

COST-VOLUME-PROFIT ANALYSIS

Key Terms and Concepts to Know

Contribution Income Statement:

- Separates expenses into variable and fixed.
- Sales – Variable Expenses = Contribution Margin.
- Contribution Margin – Fixed Expenses = Net Income (Loss).

Contribution Margin:

- The amount of sales available to cover fixed expenses with any remaining contribution margin providing profits.
- If the contribution margin is not sufficient to cover fixed expenses, there will be a net loss for the period.

Contribution Margin Ratio:

- Sales, variable expenses and contribution margin are all variable, and therefore may be expressed as a percent of revenue.
- The contribution margin ratio is calculated as the contribution margin dollars as a percent of sales dollars.
- The variable expense ratio is the complement to the contribution margin ratio. It represents the percent of sales dollars not included in the contribution margin ratio.
- In a company producing a single product, this relationship applies to either total sales dollars and total contribution margin or per-unit sales dollars and contribution margin dollars.
- In a company producing multiple products, each product will have its own unique contribution margin ratio. The contribution margin for the entire company will be calculated only for total contribution margin dollars as a percent of total sales dollars.

Break Even Point:

At the breakeven point:

- Operating Income = 0
- Total revenue = total expenses
- Fixed Expenses = Contribution Margin

Target Profit:

- Rather than setting operating income = 0, target profit calculations assume a certain operating income and calculate the sales dollars and units sold necessary to achieve it.
- The same equations are used as to calculate the breakeven point, except that a non-zero operating income term is included in the numerator.

Margin of Safety:

- The margin of safety is the excess of budgeted or actual sales over the breakeven volume of sales.
- It is expressed as both the dollar amount of the difference and as a percent of budgeted or actual sales.

Sales Mix:

- Companies that sell more than one product make the breakeven and target profit calculations a bit more complex.
- Each product has its own breakeven equation and sales volume, none of which represents the breakeven equation for the entire company. A breakeven equation can be developed for the whole company by combining the breakeven equations and sales volumes (the sales mix) for the individual products.
- The sales mix is assumed to remain constant to simplify the calculations.
- Changes in sales volume are assumed to be in the constant sales mix.

Operating Leverage:

- Operating leverage quantifies, at a given level of sales, the percent change in operating income caused by a percent change in sales.
- Leverage calculations are a two-step process:

- First, calculate the Degree of Leverage or Leverage Factor

$$\text{Degree of Leverage} = \frac{\text{Contribution Margin}}{\text{Operating Income}}$$

- Second, calculate the percent change in operating income:

$$\text{Percent change in operating income} = \text{Degree of Leverage} \times \text{Operating Income}$$

Cost Structure and Profit Volatility:

- Cost structure refers to the proportion of variable costs and fixed costs in the total costs incurred during the period.
- No one cost structure is the right one. Different industries have different cost structures and management may work to change the company's cost structure in response to changing business conditions and expectations.

Key Topics to Know

Breakeven Equations

- The breakeven point is expressed in sales dollars and units sold. The link between the two is selling price per unit, meaning that breakeven units sold x selling price per unit = breakeven sales.

- The breakeven equations are:

$$\text{Breakeven sales} = \frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin ratio}}$$

$$\text{Breakeven units} = \frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin \$ per unit}}$$

Note that since operating income = 0 at the breakeven point, this term is frequently dropped from the equations.

- Breakeven problems are made more complex because some information is given in per-unit amounts, other information is given in total dollars and still other information is not dollars but units sold.
- A useful tool to collect and analyze the various data items is:

	<u>Per Unit</u>	<u>Percent</u>	<u>Total</u>
Units	1		
Sales		100%	
- Variable costs			
= Contribution Margin			
- Fixed costs			
= Operating Income			

- The Units line may be given or may be a variable to solve for.
- The Per Unit column records only the three variable items: sales, variable costs and contribution margin.
- The Percent column calculates the three variable items: sales, variable costs and contribution margin as a percent of sales.
- The Total column contains the entire income statement.

Example #1

W Company sells only one product with a selling price of \$200 and a variable cost of \$80 per unit. The company's monthly fixed expense is \$60,000.

Required: Determine the breakeven point in units sold and sales dollars.

Solution #1

$$\begin{aligned} \text{CM ratio} &= \frac{\text{Sales} - \text{variable expenses}}{\text{Sales}} = \frac{\$200 - 80}{\$200} \\ &= 60\% \end{aligned}$$

$$\begin{aligned} \text{Breakeven sales} &= \frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin ratio}} = \frac{\$60,000 + \$0}{60\%} \\ &= \$100,000 \end{aligned}$$

$$\begin{aligned} \text{Breakeven units} &= \frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin \$ per unit}} = \frac{\$60,000 + \$0}{\$120} \\ &= 500 \text{ units} \end{aligned}$$

Target Profit

- The same equations are used as to calculate the breakeven point, except that the target profit is included in the numerator.
- An alternative solution starting from the breakeven point is also possible.

Example #2

L Company sells only one product with a selling price of \$200 and a variable cost of \$80 per unit. The company's monthly fixed expense is \$60,000. The corporation would like to achieve a profit of \$30,000 next year.

Required: Determine the units to be sold and sales dollars necessary to achieve the target profit.

Solution #2

CM ratio	$\frac{\text{Sales} - \text{variable expenses}}{\text{Sales}}$	$\frac{\$200 - 80 = 120}{\$200}$	60%
Sales	$\frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin ratio}}$	$\frac{\$60,000 + \$30,000}{60\%}$	\$150,000
Units	$\frac{\text{Fixed expenses} + \text{operating income}}{\text{Contribution margin \$ per unit}}$	$\frac{\$60,000 + \$30,000}{\$120}$	750 units
OR			
Units	$\frac{\text{Sales}}{\text{Selling price per unit}}$	$\frac{\$150,000}{\$200}$	750 units

Alternate Solution:

Additional units	$\frac{\text{Target profit}}{\text{Contribution margin \$ per unit}}$	$\frac{\$30,000}{\$120}$	250 units
Total units	Breakeven units + units to reach target	500 + 250	750 units
Additional sales	Additional units x selling price	250 x \$200	\$50,000
Total sales	Additional sales + breakeven sales	\$150,000 + 50,000	\$200,000

Example #3

S Company sells pillows for \$90 per unit. The variable expenses are \$63 per pillow and the fixed costs are \$135,000 per month. The company sells 8,000 pillows per month. The sales manager is recommending a 10% reduction in selling price, which he believes will produce a 25% increase in the number of pillows, sold each month.

Required: Prepare contribution margin income statements for current operating conditions and if the proposed changes are made.

Solution #3

	<u>Present</u>			<u>Proposed</u>		
	<u>Per Unit</u>	<u>%</u>	<u>Total</u>	<u>Per Unit</u>	<u>%</u>	<u>Total</u>
Units	1		8,000	1		10,000
Sales	\$90	100.0	\$720,000	\$81	100.0	\$810,000
Variable expenses	63	70.0	504,000	63	77.8	630,000
Contribution Margin	27	30.0	216,000	18	22.2	180,000
Fixed expenses			135,000			135,000
Operating income			<u>\$81,000</u>			<u>\$45,000</u>

8000 Pillows X 1.25 = 10,000 pillows; \$90 per pillow X .9 = \$81 per pillow

Since the operating income decreased by \$36,000, from \$81,000 to \$45,000, the sales manager's suggestion should not be implemented.

Margin of Safety
Example #4

Using the data in Example #3, determine the margin of safety under current operating conditions.

Solution #4

	<u>Present</u>			<u>Breakeven</u>	
	<u>Per Unit</u>	<u>%</u>	<u>Total</u>	<u>Total</u>	
Units	1		8,000	5,000	\$450,000/\$90
Sales	\$90	100.0	\$720,000	\$450,000	\$135,000/30%
Variable expenses	63	70.0	504,000	315,000	\$450,000x70%
Contribution Margin	27	30.0	216,000	135,000	fixed + OI
Fixed expenses			135,000	135,000	stays the same
Operating income			<u>\$81,000</u>	<u>\$0</u>	Always \$0

Margin of Safety = \$720,000 - \$450,000 = \$270,000 or 37.5%

Sales Mix

Example #5

Z Company sells two models of doghouses, the Puppy Palace and the Canine Castle.

	Puppy Palace	Canine Castle
Sales price per unit	\$50	\$75
Variable cost per unit	<u>30</u>	<u>50</u>
Contribution margin per unit	\$20	\$25

Z Company has determined that it would break even at an annual sales volume of 50,000 units, of which 75% would be Puppy Palaces.

- Required:
- What are the contribution margin ratios for each product and the company?
 - What is the amount of Sanchez's estimated annual fixed costs?
 - What is the sales mix?
 - Prepare a product line income statement with operating income of \$400,000. Fixed production costs will increase \$45,000 and fixed administrative costs will increase \$22,500 to support the increase in volume.

Solution #5

a)	Puppy Palace	Canine Castle	Sanchez Company
Volume	50,000	50,000	
	<u>75%</u>	<u>25%</u>	
	37,500	12,500	
Sales	\$1,875,000	\$937,500	\$2,812,500
Variable cost	<u>1,125,000</u>	<u>625,000</u>	<u>1,750,000</u>
Contribution margin	\$750,000	\$312,500	\$1,062,500
Contribution margin ratio	40.00%	33.33%	37.78%

b)

	Puppy Palace	Canine Castle	Sanchez Company
Sales	\$1,875,000	\$937,500	\$2,812,500
Variable cost	<u>1,125,000</u>	<u>625,000</u>	<u>1,750,000</u>
Contribution margin	\$750,000	\$312,500	\$1,062,500
Fixed costs			<u>1,062,500</u>
Operating Income			\$0

At the breakeven point, fixed costs always equal contribution margin.

c) The sales mix can be expressed as 3:1 based on the ratio of 37,500 units : 12,500 units. This means that when sales volume increases, it will be in groups of four units (3 puppy palaces and one canine castle). Each group will have a sales value of \$225 = 3 x \$50 + 1 x \$75 and a contribution margin of \$85 = 3 x \$20 + 1 x \$25.

d)

	Puppy Palace	Canine Castle	Sanchez Company
Volume in groups of 4 units	18,000	18,000	
Sales mix	<u>3</u>	<u>1</u>	
Product units	54,000	18,000	
Sales	\$2,700,000	\$1,350,000	\$4,050,000
Variable cost	<u>1,620,000</u>	<u>900,000</u>	<u>2,520,000</u>
Contribution margin	\$1,080,000	\$450,000	\$1,530,000
Fixed costs			<u>1,130,000</u>
Operating Income			\$400,000

Fixed costs = \$1,062,500 + 45,000 + 22,500

Contribution Margin = \$400,000 + 1,130,000

Company Sales = \$1,530,000 / .3778

Operating Leverage

Example #6

P Company sells pillows for \$90 per unit. The variable expenses are \$63 per pillow and the fixed costs are \$135,000 per month. The company sells 8,000 pillows per month.

Required: Compute the degree of leverage and the expected operating income if sales increase 10%.

Solution #6

	<u>Per Unit</u>	<u>Present</u>		<u>Proposed</u>	
		%	<u>Total</u>	<u>Total</u>	
Units	1		8,000	8,800	
Sales	\$90	100.0	\$720,000	\$792,000	
Variable expenses	63	70.0	504,000	554,400	
Contribution Margin	27	30.0	216,000	237,600	
Fixed expenses			135,000	135,000	
Operating income			<u>\$81,000</u>	<u>\$102,600</u>	

Degree of leverage	2.67
Percent increase in sales	10%
Percent increase in operating income	26.7%
X operating income	<u>\$81,000</u>
Increase in operating income	\$21,600
Present operating income	81,000
Proposed operating income	<u>\$102,600</u>

Cost Structure and Profit Volatility

- The proportion of variable to fixed costs will have a significant effect on operating income as the level of sales changes:
 - A higher proportion of fixed costs means a lower proportion of variable costs and a higher contribution margin ratio and contribution margin per unit.

- A higher contribution margin ratio means a higher volatility for operating income and that a change in units sold will have a proportionately larger effect on operating income.
- A lower proportion of fixed costs means a higher proportion of variable costs and a lower contribution margin ratio and contribution margin per unit.
- A lower contribution margin ratio means a lower volatility for operating income and that a change in units sold will have a proportionately smaller effect on operating income.
- Consider the results of two similar companies with the same initial revenues, total costs and operating incomes:

	<u>Current Sales Level</u>	
	<u>Company A</u>	<u>Company B</u>
Units sold	100	100
Sales	\$1,000	\$1,000
Variable	<u>700</u>	<u>300</u>
CM	300	700
Cm ratio	30%	70%
Fixed	<u>200</u>	<u>600</u>
Oper. Income	100	100

Now consider how changes in the sales level affect operating income:

	<u>Sales Increase of 50%</u>		<u>Sales Decrease of 20%</u>	
	<u>Company A</u>	<u>Company B</u>	<u>Company A</u>	<u>Company B</u>
Units sold	150	150	80	80
Sales	\$1,500	\$1,500	\$800	\$800
Variable Costs	<u>1,050</u>	<u>450</u>	<u>560</u>	<u>240</u>
CM	450	1,050	240	560
CM ratio	30%	70%	30%	70%
Fixed Costs	<u>200</u>	<u>600</u>	<u>200</u>	<u>600</u>
Operating Income	250	450	40	(40)

Company A had higher variable costs and lower fixed costs, a lower CM ratio and lower income volatility when units sold changed: income increased \$150 (\$100 to \$250) or decreased \$60 (\$100 to \$40).

Company B had lower variable costs and higher fixed costs, a higher CM ratio and higher income volatility when units sold changed: income increased \$350 (\$100 to \$450) or decreased \$140 (\$100 to a loss of \$40).

Practice Problems

Practice Problem # 1

M Company produces only one product, organic fruit baskets, which it sells for \$90 each. Unit variable costs are \$63 and total fixed expenses are \$21,000. Actual sales for the month of May totaled 2,000 units.

Required: Compute the margin of safety in dollars and percentage for the company for May.

Practice Problem #2

T Company reports the following results for the month of November:

Units sold	10,000
Sales	\$600,000
Variable costs	420,000
Contribution margin	180,000
Fixed costs	96,000
Net income	\$ 84,000

Management is considering the following independent courses of action to increase net income.

- I. Increase selling price by 10% with no change in units sold.
- II. Reduce variable costs to 50% of sales.
- III. Reduce fixed costs to \$75,600

Required: a) Prepare a breakeven income statement
 b) Prepare a breakeven income statement for each proposed course of action
 c) Calculate the contribution margin ratio for each alternative

Practice Problem #3

The H Company had wine sales for December as follows:

	<u>Red</u>	<u>White</u>	<u>Champagne</u>
Bottles sold	100	40	60
Average selling price	\$80	\$45	\$60
Average cost	\$40	\$15	\$15

The wine director's salary is \$36,000 per year plus tips, which average \$160 per month.

- Required:
- d) Prepare an income statement by type of wine and in total for December.
 - e) Prepare a breakeven income by type of wine and in total statement for December.

Practice Problem #4

I Company reported the following results from its income statement for the year: Sales of \$1,000,000 for 10,000 units sold. Contribution margin ratio was 30% and operating income was 10% of sales. Units sold are expected to increase 10% next year and an additional 20% the year thereafter with no changes in fixed expenses.

- Required:
- Using operating leverage calculations, compute the operating income for the year.

Practice Problem #5

F Company is debating whether to purchase new equipment that would increase fixed costs from \$96,000 to \$196,000, and decrease variable costs from \$14 per unit to \$8 per unit. If it were to implement the change at its current production level of 100,000, profit would not change. Selling price is \$20 per unit.

- Required:
- a) What would happen to the company's profit if the change were implemented and production decreased to 15,000?
 - b) Prepare a breakeven income statement if the new equipment was purchased

Practice Problem #6

K Company produces three picnic products: coolers, baskets and grills. A product line income statement for the year is shown below:

	<u>Koolers</u>	<u>Baskets</u>	<u>Grills</u>	<u>Total</u>
Sales	\$360,000	\$600,000	\$240,000	\$1,200,000
Variable expenses	<u>198,000</u>	<u>420,000</u>	<u>120,000</u>	<u>738,000</u>
CM	162,000	180,000	120,000	462,000
Fixed expenses				<u>240,000</u>
Operating income				\$262,000

- Required:
- Prepare a product line income statement at break-even.
 - If the company stops producing and selling grills because sales are low, fixed expenses will decrease \$60,000. Prepare a product line income statement at break-even.
 - If the company opens a sales office in Argentina next year, sales are expected to double. Prepare a product line income statement at the new sales level.
 - In second year in Argentina, total grill sales are expected to be \$800,000. Sales of all other products will increase an additional 10%. Fixed costs will increase \$140,000. Prepare a product line income statement.

Practice Problem #7

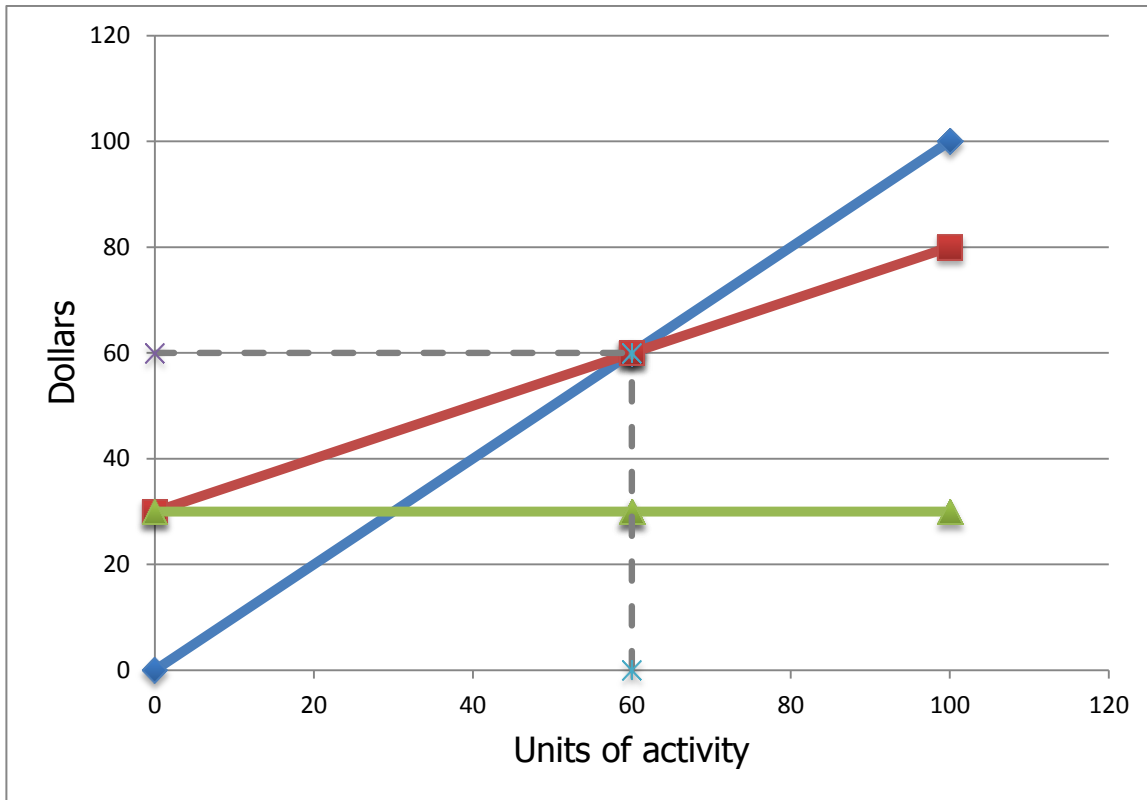
The following information is for a product manufactured and sold by R Company:

Selling price per unit	\$70
Variable cost per unit	\$40
Total fixed costs	\$600,000
Profit	\$30,000

- Required:
- How many units did Richards sell last year?
 - Management is considering decreasing the sales price to \$60 in an effort to increase market share and reach a profit of \$60,000. How many units would it have to sell at the lower selling price to achieve this target?

Practice Problem #8

Shown below is a cost-volume-profit graph.



Required: a) Label all parts of the graph

Following are several independent scenarios. For each scenario, identify whether the breakeven point will change, and if so, how.

- b)
- c)
- d)
- e)
- f)
- g)
- h)
- i)
- j)

True / False Questions

1. Contribution margin is equal to fixed costs at the break-even point.
True False
2. Break-even units equals fixed costs divided by unit contribution margin.
True False
3. Target units equals fixed costs plus target profit divided by the unit contribution margin.
True False
4. The target sales level equals fixed costs plus variable costs divided by the contribution margin ratio.
True False
5. Margin of safety is the difference between actual sales and budgeted sales.
True False
6. Cost-volume-profit analysis can be used to evaluate changes in cost structure.
True False
7. The degree of operating leverage can be multiplied by a change in sales to determine change in profit.
True False
8. In multiproduct cost-volume-profit analysis, a break-even point must be calculated separately for each product.
True False
9. If the unit contribution margin is \$1 and unit sales are 15,000 units above the break-even volume, then net income will be \$15,000.
True False
10. A target net income is calculated by taking actual sales minus the margin of safety.
True False
11. If variable costs per unit are 70% of sales, fixed costs are \$290,000 and target net income is \$70,000, required sales are \$1,200,000.
True False

12. Cost-volume-profit analysis assumes that all costs can be accurately described as either fixed or variable.
True False
13. On a CVP graph, the break-even point is the point at which the contribution margin line crosses the total cost line.
True False
14. Break-even units can be found by dividing fixed costs by unit contribution margin.
True False
15. The target sales level equals fixed costs plus variable costs divided by the contribution margin ratio.
True False

Multiple Choice Questions

1. Which component of the income statement should be set equal to zero to find the breakeven point?
 - a) Total sales revenue
 - b) Total variable costs
 - c) Total fixed costs
 - d) Profit

2. The equation for an income statement is
 - a) $\text{Unit price} \times Q - \text{Unit variable costs} \times Q - \text{Total fixed costs} = \text{Profit}$
 - b) $\text{Unit price} \times Q - \text{Unit variable costs} \times Q + \text{Total fixed costs} = \text{Profit}$
 - c) $(\text{Unit price} - \text{Unit variable costs} - \text{Total fixed costs}) \times Q = \text{Profit}$
 - d) $\text{Unit price} \times Q + \text{Unit variable costs} \times Q + \text{Total fixed costs} = \text{Profit}$

3. The formula for break-even point in terms of units is
 - a) $\text{Total variable costs} / \text{Unit contribution margin}$
 - b) $\text{Total fixed costs} / \text{Contribution margin ratio}$
 - c) $\text{Total fixed costs} / \text{Unit contribution margin}$
 - d) $\text{Total variable costs} / \text{Total fixed costs}$

4. J Company has a selling price of \$15, variable costs of \$10 per unit, and fixed costs of \$25,000. How many units must be sold to break-even?
 - a) 5,000
 - b) 10,000
 - c) 2,500
 - d) 1,667

5. A Company has a contribution margin of 40% and fixed costs of \$120,000. What is the break-even point?
 - a) \$48,000
 - b) \$300,000
 - c) \$200,000
 - d) \$72,000

6. P Company has fixed costs of \$200,000, sales price of \$50, and variable cost of \$30 per unit. How many units must be sold to earn profit of \$50,000?
 - a) 2,500
 - b) 10,000
 - c) 12,500
 - d) 25,000

7. H Company has sales of \$400,000, variable costs of \$12 per unit, fixed costs of \$100,000, and a target profit of \$60,000. How many units were sold?
 - a) 10,000
 - b) 15,000
 - c) 20,000
 - d) 25,000

8. B Company has fixed costs of \$20,000 and a contribution margin ratio of 40%. Currently, sales are \$75,000. What is Bowl's margin of safety?
 - a) \$20,000
 - b) \$25,000
 - c) \$30,000
 - d) \$50,000

The next 2 questions refer to the following information.

G Company currently sells 15,000 units a month for \$50 each, has variable costs of \$20 per unit, and fixed costs of \$300,000. G Company is considering increasing the price of its units to \$60 per unit. This will not affect costs.

9. If the price is changed, demand is expected to drop by 20%. The effect on profit will be:
 - a) Increase of \$30,000.
 - b) Increase of \$150,000.
 - c) Decrease of \$150,000.
 - d) Decrease of \$30,000

10. If the price is changed, how many units will G Company need to sell for profit to remain the same as before the price change?
 - a) 10,000 units
 - b) 11,250 units
 - c) 12,000 units
 - d) 12,500 units

11. Y Company is debating whether to change its cost structure so that fixed costs increase from \$300,000 to \$400,000, but variable costs decrease from \$5 per unit to \$4 per unit. If it were to implement the change at its current production level of 100,000, profit would not change. What would happen to the company's profit if the change were implemented and production increased to 125,000?
- It will stay the same.
 - It will increase.
 - It will decrease.
 - It could increase or decrease
12. Degree of operating leverage is calculated as
- profit divided by contribution margin
 - break-even sales divided by profit.
 - profit divided by break-even sales.
 - contribution margin divided by profit
13. F Company has a contribution margin of \$450,000 and profit of \$150,000. If sales increase 20%, by how much will profits increase?
- 20%
 - 30%
 - 60%
 - 90%
14. N Company sells two products. Product A sells for \$100 per unit, and has unit variable costs of \$60. Product B sells for \$70 per unit, and has unit variable costs of \$50. Currently, N Company sells three units of product B for every one unit of product A sold. N Company has fixed costs of \$750,000. How many units would N Company have to sell to earn a profit of \$250,000?
- 40,000 units of A and 40,000 units of B
 - 10,000 units of A and 30,000 units of B
 - 30,000 units of A and 10,000 units of B
 - 20,000 units of A and 20,000 units of B
15. Profit is indicated on a cost-volume-profit graph by
- the profit line.
 - the horizontal difference between the revenue line and the cost line.
 - the vertical difference between the revenue line and the cost line.
 - the horizontal distance from the breakeven point.

16. Last month K Company had a \$30,000 profit on sales of \$250,000. Fixed costs are \$60,000 a month. What sales revenue is needed for Calico to break even?
- \$166,667
 - \$90,000
 - \$30,000
 - \$280,000
17. Last month C Company had a \$15,000 loss on sales of \$150,000. Fixed costs are \$60,000 a month. How much do sales have to increase for Calico to break even?
- \$60,000
 - \$75,000
 - \$45,000
 - \$50,000
18. KV Company has fixed costs of \$400,000 and a contribution margin ratio of 25%. How much sales revenue must be earned for a profit of \$80,000?
- \$80,000
 - \$400,000
 - \$1,600,000
 - \$1,920,000
19. S Company has sales of \$105,000, variable costs of \$4 per unit, fixed costs of \$25,000, and a profit of \$20,000. What are the contribution margin and contribution margin ratio?
- \$4.00 and 133%
 - \$4.00 and 57.1%
 - \$3.00 and 42.9%
 - \$3.00 and 75%
20. T Company sells two products. Product A sells for \$100 per unit, and has unit variable costs of \$60. Product B sells for \$70 per unit, and has unit variable costs of \$50. Currently, T Company sells three units of product B for every one unit of product A sold. Toyoda has fixed costs of \$750,000. How many units would T Company have to sell to earn a profit of \$250,000?
- 40,000 units of A and 40,000 units of B
 - 10,000 units of A and 30,000 units of B
 - 30,000 units of A and 10,000 units of B
 - 20,000 units of A and 20,000 units of B

Solutions to Practice Problems

Practice Problem # 1

$$\begin{aligned} \text{CM ratio} &= \frac{\text{Sales} - \text{Variable Expenses}}{\text{Sales}} = \frac{\$90 - 63}{\$90} \\ &= 30\% \end{aligned}$$

$$\begin{aligned} \text{Breakeven sales} &= \frac{\text{Fixed expenses} + \text{Operating Income}}{\text{Contribution margin ratio}} = \frac{\$21,000 + \$0}{30\%} \\ &= \$70,000 \end{aligned}$$

Margin of Safety in dollars = $2000 \times \$90 - \$70,000 = \$110,000$

Margin of Safety percentage = $\$110,000 / \$180,000 = 61\%$

Practice Problem #2

a)

	<u>Present</u>	<u>Breakeven</u>
Units sold	10,000	10,000
Sales	\$600,000	\$636,000
Variable expenses	<u>420,000</u>	<u>420,000</u>
Contribution margin	180,000	110,000
Fixed expenses	<u>110,000</u>	<u>110,000</u>
Operating income	\$ 70,000	\$0
CM Ratio	30%	17.3%

b)

	I.	II.	III.
Units sold	4,000	3,200	4,200
Sales	\$264,000	\$192,000	\$252,000
Variable expenses	<u>168,000</u>	<u>96,000</u>	<u>176,400</u>
Contribution margin	96,000	96,000	75,600
Fixed expenses	<u>96,000</u>	<u>96,000</u>	<u>75,600</u>
Operating income	\$0	\$0	\$0
CM Ratio	36.4%	50%	30%

Practice Problem #3a) Current income statement:

	<u>Red</u>	<u>White</u>	<u>Champagne</u>	<u>Total</u>
Bottles sold	100	40	60	
Average selling price	\$80	\$45	\$60	
Total sales	\$8,000	\$1,800	\$3,600	\$13,400
Average cost	\$40	\$15	\$15	
Total Cost	\$4,000	\$600	\$900	5,500
Contribution margin	\$4,000	\$1,200	\$2,700	7,900
Fixed expenses				3,160
Operating income				\$4,740

b) Breakeven income statement:

- Sales mix (proportion of bottles sold) of 10:4:6 remains constant although the total number bottles may change. This means that of every 20 bottles sold, 10 will be red, 4 will be white and 6 will be champagne.
- Contribution margin for the twenty bottles will be \$790 ($10 \times \$40 + 4 \times \$30 + 6 \times \45).
- At breakeven, fixed expenses = contribution margin.
- At breakeven, contribution margin of \$3,120 / contribution margin of \$790 for twenty bottles = 4 twenty bottle groups would be sold. Therefore, 40 bottles of red, 16 bottles of white and 24 bottles of champagne were sold.

	<u>Red</u>	<u>White</u>	<u>Champagne</u>	<u>Total</u>
Bottles sold	40	16	24	
Average selling price	\$80	\$45	\$60	
Total sales	\$3,200	\$720	\$1,440	5,360
Average cost	\$40	\$15	\$15	
Total Cost	\$1,600	\$240	\$360	2,200
Contribution margin	\$1,600	\$480	\$1,080	3,160
Fixed expenses				3,160
Operating income				\$0

Practice Problem #4

	<u>Next Year</u>	<u>Year Thereafter</u>
Prior year Contribution margin	\$300,000	\$330,000
Prior year Operating income	\$100,000	130,000
Degree of leverage	3.00	2.54
Percent increase in sales	10%	20%
Percent increase in operating income	<u>30.0%</u>	<u>50.8%</u>
X operating income	<u>\$100,000</u>	<u>\$130,000</u>
Increase in operating income	\$30,000	\$66,000
Present operating income	<u>100,000</u>	<u>130,000</u>
Proposed operating income	<u><u>\$130,000</u></u>	<u><u>\$196,000</u></u>

Practice Problem #5

F Company is debating whether to purchase new equipment that would increase fixed costs from \$96,000 to \$196,000, and decrease variable costs from \$14 per unit to \$8 per unit. If it were to implement the change at its current production level of 100,000, profit would not change. Selling price is \$20 per unit.

<i>Units Sold</i>		<i>20,000</i>		<i>20,000</i>	<i>15,000</i>	<i>16,334</i>
Sales	\$20.00	\$400,000	\$20.00	\$400,000	\$300,000	\$326,667
Variable	<u>\$14.00</u>	<u>280,000</u>	<u>\$8.00</u>	<u>160,000</u>	<u>120,000</u>	<u>130,667</u>
CM	\$6.00	140,000	\$12.00	240,000	180,000	196,000
Fixed		<u>96,000</u>		<u>196,000</u>	<u>196,000</u>	<u>196,000</u>
OI		\$44,000		\$44,000	(\$16,000)	0

At 15,000 units produced and sold, the company would have a net loss of \$16,000.

Breakeven is \$326,667 with 16,334 units sold.

Practice Problem #6

Adding few basic calculations from the problem data (shown in bold) will make solving the problem much easier.

- a) Applying the percentages of total sales and the contribution margin ratios to a break-even income statement (income = 0):

	<u>Koolers</u>	<u>Baskets</u>	<u>Grills</u>	<u>Total</u>
% Total Sales	30%	50%	20%	
Sales	\$187,013	\$311,688	\$124,676	\$623,377
Variable expenses	<u>102,857</u>	<u>218,182</u>	<u>62,338</u>	<u>383,377</u>
CM	84,156	93,506	62,338	240,000
CM Ratio	45%	30%	50%	38.5%
Fixed expenses				<u>240,000</u>
Operating income				\$0

- b) Since grills have been discontinued, the percentages of total sales for the remaining two products and the overall contribution margin must be recalculated:

	<u>Koolers</u>	<u>Baskets</u>	<u>Grills</u>	<u>Total</u>
% Total Sales	37.5%	62.5%		
Sales	\$189,474	\$315,789		\$505,263
Variable expenses	<u>104,211</u>	<u>221,052</u>		<u>325,263</u>
CM	85,263	94,737		180,000
CM Ratio	45%	30%		35.625%
Fixed expenses				<u>180,000</u>
Operating income				\$0

Koolers % of sales: $30\% / (100\% - 20\%) = 37.5\%$

CM ratio = $(37.5\% \times 45\%) + (62.5\% \times 30\%) =$

35.625%

- c) Percentages and cm ratios do not change when sales are increased:

	<u>Koolers</u>	<u>Baskets</u>	<u>Grills</u>	<u>Total</u>
% Total Sales	30%	50%	20%	
Sales	\$720,000	\$1,200,000	\$480,000	\$2,400,000
Variable expenses	<u>396,000</u>	<u>840,000</u>	<u>240,000</u>	<u>1,476,000</u>
CM	324,000	360,000	240,000	924,000
CM Ratio	45%	30%	50%	38.5%
Fixed expenses				<u>240,000</u>
Operating income				\$684,000

d)

	<u>Koolers</u>	<u>Baskets</u>	<u>Grills</u>	<u>Total</u>
<i>% Total Sales</i>	<i>%</i>	<i>%</i>	<i>%</i>	
Sales	\$792,000	\$1,320,000	\$800,000	\$2,912,000
Variable expenses	<u>435,600</u>	<u>924,000</u>	<u>400,000</u>	<u>1,759,600</u>
CM	356,400	396,000	400,000	1,153,400
<i>CM Ratio</i>	<i>45%</i>	<i>30%</i>	<i>50%</i>	<i>39.6%</i>
Fixed expenses				<u>380,000</u>
Operating income				\$773,400

Practice Problem #7

	<u>Last Year</u>	<u>Next Year</u>
Net Income	\$600,000	\$600,000
Fixed costs	<u>30,000</u>	<u>60,000</u>
Contribution margin	\$630,000	\$660,000
Per Unit:		
Selling price	\$70	\$60
Variable cost	<u>40</u>	<u>40</u>
Contribution margin	\$30	\$20
Units required:	21,000	33,000

Solutions to True / False Problems

1. True
2. True
3. True
4. False - Target sales level equals fixed costs plus target profit divided by the contribution margin ratio.
5. False - The margin of safety is the difference between actual or budgeted sales and break-even sales.
6. True
7. True
8. False - The break-even point is calculated for the entire company using total contribution margin, weighted average contribution margin ratio and total fixed expenses.
9. True
10. False - Target operating income is target contribution margin – fixed expenses.
11. True
12. True
13. False - The break-even point is the point at which the total revenue line crosses the total cost line.
14. True
15. False - Target sales level equals fixed costs plus target profit divided by the contribution margin ratio.

Solutions to Multiple Choice Questions

- 1. D
- 2. A
- 3. C
- 4. A
- 5. B
- 6. C
- 7. C
- 8. B
- 9. A
- 10. B
- 11. B
- 12. D
- 13. C
- 14. B
- 15. C
- 16. A
- 17. D
- 18. D
- 19. C
- 20. B