

Chapter 18

Cost Behavior and Cost-Volume-Profit Analysis

QUESTIONS

1. A variable cost is one that varies proportionately with the volume of activity. For example, direct materials and direct labor (when the workers are paid for completed units) are treated as variable costs with respect to the number of units produced.
2. Variable costs *per unit* stay the same (remain constant) when output volume changes. This is because each unit consumes the same amount of variable costs within the relevant range of activity.
3. Fixed costs *per unit* decrease when output volume increases. This is because the total amount of fixed costs remains the same while it is being divided among more units within the relevant range of activity.
4. Cost-volume-profit analysis is especially useful in the planning phase for a business. This phase involves predicting the volume of sales activity, the costs to be incurred, revenues to be received, and profits to be earned. It is also useful in what-if (sensitivity) analysis.
5. A step-wise cost remains constant over a limited range of output activity, outside of which it changes by a lump-sum amount, then remains constant over another limited range of output activity, and so on. A curvilinear cost gradually changes in a nonlinear manner in response to changes in sales volume.
6. Contribution margin ratio means that for each sales dollar a specified percent is available to cover fixed costs and contribute to profits. To illustrate, if a company has a 75% contribution margin ratio, then 75% (or 75¢) of each sales dollar is available to cover fixed costs and contribute to profits.
7. **Definition:** Contribution margin ratio = Contribution margin / Sales price per unit. The contribution margin ratio tells what percent of each sales dollar is available to cover fixed costs, with the remainder being profit.
8. **Definition:** Unit contribution margin = Sales price per unit - Variable costs per unit. Unit contribution margin is the per unit dollars available to cover fixed costs, with the remainder being profit.
9. A CVP analysis for a manufacturing company is simplified by assuming that the production and sales volumes are equal. This is the same as assuming no changes in beginning and ending inventory levels for the period.

10. The first is that although individual costs classified as fixed or variable might not behave precisely in those patterns, some variations of individual components in the group of fixed or variable costs may tend to offset each other. The second is that management might reasonably assume that costs are either fixed or variable within the relevant range of operations (or at least the period under analysis).
11. By assuming a relevant range for operating activity, management can more justifiably assume either fixed or variable relations between costs and volume, and between revenue and volume. The assumption also helps limit the consideration of alternative strategies to those that call for volume levels that fall within the relevant range.
12. Three common methods for measuring cost behavior are: the scatter diagram, the high-low method, and least-squares regression.
13. A scatter diagram is used to display the relation between past costs and sales volumes. Management then uses the scatter diagram to identify and measure the fixed and variable components of the cost being graphed.
14. At break-even, profits are zero. Break-even is the point where sales equals fixed plus variable costs.
15. This line represents total cost, which equals the sum of the fixed and variable costs at all volume levels within the company's current capacity (relevant range). (Note: The total cost line consists of mixed costs.)
16. Fixed costs are depicted as a horizontal line on a CVP chart because they remain the same (constant) at all volume levels within the relevant range.
17. Company A has a contribution margin of 50% $[(\$20,000 - \$10,000) / (\$20,000)]$ and Company B has a contribution margin of 80% $[(\$20,000 - \$4,000) / (\$20,000)]$. This means Company B will make more profit on each additional dollar of sales compared to Company A. This is also seen by looking at operating leverage (fixed costs/total costs). Company B's operating leverage is higher.
18. Margin of safety reflects the expected sales in excess of the level of break-even sales.
19. Arctic Cat's primary variable costs in making snowmobiles are: costs of the component parts (metals, engine parts, seat components, wiring, gauges, etc.), and direct labor. The costs of operating the plant and equipment are fixed because regardless of production levels these product costs are incurred. Identification of many other variable and fixed costs is possible.
20. Polaris offers a variety of two-, three- and four- wheel vehicles. To adequately understand its operations, Polaris should compute break-even points for all types of products sold, that is, it should use multi-product breakeven analysis.
21. A 65% increase in sales of a popular scooter model of Piaggio is likely viewed as a substantial increase. When this occurs, the sales and cost structures are likely to change. Specifically, the selling price per unit, fixed costs, and variable costs are likely to change as the new sales volume moves out of the current relevant range. Variable cost per unit may go down, but total fixed costs are likely to increase due to, for example, more space needed to manage and accommodate the increase. Other activities that may increase are order processing, post-sales service, and invoicing.

QUICK STUDIES

Quick Study 18-1 (10 minutes)

Series 1 Variable cost

Series 3 Step-wise cost

Series 2 Fixed cost

Series 4 Curvilinear cost

Quick Study 18-2 (10 minutes)

1. Variable

4. Variable

7. Fixed

2. Probably Mixed

5. Fixed

3. Probably Mixed

6. Fixed

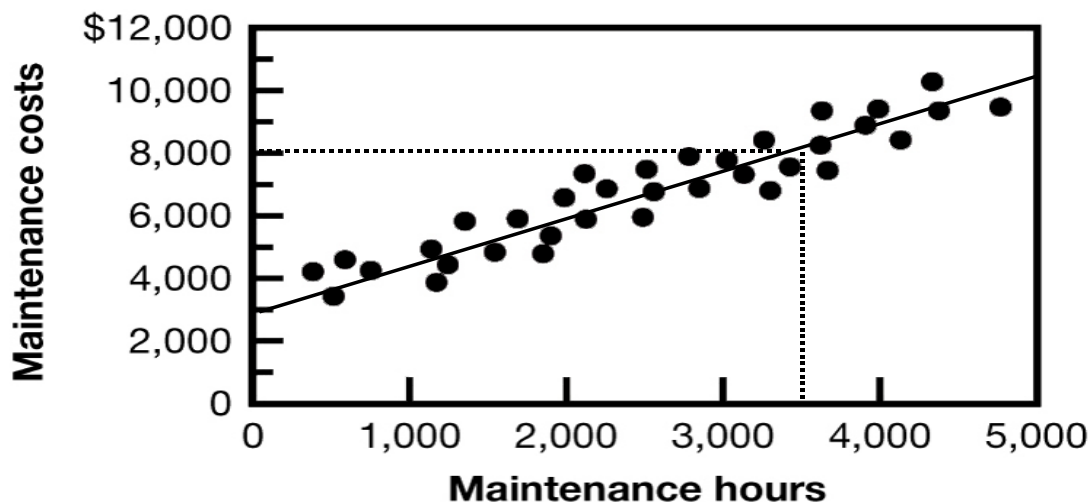
Quick Study 18-3 (10 minutes)

Variable costs = $\frac{\$8,100 - \$3,600}{24 - 6} = \underline{\$250 \text{ per maintenance hour}}$

Using the low point, $\$3,600 = (\$250/\text{maint. hr.} \times 6 \text{ maint. hrs.}) + \text{fixed cost}$
 Therefore, fixed cost = \$2,100

Quick Study 18-4 (15 minutes)

1. Estimated line of cost behavior



Quick Study 18-4 (Concluded)

2. Estimated cost components

$$\text{Fixed costs} = \underline{\$3,000}$$

$$\text{Variable costs} = \frac{\$8,000 - \$3,000}{3,500 - 0} = \underline{\$1.43 \text{ per maintenance hour}^*}$$

Instructor note: Answers to part 2 can vary slightly depending on where students draw the cost line.

*(rounded)

Quick Study 18-5 (10 minutes)

$$\text{Contribution margin} \quad \$5,000 - \$3,000 = \$2,000$$

$$\text{Contribution margin ratio} \quad (\$5,000 - \$3,000) / \$5,000 = \underline{0.40} \text{ (or } \underline{40\%})$$

Interpretation: This result indicates 40 cents of each sales dollar is available to cover fixed costs and contribute to profit.

Quick Study 18-6 (10 minutes)

$$1. \text{ Contribution margin per unit} = \$90 - \$36 = \underline{\$54}$$

$$2. \text{ Break-even point in units} = \frac{\$162,000}{\$54} = \underline{3,000 \text{ units}}$$

Quick Study 18-7 (10 minutes)

1. I 4. I

2. D 5. D

3. I 6. D

Quick Study 18-8 (10 minutes)

$$1. \text{ Contribution margin ratio} = \frac{\$54}{\$90} = \underline{60\%}$$

$$2. \text{ Break-even point in dollars} = \frac{\$162,000}{60\%} = \underline{\$270,000}$$

Quick Study 18-9 (10 minutes)

$$\text{Pretax income} = \$140,000 / (1 - 0.30) = \$200,000$$

$$\text{Income taxes} = \$200,000 \times 0.30 = \$60,000$$

$$\text{Units to be sold} = \frac{\$162,000 + \$200,000}{\$54} = \underline{6,704 \text{ units (rounded)}}$$

Quick Study 18-10 (5 minutes)

Correct (true) answer is 2.

Quick Study 18-11 (15 minutes)

Company B is likely to have a higher degree of operating leverage (DOL).

Explanation: Company B has a relatively low proportion of variable costs to total costs. This means that the contribution margin (sales - variable costs) for Company B is relatively high. Also, given that the fixed costs for Company B make up a high proportion of its costs, the income (contribution margin - fixed costs) for this company will be relatively low when sales volume is low, but high when sales volume is high. The degree of operating leverage is computed as a ratio of the contribution margin to pretax income. In the case of Company B, because the numerator (contribution margin) is a relatively high number, the DOL is also likely to be relatively high. The reverse is true for Company A.

Quick Study 18-12 (10 minutes)

$$\text{Break-even point in composite units} = \$105,000 / \$125 = 840 \text{ composite units}$$

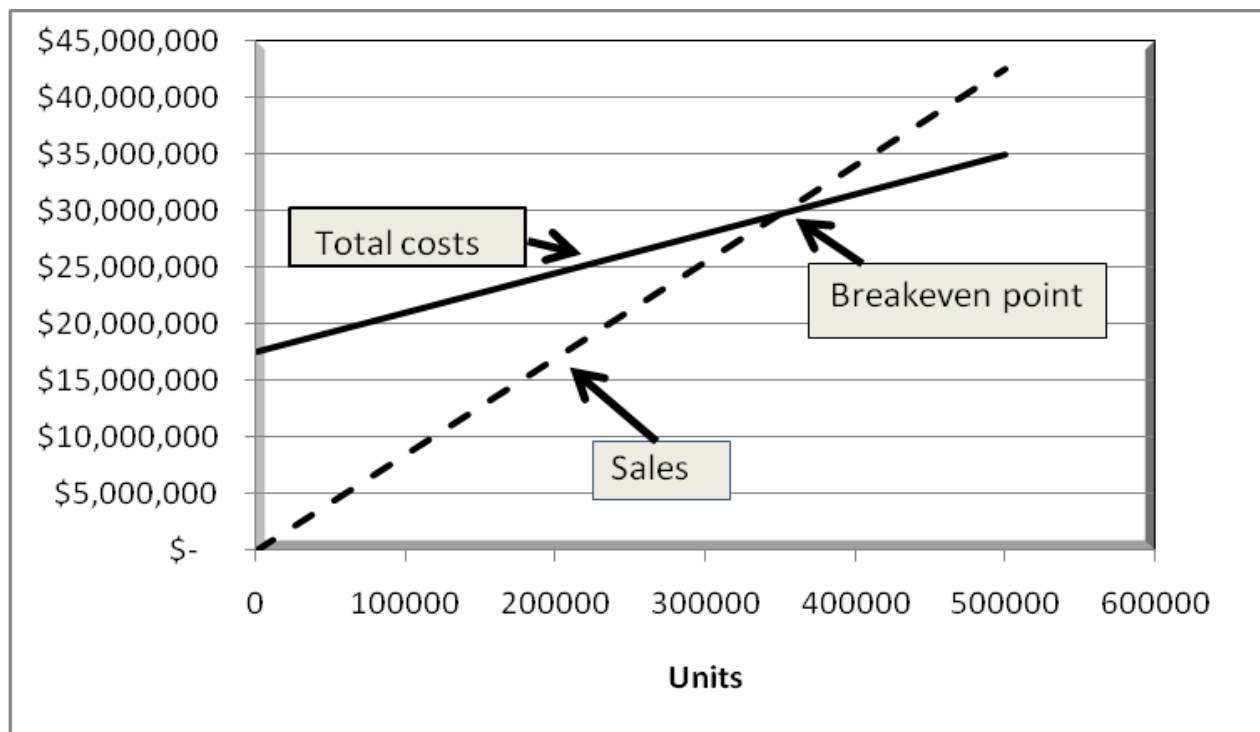
$$\text{Number of phones sold at break-even} = 8 \times 840 = 6,720 \text{ individual phones}$$

$$\text{Number of conventional phones sold at break-even: } 840 \times 5 = \underline{4,200 \text{ phones}}$$

$$\text{Number of smart phones sold at break-even: } 840 \times 3 = \underline{2,520 \text{ phones}}$$

Quick Study 18-13 (10 minutes)

CVP Chart



Notes: Expected sales are 400,000 units (\$34 million), thus selling price is \$85 per unit.
Fixed costs are \$17.5 million, and variable costs are \$35 per unit.

Break-even point in units = $\$17,500,000 / \$50 = \underline{\underline{350,000 \text{ units}}}$

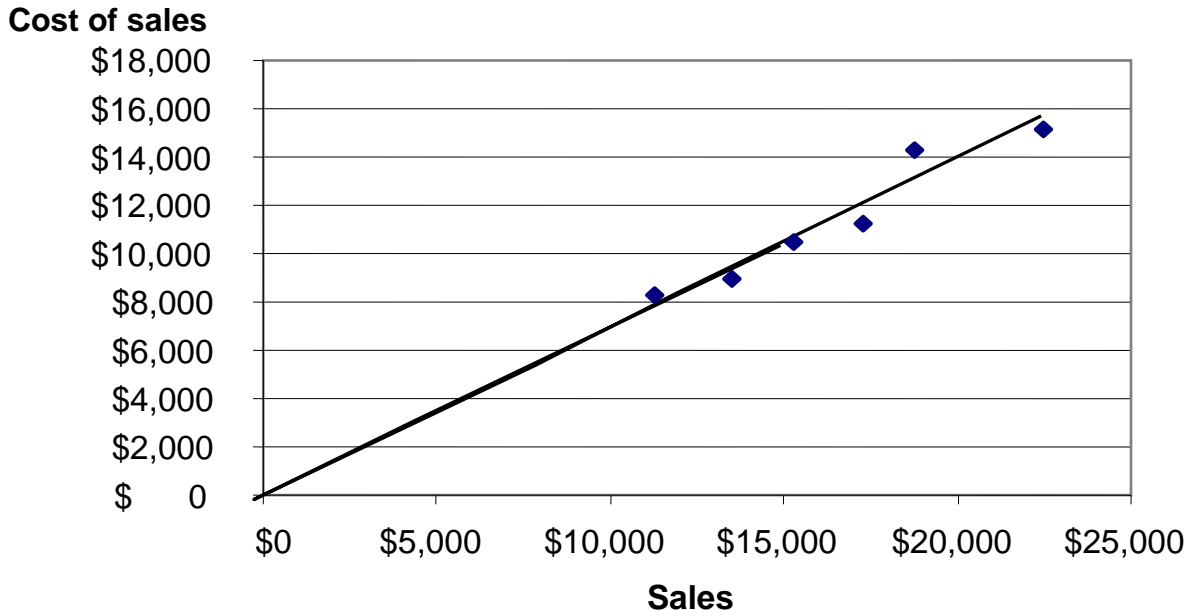
Quick Study 18-14 (10 minutes)

VOLKSWAGEN	
Contribution Margin Statement (in € millions)	
Sales	€126,875.00
Variable costs:	
Variable cost of goods sold (€105,431 x 75%)	79,073.25
Variable selling and administrative (€15,500 x 75%) ...	<u>11,625.00</u>
Contribution margin	<u>€ 36,176.75</u>

EXERCISES

Exercise 18-1 (20 minutes)

The scatter diagram and its estimated line of cost behavior appear below



The cost line appears to reflect a variable cost because it increases at a reasonably constant rate with changes in sales *and* it appears to intersect the cost axis at zero (the origin).

Exercise 18-2 (15 minutes)

1. Graph #1. Variable cost
 Graph #2. Fixed cost
 Graph #3. Mixed cost
 Graph #4. Curvilinear cost
 Graph #5. Step-wise cost

2. a. Graph #5
 b. Graph #2
 c. Graph #3
 d. Graph #1
 e. Graph #4

Exercise 18-3 (10 minutes)

1. A
2. E
3. B
4. D
5. F
6. C

Exercise 18-4 (15 minutes)

- Series A Variable cost
Series B Mixed cost
Series C Curvilinear cost
Series D Step-wise cost
Series E Fixed cost

Exercise 18-5 (20 minutes)

1. Dollar sales =
$$\frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin ratio}}$$
$$= \frac{\$160,000 + \$164,000}{25\%}$$
$$= \underline{\underline{\$1,296,000}}$$

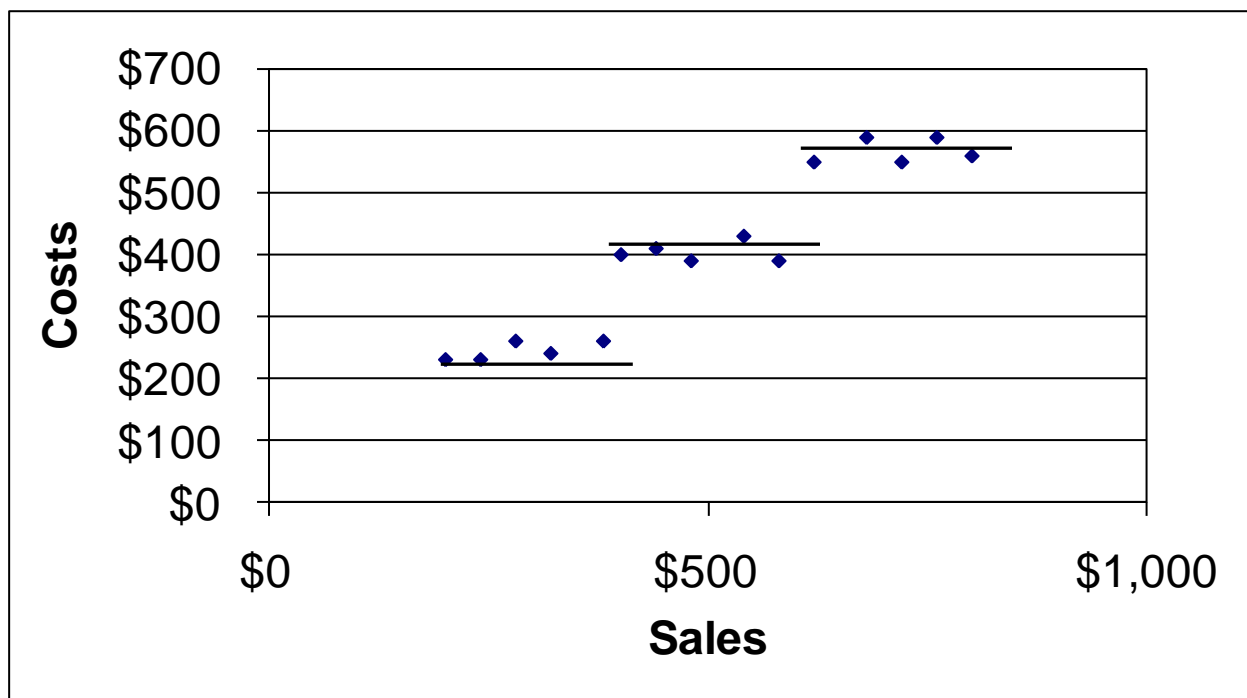
2.

Sales	\$1,296,000
Fixed costs.....	(160,000)
Pretax income	<u>(164,000)</u>
Variable costs	<u>\$ 972,000</u>

(Alternatively: \$1,296,000 in sales x [1 - 0.25 CM ratio] = \$972,000)

Exercise 18-6 (20 minutes)

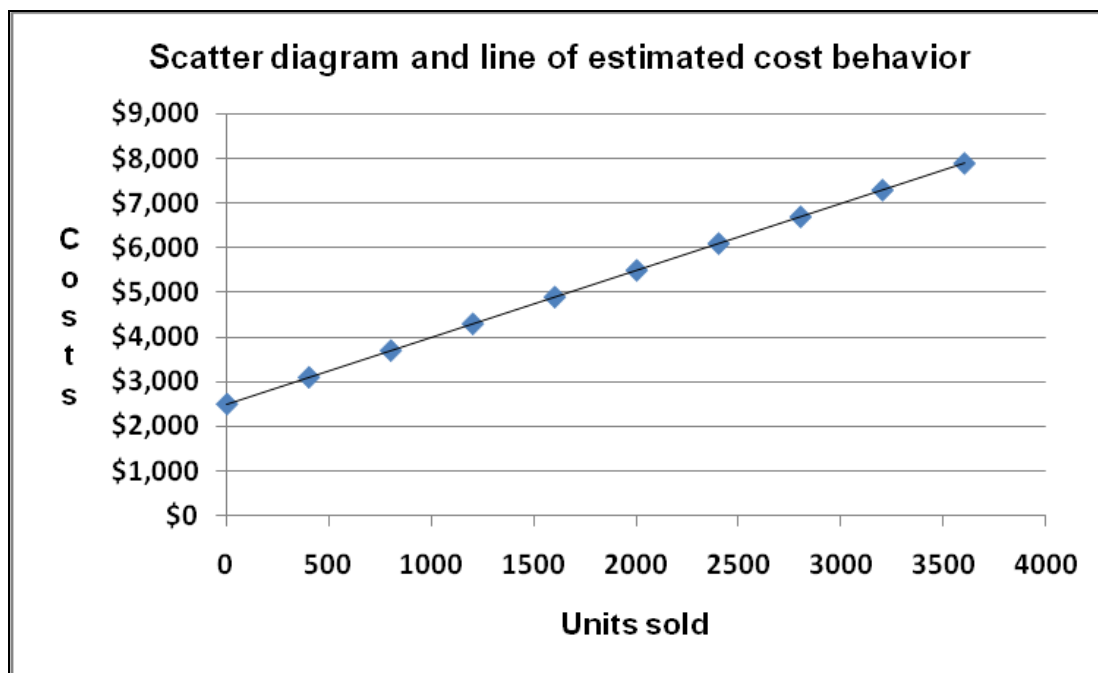
The scatter diagram and its estimated line of cost behavior appear below.



The cost pattern appears to exhibit a step-wise pattern.

Exercise 18-7 (20 minutes)

The scatter diagram and line of estimated cost behavior appear below.



Selecting 0 and 2,400 units sold as the activity levels yields \$2,500 as the estimate of fixed costs and the following estimate of variable costs per unit:

$$\frac{\text{Change in cost}}{\text{Change in units}} = \frac{\$6,100 - \$2,500}{2,400 - 0} = \frac{\$3,600}{2,400} = \$1.50 \text{ per unit}$$

Using the high-low method yields \$2,500 as the estimate of fixed costs and variable costs per unit of:

$$\frac{\text{Change in cost}}{\text{Change in units}} = \frac{\$7,900 - \$2,500}{3,600 - 0} = \frac{\$5,400}{3,600} = \$1.50 \text{ per unit}$$

Exercise 18-8^A (20 minutes)

Using Excel® to estimate an ordinary least squares regression yields an intercept of \$2,500 and a slope of \$1.50. The cost equation is thus \$2,500 plus \$1.50 per unit sold.

Exercise 18-9 (10 minutes)

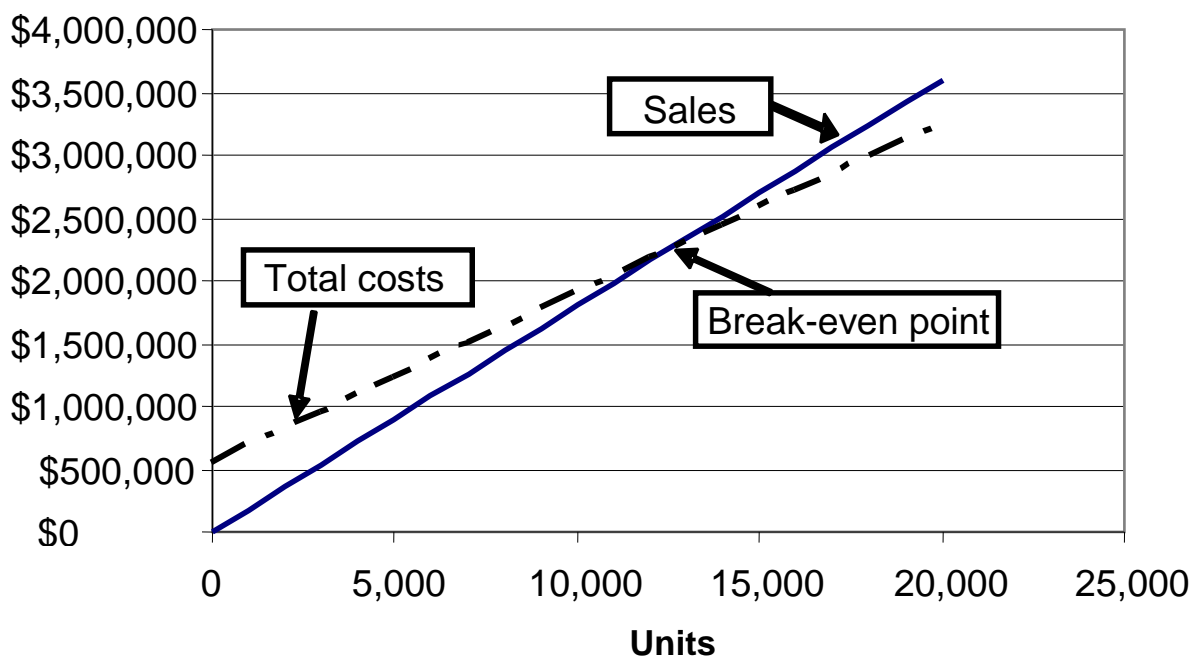
- (1) Contribution margin = Selling price – Variable costs
= \$205 - \$164 = \$41 per unit
- (2) Contribution margin ratio = $\frac{\text{Contribution margin}}{\text{Sales price}} = \frac{\$41}{\$205} = 20\%$
- (3) The contribution margin of 20% implies that for each \$1 in sales, the company has \$0.20 that contributes to fixed costs and profit.

Exercise 18-10 (30 minutes)

- (a) Contribution margin per unit = \$180 – \$135 = \$45 per unit
- (b) Contribution margin ratio = \$45 / \$180 = 25%
- (c) Break-even point in units = \$562,500 / \$45 = 12,500 units
- (d) Break-even point in dollars = \$562,500 / 25% = \$2,250,000

(Alternatively: 12,500 units x \$180 = \$2,250,000)

Exercise 18-11 (15 minutes)



Exercise 18-12 (20 minutes)

1.

BLANCHARD COMPANY	
Contribution Margin Income Statement (at Break-Even)	
Sales (12,500 x \$180)	\$2,250,000
Variable costs (12,500 x \$135)	<u>1,687,500</u>
Contribution margin (12,500 x \$45).....	562,500
Fixed costs	<u>562,500</u>
Net income.....	<u>\$ 0</u>

2. Sales (in dollars) to break even with increased fixed costs

$$\text{Break-even} = \frac{\text{Original fixed costs} + \text{Additional fixed costs}}{\text{Contribution margin ratio}}$$

$$= (\$562,500 + \$135,000) / 25\%$$

$$= \underline{\underline{\$2,790,000}}$$

Exercise 18-13 (25 minutes)

Preliminary computations

$$\begin{aligned}\text{Pretax income} &= \text{After-tax income} / (1 - \text{Tax rate}) \\ &= \$810,000 / (1 - 0.20) \\ &= \$810,000 / 0.80 \\ &= \$1,012,500\end{aligned}$$

$$\begin{aligned}\text{Income taxes} &= \text{Pretax income} \times \text{Tax rate} \\ &= \$1,012,500 \times 0.20 = \$202,500\end{aligned}$$

$$\begin{aligned}1. \text{ Unit sales at target income} &= \frac{\text{Fixed costs} + \text{Pretax income}}{\text{Contribution margin/unit}} \\ &= \frac{\$562,500 + \$1,012,500}{\$45} \\ &= \underline{\underline{35,000 \text{ units}}}\end{aligned}$$

$$\begin{aligned}2. \text{ Dollar sales at target income} &= \frac{\text{Fixed costs} + \text{Pretax income}}{\text{Contribution margin ratio}} \\ &= \frac{\$562,500 + \$1,012,500}{25\%} \\ &= \underline{\underline{\$6,300,000}}\end{aligned}$$

(Alternatively: 35,000 units x \$180 = \$6,300,000)

Exercise 18-14 (20 minutes)

BLANCHARD COMPANY	
Forecasted Contribution Margin Income Statement	
Sales (40,000 x \$200)	\$8,000,000
Variable costs (40,000 x \$140)	<u>5,600,000</u>
Contribution margin (40,000 x \$60).....	2,400,000
Fixed costs	<u>562,500</u>
Income before taxes	1,837,500
Income taxes (20% x \$1,837,500).....	<u>367,500</u>
Net income.....	<u>\$1,470,000</u>

Exercise 18-15 (20 minutes)

- 1. Pretax income = Sales – Variable costs – Fixed costs**

$$\text{\$155,000} = \text{\$?} - \$390,000 - \$430,000$$

$$\rightarrow \text{Sales} = \$155,000 + \$390,000 + \$430,000 = \underline{\underline{\text{\$975,000}}}$$

- 2. Instructor note: Use the equation in Exhibit 18.23 with no tax effects**

$$\begin{aligned}\text{Unit sales} &= \frac{\text{Fixed costs} + \text{Target pretax income}}{\text{Contribution margin per unit}} \\ &= (\$430,000 + \$155,000) / \$9 \\ &= \underline{\underline{\text{65,000 units}}}\end{aligned}$$

Exercise 18-16 (30 minutes)

(a) Total expected variable costs

= Variable costs per unit x units produced and sold

= \$60* x 200,000 units

= \$12,000,000

*The \$60 variable costs per unit is computed by determining (i) sales price per unit and (ii) subtracting contribution margin per unit:

Sales price per unit (\$17,000,000 / 200,000 units)	\$ 85
Less: Contribution margin per unit (given).....	<u>(25)</u>
Variable costs per unit	<u>\$ 60</u>

(b) To solve, set up a brief contribution margin income statement

Sales (given).....	\$17,000,000
Variable costs (from part a)	(12,000,000)
Fixed costs	<u>(?)</u>
Pretax income (given)	<u>\$ 1,250,000</u>

Thus: Fixed costs = \$ 3,750,000

Exercise 18-17 (25 minutes)

1. Selling price per composite unit

8 windows @ \$200 per unit.....	\$1,600
2 doors @ \$500 per unit.....	<u>1,000</u>
Selling price per composite unit.....	<u>\$2,600</u>

2. Variable costs per composite unit

8 windows @ \$125 per unit.....	\$1,000
2 doors @ \$350 per unit.....	<u>700</u>
Variable costs per composite unit.....	<u>\$1,700</u>

3. Break-even point in composite units

$$\begin{aligned} &= \frac{\text{Fixed costs}}{\text{Contribution margin per composite unit}} \\ &= \frac{\$900,000}{\$2,600 - \$1,700} \\ &= \underline{\underline{1,000 \text{ composite units}}} \end{aligned}$$

4. Unit sales of windows and doors at break-even point

Windows:	8 x 1,000 units (from 3).....	<u>8,000 units</u>
Doors:	2 x 1,000 units (from 3).....	<u>2,000 units</u>

Exercise 18-18 (20 minutes)

(1)	<u>Contribution margin per unit</u>	x	<u>Percentage of sales mix</u>	=	<u>Weighted unit CM</u>
Windows.....	\$75.00		80%		\$60
Doors	150.00		20		<u>30</u>
Weighted-average contribution margin					<u>\$90</u>

(2) Break-even point in units = $\frac{\$900,000}{\$90} = \underline{10,000 \text{ units}}$

(3) Unit sales of windows and doors at break-even point:

Windows: 80% x 10,000 units (from 2).....	<u>8,000 units</u>
Doors: 20% x 10,000 units (from 2).....	<u>2,000 units</u>

Exercise 18-19 (25 minutes)**1. Selling price per composite unit**

5 Easy returns @ \$50 each	\$ 250
3 Moderate returns @ \$125 each	375
2 Business returns @ \$275 each	<u>550</u>
Selling price per composite unit	<u>\$1,175</u>

2. Variable costs per composite unit

5 Easy returns @ \$30 each	\$ 150
3 Moderate returns @ \$75 each	225
2 Business returns @ \$100 each	<u>200</u>
Variable costs per composite unit	<u>\$ 575</u>

Exercise 18-19 (concluded)

3. Break-even point in composite units

$$\begin{aligned}
 &= \frac{\text{Fixed costs}}{\text{Contribution margin per composite unit}} \\
 &= \frac{\$18,000}{\$1,175 - \$575} \\
 &= \underline{\underline{30 \text{ composite units}}}
 \end{aligned}$$

4. Unit sales of Easy, Moderate, and Business returns at break-even point

Easy:	5 x 30 units (from 3).....	<u>150 units</u>
Moderate:	3 x 30 units (from 3).....	<u>90 units</u>
Business:	2 x 30 units (from 3).....	<u>60 units</u>

Exercise 18-20 (25 minutes)

(1)	<u>Contribution Margin per unit</u>	x	<u>Percentage of sales mix</u>	=	<u>Weighted Unit CM</u>
Easy	\$ 20		50%		\$10
Moderate	50		30		15
Business	175		20		<u>35</u>
Weighted-average contribution margin					<u>\$60</u>

(2) Break-even point in units = $\frac{\$18,000}{\$60} = \underline{\underline{300 \text{ units}}}$

(3) Unit sales of Easy, Moderate, and Business returns at break-even point:

Easy:	50% x 300 units (from 2)	<u>150 units</u>
Moderate:	30% x 300 units (from 2)	<u>90 units</u>
Business:	20% x 300 units (from 2)	<u>60 units</u>

Exercise 18-21 (30 minutes)

Instructor note: This exercise is solved in 3 steps

1. Prepare a contribution margin income statement for Co. A to compute its DOL;
2. Prepare a contribution margin income statement for Co. B to compute its DOL;
3. Analyze and interpret which company benefits more from a 20% sales increase.

Step 1.

Company A Contribution Margin Income Statement	
Sales (given).....	\$6,000,000
Variable costs [\$6,000,000 x (100% - 60%)].....	<u>2,400,000</u>
Contribution margin (\$6,000,000 x 60%)	3,600,000
Fixed costs (given)	<u>2,600,000</u>
Pretax income	<u>\$1,000,000</u>

$$\begin{aligned}\text{Company A's DOL} &= \text{Contribution margin in dollars} / \text{Pretax income} \\ &= \$3,600,000 / \$1,000,000 \\ &= \underline{3.6}\end{aligned}$$

Step 2.

Company B Contribution Margin Income Statement	
Sales (given).....	\$4,500,000
Variable costs [\$4,500,000 x (100% - 25%)].....	<u>3,375,000</u>
Contribution margin (\$4,500,000 x 25%)	1,125,000
Fixed costs (given)	<u>375,000</u>
Pretax income	<u>\$ 750,000</u>

$$\begin{aligned}\text{Company B's DOL} &= \text{Contribution margin in dollars} / \text{Pretax income} \\ &= \$1,125,000 / \$750,000 \\ &= \underline{1.5}\end{aligned}$$

Step 3.

Interpretation: Company A benefits more from a 20% increase in sales. This is because we expect a 20% increase in sales to yield a 72% increase in income (computed as 3.6 x 20%). For Company B we expect a 20% increase in sales to yield a 30% increase in income (computed as 1.5 x 20%). Note that although Company A's fixed costs are higher, its increase in income is greater than that for Company B due to its higher degree of operating leverage (3.6 versus 1.5).

PROBLEM SET A

Problem 18-1A (25 minutes)

Parts 1 and 2

Tom Thompson Company Contribution Margin Income Statement For Year Ended December 31, 2013				
	(1,000 units)	Per unit	% of sales	
Sales (\$500 x 1,000).....	\$500,000	\$500	100%	
Variable costs				
Plastic for casing.....	\$17,000	\$17		
Assembly worker wages	82,000	82		
Drum stands.....	26,000	26		
Sales commissions	<u>15,000</u>	<u>15</u>	<u>140</u>	<u>28%</u>
Contribution margin	360,000	<u>\$360</u>	<u>72%</u>	
Fixed costs				
Taxes on factory	5,000			
Factory maintenance	10,000			
Factory machinery deprec.	40,000			
Sales equipment lease	10,000			
Accounting staff salaries	35,000			
Admin. mgmt. salaries	<u>125,000</u>			
Pretax income	135,000			
Income tax (25%)	<u>33,750</u>			
Net income	<u>\$101,250</u>			

The contribution margin per unit is \$360, and the contribution margin ratio is 72%.

Part 3 Analysis Component

Contribution margin shows how much of total sales are available to cover fixed costs and contribute to operating income. This is why the title for this statement is “Contribution Margin Income Statement.” Contribution margin ratio shows management the percent of each sales dollar that is available to cover fixed costs and to contribute to operating income. That is, for each \$1 of sales, \$0.72 is available both to cover fixed costs and to contribute to operating income.

Problem 18-2A (40 minutes)

Part 1

(a) Instructor note: Use the equation in Exhibit 18.11

$$\begin{aligned}\text{Break-even in sales units} &= \text{Fixed costs} / \text{Contribution margin per unit} \\ &= \$270,000 / \$60^* \\ &= \underline{4,500 \text{ units}} \text{ (1 unit = 100 yards)}\end{aligned}$$

$$^*\text{Contribution margin per unit} = \$200 - \$140 = \$60 \text{ per 100 yards}$$

(b) Instructor note: Use the equation in Exhibit 18.12

$$\begin{aligned}\text{Break-even in sales dollars} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$270,000 / 30\%^* \\ &= \underline{\$900,000}\end{aligned}$$

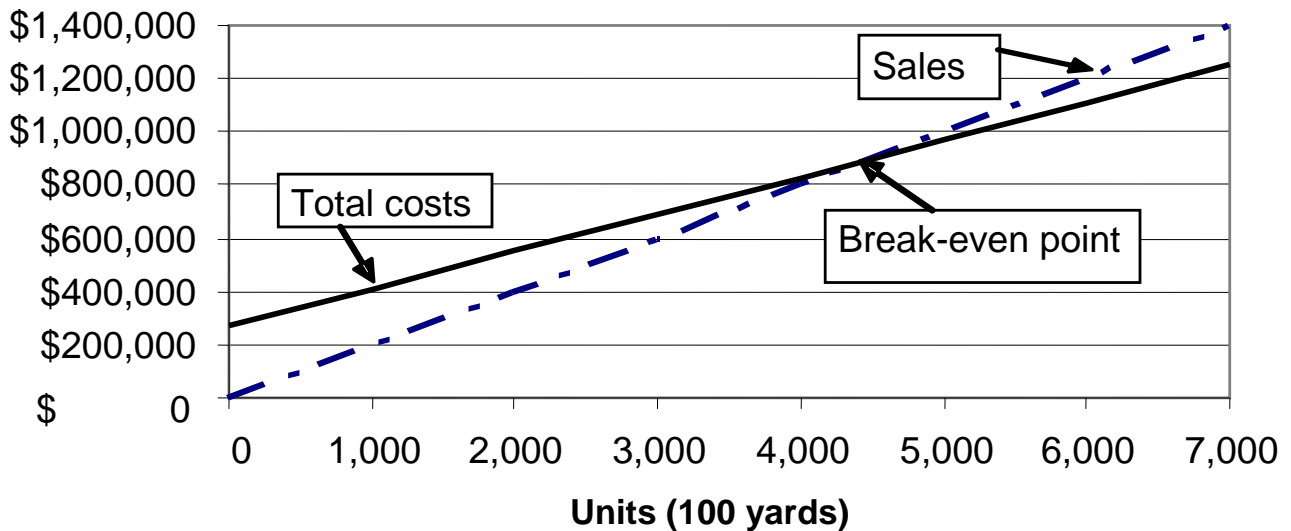
$$\text{(Alternatively: } = 4,500 \text{ units} \times \$200 = \$900,000)$$

$$^*\text{Contribution margin ratio} = \$60 / \$200 = 30\%$$

Problem 18-2A (Continued)

Part 2

CVP Chart for Xcite Equipment Company



Part 3

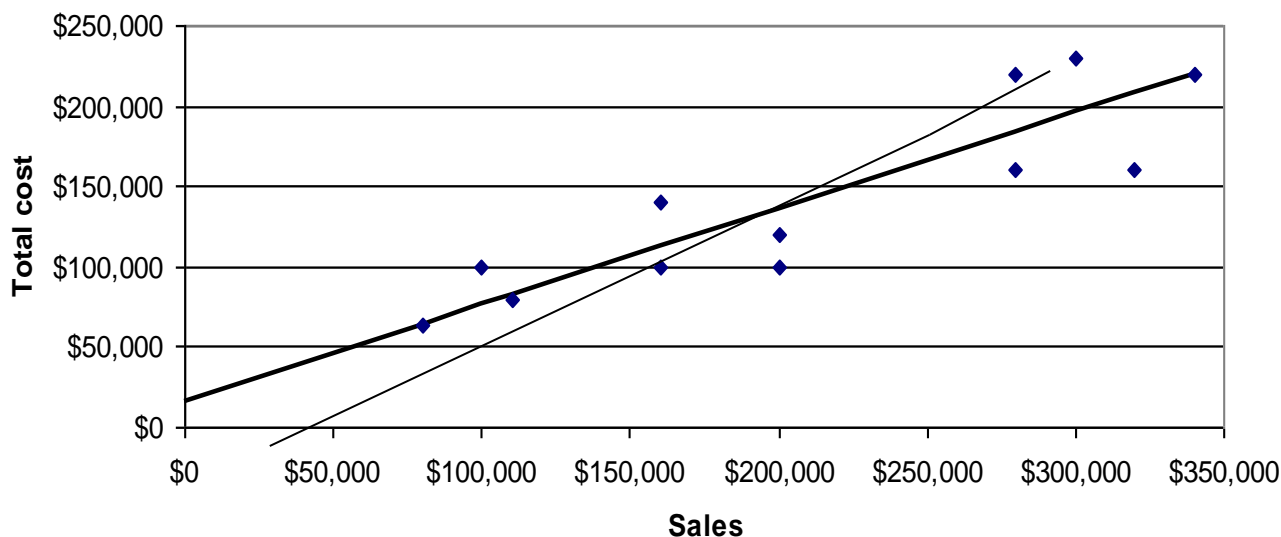
XCITE EQUIPMENT CO.	
Contribution Margin Income Statement (at Break-Even) — Product XT	
Sales (4,500 x \$200)	\$900,000
Variable costs (4,500 x \$140)	<u>630,000</u>
Contribution margin (4,500 x \$60)	270,000
Fixed costs (given)	<u>270,000</u>
Net income	<u>\$ 0</u>

Problem 18-3A (45 minutes)

Parts 1 and 2

The scatter diagram and its estimated line of cost behavior appear below.

Alden Co.



Part 2 – Calculation of variable and fixed costs

$$\text{Variable costs} = \frac{\$220,000 - \$64,000}{\$340,000 - \$80,000} = \underline{\underline{\$0.60 \text{ per dollar of sales}}}$$

Using the low point: $\$64,000 = \text{Fixed costs} + (\$0.60/\$ \text{ of sales} \times \$80,000)$
Therefore, fixed costs = \$16,000

Part 3

The estimates in Part 2 can be used to predict the total costs that will be incurred at sales levels of \$200,000 and \$300,000.

	Predictions	
Sales (given).....	\$200,000	\$300,000
Fixed costs (from part 2).....	16,000	16,000
Variable costs (from part 2)	<u>120,000*</u>	<u>180,000**</u>
Total cost	<u>\$136,000</u>	<u>\$196,000</u>

* (\$200,000 sales) x (\$0.60 per sales dollar).

** (\$300,000 sales) x (\$0.60 per sales dollar).

Problem 18-4A (75 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

$$\begin{aligned}\text{2013 break-even in sales dollars} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$250,000 / 20\%^* \\ &= \underline{\underline{\$1,250,000}}\end{aligned}$$

*To compute contribution margin ratio

Sales price per unit (\$1,000,000 / 20,000).....	\$50
Variable costs per unit (\$800,000 / 20,000)	\$40
Contribution margin ratio (\$50- \$40) / \$50)	20%

Part 2 Instructor note: Use the equation in Exhibit 18.12 with predicted numbers

$$\begin{aligned}\text{2014 break-even in sales dollars} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$450,000^* / 60\%^{**} \\ &= \underline{\underline{\$750,000}}\end{aligned}$$

*To compute predicted fixed costs

2013 fixed costs plus 2014 increase (\$250,000 + \$200,000)	\$450,000
---	-----------

**To compute predicted contribution margin ratio

Predicted sales price per unit (no change in sales price)	\$50
Predicted variable costs per unit (\$40 x 50%)	\$20
Predicted contribution margin ratio (\$50- \$20) / \$50).....	60%

Part 3

ASTRO COMPANY	
Forecasted Contribution Margin Income Statement	
For Year Ended December 31, 2014	
Sales (20,000 x \$50)	\$1,000,000
Variable costs (20,000 x \$20)	<u>400,000</u>
Contribution margin (20,000 x \$30).....	600,000
Fixed costs	<u>450,000</u>
Net income.....	<u><u>\$ 150,000</u></u>

Problem 18-4A (Continued)

Part 4 Instructor note: Use equations in Exhibits 18.22 and 18.23 with predicted numbers

$$\text{Required sales in dollars} = \frac{(\text{Fixed costs} + \text{Target pretax income})}{\text{Contribution margin ratio}}$$

$$\begin{aligned} &= (\$450,000^* + \$200,000^{**}) / 60\%^{***} \\ &= \$650,000 / 60.0\% \\ &= \underline{\$1,083,333} \text{ (rounded to whole dollars)} \end{aligned}$$

$$\text{Required sales in units} = \frac{(\text{Fixed costs} + \text{Target pretax income})}{\text{Contribution margin per unit}}$$

$$\begin{aligned} &= (\$450,000 + \$200,000) / (\$50 - \$20) \\ &= \$650,000 / \$30 \\ &= 21,667 \text{ units (rounded to whole units)} \end{aligned}$$

Alternately:

$$\begin{aligned} \text{Required sales in units} &= \$1,083,333^{\dagger} / \$50 \text{ Sales price per unit} \\ &= \underline{21,667 \text{ units}} \text{ (rounded to whole units)} \end{aligned}$$

* 2013 fixed costs plus 2014 increase (\$250,000 + \$200,000)	\$450,000
** Target after-tax income (given).....	\$140,000
Pretax target income = After-tax target income / (1 – Tax rate)	
= \$140,000 / (1 – 0.30) = \$200,000	
*** Predicted contribution margin ratio (\$50- \$30) / \$50—from part 2.....	60%
† Taken from “required sales in dollars” above	

Part 5

ASTRO COMPANY	
Forecasted Contribution Margin Income Statement	
For Year Ended December 31, 2014	
Sales (21,667 units x \$50)	\$1,083,350
Variable costs (21,667 units x \$20)	<u>433,340</u>
Contribution margin (21,667 units x \$30)	650,010
Fixed costs (from part 2).....	<u>450,000</u>
Income before income taxes	200,010
Income taxes (\$200,010 x 30%)	<u>60,003</u>
Net income*	<u>\$ 140,007</u>

*Slightly greater than the targeted \$140,000 income due to rounding of units.

Problem 18-5A (65 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

Break-even in dollar sales = Fixed costs / Contribution margin ratio

Product T:

$$= \$125,000 / 20\%^*$$

$$= \underline{\underline{\$625,000}}$$

Product O:

$$= \$1,475,000 / 87.5\%^*$$

$$= \underline{\underline{\$1,685,714 \text{ (rounded to the nearest dollar)}}}$$

*To compute contribution margin ratio

	<u>T</u>	<u>O</u>
Sales price per unit		
Product T (\$2,000,000 / 50,000).....	\$40	
Product O (\$2,000,000 / 50,000)		\$40
Variable costs per unit		
Product T (\$1,600,000 / 50,000).....	\$32	
Product O (\$250,000 / 50,000)		\$ 5
Contribution margin ratio		
Product T (\$40- \$32) / \$40)	20.0%	
Product O (\$40- \$5) / \$40).....		87.5%

Part 2

Forecasted contribution margin income statements for each product assuming sales declines to 30,000 units with no change in unit sales price

VANNA CO.		
Forecasted Contribution Margin Income Statement		
	Product T	Product O
Sales*	\$1,200,000	\$1,200,000
Variable costs**	<u>960,000</u>	<u>150,000</u>
Contribution margin	240,000	1,050,000
Fixed costs	<u>125,000</u>	<u>1,475,000</u>
Income before taxes	115,000	(425,000)
Income taxes (32%)	<u>36,800</u>	<u>(136,000)</u>
Net income	<u>\$ 78,200</u>	<u>\$ (289,000)</u>

Unit sales price and variable costs are computed in Part 1 and used in these computations:

* Product T sales = 30,000 units x \$40; Product O sales = 30,000 units x \$40.

** Product T variable costs = 30,000 units x \$32; Product O variable costs = 30,000 units x \$5.

Problem 18-5A (Continued)

Part 3 Forecasted contribution margin income statements for each product assuming sales increase to 60,000 units with no change in unit sales price

VANNA CO. Forecasted Contribution Margin Income Statement		
	Product T	Product O
Sales*	\$2,400,000	\$2,400,000
Variable costs**	<u>1,920,000</u>	<u>300,000</u>
Contribution margin	480,000	2,100,000
Fixed costs	<u>125,000</u>	<u>1,475,000</u>
Income before taxes	355,000	625,000
Income taxes (32%)	<u>113,600</u>	<u>200,000</u>
Net income	<u>\$ 241,400</u>	<u>\$ 425,000</u>

Unit sales price and variable costs are computed in Part 1 and used in these computations:

* Product T sales = 60,000 units x \$40; Product O sales = 60,000 units x \$40.

** Product T variable costs = 60,000 units x \$32; Product O variable costs = 60,000 units x \$5.

Part 4

If sales were to greatly decrease, Product O would suffer the greater loss because it would lose more contribution margin per unit than Product T (\$35 for O versus \$8 for T). Examining the operating leverage of these two products can yield the same inference. Specifically, higher operating leverage reflects higher fixed costs, which implies greater impacts on income from changes in sales levels. In the extreme, at zero sales, Product O would have a loss equal to its fixed costs of \$1,475,000, while Product T's loss would be only \$125,000.

Part 5

Factors that could cause Product T to have lower fixed costs might include:

- Labor arrangement that pays workers for units produced.
- Sales representatives that work totally on commission.
- Managers that are compensated with a share of profits instead of salaries.
- Assets that are used in production of Product T are leased with the rent based on asset usage.

In contrast, fixed costs for Product O may be higher because of:

- A salary structure that is not based on production or sales.
- Product O's assets that are owned or obtained under a lease agreement based on time, and not on asset usage.

Problem 18-6A (45 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

Break-even in dollar sales = Fixed costs / Contribution margin ratio

Plan 1:

$$= (\$200,000 + \$325,000) / 70\%^*$$

$$= \underline{\underline{\$750,000}}$$

Plan 2:

$$= (\$200,000 + \$325,000) / 75\%^*$$

$$= \underline{\underline{\$700,000}}$$

*To compute contribution margin ratio

	<u>Plan 1</u>	<u>Plan 2</u>
Sales price per unit		
Plan 1 (no change).....	\$25.00	
Plan 2 [\$25.00 x (1 + 20%)]		\$30.00
Total variable costs per unit (both Plans 1 and 2)		
Material [\$8.00 x (1 – 50%)]	\$ 4.00	\$ 4.00
Direct labor [\$5.00 x (1 – 60%)]	2.00	2.00
Variable overhead (\$1.00; given)	1.00	1.00
Variable selling & admin (\$0.50; given).....	<u>0.50</u>	<u>0.50</u>
Total variable cost per unit	\$ 7.50	\$ 7.50
Contribution margin ratio		
Plan 1 (\$25.00 - \$7.50) / \$25.00.....	70%	
Plan 2 (\$30.00 - \$7.50) / \$30.00.....		75%

Part 2

BERTRAND CO.		
Forecasted Contribution Margin Income Statement		
	<u>Plan 1</u>	<u>Plan 2</u>
Sales*	\$1,000,000	\$1,080,000
Variable costs**	<u>300,000</u>	<u>270,000</u>
Contribution margin	700,000	810,000
Fixed costs	<u>525,000</u>	<u>525,000</u>
Income before taxes	175,000	285,000
Income taxes (30%)	<u>52,500</u>	<u>85,500</u>
Net income	<u>\$ 122,500</u>	<u>\$ 199,500</u>

Unit sales price and variable costs are computed in Part 1 and used in these computations:

* Plan 1 sales = 40,000 units x \$25; Plan 2 sales = 36,000 units x \$30.

** Plan 1 variable costs = 40,000 units x \$7.50; Plan 2 variable costs = 36,000 units x \$7.50.

Problem 18-7A (50 minutes)

Part 1 BREAK-EVEN ANALYSIS ASSUMING USE OF SAME MATERIALS

Step 1: Compute break-even in composite units—Use equation in Exhibit 18.27

$$\begin{aligned}\text{Break-even in composite units} &= \text{Fixed costs} / \text{Contribution margin per composite unit} \\ &= \$250,000 / \$122^* \\ &= \underline{\underline{2,050 \text{ composite units}}} \text{ (rounded up to next whole unit)}\end{aligned}$$

*To compute the contribution margin per composite unit

	Unit Sales Price	Unit Variable Costs
5 units of Red		
@ \$20 per unit.....	\$100	
@ \$12 per unit.....		\$ 60
4 units of White		
@ \$35 per unit.....	140	
@ \$22 per unit.....		88
2 units of Blue		
@ \$65 per unit.....	130	
@ \$50 per unit.....		<u>100</u>
Selling price of a composite unit	<u>\$370</u>	
Variable cost of a composite unit		<u>\$248</u>

Thus:

$$\begin{aligned}\text{Contribution margin per composite unit} &= \$370 - \$248 = \$122 \\ \text{Contribution margin ratio (rounded)} &= \$122 / \$370 = 32.97\%\end{aligned}$$

Step 2: Compute break-even in individual product unit sales

$$\begin{aligned}\text{Unit sales of Red at break-even:} & 2,050 \times 5 = \underline{\underline{10,250 \text{ units}}} \\ \text{Unit sales of White at break-even:} & 2,050 \times 4 = \underline{\underline{8,200 \text{ units}}} \\ \text{Unit sales of Blue at break-even:} & 2,050 \times 2 = \underline{\underline{4,100 \text{ units}}}\end{aligned}$$

Step 3: Compute break-even in individual product dollar sales

$$\begin{aligned}\text{Dollar sales of Red at break-even:} & 10,250 \text{ units} \times \$20 = \underline{\underline{\$205,000}} \\ \text{Dollar sales of White at break-even:} & 8,200 \text{ units} \times \$35 = \underline{\underline{\$287,000}} \\ \text{Dollar sales of Blue at break-even:} & 4,100 \text{ units} \times \$65 = \underline{\underline{\$266,500}}\end{aligned}$$

Crossfoot Step 3 total with that from formula (\$235 rounding difference):

$$\begin{aligned}\text{Break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$250,000 / 32.97\% \\ &= \underline{\underline{\$758,265}}\end{aligned}$$

$$\text{Compare with Step 3 total} = \underline{\underline{\$758,500}}, (\$205,000 + \$287,000 + \$266,500)$$

Problem 18-7A (Continued)

Part 2 BREAK-EVEN ANALYSIS ASSUMING USE OF NEW MATERIALS

Step 1: Compute break-even in composite units—Use equation in Exhibit 18.27

$$\begin{aligned}\text{Break-even in composite units} &= \text{Fixed costs} / \text{Contribution margin per composite unit} \\ &= (\$250,000 + \$50,000) / \$220^* \\ &= \underline{1,364 \text{ composite units}} \text{ (rounded to the next whole unit)}\end{aligned}$$

*To compute the contribution margin per composite unit

	Unit Sales Price	Unit Variable Costs
5 units of Red		
@ \$20 per unit.....	\$100	
@ (\$12 - \$6) per unit		\$ 30
4 units of White		
@ \$35 per unit.....	140	
@ (\$22 - \$12) per unit		40
2 units of Blue		
@ \$65 per unit.....	130	
@ (\$50 - \$10) per unit		80
Selling price of a composite unit.....	<u>\$370</u>	<u>\$150</u>
Variable cost of a composite unit.....		

Thus:

$$\begin{aligned}\text{Contribution margin per composite unit} &= \$370 - \$150 = \$220 \\ \text{Contribution margin ratio (rounded)} &= \$220 / \$370 = 59.46\%\end{aligned}$$

Step 2: Compute break-even in individual product unit sales

$$\begin{aligned}\text{Unit sales of Red at break-even:} & 1,364 \times 5 = \underline{6,820 \text{ units}} \\ \text{Unit sales of White at break-even:} & 1,364 \times 4 = \underline{5,456 \text{ units}} \\ \text{Unit sales of Blue at break-even:} & 1,364 \times 2 = \underline{2,728 \text{ units}}\end{aligned}$$

Step 3: Compute break-even in individual product dollar sales

$$\begin{aligned}\text{Dollar sales of Red at break-even:} & 6,820 \text{ units} \times \$20 = \underline{\$136,400} \\ \text{Dollar sales of White at break-even:} & 5,456 \text{ units} \times \$35 = \underline{\$190,960} \\ \text{Dollar sales of Blue at break-even:} & 2,728 \text{ units} \times \$65 = \underline{\$177,320}\end{aligned}$$

Crossfoot Step 3 total with that from formula (\$139 rounding difference):

$$\begin{aligned}\text{Break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= (\$250,000 + \$50,000) / 59.46\% = \underline{\$504,541} \text{ (rounded)}\end{aligned}$$

$$\text{Compare with Step 3 total} = \underline{\$504,680} (\$136,400 + \$190,960 + \$177,320)$$

Part 3

When a business invests in fixed assets, as in this case, there is an increase in its risk level (more fixed costs must be recovered). However, investments in fixed assets can lower variable costs (as is the case here), which lowers its break-even point, making it easier to make a profit with less sales.

PROBLEM SET B

Problem 18-1B (25 minutes)

Parts 1 and 2

Gilmore Company Contribution Margin Income Statement For Year Ended December 31, 2013				
	(12,000 units)		Per unit	% of sales
Sales (\$18 x 12,000).....	\$216,000		\$18.000	100.00%
Variable costs				
Plastic for CD sets.....	\$ 1,500		\$0.125	
Assembly worker wages	30,000		2.500	
Labeling	3,000		0.250	
Sales commissions	<u>6,000</u>	<u>40,500</u>	<u>0.500</u>	<u>3.375</u>
Contribution margin	175,500		<u>\$14.625</u>	<u>81.25%</u>
Fixed costs				
Rent on factory	6,750			
Factory cleaning service.....	4,520			
Factory mach. depreciation	20,000			
Office equipment lease	1,050			
System staff salaries	15,000			
Admin. mgmt. salaries	<u>120,000</u>	<u>167,320</u>		
Pretax income	8,180			
Income tax (25%)	<u>2,045</u>			
Net income	<u>\$ 6,135</u>			

The contribution margin per unit is \$14.625, and the contribution margin ratio is 81.25%.

Part 3 Analysis Component

Contribution margin shows how much of total sales are available to cover fixed costs and contribute to operating income. This is why the title for this statement is “Contribution Margin Income Statement.” Contribution margin ratio shows management the percent of each sales dollar that is available to cover fixed costs and to contribute to operating income. That is, for each \$1 of sales, roughly \$0.8125 is available both to cover fixed costs and to contribute to operating income.

Problem 18-2B (40 minutes)

Part 1

(a) Instructor note: Use the equation in **Exhibit 18.11**

$$\begin{aligned}\text{Break-even in unit sales} &= \text{Fixed costs} / \text{Contribution margin per unit} \\ &= \$42,000 / \$140^* \\ &= \underline{\underline{300 \text{ units}}}\end{aligned}$$

$$^*\text{Contribution margin} = \$350 - \$210 = \$140$$

(b) Instructor note: Use the equation in **Exhibit 18.12**

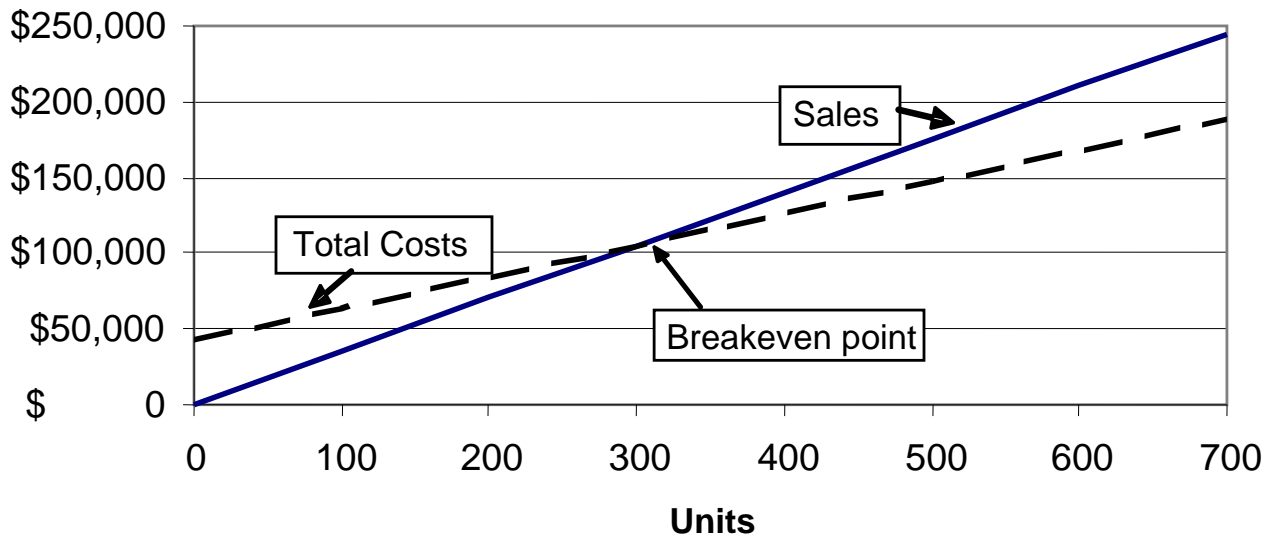
$$\begin{aligned}\text{Break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$42,000 / 40\%^* \\ &= \underline{\underline{\$105,000}}\end{aligned}$$

$$(\text{Alternatively: } = 300 \text{ units} \times \$350 = \$105,000)$$

$$^*\text{Contribution margin ratio} = \$140 / \$350 = 40\%$$

Problem 18-2B (Continued)
Part 2

Hip-Hop Company CVP chart



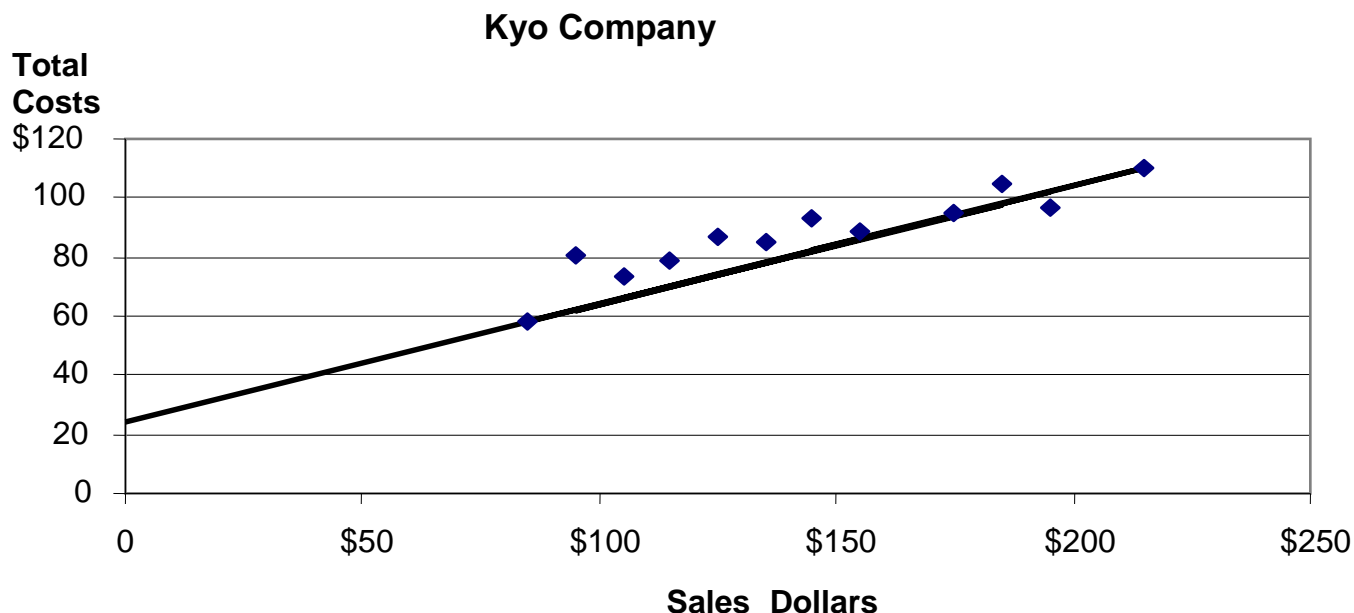
Part 3

HIP-HOP CO.	
Contribution Margin Income Statement (at Break-Even) — Keyboards	
Sales (300 x \$350)	\$105,000
Variable costs (300 x \$210)	<u>63,000</u>
Contribution margin (300 x \$140)	42,000
Fixed costs (given)	<u>42,000</u>
Net income	<u>\$ 0</u>

Problem 18-3B (45 minutes)

Parts 1 and 2

The scatter diagram and its estimated line of cost behavior appear below. Sales and cost amounts are in thousands of dollars.



Part 2 Calculation of variable and fixed costs

$$\text{Variable costs} = \frac{\$110 - \$58}{\$215 - \$85} = \underline{\underline{\$0.40 \text{ per dollar of sales}}}$$

Using the high point: $\$110 = \text{Fixed costs} + (\$0.40/\$ \text{ of sales} \times \$215)$

Therefore, fixed costs = \$24 (thousands)

Part 3

The estimates in Part 2 can be used to predict the total costs that will be incurred at sales levels of \$100 and \$170 (both in thousands).

('000s)	Predictions	
Sales (given).....	\$100	\$170
Fixed costs (from part 2).....	24	24
Variable costs (from part 2)	40*	68**
Total costs	<u>\$ 64</u>	<u>\$ 92</u>

* (\$100 sales) x (\$0.40 per sales dollar).

** (\$170 sales) x (\$0.40 per sales dollar).

Problem 18-4B (75 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

$$\begin{aligned}\text{2013 break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$200,000 / 20\%^* \\ &= \underline{\underline{\$1,000,000}}\end{aligned}$$

*To compute contribution margin ratio

Sales price per unit (\$750,000 / 20,000).....	\$37.50
Variable costs per unit (\$600,000 / 20,000)	\$30.00
Contribution margin ratio (\$37.50- \$30) / \$37.50	20%

Part 2 Instructor note: Use equation in Exhibit 18.12 with predicted numbers

$$\begin{aligned}\text{2014 break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$350,000^* / 60\%^{**} \\ &= \underline{\underline{\$583,333}} \text{ (rounded to whole dollars)}\end{aligned}$$

*To compute predicted fixed costs

2013 fixed costs plus 2014 increase (\$200,000 + \$150,000)	\$350,000
---	-----------

**To compute predicted contribution margin ratio

Predicted sales price per unit (\$750,000 / 20,000).....	\$37.50
Predicted variable costs per unit [(\$600,000 x 50%) / 20,000]	\$15.00
Predicted contribution margin ratio (\$37.50- \$15) / \$37.50	60%

Part 3

RIVERA COMPANY	
Forecasted Contribution Margin Income Statement	
For Year Ended December 31, 2014	
Sales (20,000 x \$37.50)	\$750,000
Variable costs (20,000 x \$15)	<u>300,000</u>
Contribution margin (20,000 x \$22.50).....	450,000
Fixed costs	<u>350,000</u>
Net income.....	<u>\$100,000</u>

Problem 18-4B (Continued)

Part 4 Instructor note: Use equations in Exhibit 18.22 and 18.23 with predicted numbers

$$\begin{aligned}\text{Required sales in dollars} &= \frac{(\text{Fixed costs} + \text{Pretax income})}{\text{Contribution margin ratio}} \\ &= (\$350,000^* + \$200,000^{**}) / 60\%^{***} \\ &= \$550,000 / 60\% \\ &= \underline{\$916,667} \text{ (rounded to the next dollar)}\end{aligned}$$

$$\begin{aligned}\text{Required sales in units} &= \frac{(\text{Fixed costs} + \text{Pretax income})}{\text{Contribution margin per unit}} \\ &= (\$350,000^* + \$200,000^{**}) / \$22.50 \\ &= \underline{24,445 \text{ units}} \text{ (rounded up to next unit)}\end{aligned}$$

$$\begin{aligned}\text{Alternatively} &= \$916,667^{\dagger} / \$37.50 \text{ per unit}^{\ddagger} \\ &= \underline{24,445 \text{ units}} \text{ (rounded up to the next unit)}\end{aligned}$$

* 2013 fixed costs plus 2014 increase (\$200,000 + \$150,000)	\$350,000
** Target after-tax income (given).....	\$140,000
Pretax target income = After-tax target income / (1 – Tax rate)	
= \$140,000 / (1 – 0.30) = \$200,000	

***Predicted contribution margin ratio (\$37.50-\$15)/\$37.50—from part 2.....	60%
[†] Taken from “required sales in dollars” above.....	\$916,667
[‡] Taken from part 2	\$ 37.50

Part 5

RIVERA COMPANY	
Forecasted Contribution Margin Income Statement	
For Year Ended December 31, 2014	
Sales (24,445 units x \$37.50)	\$916,688
Variable costs (24,445 units x \$15)	<u>366,675</u>
Contribution margin (24,445 units x \$22.50)	550,013
Fixed costs (from part 2).....	<u>350,000</u>
Income before income taxes	200,013
Income taxes (\$200,013 x 30%)	<u>60,004</u>
Net income*	<u>\$140,009</u>

*Slightly greater than the targeted \$140,000 income due to rounding of units from part 4.

Problem 18-5B (65 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

Break-even in dollar sales = Fixed costs / Contribution margin ratio

Product BB:

$$\begin{aligned} &= \$100,000 / 30\%^* \\ &= \underline{\$333,334} \text{ (rounded up to the next dollar)} \end{aligned}$$

Product TT:

$$\begin{aligned} &= \$560,000 / 87.5\%^* \\ &= \underline{\$640,000} \end{aligned}$$

***To compute contribution margin ratio**

Sales price per unit	<u>BB</u>	<u>TT</u>
Product BB (\$800,000 / 50,000).....	\$16.00	
Product TT (\$800,000 / 50,000)		\$16.00
Variable costs per unit		
Product BB (\$560,000 / 50,000).....	\$11.20	
Product TT (\$100,000 / 50,000)		\$2.00
Contribution margin ratio		
Product BB (\$16.00 - \$11.20) / \$16.00).....	30.0%	
Product TT (\$16 - \$2) / \$16).....		87.5%

Part 2

Forecasted contribution margin income statements for each product assuming sales decline to 33,000 units with no change in unit sales price

MINGEI CO.		
Forecasted Contribution Margin Income Statement		
	Product BB	Product TT
Sales*	\$528,000	\$ 528,000
Variable costs**	<u>369,600</u>	<u>66,000</u>
Contribution margin	158,400	462,000
Fixed costs	<u>100,000</u>	<u>560,000</u>
Income before taxes	58,400	(98,000)
Income taxes (32%)	<u>18,688</u>	<u>(31,360)</u>
Net income	<u>\$ 39,712</u>	<u>\$ (66,640)</u>

Unit sales price and variable costs are computed in Part 1 and used in these computations:

* Product BB sales = 33,000 units x \$16; Product TT sales = 33,000 units x \$16.

**Product BB variable costs = 33,000 units x \$11.20;

Product TT variable costs = 33,000 units x \$2.

Problem 18-5B (Continued)

Forecasted contribution margin income statements for each product assuming sales increase to 64,000 units with no change in unit sales price

MINGEI CO. Forecasted Contribution Margin Income Statement		
	Product BB	Product TT
Sales*	\$1,024,000	\$1,024,000
Variable costs**	<u>716,800</u>	<u>128,000</u>
Contribution margin	307,200	896,000
Fixed costs	<u>100,000</u>	<u>560,000</u>
Income before taxes	207,200	336,000
Income taxes (32%)	<u>66,304</u>	<u>107,520</u>
Net income	<u>\$ 140,896</u>	<u>\$ 228,480</u>

Unit sales price and variable costs are computed in Part 1 and used in these computations:

* Product BB sales = 64,000 units x \$16; Product TT sales = 64,000 units x \$16.

**Product BB variable costs = 64,000 units x \$11.20;

Product TT variable costs = 64,000 units x \$2.

Part 4

If sales were to greatly increase, Product TT would experience the greater increase in income because it would gain more contribution margin per unit than Product BB (\$14 for TT versus \$4.80 for BB). Examining the operating leverage of these two products would yield the same inference. Specifically, higher operating leverage reflects higher fixed costs, which implies greater impacts on income from changes in sales levels.

Part 5

Factors that could cause Product BB to have lower fixed costs include:

- Labor arrangement that pays workers for units produced.
- Sales representatives that work totally on commission.
- Managers that are compensated with a share of profits instead of salaries.
- Assets that are used in the production of Product BB are leased with the rent based on asset usage.

In contrast, the fixed costs for Product TT could be higher because of:

- Salary structure that is not based on production or sales.
- Product TT's assets that are owned or obtained under a lease agreement based on time, and not on asset usage.

Problem 18-6B (45 minutes)

Part 1 Instructor note: Use the equation in Exhibit 18.12

Break-even in dollar sales = Fixed costs / Contribution margin ratio

Existing Strategy: = \$950,000 / 55%*
= \$1,727,273 (rounded to the next dollar)

New Strategy: = \$950,000 / 55%*
= \$1,727,273 (rounded to the next dollar)

*To compute contribution margin ratio

	Existing Strategy	New Strategy
Sales price per unit		
Existing strategy	\$20.00	
New strategy [\$20.00 x (1 – 20%)].....		\$16.00
Total variable costs per unit		
Unit costs (\$800,000 / 100,000)	\$ 8.00	
Unit costs [(\$800,000/100,000) x (1 – 25%)].....		\$ 6.00
Packaging (\$100,000 / 100,000).....	1.00	
Packaging [(\$100,000/100,000) x (1 + 20%)].....		1.20
Total variable cost per unit	<u>\$ 9.00</u>	<u>\$ 7.20</u>
Contribution margin ratio		
Existing strategy (\$20.00 - \$9.00) / \$20.00)	55%	
New strategy (\$16.00 - \$7.20) / \$16.00).....		55%

Part 2

BEST COMPANY		
Forecasted Contribution Margin Income Statement		
	Existing Strategy	New Strategy
Sales*	\$2,000,000	\$2,880,000
Variable costs**	<u>900,000</u>	<u>1,296,000</u>
Contribution margin	1,100,000	1,584,000
Fixed costs	<u>950,000</u>	<u>950,000</u>
Income before taxes	150,000	634,000
Income taxes (25%)	<u>37,500</u>	<u>158,500</u>
Net income	<u>\$ 112,500</u>	<u>\$ 475,500</u>
Return on sales (Net income/Sales)	<u>5.6%</u>	<u>16.5%</u>

Unit sales price and variable costs are computed in Part 1 and used here:

* Existing strategy sales = 100,000 units x \$20; New strategy sales = 180,000 units x \$16.

** Existing strategy variable costs = 100,000 units x (\$8 + \$1).

New strategy variable costs = 180,000 units x (\$6 + \$1.20).

Problem 18-7B (50 minutes)

Part 1 BREAK-EVEN ANALYSIS ASSUMING USE OF SAME MATERIALS

Step 1: Compute break-even in composite units—Use equation in Exhibit 18.27

$$\begin{aligned}\text{Break-even in composite units} &= \text{Fixed costs} / \text{Contribution margin per composite unit} \\ &= \$270,000 / \$144^* \\ &= \underline{\underline{1,875 \text{ composite units}}}\end{aligned}$$

* To compute the contribution margin per composite unit

	Unit Sales Price	Unit Variable Costs
6 units of Product 1		
@ \$40 per unit.....	\$240	
@ \$30 per unit.....		\$180
4 units of Product 2		
@ \$30 per unit.....	120	
@ \$15 per unit.....		60
2 units of Product 3		
@ \$20 per unit.....	40	
@ \$ 8 per unit.....		16
Selling price of a composite unit	<u>\$400</u>	
Variable cost of a composite unit		<u>\$256</u>

Thus:

$$\text{Contribution margin per composite unit} = \$400 - \$256 = \$144$$

$$\text{Contribution margin ratio} = \$144 / \$400 = 36\%$$

Step 2: Compute break-even in individual product unit sales

$$\text{Unit sales of Product 1 at break-even: } 1,875 \times 6 = \underline{\underline{11,250 \text{ units}}}$$

$$\text{Unit sales of Product 2 at break-even: } 1,875 \times 4 = \underline{\underline{7,500 \text{ units}}}$$

$$\text{Unit sales of Product 3 at break-even: } 1,875 \times 2 = \underline{\underline{3,750 \text{ units}}}$$

Step 3: Compute break-even in individual product dollar sales

$$\text{Dollar sales of Product 1 at break-even: } 11,250 \text{ units} \times \$40 = \underline{\underline{\$450,000}}$$

$$\text{Dollar sales of Product 2 at break-even: } 7,500 \text{ units} \times \$30 = \underline{\underline{\$225,000}}$$

$$\text{Dollar sales of Product 3 at break-even: } 3,750 \text{ units} \times \$20 = \underline{\underline{\$75,000}}$$

Crossfoot Step 3 total with that from formula:

$$\begin{aligned}\text{Break-even in dollar sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= \$270,000 / 36\% \\ &= \underline{\underline{\$750,000}}\end{aligned}$$

$$\text{Compare with Step 3 total} = \underline{\underline{\$750,000}} (\$450,000 + \$225,000 + \$75,000)$$

Problem 18-7B (Continued)

Part 2 BREAK-EVEN ANALYSIS ASSUMING USE OF NEW MATERIALS

Step 1: Compute break-even in composite units—Use equation in Exhibit 18.27

$$\begin{aligned}\text{Break-even in composite units} &= \text{Fixed costs} / \text{Contribution margin per composite unit} \\ &= (\$270,000 + \$50,000) / \$224^* \\ &= \underline{1,429 \text{ composite units}} \text{ (rounded to the next unit)}\end{aligned}$$

*To compute the contribution margin per composite unit

	Unit Sales Price	Unit Variable Costs
6 units of Product 1		
@ \$40 per unit.....	\$240	
@ (\$30 - \$10) per unit		\$120
4 units of Product 2		
@ \$30 per unit.....	120	
@ (\$15 - \$5) per unit		40
2 units of Product 3		
@ \$20 per unit.....	40	
@ (\$8 - \$0) per unit		16
Selling price of a composite unit.....	<u>\$400</u>	
Variable cost of a composite unit.....		<u>\$176</u>

Thus:

$$\text{Contribution margin per composite unit} = \$400 - \$176 = \$224$$

$$\text{Contribution margin ratio} = \$224 / \$400 = 56\%$$

Step 2: Compute break-even in individual product unit sales

$$\text{Unit sales of Product 1 at break-even: } 1,429 \times 6 = \underline{8,574 \text{ units}}$$

$$\text{Unit sales of Product 2 at break-even: } 1,429 \times 4 = \underline{5,716 \text{ units}}$$

$$\text{Unit sales of Product 3 at break-even: } 1,429 \times 2 = \underline{2,858 \text{ units}}$$

Step 3: Compute break-even in individual product dollar sales

$$\text{Dollar sales of Product 1 at break-even: } 8,574 \text{ units} \times \$40 = \underline{\$342,960}$$

$$\text{Dollar sales of Product 2 at break-even: } 5,716 \text{ units} \times \$30 = \underline{\$171,480}$$

$$\text{Dollar sales of Product 3 at break-even: } 2,858 \text{ units} \times \$20 = \underline{\$57,160}$$

Crossfoot Step 3 total with that from formula (\$171 of rounding differences):

$$\begin{aligned}\text{Break-even in \$ sales} &= \text{Fixed costs} / \text{Contribution margin ratio} \\ &= (\$270,000 + \$50,000) / 56\% = \underline{\$571,429} \text{ (rounded)}\end{aligned}$$

$$\text{Compare to Step 3 total} = \underline{\$571,600} (\$342,960 + \$171,480 + \$57,160)$$

Part 3

When a business invests in fixed assets, as in this case, there is an increase in its risk level (more fixed costs must be recovered). However, investments in fixed assets can lower variable costs (as is the case here), which lowers its break-even point, making it easier to make a profit with less sales.

SERIAL PROBLEM — SP 18

Serial Problem, Success Systems (50 minutes)

1. Selling price per composite unit

3 desk units @ \$1,250 per unit	\$3,750
2 chairs @ \$500 per unit	<u>1,000</u>
Selling price per composite unit	<u>\$4,750</u>

2. Variable costs per composite unit

3 desk units @ \$750 per unit	\$2,250
2 chairs @ \$250 per unit	<u>500</u>
Variable costs per composite unit	<u>\$2,750</u>

3. Break-even point in composite units

$$\begin{aligned} &= \frac{\text{Fixed costs}}{\text{Contribution margin per composite unit}} \\ &= \frac{\$120,000}{\$4,750 - \$2,750} \\ &= \underline{\underline{60 \text{ composite units}}} \end{aligned}$$

4. Unit sales of desk units and chairs at break-even point

Desk units: 3 x 60 units (from 3)	<u>180 units</u>
Chairs: 2 x 60 units (from 3)	<u>120 units</u>

Reporting in Action — BTN 18-1

1. Some of the costs of Polaris's services department are:
 - Variable: Parts used to repair vehicles, direct labor used to perform the repairs, indirect supplies used
 - Mixed: Utilities
 - Fixed: Management salaries, rent on facilities used
 (Other answers are possible)

2. As revenues grow, the variable costs will increase in total, as will the mixed costs. Total fixed costs should not change. Since the "product" (Polaris repair services) can vary depending on the repairs needed by each customer, it is hard to predict by how much the variable costs will increase.

3. Since variable costs are not likely to increase with volume increases by a constant amount, Polaris cannot use a simple contribution margin ratio calculation to determine the increase in profits with an increase in sales dollars or number of customers served. Note, if the services were constant across customers, variable cost increases might be constant, in which case a simple contribution margin ratio calculation would be useful.

Comparative Analysis — BTN 18-2

- | | Polaris | Arctic Cat |
|--|---------------|---------------|
| 1. Average selling price per unit..... | \$ 10,500 | \$ 11,200 |
| Average variable cost per unit..... | <u>4,200</u> | <u>5,100</u> |
| Average contribution margin per unit..... | \$ 6,300 | \$ 6,100 |
|
Total fixed costs (\$ thousands) |
\$146,570 |
\$133,570 |
| Break-even point in units (rounded) | <u>23,266</u> | <u>21,897</u> |
-
2. As unit sales decline, Polaris's operating profits will fall by \$6,300 per unit versus Arctic Cat's decline in operating profits of \$6,100 per unit. Thus, operating profit will decline more for Polaris than for Arctic Cat as unit sales decline.

Ethics Challenge — BTN 18-3

Instructor note: This question can serve to generate class discussion on cost analysis and estimation. Discussion can focus on accounting, business, and other ethical concerns.

MEMORANDUM

To: “Mechanics” and “Owners”
From: Your name
RE: Analysis of labor costs for survey
Date: Current date

The memorandum should include many of the following points:

Objectivity: A statement about the need to be objective in the analysis. Both ethical and professional concerns should motivate the preparer’s desire for objectivity.

Cost Accounting Estimation: The memorandum should outline how cost estimation is conducted. For example, you might describe how regression analysis was used to estimate the average time to complete the most common jobs. Explain why such an objective estimate is the time value that must be reported. Reporting a greater time value would be in violation of the code of professional ethics.

Business Concerns: The memorandum should point out that the repair business should follow established business practices for setting cost estimates. There should also be an expressed concern of fairness for the customer in getting a fair value for the amount paid. Another concern will be a possible perception that the repair business typically overcharges the customer and something must be done about it. It is not fair to the customer to pay for time never received, and it is not fair to the mechanic to be paid on a jobs completed basis. Perhaps the compensation structure of the mechanic should be changed.

Mechanic-Related Issues: The memorandum should also be concerned about the quality of mechanical work. Is the work being done correctly and is customer safety in jeopardy by paying the mechanic on a job-by-job basis? Who is responsible for establishing a fair compensation system? These issues are likely topics for the memorandum.

Communicating in Practice — BTN 18-4

Instructor note: Reports will vary, but a typical report would likely include assumptions similar to the following.

1. Revenue (salary) assumptions

- Find job that pays a specified amount.
- Keep the job for an entire year.
- Employer stays in business.
- Expectations regarding overtime pay.

2. Cost assumptions

- Find living accommodations at a specified amount.
- Avoid costly entertainment events.
- Stay healthy and do not incur excess medical expenses.
- Cost estimates for food, clothing, and other necessities.

Taking It to the Net — BTN 18-5

The site offers many tools for an entrepreneur in assessing costs, sales, and profits. Specifically, a spreadsheet file is provided that allows an entrepreneur to identify the start-up costs of the business. A new business requires many different types of costs for the different resources to be acquired (such as people, space, and equipment), which sometimes are overlooked by less-experienced entrepreneurs. This worksheet can serve as a “check-list,” prompting the entrepreneur to at least think about the different costs and their amounts.

Also, many of the tools (such as the worksheet) are in the form of a spreadsheet. This means an entrepreneur can modify the spreadsheet and use it to conduct various types of “what-if” analyses by considering different possible scenarios of business.

Teamwork in Action — BTN 18-6

(a) Questions for school administrators (others are possible)

- Number of students that would attend the theater.
- Frequency of class scheduled showings.
- Legal (liability) issues for field trips and associated costs.
- Costs of providing movies to students at school.

(b) Questions for owners (others are possible)

- List of other potential markets for theater showings during school days.
- Labor costs to show a movie during school days.
- Copyright laws and costs to show a movie.
- Insurance, if any, on school children attending the theater.
- Any additional heat and lighting costs.

Entrepreneurial Decision — BTN 18-7

1. Costs that won't change regardless of how many footballs Paul Cunningham makes (i.e. fixed costs) likely include rent, depreciation on sewing equipment, and salaries.
2. Overly optimistic sales estimates could lead the company to expand into markets or products that are unable to break-even or make profits.
3. Paul Cunningham can use CVP techniques to manage his company. Focusing on contribution margin per unit enables the company to set selling prices that cover fixed costs and enable a target profit level. Paul can use sensitivity analysis to see how revised contribution margins resulting from changes in costs can impact his break-even sales levels. He can also use multi-product contribution margin information to plan the company's product mix.

Hitting the Road — BTN 18-8

1. There is no set solution for this problem. Answers will vary because each student will make different estimates for groups, costs, and volume. The instructor should make certain the student follows the correct steps in preparing a multiproduct break-even analysis. This activity is designed to show the student that several estimates are required in this type of CVP analysis.

One simple example with crucial facts

Product	Estimated Selling Price per unit	Estimated CM ratio	Estimated CM per unit	Estimated Sales Mix	Estimated CM for each component in composite unit
Burgers.....	\$2.00	0.75	\$1.50	3.5	\$ 5.25
Fries.....	\$1.00	0.70	\$0.70	5.0	3.50
Drinks	\$1.00	0.90	\$0.90	3.5	3.15
Desserts.....	\$0.50	0.40	\$0.20	1.2	0.24
Other	\$0.80	0.30	\$0.24	1.0	<u>0.24</u>
Total contribution margin (CM) per composite unit					<u>\$12.38</u>

Estimated fixed costs per year: \$500,000

Break-even point in composite unit sales: $\$500,000/\$12.38 = \underline{40,388}$

Unit sales of individual products per year required to break-even:

Burgers.....	40,388 x 3.5 =	141,358 units
Fries.....	40,388 x 5.0 =	201,940 units
Drinks	40,388 x 3.5 =	141,358 units
Desserts.....	40,388 x 1.2 =	48,466 units
Other	40,388 x 1.0 =	40,388 units

In general, when evaluating a student's solutions, look for:

- Estimated selling price of products
- Estimated contribution margin per item
- Estimated sales mix
- Estimated composite contribution margin
- Estimated fixed costs per year
- Calculation of BE in composite units: Estimated fixed costs/Composite CM
- Individual unit sales required = (Sales mix) x (BE composite units)

Detailed computations are described in the chapter under the section Computing Multiproduct Break-Even Point.

2. The report should properly interpret the analysis from part 1. This question is also designed to show students that a fast food restaurant must sell high volumes of certain product categories to make a profit. Students recognize that to generate this volume a restaurant must have a reasonably consistent flow of customers.

- 1. Managers at Piaggio likely use multiproduct CVP analysis when planning. Piaggio offers a large mix of two- three- and four-wheeled vehicles that would require multiproduct sales mix analysis rather than single product analysis.**
- 2. If Piaggio adds a new product line to their offerings, they will have to consider its selling price and any variable costs, such as cost of the item manufactured or acquired, any delivery expense for the item, or any sales commissions. It is not likely that fixed costs will change with a new product line, unless it requires new facilities.**