2016, Simplex sold 540,000 units of its product; its total fixed costs are $2,100,000.

Required:

1. Calculate (a) the total contribution margin, (b) the total variable costs, and (c) the overall operating income.
2. The production manager of Simplex has proposed modernizing the whole production process in order to save labor costs. However, the modernization of the production process will increase the annual fixed costs by $3,800,000. The variable costs are expected to decrease by 20%. Simplex expects to maintain the same sales volume and selling price next year. How would the acceptance of the production manager's proposal affect your answers to (a) and (c) in requirement 1?
3. Should Simplex accept the production manager's proposal? Explain.

SOLUTION

(10–15 min.) **CVP computations.**

1a.	Contribution margin ($80 per unit× 40% × 540,000 units)	$ 17,280,000
1b.	Sales ($80 per unit × 540,000 units)	$43,200,000
	Contribution margin (from above)	17,280,000
	Variable costs	$25,920,000
1c.	Contribution margin (from above)	$17,280,000
	Fixed costs	2,100,000
	Operating income	$15,180,000
2a.	Sales (from above)	$43,200,000
	Variable costs ($25,920,000 × 80%)	20,736,000
	Contribution margin	$22,464,000
2b.	Contribution margin (from above)	$22,464,000
	Fixed costs ($2,100,000 + 3,800,000)	5,900,000
	Operating income	$16,564,000

3. If the production manager's proposal is accepted, the operating income is expected to increase by $1,384,000 ($16,564,000 − $15,180,000).
   The management would consider other factors before making the final decision. It is likely that product quality will improve as a result of the modernized production process. However, due to increased automation, many workers will probably have to be laid off. Simplex's management will have to consider the impact of such an action on employee morale. In

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addition, the proposal increases the company's fixed costs dramatically. This will increase the company's operating leverage and risk.

3-23 CVP analysis, changing revenues and costs. Brilliant Travel Agency specializes in flights between Toronto and Vishakhapatnam. It books passengers on EastWest Air. Brilliant's fixed costs are $36,000 per month. EastWest Air charges passengers $1,300 per round-trip ticket.

Calculate the number of tickets Brilliant must sell each month to (a) break even and (b) make a target operating income of $12,000 per month in each of the following independent cases.

Required:

1. Brilliant's variable costs are $34 per ticket. EastWest Air pays Brilliant 10% commission on ticket price.
2. Brilliant's variable costs are $30 per ticket. EastWest Air pays Brilliant 10% commission on ticket price.
3. Brilliant's variable costs are $30 per ticket. EastWest Air pays $46 fixed commission per ticket to Brilliant. Comment on the results.
4. Brilliant's variable costs are $30 per ticket. It receives $46 commission per ticket from EastWest Air. It charges its customers a delivery fee of $8 per ticket. Comment on the results.

SOLUTION

(35–40 min.) **CVP analysis, changing revenues and costs.**

1a. SP = 10% × $1,300 = $130 per ticket
VCU = $34 per ticket
CMU = $130 – $34 = $96 per ticket
FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$96 \text{ per ticket}}$$

$$= 375 \text{ tickets}$$

1b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$96 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$96 \text{ per ticket}}$$

$$= 500 \text{ tickets}$$

2a. SP = $130 per ticket
VCU = $30 per ticket
CMU = $130 – $30 = $100 per ticket

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FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$100 \text{ per ticket}}$$

= 360 tickets

2b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$100 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$100 \text{ per ticket}}$$

= 480 tickets

3a. SP = $46 per ticket
VCU = $30 per ticket
CMU = $46 – $30 = $16 per ticket
FC = $36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$16 \text{ per ticket}}$$

= 2,250 tickets

3b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$16 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$16 \text{ per ticket}}$$

= 3,000 tickets

The reduced commission sizably increases the breakeven point and the number of tickets required to yield a target operating income of $12,000:

	Commission	Fixed	10%	
			(Requirement 2)	Commission of $60
Breakeven point			360	2,250
Attain OI of $12,000			480	3,000

4a. The $8 delivery fee can be treated as either an extra source of revenue (as done below) or as a cost offset. Either approach increases CMU $8:

SP = $54 ($46 + $8) per ticket

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VCU = \$30 per ticket
CMU = \$54 – \$30 = \$24 per ticket
FC = \$36,000 a month

$$Q = \frac{FC}{CMU} = \frac{\$36,000}{\$24 \text{ per ticket}}$$

= 1,500 tickets

4b. $$Q = \frac{FC + TOI}{CMU} = \frac{\$36,000 + \$12,000}{\$24 \text{ per ticket}}$$

$$= \frac{\$48,000}{\$24 \text{ per ticket}}$$

= 2,000 tickets

The \$8 delivery fee results in a higher contribution margin, which reduces both the breakeven point and the tickets sold to attain operating income of \$12,000.

3-24 CVP exercises. The Patisserie Hartog owns and operates 10 puff pastry outlets in and around Amsterdam. You are given the following corporate budget data for next year:

Revenues	\$12,500,000
Fixed costs	\$ 2,240,000
Variable costs	\$ 9,750,000

Variable costs change based on the number of puff pastries sold.
Compute the budgeted operating income for each of the following deviations from the original budget data. (Consider each case independently.)

Required:

1. A 15% increase in contribution margin, holding revenues constant
2. A 15% decrease in contribution margin, holding revenues constant
3. A 10% increase in fixed costs
4. A 10% decrease in fixed costs
5. A 12% increase in units sold
6. A 12% decrease in units sold
7. An 8% increase in fixed costs and an 8% increase in units sold
8. A 6% increase in fixed costs and a 6% decrease in variable costs
9. Which of these alternatives yields the highest budgeted operating income? Explain why this is the case.

SOLUTION

(20 min.) **CVP exercises.**

EA

	Revenues		Variable Costs		Contribution Margin		Fixed Costs		Budgeted Operating Income
Orig.	$12,500,000	G	$9,750,000	G	$2,750,000		$2,240,000	G	$ 510,000
1.	12,500,000		9,750,000		3,162,500	a	2,240,000		922,500
2.	12,500,000		9,750,000		2,337,500	b	2,240,000		97,500
3.	12,500,000		9,750,000		2,750,000		2,464,000	c	286,000
4.	12,500,000		9,750,000		2,750,000		2,016,000	d	734,000
5.	14,000,000	e	10,920,000	f	3,080,000		2,240,000		840,000
6.	11,000,000	g	8,580,000	h	2,420,000		2,240,000		180,000
7.	13,500,000	i	10,530,000	j	2,970,000		2,419,200	k	550,800
8.	12,500,000		9,165,000	l	3,335,000		2,374,400	m	960,600

[G]stands for given.
[a]$2,750,000 × 1.15; [b]$2,750,000 × 0.85; [c]$2,240,000 × 1.10; [d]$2,240,000 × 0.90; [e]$12,500,000 × 1.12; [f]$9,750,000 × 1.12; [g]$12,500,000 × 0.88; [h]$9,750,000 × 0.88; [i]$12,500,000 × 1.08; [j]$9,750,000 × 1.08; [k]$2,240,000 × 1.08; [l]$9,750,000 × 0.94; [m]$2,240,000 × 1.06

9. Alternative 8, an 8% decrease in variable costs holding revenues constant with a 6% increase in fixed costs, yields the highest budgeted operating income because it has decreased variables costs and consequently made a highest increase in the contribution margin which has contributed in the highest increase in operating income after nullifying the effect of increase in fixed costs.

3-25 The Unique Toys Company manufactures and sells toys. Currently, 300,000 units are sold per year at $12.50 per unit. Fixed costs are $880,000 per year. Variable costs are $7.00 per unit. Consider each case separately:

Required:

1. a. What is the current annual operating income?

b. What is the present breakeven point in revenues?

Compute the new operating income for each of the following changes:

2. A 10% increase in variable costs

3. A $250,000 increase in fixed costs and a 2% increase in units sold

4. A 10% decrease in fixed costs, a 10% decrease in selling price, a 10% increase in variable cost per unit, and a 25% increase in units sold

Compute the new breakeven point in units for each of the following changes:

5. A 20% increase in fixed costs

6. A 12% increase in selling price and a $30,000 increase in fixed costs

SOLUTION

(20 min.) **CVP exercises.**

1a. [Units sold (Selling price – Variable costs)] – Fixed costs = Operating income

EA

$$[300{,}000\ (\$12.50 - \$7.00)] - \$880{,}000 = \$770{,}000$$

1b. Fixed costs ÷ Contribution margin per unit = Breakeven units

$\$880{,}000 \div [(\$12.50 - \$7.00)] = 160{,}000$ units

Breakeven units × Selling price = Breakeven revenues

160,000 units × \$12.50 per unit = \$2,000,000

or,

$$\text{Contribution margin ratio} = \frac{\text{Selling price - Variable costs}}{\text{Selling price}}$$

$$= \frac{\$12.50 - \$7.00}{\$12.50} = 0.44 = 44\%$$

Fixed costs ÷ Contribution margin ratio = Breakeven revenues

$\$880{,}000 \div 0.44 = \$2{,}000{,}000$

2.	300,000 (\$12.50 – \$7.00 × 110%)) – \$880,000	=	\$560,00
3.	[300,000 (1.02) (\$12.50 – \$7.00)] – (\$880,000 + 250,000)]	=	\$2,813,000
4.	[300,000 (1.25) (\$11.25 – \$7. 70)] – [\$880,000 (0.9)]	=	\$539,25
5.	\$880,000 (1.2) ÷ (\$12.50 – \$7.00)	=	192,000 units
6.	(\$880,000 + \$30,000) ÷ (\$14.00 – \$7.00)	=	130,000 units

3-26 CVP analysis, income taxes. Sonix Electronics is a dealer of industrial refrigerator. Its average selling price of an industrial refrigerator is \$5,000, which it purchases from the manufacturer for \$4,200. Each month, Sonix Electronics pays \$52,800 in rent and other office expenditures and \$75,200 for salespeople's salaries. In addition to their salaries, salespeople are paid a commission of 4% of sale price on each refrigerator they sell. Sonix Electronics also spends \$18,400 each month for local advertisements. Its tax rate is 30%.

Required:

1. How many refrigerators must Sonix Electronics sell each month to break even?

2. Sonix Electronics has a target monthly net income of \$63,000. What is its target monthly operating income? How many refrigerators must be sold each month to reach the target monthly net income of \$63,000?

SOLUTION

(10 min.) **CVP analysis, income taxes.**

1. Monthly fixed costs = \$52,800 + \$75,200 + \$18,400 = \$146,400

   Contribution margin per unit = \$5,000 – \$4,200 – \$5,000 × .04 = \$600

   Breakeven units per month = $\frac{\textit{Monthly fixed costs}}{\textit{Contribution margin per unit}} = \frac{\$146{,}400}{600 \textit{ per refrigerator}} =$ 244 refrigerators

2. Tax rate 30%

   Target net income \$65,000

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$$\text{Target operating income} = \frac{\text{Target net income}}{1-\text{tax rate}} = \frac{\$63,000}{(1-0.30)} = \frac{\$63,000}{0.70} = \$90,000$$

$$\text{Quantity of output required to be sold} = \frac{\textit{Fixed costs+Target operating income}}{\textit{Contribution margin per unit}} = \frac{\$146,400+\$90,000}{\$600}$$

= 394 refrigerators

3-27 CVP analysis, income taxes. The Swift Meal has two restaurants that are open 24 hours a day. Fixed costs for the two restaurants together total $456,000 per year. Service varies from a cup of coffee to full meals. The average sales check per customer is $9.50. The average cost of food and other variable costs for each customer is $3.80. The income tax rate is 30%. Target net income is $159,600.

Required:

1. Compute the revenues needed to earn the target net income.
2. How many customers are needed to break even? To earn net income of $159,600?
3. Compute net income if the number of customers is 145,000.

SOLUTION

(20–25 min.) **CVP analysis, income taxes.**

1. Variable cost percentage is $3.80 ÷ $9.50 = 40%

Let R = Revenues needed to obtain target net income

$$R - 0.40R - \$456,000 = \frac{\$159,600}{1-0.30}$$

$$0.60R = \$456,000 + \$228,000$$

$$R = \$684,000 \div 0.60$$

$$R = \$1,140,000$$

$$\text{or,} \quad \text{Target revenues} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin percentage}}$$

$$\text{Target revenues} = \frac{\text{Fixed costs} + \frac{\text{Target net income}}{1-\text{Tax rate}}}{\text{Contribution margin percentage}} = \frac{\$456,000 + \frac{\$159,600}{1-0.30}}{0.60} = \$1,140,000$$

Proof:		
	Revenues	$1,140,000
	Variable costs (at 40%)	456,000
	Contribution margin	684,000
	Fixed costs	456,000
	Operating income	228,000
	Income taxes (at 30%)	68,400
	Net income	$ 159,600

2.a. Customers needed to break even:

Contribution margin per customer = $9.50 – $3.80 = $5.70

Breakeven number of customers = Fixed costs ÷ Contribution margin per customer

= $456,000 ÷ $5.70 per customer
= 80,000 customers

2.b. Customers needed to earn net income of $159,600:

Total revenues ÷ Sales check per customer
$1,140,000 ÷ $9.50 = 120,000 customers

3. Using the shortcut approach:

$$\text{Change in net income} = \begin{pmatrix}\text{Change in}\\ \text{number of}\\ \text{customers}\end{pmatrix} \times \begin{pmatrix}\text{Unit}\\ \text{contribution}\\ \text{margin}\end{pmatrix} \times (1 - \text{Tax rate})$$

$$= (145{,}000 - 120{,}000) \times \$5.70 \times (1 - 0.30)$$

$$= \$142{,}500 \times 0.7 = \$99{,}750$$

$$\text{New net income} = \$99{,}750 + \$159{,}600 = \$259{,}350$$

Alternatively, with 145,000 customers,

Operating income = Number of customers × Selling price per customer
– Number of customers × Variable cost per customer – Fixed costs
= 145,000 × $9.50 – 145,000 × $3.80 – $456,000 = $370,500

Net income = Operating income × (1 – Tax rate) = $370,500 × 0.70 = $259,350

The alternative approach is:

Revenues, 145,000 × $9.50	$1,377,500
Variable costs at 40%	551,000
Contribution margin	826,500
Fixed costs	456,000
Operating income	370,500
Income tax at 30%	111,150
Net income	$ 259,350

3-28 CVP analysis, sensitivity analysis. Roughstyle Shirts Co. sells shirts wholesale to major retailers across Australia. Each shirt has a selling price of $40 with $26 in variable costs of goods sold. The company has fixed manufacturing costs of $1,600,000 and fixed marketing costs of $650,000. Sales commissions are paid to the wholesale sales reps at 10% of revenues. The company has an income tax rate of 30%.

Required:

1. How many shirts must Roughstyle sell in order to break even?
2. How many shirts must it sell in order to reach:
  a. a target operating income of $600,000?
  b. a net income of $600,000?
3. How many shirts would Roughstyle have to sell to earn the net income in part 2b if: (Consider each requirement independently.)
  a. the contribution margin per unit increases by 15%.
  b. the selling price is increased to $45.00.
  c. the company outsources manufacturing to an overseas company increasing variable costs per unit by $3.00 and saving 50% of fixed manufacturing costs.

EA

SOLUTION

CVP analysis, sensitivity analysis.

1. CMU = \$40−\$26−(0.1 × \$40) = \$10.00

$$Q = \frac{FC}{CMU} = \frac{\$2{,}250{,}000}{\$10 \text{ per shirt}} = 225{,}000 \text{ shirts}$$

Note: No income taxes are paid at the breakeven point because operating income is \$0.

2a. $$Q = \frac{FC + TOI}{CMU} = \frac{\$2{,}250{,}000 + \$600{,}000}{\$10 \text{ per shirt}}$$

$$= \frac{\$2{,}850{,}000}{\$10 \text{ per shirt}}$$

= 285,000 shirts

2b. $$\text{Target operating income} = \frac{\text{Target net income}}{1 - \text{tax rate}} = \frac{\$600{,}000}{(1-0.3)} = \frac{\$600{,}000}{0.7}$$

= \$857,143 (rounded)

$$\text{Quantity of output units required to be sold} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$2{,}250{,}000 + \$857{,}143}{\$10}$$

= 310,714 shirts (rounded)

3a. Contribution margin per unit increases by 15%
Contribution margin per unit = \$10 × 1.15 = \$11.5

$$\text{Quantity of output units required to be sold} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$2{,}250{,}000 + \$857{,}143}{\$11.5}$$

= 270,186 shirts (rounded)

The net income target in units decreases from 310,714 shirts in requirement 2b to 270,186 shirts.

3b. Increasing the selling price to \$45.00
Contribution margin per unit = \$45 − \$26 − (0.1 × \$45) = \$14.5

$$\text{Quantity of output units required to be sold} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$2{,}250{,}000 + \$857{,}143}{\$14.5}$$

EA

= 214,286 shirts (rounded)

The net income target in units decreases from 310,714 pieces in requirement 2b to 214,286 shirts.

3c. Increase variable costs by $3.00 per unit and decrease fixed manufacturing costs by 50%.

Contribution margin per unit = $40 – $29 ($26 + $3) – (0.1 × $40) = $7.00
Fixed manufacturing costs = (1 – 0.5) × $1,600,000 = $800,000
Fixed marketing costs = $650,000
Total fixed costs = $800,000 + $650,000 = $1,450,000

$$\text{Quantity of output units required to be sold} = \frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}} = \frac{\$1,450,000 + \$857,143}{\$7}$$

= 329,592 shirts (rounded)

The net income target in units increases from 310,714 shirts in requirement 2b to 329,592 shirts.

3-29 CVP analysis, margin of safety. Ariba Corporation reaches its breakeven point at $3,200,000 of revenues. At present, it is selling 105,000 units and its variable costs are $30. Fixed manufacturing costs, administrative costs, and marketing costs are $400,000, $250,000, and $150,000 respectively.

Required:

1. Compute the contribution margin percentage.
2. Compute the selling price.
3. Compute the margin of safety in units and dollars.
4. What does this tell you about the risk of Ariba making a loss? What are the most likely reasons for this risk to increase?

SOLUTION

(10 min.) **CVP analysis, margin of safety.**

1. Breakeven point revenues = $\dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

Contribution margin percentage =

$$= \frac{\text{(Fixed manufacturing costs + Fixed administrative costs + Fixed marketing costs)}}{\text{Breakeven point revenues}}$$

$$= \frac{(\$400,000 + \$250,000 + \$150,000)}{\$3,200,000} = \frac{\$800,000}{\$3,200,000} = 0.25 \text{ or } 25\%$$

2. Contribution margin percentage = $\dfrac{\text{Selling price} - \text{Variable cost per unit}}{\text{Selling price}}$

EA

$$0.25 = \frac{SP - \$30}{SP}$$

$$0.25\ SP = SP - \$30$$

$$0.75\ SP = \$30$$

$$SP = \$40$$

3. Breakeven sales in units = Breakeven revenues ÷ Selling price = $3,200,000 ÷ $40 = 80,000 units

Margin of safety in units = Sales in units – Breakeven sales in units

= 105,000 – 80,000 = 25,000 units

Revenues, 105,000 units × $40	$4,200,000
Breakeven revenues	3,200,000
Margin of safety	$1,000,000

The risk of making a loss is high. If due to adverse situations, sales decrease by 25,000 units ÷ 105,000 units i.e. by 23.81% or more, Ariba will make a loss. The most likely reasons for this risk are increased competition, entry of substitute products, sudden drop in demand due to economic condition, or bad management.

3-30 Operating leverage. Broadpull Rugs is holding a 4-week carpet sale at Tryst's Club, a local warehouse store. Broadpull Rugs plans to sell carpets for $1,500 each. The company will purchase the carpets from a local distributor for $900 each, with the privilege of returning any unsold units for a full refund. Tryst's Club has offered Broadpull Rugs two payment alternatives for the use of space.

- Option 1: 25% of total revenues earned during the sale period
- Option 2: A fixed payment of $30,000 for the sale period

Assume Broadpull Rugs will incur no other costs.

Required:

1. Calculate the breakeven point in units for (a) option 1 and (b) option 2.

2. At what level of revenues will Broadpull Rugs earn the same operating income under either option?
   a. For what range of unit sales will Broadpull Rugs prefer option 1?
   b. For what range of unit sales will Broadpull Rugs prefer option 2?

3. Calculate the degree of operating leverage at sales of 80 units for the two rental options.

4. Briefly explain and interpret your answer to requirement 3.

SOLUTION

(25 min.) **Operating leverage.**

1a. Let Q denote the quantity of carpets sold

Breakeven point under Option 1

$$\$1{,}500Q - \$900Q - (0.25 \times \$1{,}500Q) = 0$$

$$225Q = 0$$

EA

$$Q = 0$$

1b. Breakeven point under Option 2

$\$1{,}500Q - \$900Q = \$30{,}000$

$\$600Q = \$30{,}000$

$Q = \$30{,}000 \div \$600 = 50$ carpets

2. Operating income under Option 1 = $\$225Q$

Operating income under Option 2 = $\$600Q - \$30{,}000$

Find Q such that $\$225Q = \$600Q - \$30{,}000$

Or $\$375Q = \$30{,}000$

$Q = \$30{,}000 \div \$375 = 80$ carpets

Revenues = $\$1{,}500 \times 80$ carpets = $\$120{,}000$

For Q = 80 carpets, operating income under both Option 1 ($\$225 \times 80$) and Option 2 ($\$600 \times 80 - \$30{,}000$) = $\$18{,}000$

For Q > 80, say, 81 carpets,

Option 1 gives operating income = $\$225 \times 81$ = $\$18{,}225$

Option 2 gives operating income = ($\$600 \times 81$) – $\$30{,}000$ = $\$18{,}600$

So Broadpull Rugs will prefer Option 2.

For Q < 80, say, 79 carpets,

Option 1 gives operating income = $\$225 \times 79 = \$17{,}775$

Option 2 gives operating income = ($\$600 \times 79$) – $\$30{,}000 = \$17{,}400$

So Broadpull Rugs will prefer Option 1.

3. Degree of operating leverage $= \dfrac{\text{Contribution margin}}{\text{Operating income}}$

$$= \frac{\text{Contribution margin per unit} \times \text{Quantity of carpets sold}}{\text{Operating income}}$$

Under Option 1, contribution margin per unit = $\$1{,}500 - \$900 - 0.25 \times \$1{,}500 = \$225$, so

Degree of operating leverage $= \dfrac{\$225 \times 80}{\$18{,}000} = 1.0$

Under Option 2, contribution margin per unit = $\$1{,}500 - \$900 = \$600$, so

Degree of operating leverage $= \dfrac{\$600 \times 80}{\$18{,}000} = 2.67$ (rounded)

4. The calculations in requirement 3 indicate that when sales are 80 units, a percentage change in sales and contribution margin will result in 2.67 times that percentage change in operating income for Option 2, but the same percentage change in operating income for Option 1 (because there are no fixed costs in Option 1). The degree of operating leverage at a given level of sales helps managers calculate the effect of fluctuations in sales on operating incomes.

EA

3-31 CVP analysis, international cost structure differences. Plush Decor, Inc., is considering three possible countries for the sole manufacturing site of its newest area rug: Italy, Spain, and Singapore. All area rugs are to be sold to retail outlets in Australia for $200 per unit. These retail outlets add their own markup when selling to final customers. Fixed costs and variable cost per unit (area rug) differ in the three countries.

Country	Sales Price to Retail Outlets	Annual Fixed Costs	Variable Manufacturing Cost per Area Rug	Variable Marketing & Distribution Cost per Area Rug
Italy	$200.00	$ 6,386,000.00	$70.00	$27.00
Spain	200.00	5,043,000.00	61.00	16.00
Singapore	200.00	12,240,000.00	84.00	14.00

Required:

1. Compute the breakeven point for Plush Decor, Inc., in each country in (a) units sold and (b) revenues.
2. If Plush Decor, Inc., plans to produce and sell 80,000 rugs in 2014, what is the budgeted operating income for each of the three manufacturing locations? Comment on the results.

SOLUTION

(15 min.) **CVP analysis, international cost structure differences.**

Country	(1)	(2)	(3)	(4)	(5) = (1) – (3) – (4)	(6) = (2) ÷ (5)	(6) × (1)	(7) = [80,000 × (5)]– (2)
Italy	$200	$ 6,386,000	$70	$27	$103.00	62,000	$12,400,000	$1,854,000
Spain	200	5,043,000	61	16	123.00	41,000	8,200,000	4,797,000
Singapore	200	12,240,000	84	14	102.00	120,000	24,000,000	(4,080,000)

Requirement 1 | Requirement 2

Spain has the lowest breakeven point because it has both the lowest fixed costs ($5,043,000) and the lowest variable cost per unit ($77.00). Hence, for a given selling price, Spain will always have a higher operating income (or a lower operating loss) than Italy or Singapore.

The Singapore breakeven point is 120,000 units. Hence, with sales of only 80,000 units, it has an operating loss of $4,080,000.

3-32 Sales mix, new and upgrade customers. Chartz 1-2-3 is a top-selling electronic spreadsheet product. Chartz is about to release version 5.0. It divides its customers into two groups: new customers and upgrade customers (those who previously purchased Chartz 1-2-3 4.0 or earlier versions). Although the same physical product is provided to each customer group, sizable differences exist in selling prices and variable marketing costs:

EA

	New Customers		Upgrade Customers	
Selling price		$195		$115
Variable costs				
Manufacturing	$15		$15	
Marketing	50	65	20	35
Contribution margin		$130		$ 80

The fixed costs of Chartz 1-2-3 5.0 are $16,500,000. The planned sales mix in units is 60% new customers and 40% upgrade customers.

Required:

1. What is the Chartz 1-2-3 5.0 breakeven point in units, assuming that the planned 60%40% sales mix is attained?
2. If the sales mix is attained, what is the operating income when 170,000 total units are sold?
3. Show how the breakeven point in units changes with the following customer mixes:
   a. New 40% and upgrade 60%
   b. New 80% and upgrade 20%
   c. Comment on the results.

SOLUTION

(30 min.) **Sales mix, new and upgrade customers.**

1.

	New Customers	Upgrade Customers
SP	$195	$115
VCU	65	35
CMU	$130	$ 80

The 60%/40% sales mix implies that, in each bundle, 3 units are sold to new customers and 2 units are sold to upgrade customers.

Contribution margin of the bundle = $3 \times \$130 + 2 \times \$80 = \$390 + \$160 = \$550$

Breakeven point in bundles = $\frac{\$16,500,000}{\$550} = 30{,}000$ bundles

Breakeven point in units is:

Sales to new customers:	30,000 bundles × 3 units per bundle	90,000 units
Sales to upgrade customers:	30,000 bundles × 2 units per bundle	60,000 units
Total number of units to breakeven (rounded)		150,000 units

Alternatively,

Let S = Number of units sold to upgrade customers

$1.5S$ = Number of units sold to new customers

Revenues – Variable costs – Fixed costs = Operating income

$[\$195\ (1.5S) + \$115S] – [\$65\ (1.5S) + \$35S] – \$16,500,000 = OI$

$\$407.5S – \$132.5S – \$16,500,000 = OI$

Breakeven point is 150,000 units when OI = $0 because

EA

$275S = \$16,500,000$
S = 60,000 units sold to upgrade customers
$1.5S$ = 90,000 units sold to new customers
BEP = 150,000 units

Check

Revenues ($195 × 90,000) + ($115 × 60,000)	$24,450,000
Variable costs ($65 × 90,000) + ($35 × 60,000)	7,950,000
Contribution margin	16,500,000
Fixed costs	16,500,000
Operating income	$ 0

2. When 170,000 units are sold, mix is:

Units sold to new customers (60% × 170,000)	102,000
Units sold to upgrade customers (40% × 170,000)	68,000
Revenues ($195 × 102,000) + ($115 × 68,000)	$27,710,000
Variable costs ($65 × 102,000) + ($35 × 68,000)	9,010,000
Contribution margin	18,700,000
Fixed costs	16,500,000
Operating income	$ 2,200,000

3a. At New 40%/Upgrade 60% mix, each bundle contains 2 units sold to new customers and 3 units sold to upgrade customers.

Contribution margin of the bundle = $2 × \$130 + 3 × \$80 = \$260 + \$240 = \$500$

Breakeven point in bundles = $\frac{\$16,500,000}{\$500}$ = 33,000 bundles

Breakeven point in units is:

Sales to new customers:	33,000 bundles × 2 unit per bundle	66,000 units
Sales to upgrade customers:	33,000 bundles × 3 unit per bundle	99,000 units
Total number of units to breakeven		165,000 units

Alternatively,

Let S = Number of units sold to new customers
then $1.5S$ = Number of units sold to upgrade customers

$[\$195S + \$115 (1.5S)] – [\$65S + \$35 (1.5S)] – \$16,500,000 =$ OI

$367.5S – 117.5S = \$16,500,000$
$250S = \$16,500,000$
S = 66,000 units sold to new customers
$1.5S$ = 99,000 units sold to upgrade customers
BEP = 165,000 units

Check

Revenues ($195 × 66,000) + ($115 × 99,000)	$24,255,000
Variable costs ($65 × 66,000) + ($35 × 99,000)	7,755,000
Contribution margin	16,500,000

EA

Fixed costs	16,500,000
Operating income	$ 0

3b. At New 80%/ Upgrade 20% mix, each bundle contains 4 units sold to new customers and 1 unit sold to upgrade customers.

Contribution margin of the bundle = 4 × $130 + 1 × $80 = $520 + $80 = $600

Breakeven point in bundles = $\frac{\$16,500,000}{\$600}$ = 27,500 bundles

Breakeven point in units is:

Sales to new customers:	27,500 bundles × 4 units per bundle	110,000 units
Sales to upgrade customers:	27,500 bundles × 1 unit per bundle	27,500 units
Total number of units to breakeven		137,500 units

Alternatively,

Let S = Number of units sold to upgrade customers
then $4S$ = Number of units sold to new customers

$[\$195\ (4S) + \$115S] - [\$65\ (4S) + \$35S] - \$16,500,000 = OI$

$895S - 295S = \$16,500,000$

$600S = \$16,500,000$

S = 27,500 units sold to upgrade customers

$4S$ = 110,000 units sold to new customers

137,500 units

Check

Revenues ($195 × 110,000) + ($115 × 27,500)	$24,612,500
Variable costs ($65 × 110,000) + ($35 × 27,500)	8,112,000
Contribution margin	16,500,000
Fixed costs	16,500,000
Operating income	$ 0

3c. As Chartz increases its percentage of new customers, which have a higher contribution margin per unit than upgrade customers, the number of units required to break even decreases:

	New Customers	Upgrade Customers	Breakeven Point
Requirement 3(a)	40%	60%	165,000
Requirement 1	60	40	150,000
Requirement 3(b)	80	20	137,500

3-33 Sales mix, three products. The Belkin Company has three product lines of coffee mugs—A, B, and C—with contribution margins of $7, $5, and $4, respectively. The president foresees sales of 240,000 units in the coming period, consisting of 40,000 units of A, 120,000 units of B, and 80,000 units of C. The company's fixed costs for the period are $552,000.

Required:

1. What is the company's breakeven point in units, assuming that the given sales mix is maintained?

EA

2. If the sales mix is maintained, what is the total contribution margin when 220,000 units are sold? What is the operating income?

3. What would operating income be if the company sold 40,000 units of A, 100,000 units of B, and 100,000 units of C? What is the new breakeven point in units if these relationships persist in the next period?

4. Comparing the breakeven points in requirements 1 and 3, is it always better for a company to choose the sales mix that yields the lower breakeven point? Explain.

SOLUTION

(15–25 min.) **Sales mix, three products.**

1. Sales of A, B, and C are in ratio 40,000 : 120,000 : 80,000. So for every 1 unit of A, 3 (120,000 ÷ 40,000) units of B are sold, and 2 (80,000 ÷ 40,000) units of C are sold.

Contribution margin of the bundle = (1 × $7) + (3 × $5) + (2 × $4) = $7 + $15 + $8 = $30

Breakeven point (in bundles) $= \frac{\$552{,}000}{\$30} = 18{,}400$ bundles

Breakeven point in units is:

Product A:	18,400 bundles × 1 unit per bundle	18,400 units
Product B:	18,400 bundles × 3 units per bundle	55,200 units
Product C:	18,400 bundles × 2 units per bundle	36,800 units
Total number of units to breakeven		110,400 units

Alternatively,

Let Q = Number of units of A to break even
3Q = Number of units of B to break even
2Q = Number of units of C to break even

Contribution margin – Fixed costs = Zero operating income

$7Q + $5(3Q) + $4(2Q) – $552,000 = 0
$30Q = $552,000
Q = 18,400 ($552,000 ÷ $30) units of A
3Q = 55,200 units of B
2Q = 36,800 units of C
Total = 110,400 units

2. Calculate sales mix at 220,000 total units:

A: 1/6 (or 40,000/240,000) × 220,000 = 0.167; 0.167 × 220,000 = 36,740 units
B: 3/6 (or 120,000/240,000) × 220,000 = 0.5; 0.5 × 220,000 = 110,000 units
C: 2/6 (or 80,000/240,000) × 220,000 = 0.333; 0.333 × 220,000 = 73,260 units

Contribution margin:

A:	36,740 × $7	$257,180
B:	110,000 × $5	550,000
C:	73,260 × $4	293,040

EA

Contribution margin		$1,100,220
Fixed costs		552,000
Operating income	$548,220	

3.

Contribution margin		
A:	40,000 × $7	$280,000
B:	100,000 × $5	500,000
C:	100,000 × $4	400,000
Contribution margin		$1,180,000
Fixed costs		552,000
Operating income	$628,000	

Sales of A, B, and C are in ratio 40,000 : 100,000 : 100,000. So for every 1 unit of A, 2.5 (1,000,000 ÷ 40,000) units of B and 2.5 (100,000 ÷ 40,000) units of C are sold, that is, for every 2 units of A, 5 units of B and 5 units

Contribution margin of the bundle = (2 × $7) + (5 × $5) + (5 × $4) = $14 + $25 + $20 = $59

Breakeven point in bundles = 552,000 / $59 = 9,356 bundles (rounded)

Breakeven point in units is:

Product A:	9,356 bundles × 2 units per bundle	18,712 units
Product B:	9,356 bundles × 5 units per bundle	46,780 units
Product C:	9,356 bundles × 5 units per bundle	46,780 units
Total number of units to breakeven		112,272 units

Alternatively,

Let 2Q = Number of units of A to break even
5Q = Number of units of B to break even
5Q = Number of units of C to break even

Contribution margin – Fixed costs = Breakeven point

$7(2Q) + $5(5Q) + $4(5Q) – $552,000 = 0
$59Q = $552,000
2Q = 18,712 [($552,000 ÷ $59) × 2] units of A
5Q = 46,780 units of B
5Q = 46,780 units of C
Total = 112,272 units

Breakeven point increases because the new mix contains less of the higher contribution margin per unit, product B, and more of the lower contribution margin per unit, product C.

4. No, it is not always better to choose the sales mix with the lowest breakeven point because this calculation ignores the demand for the various products. The company should look to and sell as much of each of the three products as it can to maximize operating income even if this means that this sales mix results in a higher breakeven point.

3-34 CVP, not-for-profit. Recreational Music Society is a not-for-profit organization that brings guest artists to the community's greater metropolitan area. The society just bought a small concert hall in the center of town to house its performances. The lease payments on the concert hall are expected to be $6,000 per month. The organization pays its guest performers $2,200 per concert and anticipates corresponding ticket sales to be $6,000 per concert. The society also incurs costs of approximately $1,400 per concert for marketing and advertising. The organization pays its artistic director $47,000 per year and expects to receive $23,000 in donations in addition to its ticket sales.

Required:

1. If the Recreational Music Society just breaks even, how many concerts does it hold?

2. In addition to the organization's artistic director, the society would like to hire a marketing director for $36,000 per year. What is the breakeven point? The society anticipates that the addition of a marketing director would allow the organization to increase the number of concerts to 50 per year. What is the society's operating income/(loss) if it hires the new marketing director?

3. The society expects to receive a grant that would provide the organization with an additional $36,000 toward the payment of the marketing director's salary. What is the breakeven point if the society hires the marketing director and receives the grant?

SOLUTION

CVP, Not for profit

1.	Ticket sales per concert		$ 6,000
	Variable costs per concert:		
	Guest performers	$ 2,200	
	Marketing and advertising	1,400	
	Total variable costs per concert		3,600
	Contribution margin per concert		$ 2,400
	Fixed costs		
	Salaries	$47,000	
	Lease payments ($6,000 × 12)	72,000	
	Total fixed costs		$119,000
	Less donations		23,000
	Net fixed costs		$96,000

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$96{,}000}{\$2{,}400} = 40 \text{ concerts}$$

Check

Donations	$ 23,000
Revenue ($6,000 × 40)	240,000

EA

Total revenue		263,000
Less variable costs		
Guest performers ($2,200 × 40)	$88,000	
Marketing and advertising ($1,400 × 40)	56,000	
Total variable costs		144,000
Less fixed costs		
Salaries	$47,000	
Lease payments	72,000	
Total fixed costs		119,000
Operating income		$ 0

2.

Ticket sales per concert		$ 6,000
Variable costs per concert:		
Guest performers	$2,200	
Marketing and advertising	1,400	
Total variable costs per concert		3,600
Contribution margin per concert		$ 2,400
Fixed costs		
Salaries ($47,000 + $36,000)	$83,000	
Lease payments ($6,000 × 12)	72,000	
Total fixed costs		$155,000
Less donations		23,000
Net fixed costs		$ 132,000

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$132{,}000}{\$2{,}400} = 55 \text{ concerts}$$

Check

Donations		$ 23,000
Revenue ($6,000 × 55)		303,000
Total revenue		353,000
Less variable costs		
Guest performers ($2,200 × 55)	$121,000	
Marketing and advertising ($1,400 × 55)	77,000	
Total variable costs		198,000
Less fixed costs		
Salaries	$83,000	
Lease payments	72,000	
Total fixed costs		155,000
Operating income		$ 0

Operating Income if 50 concerts are held

Donations		$ 23,000
Revenue ($6,000 × 50)		300,000
Total revenue		323,000
Less variable costs		
Guest performers ($2,200 × 50)	$110,000	
Marketing and advertising ($1,400 × 50)	70,000	
Total variable costs		180,000
Less fixed costs		
Salaries	$83,000	
Lease payments	72,000	
Total fixed costs		155,000
Operating income (loss)		$(12,000)

The society would not be able to afford the new marketing director if the number of concerts were to increase to only 50 events. The addition of the new marketing director would require the society to hold at least 55 concerts in order to breakeven. If only 50 concerts were held, the organization would lose $12,000 annually. The society could look for other contributions to support the new marketing director's salary or perhaps increase the number of attendees per concert if the number of concerts could not be increased beyond 50.

3.

Ticket sales per concert		$ 6,000
Variable costs per concert:		
Guest performers	$ 2,200	
Marketing and advertising	1,400	
Total variable costs per concert		3,600
Contribution margin per concert		$ 2,400
Fixed costs		
Salaries ($47,000 + $36,000)	$83,000	
Lease payments ($6,000 × 12)	72,000	
Total fixed costs		$155,000
Deduct donations		59,000
Net fixed costs		$ 96,000

$$\text{Breakeven point in units} = \frac{\text{Net fixed costs}}{\text{Contribution margin per concert}} = \frac{\$96,000}{\$2,400} = 40 \text{ concerts}$$

Check

Donations	$ 59,000
Revenue ($6,000 × 40)	240,000
Total revenue	299,000

EA

Less variable costs		
Guest performers ($2,200 × 40)	$88,000	
Marketing and advertising ($1,400 × 40)	56,000	
Total variable costs		144,000
Less fixed costs		
Salaries	$83,000	
Lease payments	72,000	
Total fixed costs		155,000
Operating income		$ 0

3-35 Contribution margin, decision making. Brandon Harris has a small bakery business called Super Bakery. Revenues and cost data of Super Bakery for the year 2016 are as follows:

Sales revenues			$475,000
Cost of goods sold (40% of sales revenues)			190,000
Gross margin			285,000
Operating costs:			
Salaries fixed	$175,000		
Sales commissions (15% of sales)	71,250		
Depreciation of equipment and fixtures	22,000		
Insurance for the year	5,000		
Store rent ($5,000 per month)	60,000		
Other operating costs	50,000	383,250	
Operating income (loss)			
$(98,250)			

An analysis of other operating costs reveals that 80% of it varies with sales volume, and remaining 20% does not vary with sales volume rather remains same irrespective of sales volume.

Required:

1. Compute the contribution margin of Super Bakery.
2. Compute the contribution margin percentage.
3. Mr. Harris estimates that if he can spend an additional $15,000 towards sales promotion, sales revenues may increase by 30%. What should Mr. Harris' decision be?
4. What other actions can he take to improve the operating income?

SOLUTION

(15 min.) **Contribution margin, decision making.**

1. Revenues			$475,000
Deduct variable costs:			
Cost of goods sold (40%)	**$190,000**		
Sales commissions	71,250		
Other operating costs	40,000	301,250	
Contribution margin		$173,750	

EA

2. Contribution margin percentage = $\frac{\$173,750}{\$475,000}$ = 36.58% (rounded)

3. Incremental revenue (30% × $475,000) = $142,500

Incremental contribution margin (36.58% × $142,500)	$52,125
Incremental costs (sales promotion)	15,000
Incremental operating income	$37,125

If Mr. Harris spends $15,000 more on sales promotion, the operating income will increase by $37,125, decreasing the operating loss from $98,250 to an operating loss of $61,125. Therefore, Mr. Harris should spend $15,000 more on sales promotion.

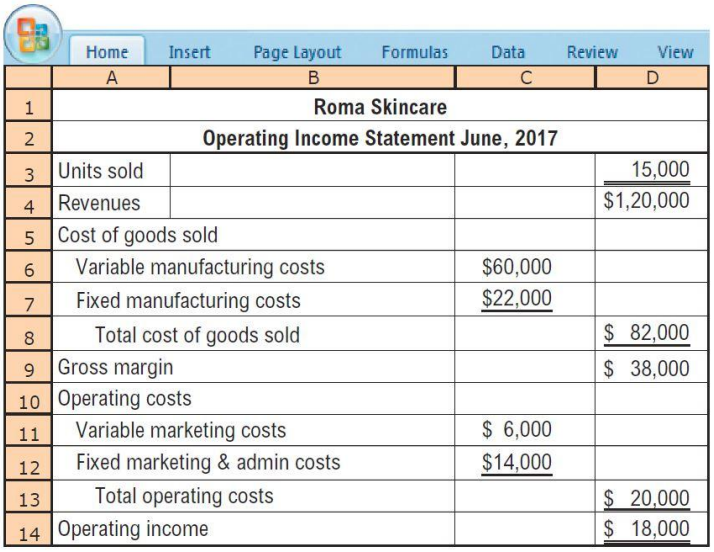
Proof (Optional):

Revenues (130% × $475,000)		$617,500
Cost of goods sold (40% of sales revenue)		247,000
Gross margin		370,500
Operating costs:		
Salaries and wages		$175,000
Sales commissions (15% of sales)		92,625
Depreciation of equipment and fixtures		22,000
Insurance for the year		5,000
Store rent		60,000
Sales promotion		15,000
Other operating costs:		
Variable $\left(\frac{\$40,000}{\$475,000}\times\$617,500\right)$		52,000
Fixed	10,000	431,625
Operating income		$ (61,125)

To improve operating income, Mr. Harris must find ways to decrease variable costs without compromising the quality of products, decrease fixed costs that can be avoided, or increase selling prices keeping in mind the selling prices of his competitors' products.

3-36 Contribution margin, gross margin, and margin of safety. Roma Skincare manufactures and sells a face cream to small specialty stores in Victoria, Australia. It presents the monthly operating income statement shown here to Jacob Scott, a potential investor in the business. Help Mr. Scott understand Roma Skincare's cost structure.

EA



	A	B	C	D
1	Roma Skincare			
2	Operating Income Statement June, 2017			
3	Units sold			15,000
4	Revenues			$1,20,000
5	Cost of goods sold			
6	Variable manufacturing costs		$60,000	
7	Fixed manufacturing costs		$22,000	
8	Total cost of goods sold			$ 82,000
9	Gross margin			$ 38,000
10	Operating costs			
11	Variable marketing costs		$ 6,000	
12	Fixed marketing & admin costs		$14,000	
13	Total operating costs			$ 20,000
14	Operating income			$ 18,000

Required:

1. Recast the income statement to emphasize contribution margin.
2. Calculate the contribution margin percentage and breakeven point in units and revenues for June 2017.
3. What is the margin of safety (in units) for June 2017?
4. If sales in June were only 12,000 units and Roma Skincare's tax rate is 30%, calculate its net income.

SOLUTION

(20 min.) **Contribution margin, gross margin and margin of safety.**

1.

Roma Skincare
Operating Income Statement, June 2017

Units sold		15,000
Revenues		$1,20,000
Variable costs		
Variable manufacturing costs	$60,000	
Variable marketing costs	6,000	
Total variable costs		66,000
Contribution margin		54,000
Fixed costs		
Fixed manufacturing costs	$22,000	
Fixed marketing & administration costs	14,000	
Total fixed costs		36,000
Operating income		$18,000

2.

EA

Contribution margin per unit $= \frac{\$54{,}000}{15{,}000\ units} = \$3.6\ per\ unit$

$$Breakeven\ quanitity = \frac{Fixed\ costs}{Contribution\ margin\ per\ unit} = \frac{\$36{,}000}{\$3.6\ per\ unit} = 10{,}000\ units$$

$$Selling\ price = \frac{Revenues}{Units\ sold} = \frac{\$120{,}000}{15{,}000\ units} = \$8\ per\ unit$$

Breakeven revenues = 10,000 units × $8 per unit = $80,000

Alternatively,

$$Contribution\ margin\ percentage = \frac{Contribution\ margin}{Revenues} = \frac{\$54{,}000}{\$120{,}000} = 45\%$$

$$Breakeven\ revenues = \frac{Fixed\ costs}{Contribution\ margin\ percentage} = \frac{\$36{,}000}{0.45} = \$80{,}000$$

3. Margin of safety (in units) = Units sold – Breakeven quantity
= 15,000 units – 10,000 units = 5,000 units

4.

Units sold	12,000
Revenues (Units sold × Selling price = 12,000 ×$8)	$96,000
Contribution margin (Revenues × CM percentage = $96,000 × 45%)	$43,200
Fixed costs	36,000
Operating income	7,200
Taxes (30% × $7,200)	2,160
Net income	$5,040

3-37 Uncertainty and expected costs. Futuremart is an international retail store. They are considering implementing a new business-to-business (B2B) information system for processing merchandise orders. The current system costs Futuremart $2,500,000 per month and $62 per order. Futuremart has two options, a partially automated B2B and a fully automated B2B system. The partially automated B2B system will have a fixed cost of $7,200,000 per month and a variable cost of $50 per order. The fully automated B2B system has a fixed cost of $11,400,000 per month and $30 per order.

Based on data from the past two years, Futuremart has determined the following distribution on monthly orders:

Monthly Number of Orders	Probability
400,000	0.35
600,000	0.40
800,000	0.25

Required:

EA

1. Prepare a table showing the cost of each plan for each quantity of monthly orders.
2. What is the expected cost of each plan?
3. In addition to the information systems costs, what other factors should Futuremart consider before deciding to implement a new B2B system?

SOLUTION

(30 min.) **Uncertainty and expected costs.**

1. **Monthly Number of Orders** | **Cost of Current System**

400,000	$2,500,000 + $62(400,000) =	**$27,300,000**
600,000	$2,500,000 + $62(600,000) =	**$39,700,000**
800,000	$2,500,000 + $62(800,000) =	**$52,100,000**

Monthly Number of Orders	**Cost of Partially Automated System**	
400,000	$7,200,000 + $50(400,000) =	**$27,200,000**
600,000	$7,200,000 + $50(600,000) =	**$37,200,000**
800,000	$7,200,000 + $50(800,000) =	**$47,200,000**

Monthly Number of Orders	**Cost of Partially Automated System**	
400,000	$11,400,000 + $30(400,000) =	**$23,400,000**
600,000	$11,400,000 + $30(600,000) =	**$29,400,000**
800,000	$11,400,000 + $30(800,000) =	**$35,400,000**

2. **Current System Expected Cost:**

$27,300,000	×	0.35	=	$9,555,000
39,700,000	×	0.40	=	15,880,000
52,100,000	×	0.25	=	13,025,000
				$38,460,000

Partially Automated System Expected Cost:

$27,200,000	×	0.35	=	$9,520,000
37,200,000	×	0.40	=	14,880,000
47,200,000	×	0.25	=	11,800,000
				$36,200,000

Fully Automated System Expected Cost:

$23,400,000	×	0.35	=	$8,190,000
29,400,000	×	0.40	=	11,760,000

EA

35,400,000	×	0.25	=	8,850,000
				$28,800,000

3. Futuremart should consider the impact of the different systems on its relationship with suppliers. The interface with Futuremart's system may require that suppliers also update their systems. This could cause some suppliers to raise the cost of their merchandise. It could force other suppliers to drop out of Futuremart's supply chain because the cost of the system change would be prohibitive. Futuremart may also want to consider other factors such as the reliability of different systems and the effect on employee morale if employees have to be laid off as it automates its systems.

3-38 CVP analysis, service firm. Appolo Healthcare Solutions provides preventive health check-up packages for men and women over 40 years of age and charges $12,500 per package on an average. The average variable costs per package are as follows:

Doctor's fees	$1,000
Pathological tests and clinical examinations	3,500
Medicines	2,800
Refreshments and health drinks	300
Costs of miscellaneous services	800
Total	$8,400

Annual fixed costs total $900,000.

Required:

1. Calculate the number of health check-up packages that must be sold to break even.
2. Calculate the revenue needed to earn a target operating income of $270,000.
3. If fixed costs increase by $19,000, what decrease in variable cost per person must be achieved to maintain the breakeven point calculated in requirement 1?
4. The managing director at Appolo proposes to increase the average price of the packages by $900 to decrease the breakeven point in units. Using information in the original problem, calculate the new breakeven point in units. What factors should the managing director consider before deciding to increase the price of the package?

SOLUTION

(15–20 min.) **CVP analysis, service firm**.

1.

Average revenue per package	$12,500
Variable cost per package	8,400
Contribution margin per package	$3,600

Breakeven (packages) = Fixed costs ÷ Contribution margin per package

$$= \frac{\$450{,}000}{\$3{,}600 \text{ per person}} = 250 \text{ health check-up packages}$$

2. Contribution margin ratio = $\dfrac{\text{Contribution margin per package}}{\text{Selling price}} = \dfrac{\$3{,}600}{\$12{,}000} = 30\%$

EA

Revenue to achieve target income = (Fixed costs + target OI) ÷ Contribution margin ratio

$$= \frac{\$900{,}000 + \$270{,}000}{0.30} = \$11{,}700{,}000, \text{ or}$$

Number of health check-up packages to earn $270,000 operating income $= \frac{\$900{,}000 + \$270{,}000}{\$3{,}600} = 325$ health check-up packages

Revenues to earn $270,000 OI = 325 health check-up packages × $12,000 = $11,700,000.

3. Fixed costs = $900,000 + $25,000 = $925,000

$$\text{Breakeven (packages)} = \frac{\text{Fixed costs}}{\text{Contribution margin per package}}$$

$$\text{Contribution margin per package} = \frac{\text{Fixed costs}}{\text{Breakeven (packages)}}$$

$$= \frac{\$925{,}000}{250 \text{ health check-up packages}} = \$3{,}700 \text{ per health check-up package}$$

Desired variable cost per health check-up package = $12,000 – $3,700 = $8,300

Because the current variable cost per unit is $8,400, the unit variable cost will need to be reduced by $100 ($8,400– $8,300) to achieve the breakeven point calculated in requirement 1.

Alternate Method: If fixed cost increases by $25,000, then total variable costs must be reduced by $25,000 to keep the breakeven point of 250 health check-up packages.

Therefore, the variable cost per unit reduction = $25,000 ÷ 250= $100 per health check-up package.

4. Contribution margin per package = $12,900 − $8,400 = $4,500

Breakeven (packages) = Fixed costs ÷ Contribution margin per package
= $900,000 ÷ $4,500 per package = 200 health check-up packages

Breakeven point in dollars = $12,900 per package × 200 health check-up packages = $2,580,000
The key question for the managing director is: can Appolo Health-care Solutions sell enough health check-up packages at $12,900 per package to earn more total operating income than when selling packages at $12,000. Lowering the breakeven point per package should not be the objective. Appolo's objective should be to increase the total operating income.

3-39 CVP, target operating income, service firm. Modern Beauty Parlor provides beauty treatment for women. Its average monthly variable costs per woman are as follows:

Materials for beauty treatment	$110
Beautician's commission	50
Other supplies (soaps, napkins, etc.)	40

EA

Total	$200

Monthly fixed costs consist of the following:

Rent	$1,250
Utilities	300
Advertisements in a local TV channel	250
Salaries	1,500
Miscellaneous	300
Total	$3,600

Modern Beauty charges $250 per woman on an average.

Required:

1. Calculate the breakeven point.
2. Modern Beauty's target operating income is $4,000 per month. Compute the number of customers required to achieve the target operating income.
3. The parlor wants to move to another building for geographical advantage. Monthly rent for the new building is $2,350. With the objective of better visibility for the prospective customers, it plans to advertise on another local TV channel, incurring a monthly cost of $420. By how much should the parlor increase its average fees per customer to meet the target operating income of $4,000 per month, assuming the same number of customers as in requirement 2?

SOLUTION

(30 min.) **CVP, target operating income, service firm.**

1.

Revenue per woman	$250
Variable costs per woman	200
Contribution margin per woman	$ 50

$$\text{Breakeven point} = \frac{\text{Fixed costs per momth}}{\text{Contribution margin per woman}}$$

$$= \frac{\$3{,}600}{\$50} = 72 \text{ woman per month}$$

2. $$\text{Target number of woman} = \frac{\text{Fixed costs} + \text{Target operating income}}{\text{Contribution margin per woman}}$$

$$= \frac{\$3{,}600 + \$4{,}000}{\$50} = 152 \text{ woman per month}$$

3.

Increase in rent ($2,350 – $1,250)	$1,100
New advertisement	420
Total increase in fixed costs	$1,520

EA

Divide by the number of woman	÷ 152
Increase in average charge per woman	$ 10

Therefore, the charge per woman will increase from $250 to $260.

Alternatively,

$$\text{New contribution margin per woman} = \frac{\$3{,}600 + \$1{,}520 + \$4{,}000}{152} = \$60$$

New average charge per woman = Variable costs per woman + New contribution margin per woman

= $200 + $60 = $260

3-40 CVP analysis, margin of safety. United Project Consultants (UPC) provides project consultancy services to new business projects. For 2017, it has a total budgeted-revenue of $480,000, based on an average price of $240 per business project prepared. UPC would like to achieve at least 50% as a margin of safety. The company's current fixed costs are $241,956, and variable costs average $42 per project. (Consider each of the following separately.)

Required:

1. Calculate UPC's breakeven point and margin of safety in units.
2. Which of the following changes would help UPC achieve its desired margin of safety?
   - **a.** Average revenue per business project increases to $276.
   - **b.** Planned number of business projects prepared increases by 25%
   - **c.** United Project Consultants purchases new tax-software that results in a 7.5% increase in fixed costs, but makes project calculations easier. The software reduces variable costs by an average of $2 per project.

SOLUTION

CVP analysis, margin of safety.

1.

Selling price	$240
Variable costs per unit:	42
Contribution margin per unit (CMU)	$198

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$241{,}956}{\$198} = 1{,}222 \text{ business projects (units)}$$

Margin of safety (units) = 2,000* – 1,222 = 778 business projects (units)

*$480,000 budgeted revenue÷$240 = 2,000 business projects (units)

EA

Breakeven revenues = $240× 1,222 = $293,280
Margin of safety percentage = ($480,000−$293,280) ÷ $480,000= 38.90%

2a. Increase selling price to $276

Selling price	$276
Variable costs per unit:	42
Contribution margin per unit (CMU)	$234

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$241{,}956}{\$234} = 1{,}034 \text{ business projects (units)}$$

Breakeven revenues = $276 × 1,034 units = $285,384

Margin of safety percentage = ($480,000 − $285,384) ÷ $480,000 = 40.55% (rounded)
This change will not help United Project Consultants achieve its desired margin of safety of 40%.

2b.

Selling price	$240
Variable costs per unit:	42
Contribution margin per unit (CMU)	$198

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$241{,}956}{\$198} = 1{,}222 \text{ business projects (units)}$$

Breakeven revenues = $240× 1,222 = $293,280

Budgeted revenues = $480,000 × 1.25 = $600,000
Margin of safety percentage = ($600,000 − $293,280) ÷ $600,000 = 51.12%
This change will help Arvin achieve its desired margin of safety of 50%.

2c.

Selling price	$240
Variable costs per unit ($42 – $2):	40
Contribution margin per unit (CMU)	$200

Fixed costs = $241,956 × 1.075 = $260,103 (rounded)

EA

$$\text{Breakeven point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

$$\text{Breakeven point in units} = \frac{\$\$260{,}103}{\$200} = 1{,}301 \text{ business projects/units (rounded up)}$$

Breakeven revenues = $240 × 1,301 units = $312,240
Margin of safety percentage = ($480,000− $312,240) ÷ $480,000= 34.95%
This change will not help United Project Consultants achieve its desired margin of safety of 50%.

Options 2a and 2b both improve the margin of safety, but only option 2b exceeds the company's desired margin of safety. Option 2c actually lowers the company's margin of safety. Therefore, option only 2b would help United Project Consultants achieve its desired margin of safety.

3-41 CVP analysis, income taxes. (CMA, adapted) J.T. Brooks and Company, a manufacturer of quality handmade walnut bowls, has had a steady growth in sales for the past 5 years. However, increased competition has led Mr. Brooks, the president, to believe that an aggressive marketing campaign will be necessary next year to maintain the company's present growth. To prepare for next year's marketing campaign, the company's controller has prepared and presented Mr. Brooks with the following data for the current year, 2017:

Variable cost (per bowl)	
Direct materials	$ 3.00
Direct manufacturing labor	8.00
Variable overhead (manufacturing, marketing, distribution, and customer service)	7.50
Total variable cost per bowl	$ 18.50
Fixed costs	
Manufacturing	$ 20,000
Marketing, distribution, and customer service	194,500
Total fixed costs	$214,500
Selling price	$ 35.00
Expected sales, 22,000 units	$770,000
Income tax rate	40%

Required:

1. What is the projected net income for 2017?
2. What is the breakeven point in units for 2017?
3. Mr. Brooks has set the revenue target for 2018 at a level of $875,000 (or 25,000 bowls). He believes an additional marketing cost of $16,500 for advertising in 2018, with all other costs remaining constant, will be necessary to attain the revenue target. What is the net income for 2018 if the additional $16,500 is spent and the revenue target is met?
4. What is the breakeven point in revenues for 2018 if the additional $16,500 is spent for advertising?

EA

5. If the additional $16,500 is spent, what are the required 2018 revenues for 2018 net income to equal 2017 net income?

6. At a sales level of 25,000 units, what maximum amount can be spent on advertising if a 2018 net income of $108,450 is desired?

SOLUTION

(30–40 min.) **CVP analysis, income taxes.**

1. Revenues – Variable costs – Fixed costs $= \dfrac{\text{Target net income}}{1 - \text{Tax rate}}$

Let X = Net income for 2017

$$22{,}000(\$35.00) - 22{,}000(\$18.50) - \$214{,}500 = \frac{X}{1 - 0.40}$$

$$\$770{,}000 - \$407{,}000 - \$214{,}500 = \frac{X}{0.60}$$

$$\$462{,}000 - \$244{,}200 - \$128{,}700 = X$$

$$X = \$89{,}100$$

Alternatively,

Operating income = Revenues – Variable costs – Fixed costs
= $770,000 – $407,000 – $214,500 = $148,500
Income taxes = 0.40 × $148,500 = $59,400
Net income = Operating income – Income taxes
= $148,500 – $59,400 = $89,100

2. Let Q = Number of units to break even
$35.00Q – $18.50Q – $214,500 = 0
Q = $214,500 ÷ $16.50 = 13,000 units

3. Let X = Net income for 2018

$$25{,}000(\$35.00) - 25{,}000(\$18.50) - (\$214{,}500 + \$16{,}500) = \frac{X}{1 - 0.40}$$

$$\$875{,}000 - \$462{,}500 - \$231{,}000 = \frac{X}{0.60}$$

$$\$181{,}500 = \frac{X}{0.60}$$

$$X = \$108{,}900$$

4. Let Q = Number of units to break even with new fixed costs of $146,250

$35.00Q – $18.50Q – $231,000 = 0
Q = $231,000 ÷ $16.50 = 14,000 units
Breakeven revenues = 14,000 × $35.00 = $490,000

5. Let S = Required sales units to equal 2017 net income

$$\$35.00S - \$18.50S - \$231{,}000 = \frac{\$89{,}100}{0.60}$$

$$\$16.50S = \$379{,}500$$

EA

$$S = 23{,}000 \text{ units}$$
$$\text{Revenues} = 23{,}000 \text{ units} \times \$35 = \$805{,}000$$

6. Let A = Amount spent for advertising in 2018

$$\$875{,}000 - \$462{,}500 - (\$214{,}500 + A) = \frac{\$108{,}450}{0.60}$$
$$\$875{,}000 - \$462{,}500 - \$214{,}500 - A = \$180{,}750$$
$$\$875{,}000 - \$857{,}750 = A$$
$$A = \$17{,}250$$

3-42 CVP, sensitivity analysis. Mundial Nails produces a famous nail polish with a unique glossy feature and sells it for $25 per unit. The operating income for 2017 is as follows:

	Per unit ($)	Total ($)
Sales revenue	$25	$750,000
Raw-materials	5	150,000
Variable manufacturing costs	4	120,000
Other variable costs	6	180,000
Contribution margin	10	300,000
Fixed cost		174,000
Operating income		$126,000

Mundial Nails would like to increase its profitability over the next year by at least 20%. To do so, the company is considering the following options:

Required:

1. Replacing a portion of its variable labor with an automated machining process. This would result in a 25% decrease in variable manufacturing costs per unit, but a 20% increase in fixed costs. Sales would remain the same.
2. Spending $30,000 on a new advertising campaign, which would increase sales by 20%.
3. Increasing both selling price by $5 per unit and raw-material costs by $3 per unit by using a higher-quality raw materials in producing its nail polish. The higher-priced nail polish would cause demand to drop by approximately 20%.
4. Adding a second manufacturing facility that would double Mundial Nails' fixed costs, but would increase sales by 60%.

Evaluate each of the alternatives considered by Mundial Nails. Do any of the options meet or exceed Mundial's targeted increase in income of 25%? What should Mundial Nails do?

SOLUTION

(25 min.) **CVP, sensitivity analysis**.

EA

Contribution margin per unit = $25 – $15 = $10
Fixed costs = $174,000
Units sold = Total sales ÷ Selling price = $750,000 ÷ $25 per pair = 30,000 units
Variable costs per unit = $5 +$4 + $6 = $15

1. variable manufacturing costs per unit decrease by 25%; Fixed costs increase by 20%

Sales revenues: 30,000 × $25	$750,000
Variable costs: 30,000 × ($15 – $4 × 0.25)	420,000
Contribution margin: 30,000 ×$11	330,000
Fixed costs $174,000 × 1.20	208,800
Operating income	$121,200

2. Increase advertising (fixed costs) by $30,000; Increase sales 20%

Sales revenues: 30,000 × 1.20 × $25.00	$900,000
Variable costs: 30,000 × 1.20 × $15.00	540,000
Contribution margin	360,000
Fixed costs: ($174,000 + $30,000)	204,000
Operating income	$ 156,000

3. Increase selling price by $5; Sales decrease 20%; Increase Raw-material costs by $3

Sales revenues: 30,000 × (1 –0.2)× ($25 + $5)	$720,000
Variable costs: 30,000 × (1 –0.2)× ($15 + $3)	432,000
Contribution margin: 30,000 ×(1 –0.2) ×$12	288,000
Fixed costs	174,000
Operating income	$ 114,000

4. Double fixed costs; Increase sales by 60%

Sales revenues: 30,000 × 1.60 × $25	$1,200,000
Variable costs: 30,000 × 1.60 × $15	720,000
Contribution margin: 30,000 × 1.60 × $10	480,000
Fixed costs $100,000 × 2	348,000
Operating income	$132,000

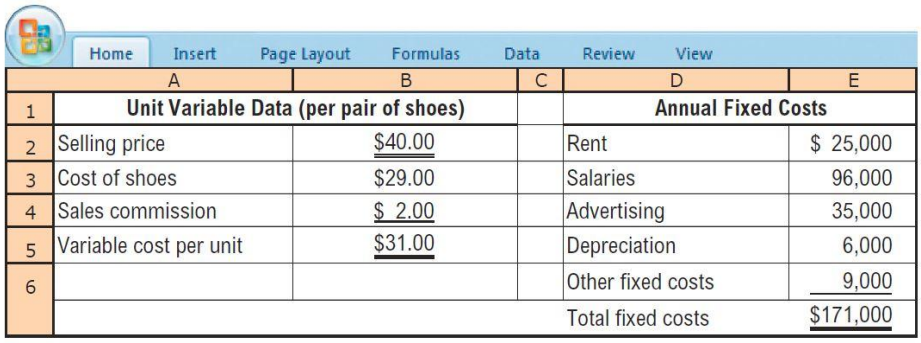
Alternative 2 yields the highest operating income. Choosing alternative 2 will give Mundial Nails a 23.81% [($156,000 – $126,000)/$126,000 = 23.81%] increase in operating income, which is less than the company's 25% targeted increase. Alternative 4 also generates more operating income for Mundial Nails, but it too does not meet Mundial Nails' target of 25% increase in operating income. Alternatives 1 and 3 actually result in lower operating income than under Mundial Nails' current cost structure. There is no reason, however, for Mundial Nails to think of these alternatives as being mutually exclusive. For example, Mundial Nails can combine actions 1 and 2, automate the machining process and spend for a new advertising campaign and by this process increase sales by 20% and decrease variable manufacturing costs per unit by 25% while increasing fixed costs by 20% and spending $30,000 for the new advertisement campaign. This will result in a 24.76% [($157,200 – $126,000)/$126,000 = 24.76%] increase in operating income as follows:

EA

Sales revenue: 30,000 × 1.20 × $25	$900,000
Variable costs: 30,000 × 1.20 × ($15 – $4× 0.25)	504,000
Contribution margin: 30,000 × 1.20× $11	396,000
Fixed costs: $174,000 × 1.20 + $30,000	238,800
Operating income	$157,200

The point of this problem is that managers always need to consider broader rather than narrower alternatives to meet ambitious future or stretch goals.

3-43 CVP analysis, shoe stores. The LadyStyle sells women's shoes across the country through its chain of shoe stores. It sells 20 different styles of shoes with identical unit costs and selling prices. A unit is defined as a pair of shoes. Each store has a store manager and a store supervisor who are paid a fixed salary. Shoes are sold by sales-women who receive a fixed salary and a sales commission. LadyStyle is considering opening another store that is expected to have the revenue and cost relationships shown here.



	A	B	C	D	E
1	**Unit Variable Data (per pair of shoes)**			**Annual Fixed Costs**	
2	Selling price	$40.00		Rent	$ 25,000
3	Cost of shoes	$29.00		Salaries	96,000
4	Sales commission	$ 2.00		Advertising	35,000
5	Variable cost per unit	$31.00		Depreciation	6,000
6				Other fixed costs	9,000
				Total fixed costs	$171,000

Consider each question independently.

Required:

1. What is the annual breakeven point in (a) units sold and (b) revenues?
2. If 15,000 units are sold, what will be the store's operating income (loss)?
3. If sales commissions are discontinued and fixed salaries are raised by a total of $19,190, what would be the annual breakeven point in (a) units sold and (b) revenues?
4. Refer to the original data. If, in addition to their fixed salary, the store supervisor and store manager are paid a commission of $0.50 per unit sold and $1.00 per unit sold respectively, what would be the annual breakeven point in (a) units sold and (b) revenues?
5. Refer to the original data. If, in addition to their fixed salary, the store supervisor and store manager are paid a commission of $0.50 per unit and $1.00 per unit sold respectively in excess of the breakeven point, what would be the store's operating income if 25,000 units were sold?

SOLUTION

(20–30 min.) **CVP analysis, shoe stores.**

1. CMU (SP – VCU = $40 – $31)	$ 9.00
a. Breakeven units (FC ÷ CMU = $171,000 ÷ $9 per unit)	19,000
b. Breakeven revenues	

EA

(Breakeven units × SP = 19,000 units × $40 per unit)	$760,000
2. Pairs sold	15,000
Revenues, 15,000 × $40	$600,000
Total cost of shoes, 15,000 × $29	435,000
Total sales commissions, 15,000 × $2	30,000
Total variable costs	465,000
Contribution margin	135,000
Fixed costs	171,000
Operating income (loss)	$ (36,000)
3. Unit variable data (per pair of shoes)	
Selling price	$ 40.00
Cost of shoes	29.00
Sales commissions	0
Variable cost per unit	$ 29.00
Annual fixed costs	
Rent	$ 25,000
Salaries, $96,000 + $19,190	115,190
Advertising	35,000
Depreciation	6,000
Other fixed costs	9,000
Total fixed costs	$ 190,190
CMU, $40 – $29	$ 11
a. Breakeven units, $190,190 ÷ $11 per unit	17,290
b. Breakeven revenues, 17,290 units × $40 per unit	$691,600
4. Unit variable data (per pair of shoes)	
Selling price	$ 40.00
Cost of shoes	29.00
Sales commissions	3.50
Variable cost per unit	$ 32.50
Total fixed costs	$171,000
CMU, $40 – $32.5	$ 7.50
a. Break even units = $171,000 ÷ $7.50 per unit	22,800
b. Break even revenues = 22,800 units × $40 per unit	$912,000
5. Pairs sold	25,000
Revenues (25,000 pairs × $40 per pair)	$1,000,000
Total cost of shoes (25,000 pairs × $29 per pair)	725,000
Sales commissions on first 19,000 pairs (19,000 pairs × $2 per pair)	38,000
Sales commissions on additional 6,000 pairs [6,000 pairs × ($2 + $1.50 per pair)]	21,000
Total variable costs	784,000
Contribution margin	216,000
Fixed costs	171,000

EA

Operating income	$ 45,000

Alternative approach:
Breakeven point in units = 19,000 pairs
Store manager and store supervisor receive commission of $1.50 ($1+$0.50) on 6,000 (25,000 – 19,000) pairs.
Contribution margin per pair beyond breakeven point of 19,000 pairs = $7.50 ($40 – $31 – $1.50) per pair.
Operating income = 6,000 pairs × $7.50 contribution margin per pair = $45,000.

3-44 CVP analysis, shoe stores (continuation of 3-43). Refer to requirement 3 of Problem 3-43. In this problem, assume the role of the owner of LadyStyle.

Required:

1. As owner, which sales compensation plan would you choose if forecasted annual sales of the new store were at least 25,000 units? What do you think of the motivational aspect of your chosen compensation plan?
2. Suppose the target operating income is $99,000. How many units must be sold to reach the target operating income under (a) the original salary-plus-commissions plan and (b) the higher-fixed-salaries-only plan? Which method would you prefer? Explain briefly.
3. You open the new store on January 1, 2017, with the original salary-plus-commission compensation plan in place. Because you expect the cost of the shoes to rise due to inflation, you place a firm bulk order for 25,000 shoes and lock in the $29 price per unit. But toward the end of the year, only 20,000 shoes are sold, and you authorize a markdown of the remaining inventory to $35 per unit. Finally, all units are sold. Salespeople, as usual, get paid a commission of 5% of revenues. What is the annual operating income for the store?

SOLUTION

(30 min.) **CVP analysis, shoe stores (continuation of 3-43).**

1. For an expected volume of 25,000 pairs, the owner would be inclined to choose the higher-fixed-salaries-only plan because income would be much higher by $30,810 compared to the salary-plus-commission plan.

Operating income for salary plan = $11 × 25,000 – $190,190 = $84,810
Operating income under commission pan = $9 × 25,000 – $171,000 = $54,000

However, it is likely that sales volume itself is determined by the nature of the compensation plan. The salary-plus-commission plan provides a greater motivation to the salespeople, and it may well be that for the same amount of money paid to salespeople, the salary-plus-commission plan generates a higher volume of sales than the fixed-salary plan.

2. Let TQ = Target number of units

For the salary-only plan,

$40TQ – $29TQ – $190,190 = $99,000

EA

$$\$11TQ = \$289,190$$
$$TQ = \$289,190 \div \$11$$
$$TQ = 26,290 \text{ units}$$

For the salary-plus-commission plan,

$$\$40TQ - \$31TQ - \$171,000 = \$99,000$$
$$\$9TQ = \$270,000$$
$$TQ = \$270,000 \div \$9$$
$$TQ = 30,000 \text{ units}$$

The decision regarding the salary-plus-commission plan depends heavily on predictions of demand. For instance, the salary-only plan offers the same operating income at 26,290 units as the commission plan offers at 30,000 units.

3.

LadyStyle
Operating Income Statement, 2017

Revenues (20,000 pairs × $40) + (5,000 pairs × $35)	$975,000
Cost of shoes, 25,000 pairs × $29	725,000
Commissions = Revenues × 5% = $975,000 × 0.05	48,750
Contribution margin	201,250
Fixed costs	171,000
Operating income	$ 30,250

3-45 Alternate cost structures, uncertainty, and sensitivity analysis. Sunshine Printing Company currently leases its only copy machine for $1,500 a month. The company is considering replacing this leasing agreement with a new contract that is entirely commission based. Under the new agreement, Sunshine would pay a commission for its printing at a rate of $10 for every 500 pages printed. The company currently charges $0.20 per page to its customers. The paper used in printing costs the company $0.08 per page and other variable costs, including hourly labor, amount to $0.07 per page.

Required:

1. What is the company's breakeven point under the current leasing agreement? What is it under the new commission-based agreement?
2. For what range of sales levels will Sunshine prefer (a) the fixed lease agreement and (b) the commission agreement?
3. Do this question only if you have covered the chapter appendix in your class. Sunshine estimates that the company is equally likely to sell 30,000, 45,000, 60,000, 75,000, or 90,000 pages of print. Using information from the original problem, prepare a table that shows the expected profit at each sales level under the fixed leasing agreement and under the commission-based agreement. What is the expected value of each agreement? Which agreement should Sunshine choose?

SOLUTION

(40 min.) **Alternative cost structures, uncertainty, and sensitivity analysis.**

EA

1. Contribution margin per page assuming current fixed leasing agreement = \$0.20 – \$0.08 – \$0.07 = \$0.05 per page

Fixed costs = \$1,500

$$\text{Breakeven point} = \frac{\text{Fixed costs}}{\text{Contribution margin per page}} = \frac{\$1,500}{\$0.05 \text{ per page}} = 30,000 \text{ pages}$$

New commission-based agreement	
Contribution margin per page assuming \$10 per 500 page commission agreement	= \$0.20 – \$0.02[a] – \$0.08 – \$0.07 = \$0.03 per page

Fixed costs = \$0

$$\text{Breakeven point} = \frac{\text{Fixed costs}}{\text{Contribution margin per page}} = \frac{\$0}{\$0.03 \text{ per page}} = 0 \text{ pages}$$

(i.e., Sunshine makes a profit no matter how few pages it sells)

[a]\$10 ÷ 500 pages = \$0.02 per page

2. Let x denote the number of pages Sunshine must sell for it to be indifferent between the fixed leasing agreement and commission based agreement.

To calculate x we solve the following equation.

$\$0.20x - \$0.08x - \$0.07x - \$1,500 = \$0.20x - \$0.02x - \$0.08x - \$.07x$

$\$0.05x - \$1,500 = \$0.03x$

$\$0.02x = \$1,500$

$x = \$1,500 \div \$0.02 = 75,000$ pages

For sales between 0 to 75,000 pages, Sunshine prefers the commission-based agreement because in this range, $\$0.03x > \$0.05x - \$1,500$. For sales greater than 75,000 pages, Sunshine prefers the fixed leasing agreement because in this range, $\$0.05x - \$1,500 > \$0.03x$.

3. Fixed leasing agreement

Pages Sold (1)	**Revenue (2)**	**Variable Costs (3)**	**Fixed Costs (4)**	**Operating Income (Loss) (5) = (2) – (3) – (4)**	**Probability (6)**	**Expected Operating Income (7)=(5)×(6)**
30,000	30,000×\$.20 = \$ 6,000	30,000×\$.15 = \$4,500	\$1,500	\$ 0	0.20	\$ 0
45,000	45,000×\$.20 = \$ 9,000	45,000×\$.15=\$6,750	\$1,500	\$ 750	0.20	150
60,000	60,000×\$.20 = \$ 12,000	60,000×\$.15=\$9,000	\$1,500	\$1,500	0.20	300
75,000	75,000×\$.20 = \$ 15,000	75,000×\$.15=\$11,250	\$1,500	\$2,250	0.20	450
90,000	90,000×\$.20 = \$ 18,000	90,000×\$.15=\$13,500	\$1,500	\$3,000	0.20	600

EA

Expected value of fixed leasing agreement	$1,500

Commission-based leasing agreement:

Pages Sold (1)	Revenue (2)	Variable Costs (3)	Operating Income (4) = (2) – (3)	Probability (5)	Expected Operating Income (6)=(4)×(5)
30,000	30,000×$.20 = $ 6,000	30,000×$.17 = $5100	$900	0.20	$ 180
45,000	45,000×$.20=$ 9,000	45,000×$.17=$,7,650	$1,350	0.20	270
60,000	60,000×$.20 = $ 12,000	60,000×$.17 = $10,200	$1,800	0.20	360
75,000	75,000×$.20=$ 15,000	75,000×$.17=$12,750	$2,250	0.20	450
90,000	90,000×$.20=$ 18,000	90,000×$.17=$15,300	$2,700.00	0.20	540
Expected value of commission based agreement					$1,800

Sunshine should choose the commission-based agreement because the expected value is higher than under the fixed cost leasing agreement. The range of sales is not high enough (i.e. >75,000) to make the fixed leasing agreement more attractive.

3-46 CVP, alternative cost structures. TopHats operates a kiosk at a local mall, selling hats for $30 each. TopHats currently pays $900 a month to rent the space and pays three full-time employees to each work 160 hours a month at $12 per hour. The store shares a manager with a neighboring mall and pays 40% of the manager's annual salary of $60,000 and benefits equal to 18% of salary. The wholesale cost of the hats to the company is $10 a hat.

Required:

1. How many hats does TopHats need to sell each month to break even?
2. If TopHats wants to earn an operating income of $5,000 per month, how many hats does the store need to sell?
3. If the store's hourly employees agreed to a 20% sales-commission-only pay structure, instead of their hourly pay, how many hats would TopHats need to sell to earn an operating income of $5,000?
4. Assume TopHats pays its employees hourly under the original pay structure, but is able to pay the mall 5% of its monthly revenue instead of monthly rent. At what sales levels would TopHats prefer to pay a fixed amount of monthly rent, and at what sales levels would it prefer to pay 5% of its monthly revenue as rent?

SOLUTION

(20-30 min.) **CVP, alternative cost structures.**

1. Variable cost per unit = $10

Contribution margin per unit = Selling price –Variable cost per unit

= $30 – $10 = $20

Fixed Costs:

Manager's salary ($60,000 × 1.18 × 0.4) ÷12 $2,360 per month

EA

Rent	900 per month
Hourly employee wages (3 × 160 hours × $12)	5,760 per month
Total fixed costs	$9,020 per month

Breakeven point = Fixed costs ÷ Contribution margin per unit
= $9,020 ÷ $20 = 451 hats (per month)

2. Target number of hats $= \dfrac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}}$

$$= \frac{\$9{,}020 + \$5{,}000}{\$20} = 701 \text{ hats}$$

3. Contribution margin per unit = Selling price – Variable cost per computer
= $30 – (0.20 × $30) – $10 = $14

Fixed costs = Manager's salary + Rent = $2,360 + $900 = $3,260

Target number of hats $= \dfrac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}}$

$$= \frac{\$3{,}260 + \$5{,}000}{\$14} = 590 \text{ hats}$$

4. Let x be the number of hats for which TopHats is indifferent between paying a monthly rental fee for the retail space and paying a 5% commission on sales. TopHats will be indifferent when the operating incomes under the two alternatives are equal.

$$\$30x - \$10x - \$9{,}020 = \$30x - \$10x - \$30(0.05)x - \$8{,}120$$
$$\$20x - \$9{,}020 = \$18.50x - \$8{,}120$$
$$\$1.50x = \$900$$
$$x = 600 \text{ hats}$$

For sales between 0 and 600 hats, TopHats prefers to pay the 5% commission because in this range, $\$18.50x - \$8{,}120 > \$20x - \$9{,}020$. For sales greater than 600 hats, the company prefers to pay the monthly fixed rent of $900 because $\$20x - \$9{,}020 > \$18.50x - \$8{,}120$.

3-47 CVP analysis, income taxes, sensitivity. (CMA, adapted) Carlisle Engine Company manufactures and sells diesel engines for use in small farming equipment. For its 2014 budget, Carlisle Engine Company estimates the following:

Selling price	$ 4,000
Variable cost per engine	$ 1,000
Annual fixed costs	$4,800,000
Net income	$1,200,000
Income tax rate	20%

The first-quarter income statement, as of March 31, reported that sales were not meeting

expectations. During the first quarter, only 400 units had been sold at the current price of $4,000. The income statement showed that variable and fixed costs were as planned, which meant that the 2014 annual net income projection would not be met unless management took action. A management committee was formed and presented the following mutually exclusive alternatives to the president:

Required:

1. Reduce the selling price by 15%. The sales organization forecasts that at this significantly reduced price, 2,100 units can be sold during the remainder of the year. Total fixed costs and variable cost per unit will stay as budgeted.

2. Lower variable cost per unit by $300 through the use of less-expensive direct materials. The selling price will also be reduced by $400, and sales of 1,750 units are expected for the remainder of the year.

3. Reduce fixed costs by 10% and lower the selling price by 30%. Variable cost per unit will be unchanged. Sales of 2,200 units are expected for the remainder of the year.

   a. If no changes are made to the selling price or cost structure, determine the number of units that Carlisle Engine Company must sell (i) to break even and (ii) to achieve its net income objective.

   b. Determine which alternative Carlisle Engine should select to achieve its net income objective. Show your calculations.

SOLUTION

(30 min.) **CVP analysis, income taxes, sensitivity.**

1a.To breakeven, Carlisle Engine Company must sell 1,200 units. This amount represents the point where revenues equal total costs.

Let Q denote the quantity of engines sold.

Revenue	=	Variable costs + Fixed costs
$4,000Q	=	$1000Q + $4,800,000
$3,000Q	=	$4,800,000
Q	=	1,600 units

Breakeven can also be calculated using contribution margin per unit.

Contribution margin per unit = Selling price – Variable cost per unit = $4,000 – $1,000 = $3,000

Breakeven = Fixed Costs ÷ Contribution margin per unit
= $4,800,000 ÷ $3,000
= 1,600 units

1b. To achieve its net income objective, Carlisle Engine Company must sell 2,100 units. This amount represents the point where revenues equal total costs plus the corresponding operating income objective to achieve net income of $1,200,000.

Revenue = Variable costs + Fixed costs + [Net income ÷ (1 – Tax rate)]
$4,000Q = $1,000Q + $4,800,000 + [$1,200,000 ÷ (1 – 0.20)]
$4,000Q = $1,000Q + $4,800,000 + $1,500,000
Q = 2,100 units

EA

2. None of the alternatives will help Carlisle Engineering achieve its net income objective of $1,200,000. Alternative b, where variable costs are reduced by $300 and selling price is reduced by $400 resulting in 1,750 additional units being sold through the end of the year, yields the highest net income of $1,180,000. Carlisle's managers should examine how to modify Alternative b to further increase net income. For example, could variable costs be decreased by more than $300 per unit or selling prices decreased by less than $400? Calculations for the three alternatives are shown below.

Alternative a

Revenues = ($4,000 × 400) + ($3,400[a] × 2,100) = $8,740,000

Variable costs = $1,000 × 2,500[b] = $2,500,000

Operating income = $8,740,000– $2,500,000 – $4,800,000 = $1,440,000

Net income = $1,440,000 × (1 – 0.20) = $1,152,000

[a]$4,000 – ($4,000 × 0.15) ; [b]400 units + 2,100 units.

Alternative b

Revenues = ($4,000 × 400) + ($3,600[a] × 1,750) = $7,900,000

Variable costs = ($1,000 × 400) + (700[b] × 1,750) = $1,625,000

Operating income = $7,900,000 – $1,625,000 – $4,800,000 = $1,475,000

Net income = $1,475,000 × (1 – 0.20) = $1,180,000

[a]$4,000 – 400 ; [b]$1,000 – $300.

Alternative c

Revenues = ($4,000 × 400) + ($2,800[a] × 2,200) = $7,760,000

Variable costs = $1,000 × 2,600[b] = $2,600,000

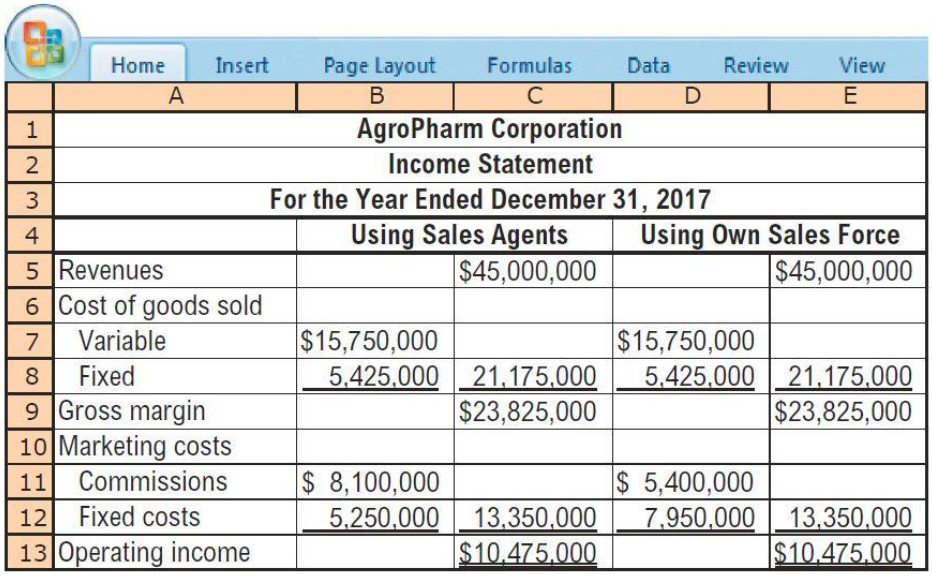
Operating income = $7,760,000– $2,600,000 – $4,320,000[c] = 840,000

Net income = $840,000 × (1 – 0.20) = $672,000

[a]$4,000 – ($4,000× 0.30); [b]400 units + 2,200nits; [c]$4,800,000 – ($4,800,000 × 0.10)

3-48 Choosing between compensation plans, operating leverage. CMA, adapted) AgroPharm Corporation manufactures pharmaceutical products that are sold through a network of external sales agents. The agents are paid a commission of 18% of revenues. AgroPharm is considering replacing the sales agents with its own salespeople, who would be paid a commission of 12% of revenues and total salaries of $7,950,000. The income statement for the year ending December 31, 2017, under the two scenarios is shown here.

EA



	A	B	C	D	E
1	AgroPharm Corporation				
2	Income Statement				
3	For the Year Ended December 31, 2017				
4		Using Sales Agents		Using Own Sales Force	
5	Revenues		$45,000,000		$45,000,000
6	Cost of goods sold				
7	Variable	$15,750,000		$15,750,000	
8	Fixed	5,425,000	21,175,000	5,425,000	21,175,000
9	Gross margin		$23,825,000		$23,825,000
10	Marketing costs				
11	Commissions	$ 8,100,000		$ 5,400,000	
12	Fixed costs	5,250,000	13,350,000	7,950,000	13,350,000
13	Operating income		$10,475,000		$10,475,000

Required:

1. Calculate AgroPharm's 2017 contribution margin percentage, breakeven revenues, and degree of operating leverage under the two scenarios.
2. Describe the advantages and disadvantages of each type of sales alternative.
3. In 2018, AgroPharm uses its own salespeople, who demand a 14% commission. If all other cost-behavior patterns are unchanged, how much revenue must the salespeople generate in order to earn the same operating income as in 2017?

SOLUTION

(30 min.) **Choosing between compensation plans, operating leverage.**

1. We can recast AgroPharm's income statement to emphasize contribution margin, and then use it to compute the required CVP parameters.

AgroPharm Corporation
Income Statement for the Year Ended Decemeber 31, 2017

	Using Sales Agents		Using Own Sales Force	
Revenues		$45,000,000		$45,000,000
Variable Costs				
Cost of goods sold − variable	$15,750,000		$15,750,000	
Marketing commissions	8,100,000	23,850,000	5,400,000	21,150,000
Contribution margin		$21,150,000		$23,850,000
Fixed costs				
Cost of goods sold − fixed	$5,425,000		$5,425,000	

EA

Marketing fixed	5,250,000	10,675,000	7,950,000	13,375,000
Operating income		$10,475,000		$10,475,000
Contribution margin percentage ($21,150,000-:-$45,000,000; $23,850,000÷$45,000,000)		47.00%		53.00%
Breakeven revenues ($10,675,000 ÷ 0.47; $13,375,000 ÷ 0.53)		$22,712,766		$25,235,849
Degree of operating leverage ($21,150,000 ÷ $10,475,000; $23,850,000 ÷ $10,475,000)		2.02		2.28

2. The calculations indicate that at sales of $45,000,000, a percentage change in sales and contribution margin will result in 2.02 times that percentage change in operating income if AgroPharm continues to use sales agents and 2.28 times that percentage change in operating income if AgroPharm employs its own sales staff. The higher contribution margin per dollar of sales and higher fixed costs gives AgroPharm more operating leverage, that is, greater benefits (increases in operating income) if revenues increase but greater risks (decreases in operating income) if revenues decrease. AgroPharm also needs to consider the skill levels and incentives under the two alternatives. Sales agents have more incentive compensation and, hence, may be more motivated to increase sales. On the other hand, AgroPharm's own sales force may be more knowledgeable and skilled in selling the company's products. That is, the sales volume itself will be affected by who sells and by the nature of the compensation plan.

3. Variable costs of marketing = 14% of Revenues
   Fixed marketing costs = $7,950,000

$$\text{Operating income} = \text{Revenues} - \underset{\text{manuf. costs}}{\text{Variable}} - \underset{\text{manuf. costs}}{\text{Fixed}} - \underset{\text{costs}}{\text{Variable marketing}} - \underset{\text{costs}}{\text{Fixed marketing}}$$

Denote the revenues required to earn $10,475,000 of operating income by R, then

$$R - 0.35R - \$5,425,000 - 0.14R - \$7,950,000 = \$10,475,000$$
$$R - 0.35R - 0.14R = \$5,425,000 + \$7,950,000 + \$10,475,000$$
$$0.51R = \$23,850,000$$
$$R = \$\$23,850,000 \div 0.51 = \$46,764,706$$

3-49 Sales mix, three products. The Matrix Company has three product lines of belts—A, B, and C—with contribution margins of $7, $5, and $4, respectively. The president foresees sales of

EA

400,000 units in the coming period, consisting of 40,000 units of A, 200,000 units of B, and 160,000 units of C. The company's fixed costs for the period are $1,020,000.

Required:

1. What is the company's breakeven point in units, assuming that the given sales mix is maintained?

2. If the sales mix is maintained, what is the total contribution margin when 400,000 units are sold? What is the operating income?

3. What would operating income be if 40,000 units of A, 160,000 units of B, and 200,000 units of C were sold? What is the new breakeven point in units if these relationships persist in the next period?

SOLUTION

(15–25 min.) **Sales mix, three products.**

1. Sales of A, B, and C are in ratio 40,000 : 200,000 : 160,000. So for every 1 unit of A, 5 (200,000 ÷ 40,000) units of B are sold, and 4 (160,000 ÷ 40,000) units of C are sold.

Contribution margin of the bundle = 1 × $7 + 5 × $5 + 4 × $4 = $7 + $25 + $16 = $48

$$\text{Breakeven point in bundles} = \frac{\$1,020,000}{\$48} = 21,250 \text{ bundles}$$

Breakeven point in units is:

Product A:	21,250 bundles × 1 unit per bundle	21,250 units
Product B:	21,250 bundles × 5 units per bundle	106,250 units
Product C:	21,250 bundles × 4 units per bundle	85,000 units
Total number of units to breakeven		212,500 units

Alternatively,

Let Q = Number of units of A to break even
5Q = Number of units of B to break even
4Q = Number of units of C to break even

Contribution margin – Fixed costs = Zero operating income

$$\$7Q + \$5(5Q) + \$4(4Q) - \$1,020,000 = 0$$
$$\$48Q = \$1,020,000$$
$$Q = 21,250 \text{ (\$1,020,000 ÷ \$48) units of A}$$
$$5Q = 106,250 \text{ units of B}$$
$$4Q = 85,000 \text{ units of C}$$
$$\text{Total} = 212,500 \text{ units}$$

2. Contribution margin:

A:	40,000 × $7	$ 280,000
B:	200,000 × $5	1,000,000

EA

C:	160,000 × $4	640,000
Contribution margin		$1,920,000
Fixed costs		1,020,000
Operating income		$ 900,000

3. Contribution margin

A:	40,000 × $7	$ 280,000
B:	160,000 × $5	800,000
C:	200,000 × $4	800,000
Contribution margin		$1,880,000
Fixed costs		1,020,000
Operating income		$ 860,000

Sales of A, B, and C are in ratio 40,000 : 160,000 : 200,000. So for every 1 unit of A, 4 (160,000 ÷ 40,000) units of B and 5 (200,000 ÷ 40,000) units of C are sold.

Contribution margin of the bundle = 1 × $7 + 4 × $5 + 5 × $4 = $7 + $20 + $20 = $47

$$\text{Breakeven point in bundles} = \frac{\$1,020,000}{\$47} = 21{,}703 \text{ bundles (rounded up)}$$

Breakeven point in units is:

Product A:	21,703 bundles × 1 unit per bundle	21,703 units
Product B:	21,703 bundles × 4 units per bundle	86,812 units
Product C:	21,703 bundles × 5 units per bundle	108,515 units
Total number of units to breakeven		217,030 units

Alternatively,

Let Q	=	Number of units of A to break even
4Q	=	Number of units of B to break even
5Q	=	Number of units of C to break even

Contribution margin – Fixed costs = Breakeven point

$7Q + $5(4Q) + $4(5Q) – $1,020,000 = 0

$47Q = $1,020,000

Q = 21,703 ($1,020,000 ÷ $47) units of A (rounded up)

4Q = 86,812 units of B

5Q = 108,515 units of C

Total = 217,030 units

Breakeven point increases because the new mix contains less of the higher contribution margin per unit, product B, and more of the lower contribution margin per unit, product C.

3-50 Multiproduct CVP and decision making. Romi Filters produces two types of water filters. One attaches to the faucet and cleans all water that passes through the faucet; the other is a pitcher-cum-filter that only purifies water meant for drinking.

The unit that attaches to the faucet is sold for $150 and has variable costs of $90.

EA

The pitcher-cum-filter sells for $160 and has variable costs of $80.

Romi Filters sells two faucet models for every three pitchers sold. Fixed costs equal $1,260,000.

Required:

1. What is the breakeven point in unit sales and dollars for each type of filter at the current sales mix?

2. Romi Filters is considering buying new production equipment. The new equipment will increase fixed cost by $240,000 per year and will decrease the variable cost of the faucet and the pitcher units by $5 and $10, respectively. Assuming the same sales mix, how many of each type of filter does Romi Filters need to sell to break even?

3. Assuming the same sales mix, at what total sales level would Romi Filters be indifferent between using the old equipment and buying the new production equipment? If total sales are expected to be 28,000 units, should Romi Filters buy the new production equipment?

SOLUTION

(40 min.) **Multi-product CVP and decision making.**

1. Faucet filter:

Selling price	$150
Variable cost per unit	90
Contribution margin per unit	$60

Pitcher-cum-filter:

Selling price	$160
Variable cost per unit	80
Contribution margin per unit	$ 80

Each bundle contains two faucet models and three pitcher models.
So contribution margin of a bundle = $2 \times \$60 + 3 \times \$80 = \$360$

$$\text{Breakeven point in bundles} = \frac{\text{Fixed costs}}{\text{Contribution margin per bundle}} = \frac{\$1,260,000}{\$360} = 3,500 \text{ bundles}$$

Breakeven point in units of faucet models and pitcher models is:

Faucet models: 3,500 bundles × 2 units per bundle	= 7,000 units
Pitcher models: 3,500 bundles × 3 units per bundle	=10,500 units
Total number of units to breakeven	17,500 units

Breakeven point in dollars for faucet models and pitcher models is:

Faucet models: 7,000 units × $150 per unit =	$1,050,000
Pitcher models: 10,500 units × $160 per unit =	1,680,000
Breakeven revenues =	$2,730,000

EA

Alternatively, weighted average contribution margin per unit = $\frac{(2\times\$60) + (3\times\$80)}{5} = \$72$

Breakeven point = $\frac{\$1{,}260{,}000}{\$72} = 17{,}500$ units

Faucet filter: $\frac{2}{5} \times$ 17,500 units = 7,000 units

Pitcher-cum-filter: $\frac{3}{5}\times 17{,}500$ units $= 10{,}500$ units

Breakeven point in dollars
Faucet filter: 7,000 units $\times$ \$150 per unit = \$1,050,000
Pitcher-cum-filter: 10,500 units $\times$ \$160 per unit = \$1,680,000

2. Faucet filter:

Selling price	\$150
Variable cost per unit	85
Contribution margin per unit	\$ 65

Pitcher-cum-filter:

Selling price	\$160
Variable cost per unit	70
Contribution margin per unit	\$ 90

Each bundle contains two faucet models and three pitcher models.
So contribution margin of a bundle = $2\times\$65 + 3\times\$90 = \$400$

$$\text{Breakeven point in bundles} = \frac{\text{Fixed costs}}{\text{Contribution margin per bundle}} = \frac{\$1{,}260{,}000 + \$240{,}000}{\$400} = 3{,}750 \text{ bundles}$$

Breakeven point in units of faucet models and pitcher models is:

Faucet models: 3,750 bundles $\times$ 2 units per bundle =	7,500 units
Pitcher models: 3,750 bundles $\times$ 3 units per bundle =	11,250 units
Total number of units to breakeven:	18,750 units

Breakeven point in dollars for faucet models and pitcher models is:

Faucet models: 7,500 bundles $\times$ \$150 per unit =	\$ 1125,000
Pitcher models: 11,250 bundles $\times$ \$160 per unit =	1,800,000
Breakeven revenues:	\$2,925,000

Alternatively, weighted average contribution margin per unit = $\frac{(2\times\$65) + (3\times\$90)}{5} = \$80$

Breakeven point = $\frac{\$1{,}260{,}000 + \$240{,}000}{\$80} = 18{,}750$ units

Faucet filter: $\frac{2}{5} \times 18{,}750$ units = 7,500 units

Pitcher-cum-filter: $\frac{3}{5}\times 18{,}750$ units $= 11{,}250$ units

Breakeven point in dollars:

Faucet filter: 7,500 units × $150 per unit = $1,125,000
Pitcher-cum-filter: 11,250 units × $160 per unit = $1,800,000

3. Let x be the number of bundles for Romi Filters to be indifferent between the old and new production equipment.

Operating income using old equipment = $360 x – $1,260,000
Operating income using new equipment = $400 x – $1,260,000 – $240,000
At point of indifference:
$360 x – $1,260,000= $400 x – $1,500,000
$400 x – $360 x = $1,500,000 – $1,260,000
$40 x = $240,000
x = $240,000 ÷ $40 = 6,000 bundles

Faucet models = 6,000 bundles × 2 units per bundle = 12,000 units
Pitcher models = 6,000 bundles × 3 units per bundle = 18,000 units
Total number of units: 30,000 units

Let x be the number of bundles; When total sales are less than 30,000 units (6,000 bundles)
$360x - $1,260,000 > $400x - $1,500,000.

Romi Filters is better off with the old equipment.
When total sales are greater than 30,000 units (6,000 bundles)
$400x - $1,500,000 > $360x - $1,260,000.
Romi Filters is better off buying the new equipment.
At total sales of 28,000 units (5,600 bundles), Romi Filters should keep the old production equipment.
Check
$360 × 5,600 – $1,260,000 = $756,000 is greater than $400 × 5,600 –$1,500,000 = $740,000.

3-51 Sales mix, two products. The Stackpole Company retails two products: a standard and a deluxe version of a luggage carrier. The budgeted income statement for next period is as follows:

	Standard Carrier	Deluxe Carrier	Total
Units sold	187,500	62,500	250,000
Revenues at $28 and $50 per unit	$5,250,000	$3,125,000	$8,375,000
Variable costs at $18 and $30 per unit	3,375,000	1,875,000	5,250,000
Contribution margins at $10 and $20 per unit	$1,875,000	$1,250,000	3,125,000
Fixed costs			2,250,000
Operating income			$ 875,000

Required:

1. Compute the breakeven point in units, assuming that the company achieves its planned sales mix.
2. Compute the breakeven point in units (a) if only standard carriers are sold and (b) if only

deluxe carriers are sold.

3. Suppose 250,000 units are sold but only 50,000 of them are deluxe. Compute the operating income. Compute the breakeven point in units. Compare your answer with the answer to requirement 1. What is the major lesson of this problem?

SOLUTION

(20–25 min.) **Sales mix, two products.**

1. Sales of standard and deluxe carriers are in the ratio of 187,500 : 62,500. So for every 1 unit of deluxe, 3 (187,500 ÷ 62,500) units of standard are sold.

Contribution margin of the bundle = 3 × \$10 + 1 × \$20 = \$30 + \$20 = \$50

Breakeven point in bundles = $\frac{\$2,250,000}{\$50}$ = 45,000 bundles

Breakeven point in units is:

Standard carrier:	45,000 bundles × 3 units per bundle	135,000 units
Deluxe carrier:	45,000 bundles × 1 unit per bundle	45,000 units
Total number of units to breakeven		180,000 units

Alternatively,

Let Q = Number of units of Deluxe carrier to break even

3Q = Number of units of Standard carrier to break even

Revenues – Variable costs – Fixed costs = Zero operating income

$$\begin{aligned} \$28(3Q) + \$50Q - \$18(3Q) - \$30Q - \$2,250,000 &= 0 \\ \$84Q + \$50Q - \$54Q - \$30Q &= \$2,250,000 \\ \$50Q &= \$2,250,000 \\ Q &= 45,000 \text{ units of Deluxe} \\ 3Q &= 135,000 \text{ units of Standard} \end{aligned}$$

The breakeven point is 135,000 Standard units plus 45,000 Deluxe units, a total of 180,000 units.

2a. Unit contribution margins are: Standard: \$28 – \$18 = \$10; Deluxe: \$50 – \$30 = \$20
If only Standard carriers were sold, the breakeven point would be:
\$2,250,000 ÷ \$10 = 225,000 units.

2b. If only Deluxe carriers were sold, the breakeven point would be:
\$2,250,000 ÷ \$20 = 112,500 units

3. Operating income = Contribution margin of Standard + Contribution margin of Deluxe - Fixed costs
= 200,000(\$10) + 50,000(\$20) – \$2,250,000
= \$2,000,000 + \$1,000,000 – \$2,250,000
= \$750,000

EA

Sales of standard and deluxe carriers are in the ratio of 200,000 : 50,000. So for every 1 unit of deluxe, 4 (200,000 ÷ 50,000) units of standard are sold.

Contribution margin of the bundle = $4 \times \$10 + 1 \times \$20 = \$40 + \$20 = \$60$

Breakeven point in bundles = $\dfrac{\$2,250,000}{\$60}$ = 37,500 bundles

Breakeven point in units is:

Standard carrier:	37,500 bundles × 4 units per bundle	150,000 units
Deluxe carrier:	37,500 bundles × 1 unit per bundle	37,500 units
Total number of units to breakeven		187,500 units

Alternatively,

Let Q = Number of units of Deluxe product to break even

4Q = Number of units of Standard product to break even

$$\begin{aligned} \$28(4Q) + \$50Q - \$18(4Q) - \$30Q - \$2,250,000 &= 0 \\ \$112Q + \$50Q - \$72Q - \$30Q &= \$2,250,000 \\ \$60Q &= \$2,250,000 \\ Q &= 37,500 \text{ units of Deluxe} \\ 4Q &= 150,000 \text{ units of Standard} \end{aligned}$$

The breakeven point is 150,000 Standard +37,500 Deluxe, a total of 187,500 units.

The major lesson of this problem is that changes in the sales mix change breakeven points and operating incomes. In this example, the budgeted and actual total sales in number of units were identical, but the proportion of the product having the higher contribution margin declined. Operating income suffered, falling from $875,000 to $750,000. Moreover, the breakeven point rose from 180,000 to 187,500 units.

3-52 Gross margin and contribution margin. The Garden Club is preparing for its annual meeting in which a magic show will be shown to its contributing members only. Last year, out of 1,500 members, only 600 contributed for the magic show. Tickets for the show were $30 per attendee. The profit report for last year's show follows.

Ticket sales	$18,000
Cost of magic show	20,000
Gross margin	(2,000)
Printing, invitations and paperwork	1,800
Profit / (loss)	$(3,800)

This year, the club committee does not want to lose money on the magic show due to poor attendance and to achieve this goal, the committee analyzed last year's costs. It found that of the $20,000 cost of the magic show, 40% was fixed costs and the remaining 60% was variable costs. Of the $1,800 cost of printing, invitations and paperwork, 50% was fixed and 50% variable.

Required:

1. Prepare last year's profit report using the contribution margin format.

EA

2. The club committee is considering expanding this year's magic show invitation list to include volunteer members (in addition to its contributing members). If the club committee expands the magic show invitation list, it expects an 80% increase in attendance. Calculate the effect this will have on the profitability of the show assuming that fixed costs will be the same as last year.

SOLUTION

(20 min.) **Gross margin and contribution margin**.

1.	Ticket sales ($30×600 attendees)		$18,000	
	Variable cost of magic show ($20[a]×600 attendees)	$12,000		
	Variable printing, invitations and paperwork ($1.5[b]×600)	90,012,900		
	Contribution margin	5,100		
	Fixed cost of magic show	8,000		
	Fixed cost of printing, invitations and paperwork	900	8,900	
	Operating profit (loss)		$ (3,800)	

[a]($20,000 ×60%)/600 attendees = $20/attendee
[b]($1,800 ×50%)/600 attendees = $1.50/attendee

2.	Ticket sales ($30×600 attendees× 180%)			$32,400
	Variable cost of magic show ($20× 1,080 attendees)	$21,600		
	Variable printing, invitations and paperwork ($1.50×1,080)		1,620	23,220
	Contribution margin			9,180
	Fixed cost of magic show	8,000		
	Fixed cost of printing, invitations and paperwork	900	8,900	
	Operating profit (loss)			$ 280

3-53 Ethics, CVP analysis. Megaphone Corporation produces a molded plastic casing, M&M101, for many cell phones currently on the market. Summary data from its 2017 income statement are as follows:

Revenues	$5,000,000
Variable costs	3,250,000
Fixed costs	1,890,000
Operating income	$ (140,000)

Joshua Kirby, Megaphone's president, is very concerned about Megaphone Corporation's poor profitability. He asks Leroy Gibbs, production manager, and Tony DiNunzo, controller, to see if there are ways to reduce costs.

After 2 weeks, Leroy returns with a proposal to reduce variable costs to 55% of revenues by reducing the costs Megaphone currently incurs for safe disposal of wasted plastic. Tony is concerned that this would expose the company to potential environmental liabilities. He tells Leroy, "We would need to estimate some of these potential environmental costs and include them in our analysis." "You can't do that," Leroy replies. "We are not violating any laws. There is some possibility that we may have to incur environmental costs in the future, but if we bring it up now, this proposal will not go through because our senior management always assumes these

costs to be larger than they turn out to be. The market is very tough, and we are in danger of shutting down the company and costing all of us our jobs. The only reason our competitors are making money is because they are doing exactly what I am proposing."

Required:

1. Calculate Megaphone Corporation's breakeven revenues for 2017.
2. Calculate Megaphone Corporation's breakeven revenues if variable costs are 55% of revenues.
3. Calculate Megaphone Corporation's operating income for 2017 if variable costs had been 55% of revenues.
4. Given Leroy Gibbs's comments, what should Tony DiNunzo do?

SOLUTION

(30 min.) **Ethics, CVP analysis.**

1. Contribution margin percentage $= \dfrac{\text{Revenues} - \text{Variable costs}}{\text{Revenues}}$

$= \dfrac{\$5,000,000 - \$3,250,000}{\$5,000,000}$

$= \dfrac{\$1,750,000}{\$5,000,000} = 35\%$

Breakeven revenues $= \dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

$= \dfrac{\$1,890,000}{0.35} = \$5,400,000$

2. If variable costs are 55% of revenues, contribution margin percentage equals 45% (100% – 55%)

Breakeven revenues $= \dfrac{\text{Fixed costs}}{\text{Contribution margin percentage}}$

$= \dfrac{\$1,890,000}{0.45} = \$4,200,000$

3.

Revenues	$5,000,000
Variable costs (0.55 × $5,000,000)	2,750,000
Fixed costs	1,890,000
Operating income	$ 360,000

4. Incorrect reporting of environmental costs with the goal of continuing operations is unethical. In assessing the situation, the specific "Standards of Ethical Conduct for Management Accountants" (described in Exhibit 1-7) that the management accountant should consider are listed below.

EA

Competence

Clear reports using relevant and reliable information should be prepared. Preparing reports on the basis of incorrect environmental costs to make the company's performance look better than it is violates competence standards. It is unethical for DiNunzo not to report environmental costs to make the plant's performance look good.

Integrity

The management accountant has a responsibility to avoid actual or apparent conflicts of interest and advise all appropriate parties of any potential conflict. DiNunzo may be tempted to report lower environmental costs to please Kirby and Gibbs and save the jobs of his colleagues. This action, however, violates the responsibility for integrity. The Standards of Ethical Conduct require the management accountant to communicate favorable as well as unfavorable information.

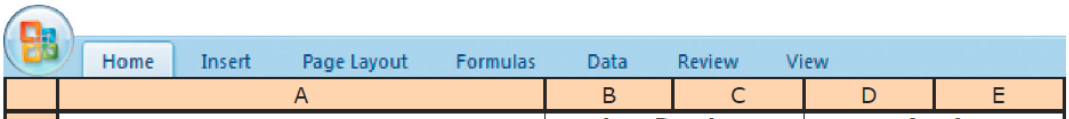
Credibility

The management accountant's Standards of Ethical Conduct require that information should be fairly and objectively communicated and that all relevant information should be disclosed. From a management accountant's standpoint, underreporting environmental costs to make performance look good would violate the standard of objectivity.

DiNunzo should indicate to Gibbs that estimates of environmental costs and liabilities should be included in the analysis. If Gibbs still insists on modifying the numbers and reporting lower environmental costs, DiNunzo should raise the matter with Kirby or one of Gibbs's superiors. If after taking all these steps, there is continued pressure to understate environmental costs, DiNunzo should consider resigning from the company and not engage in unethical behavior.

ERRATA NOTE: There were revisions made to the question and the solution. Please refer to the figures in the question set here in the ISM. The print version will be corrected at reprinting.

3-54 Deciding where to produce. (CMA, adapted) Central térmica, Inc., produces the same power generator in two Spanish plants, a new plant in Los Barrios and an older plant in Ascó. The following data are available for the two plants.



	A	B	C	D	E
1		Los Barrios		Ascó	
2	Selling price		$200.00		$200.00
3	Variable manufacturing cost per unit	$80.00		$85.00	
4	Fixed manufacturing cost per unit	35.00		27.00	
5	Variable marketing cost per unit	20.00		25.00	
6	Fixed marketing cost per unit	30.00		24.00	
7	Total cost per unit		165.00		161.00
8	Operating income per unit		$ 35.00		$ 39.00
9	Production rate per day	500	units	400	units
10	Normal annual capacity usage	240	days	240	days
11	Maximum annual capacity	300	days	300	days

EA

All fixed costs per unit are calculated based on a normal capacity usage consisting of 240 working days. When the number of working days exceeds 240, overtime charges raise the variable manufacturing costs of additional units by $5.00 per unit in Los Barrios and $10.00 per unit in Ascó.

Central térmica, Inc., is expected to produce and sell 240,000 power generators during the coming year. Wanting to take advantage of the higher operating income per unit at Ascó, the company's production manager has decided to manufacture 120,000 units at each plant, resulting in a plan in which Ascó operates at maximum capacity (400 units per day × 300 days) and Los Barrios operates at its normal volume (500 units per day × 240 days).

Required:

1. Calculate the breakeven point in units for the Los Barrios plant and for the Ascó plant.
2. Calculate the operating income that would result from the production manager's plan to produce 120,000 units at each plant.
3. Determine how the production of 240,000 units should be allocated between the Los Barrios and Ascó plants to maximize operating income for Central térmica, Inc. Show your calculations.

SOLUTION

(35 min.) **Deciding where to produce.**

	Los Barrios		Ascó	
Selling price		$200.00		$200.00
Variable cost per unit	$80.00		$85.00	
Manufacturing	0.00		0.00	
Marketing and distribution	20.00	100.00	25.00	110.00
Contribution margin per unit (CMU)		$100.00		$90.00
Fixed costs per unit				
Manufacturing	35.00		27.00	
Marketing and distribution	30.00	65.00	24.00	51.00
Operating income per unit		$35.00		$39.00

CMU of normal production (as shown above)	$100.00	$90.00
CMU of overtime production ($100 - $5; $90 - $10)	95.00	80.00

1.	**Los Barrios**		**Ascó**	
Annual fixed costs = Fixed cost per unit × Daily production rate × Normal annual capacity ($65 × 500 units × 240 days; $51 × 400 units × 240 days)	$7,800,000		$4,896,000	
Breakeven volume = FC ÷ CMU of normal production ($7,800,000 ÷ $100;	78,000	units	54,400	units

EA

$4,896,000 ÷ 90)				
2.				
Units produced and sold	120,000		120,000	
Normal annual volume (units) (500 × 240; 400 × 240)	120,000		96,000	
Units over normal volume (needing overtime)	0		24,000	
CM from normal production units (normal annual volume × CMU normal production) (120,000 × $100; 96,000 × $90)	$12,000,000		$8,640,000	
CM from overtime production units (0; 24,000 × $80)	0		1,920,000	
Total contribution margin	$12,000,000		10,560,000	
Total fixed costs	7,800,000		4,896,000	
Operating income	$4,200,000		$5,664,000	
Total operating income		$9,864,000		

3. The optimal production plan is to produce 150,000 units at the Los Barrios plant and 90,000 units at the Ascó plant. The full capacity of the Los Barrios plant, 150,000 units (500 units × 300 days), should be used because the contribution from these units is higher at all levels of production than is the contribution from units produced at the Ascó plant.

Operating income at optimum production level:

Los Barrios: 120,000 × $100	$ 12,000,000
Los Barrios: 30,000 × ($100 – $5)	2,850,000
Ascó: 90,000 × $90	8,100,000
Total contribution margin	22,950,000
Deduct total fixed costs	12,696,000
Operating income	$ 10,254,000

The contribution margin is higher when 150,000 units are produced at the Los Barrios plant and 90,000 units at the Ascó plant. As a result, operating income will also be higher in this case because total fixed costs for the division remain unchanged regardless of the quantity produced at each plant.

Try It 3-1 Solution

Equation Method:

$$\left[\begin{pmatrix}\text{Selling}\\ \text{price}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}-\begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}\right]-\begin{matrix}\text{Fixed}\\ \text{costs}\end{matrix}=\begin{matrix}\text{Operating}\\ \text{income}\end{matrix}$$

Operating income =

($500 × 2,000) – ($400 × 2,000) – $150,000 = $1,000,000 – $800,000 – $150,000 = $50,000

Contribution Method:

EA

Rearranging the equation above,

$$\left[\left(\begin{array}{c}\text{Selling}\\ \text{price}\end{array}-\begin{array}{c}\text{Variable cost}\\ \text{per unit}\end{array}\right)\times\left(\begin{array}{c}\text{Quantity of}\\ \text{units sold}\end{array}\right)\right]-\begin{array}{c}\text{Fixed}\\ \text{costs}\end{array}=\begin{array}{c}\text{Operating}\\ \text{income}\end{array}$$

$$\left(\begin{array}{c}\text{Contribution margin}\\ \text{per unit}\end{array}\times\begin{array}{c}\text{Quantity of}\\ \text{units sold}\end{array}\right)-\begin{array}{c}\text{Fixed}\\ \text{costs}\end{array}=\begin{array}{c}\text{Operating}\\ \text{income}\end{array}$$

Contribution margin per unit = Selling price – Variable cost per unit = \$500 – \$400 = \$100

Operating income = \$100 × 2,000 – \$150,000 = \$50,000

Try It 3-2 Solution

(a) Recall the equation method (equation 1):

$$\left[\begin{pmatrix}\text{Selling}\\ \text{price}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}-\begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}\right]-\begin{matrix}\text{Fixed}\\ \text{costs}\end{matrix}=\begin{matrix}\text{Operating}\\ \text{income}\end{matrix}$$

Setting operating income equal to \$0 and denoting quantity of output units that must be sold by *Q*, the breakeven number of units is

$$\begin{aligned}(\$500\times Q)-(\$400\times Q)-\$150,000&=\$0\\ \$100\times Q&=\$150,000\\ Q&=\$150,000\div\$100\text{ per unit}=1,500\text{ units}\end{aligned}$$

Recall the contribution margin method (equation 2):

$$\begin{pmatrix}\text{Contribution}\\ \text{margin per unit}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}-\text{Fixed costs}=\text{Operating income}$$

At the breakeven point, operating income is by definition \$0, and so,

$$\text{Contribution margin per unit}\times\text{Breakeven quantity of units}=\text{Fixed costs}\quad\text{(Equation 3)}$$

Rearranging equation 3 and entering the data,

$$\begin{matrix}\text{Breakeven}\\ \text{number of units}\end{matrix}=\frac{\text{Fixed costs}}{\text{Contribution margin per unit}}=\frac{\$150,000}{\$100\text{ per unit}}=1,500\text{ units}$$

$$\begin{aligned}\text{Breakeven revenues}&=\text{Breakeven number of units}\times\text{Selling price}\\ &=1,500\text{ units}\times\$500\text{ per unit}=\$750,000\end{aligned}$$

(b)

$$\left[\begin{pmatrix}\text{Selling}\\ \text{price}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}-\begin{pmatrix}\text{Variable cost}\\ \text{per unit}\end{pmatrix}\times\begin{pmatrix}\text{Quantity of}\\ \text{units sold}\end{pmatrix}\right]-\begin{matrix}\text{Fixed}\\ \text{costs}\end{matrix}=\begin{matrix}\text{Operating}\\ \text{income}\end{matrix}\qquad\text{(Equation 1)}$$

We denote by *Q* the unknown quantity of units Bernard Windows must sell to earn an operating income of \$100,000. Selling price is \$500, variable cost per package is \$400, fixed costs are \$150,000, and target operating income is \$100,000. Substituting these values into equation 1, we have

$$\begin{aligned}(\$500\times Q)-(\$400\times Q)-\$150,000&=\$100,000\\ \$100\times Q&=\$150,000+\$100,000=\$250,000\\ Q&=\$250,000\div\$100\text{ per unit}=2,500\text{ units}\end{aligned}$$

Alternatively, we could use equation 2,

EA

$$\left(\begin{matrix}\text{Contribution margin}\\ \text{per unit}\end{matrix}\times\begin{matrix}\text{Quantity of}\\ \text{units sold}\end{matrix}\right)-\begin{matrix}\text{Fixed}\\ \text{costs}\end{matrix}=\begin{matrix}\text{Operating}\\ \text{income}\end{matrix}\qquad\text{(Equation 2)}$$

Given a target operating income ($100,000 in this case), we can rearrange terms to get equation 4.

$$\begin{matrix}\text{Quantity of units}\\ \text{required to be sold}\end{matrix}=\frac{\text{Fixed costs + Target operating income}}{\text{Contribution margin per unit}}\qquad\text{(Equation 4)}$$

$$\begin{matrix}\text{Quantity of units}\\ \text{required to be sold}\end{matrix}=\frac{\$150,000+\$100,000}{\$100\text{ per unit}}=2,500\text{ units}$$

Revenues to earn an operating income of $100,000 is

Revenues = Number of units required to be sold × Selling price

2,500 units × $500 = $1,250,000

Try It 3-3 Solution

$$\text{Target net income}=\left(\begin{matrix}\text{Target}\\ \text{operating income}\end{matrix}\right)-\left(\begin{matrix}\text{Target}\\ \text{operating income}\end{matrix}\times\text{Tax rate}\right)$$

$$\text{Target net income}=(\text{Target operating income})\times(1-\text{Tax rate})$$

$$\text{Target operating income}=\frac{\text{Target net income}}{1-\text{Tax rate}}=\frac{\$63,000}{1-0.30}=\$90,000$$

In other words, to earn a target net income of $63,000, Bernard Windows's target operating income is $90,000.

Proof:		
	Target operating income	$90,000
	Tax at 30% (0.30 × $90,000)	27,000
	Target net income	$63,000

The key step is to take the target net income number and convert it into the corresponding target operating income number. We can then use equation 1 to determine the target operating income and substitute numbers from our Bernard Windows example.

$$\left[\left(\begin{matrix}\text{Selling}\\ \text{price}\end{matrix}\times\begin{matrix}\text{Quantity of}\\ \text{units sold}\end{matrix}\right)-\left(\begin{matrix}\text{Variable cost}\\ \text{per unit}\end{matrix}\times\begin{matrix}\text{Quantity of}\\ \text{units sold}\end{matrix}\right)\right]-\begin{matrix}\text{Fixed}\\ \text{costs}\end{matrix}=\begin{matrix}\text{Operating}\\ \text{income}\end{matrix}\qquad\text{(Equation 1)}$$

$$(\$500\times Q)-(\$400\times Q)-\$150,000=\$90,000$$

$$\$100\times Q=\$240,000$$

$$Q=\$240,000\div\$100\text{ per unit}=2,400\text{ units}$$

Alternatively, we can calculate the number of units Bernard Windows must sell by using the contribution margin method and equation 4:

EA

$$\begin{aligned}\text{Quantity of units required to be sold} &= \frac{\text{Fixed costs} + \text{Target operating income}}{\text{Contribution margin per unit}} \\ &= \frac{\$150,000 + \$90,000}{\$100 \text{ per unit}} = 2,400 \text{ units}\end{aligned} \qquad \text{(Equation 4)}$$

Revenues to earn net income of $63,000 or equivalently operating income of $90,000 is

Revenues = Number of units required to be sold × Selling price

2,400 units × $500 = $1,200,000

Try It 3-4 Solution

$$\text{Margin of safety} = \frac{\text{Budgeted}}{\text{revenues}} - \frac{\text{Breakeven}}{\text{revenues}} = \$1,200,000 - \$750,000 = \$450,000$$

$$\frac{\text{Margin of}}{\text{safety (in units)}} = \frac{\text{Budgeted}}{\text{sales (units)}} - \frac{\text{Breakeven}}{\text{sales (units)}} = 2,400 - 1,500 = 900 \text{ units}$$

The margin of safety indicates that sales would have to decrease by 900 units and revenues by $450,000 before the breakeven point is reached.

Sometimes margin of safety is expressed as a percentage:

$$\text{Margin of safety percentage} = \frac{\text{Margin of safety in dollars}}{\text{Budgeted (or actual) revenues}}$$

In our example, margin of safety percentage $= \frac{\$450,000}{\$1,200,000} = 37.5\%$

This result means that revenues would have to decrease substantially, by 60%, to reach the breakeven revenues.

The high margin of safety gives management of Bernard Windows confidence that the company is unlikely to suffer a loss.

Try It 3-5 Solution

At any given level of sales,

$$\frac{\text{Degree of}}{\text{operating leverage}} = \frac{\text{Contribution margin}}{\text{Operating income}}$$

The following table shows the **degree of operating leverage** at sales of 2,500 units for the two options.

EA

	Option 1 No Commission	Option 2 5% Commission
1. Selling price	$ 500	$ 500
2. Variable cost ($400; $400 + 0.05 × $500)	$ 400	$ 425
3. Contribution margin per unit	$ 100	$ 75
4. Contribution margin (row 3 × 2,500 units)	$250,000	$187,500
5. Fixed costs	$150,000	$ 87,500
3. Operating income (from Exhibit 3-5)	$100,000	$100,000
4. Degree of operating leverage (row 2 ÷ row 3)	$\frac{\$250,000}{\$100,000} = 2.50$	$\frac{\$187,500}{\$100,000} = 1.875$

These results indicate that, when sales are 2,500 units, a 1% change in sales and contribution margin will result in 2.5% change in operating income for Option 1. For Option 2, a 1% change in sales and contribution margin will result in only a 1.875% change in operating income. The degree of operating leverage at a given level of sales helps managers calculate the effect of sales fluctuations on operating income.

Try It 3-6 Solution

We assume that the budgeted sales mix (2,500 units of Chad Windows sold for every 1,000 units of Musk Windows sold, that is, a ratio of 5:2) will not change at different levels of total unit sales. That is, we think of Bernard Windows selling a bundle of 5 units of Chad Windows and 2 units of Musk Windows. (Note that this does not mean that Bernard Windows physically bundles the two products together into one big package.)

Each bundle yields a contribution margin of $650, calculated as follows:

	Number of Units of Chad Windows and Musk Windows in Each Bundle	Contribution Margin per Unit for Chad Windows and Musk Windows	Contribution Margin of the Bundle
Chad Windows	5	$100	$500
Musk Windows	2	75	150
Total			$650

To compute the breakeven point, we calculate the number of bundles Bernard needs to sell.

$$\text{Breakeven point in bundles} = \frac{\text{Fixed costs}}{\text{Contribution margin per bundle}} = \frac{\$195,000}{\$650 \text{ per bundle}} = 300 \text{ bundles}$$

The breakeven point in units of Chad Windows and Musk Windows is as follows:

EA

Chad Windows: 300 bundles × 5 units per bundle	1,500 units
Musk Windows: 300 bundles × 2 units per bundle	600 units
Total number of units to break even	2,100 units

The breakeven point in dollars for Chad Windows and Musk Windows is as follows:

Chad Windows: 1,500 units × $500 per unit	$750,000
Musk Windows: 600 units × $350 per unit	210,000
Breakeven revenues	$960,000

When there are multiple products, it is often convenient to use the contribution margin percentage. Under this approach, Bernard also calculates the revenues from selling a bundle of 5 units of Chad Windows and 2 units of Musk Windows:

	Number of Units of Chad Windows and Musk Windows in Each Bundle	Selling Price for Chad Windows and Musk Windows	Revenue of the Bundle
Chad Windows	5	$500	$2,500
Musk Windows	2	350	700
Total			$3,200

$$\text{Contribution margin percentage for the bundle} = \frac{\text{Contribution margin of the bundle}}{\text{Revenue of the bundle}} = \frac{\$650}{\$3,200} = 0.203125, \text{ or } 20.3125\%$$

$$\text{Breakeven revenues} = \frac{\text{Fixed costs}}{\text{Contribution margin \% for the bundle}} = \frac{\$195,000}{0.203125} = \$960,000$$

$$\text{Number of bundles required to be sold to break even} = \frac{\text{Breakeven revenues}}{\text{Revenue per bundle}} = \frac{\$960,000}{\$3,200 \text{ per bundle}} = 300 \text{ bundles}$$

The breakeven point in units and dollars for Chad Windows and Musk Windows are as follows:

Chad Windows: 300 bundles × 5 units per bundle = 1,500 units × $500 = $750,000

Musk Windows: 300 bundles × 2 units per bundle = 600 units × $350 = $210,000