

Chapter 03 Fundamentals of Cost-Volume-Profit Analysis

(medium) Multiproduct CVP Analysis

87. The president of AMG Enterprises is considering expanding sales by producing three different versions of their product. Each will be targeted by the marketing department to different income levels and hence will be produced from three different qualities of materials. After reviewing the sales forecasts, the sales department feels that for every item of A sold, 4 of M can be sold and 8 of G can be sold. The following information has been assembled by the sales department and the production department.

Unit Mix	1	+	4	+	8	= 13
	<u>A</u>		<u>M</u>		<u>G</u>	
Sales price (per unit)	\$15.00		\$10.00		\$5.00	
Material cost	9 $\left[\begin{array}{l} 5.00 \\ 2.00 \\ 2.00 \end{array} \right]$		7 $\left[\begin{array}{l} 4.00 \\ 1.50 \\ 1.50 \end{array} \right]$		4.50 $\left[\begin{array}{l} 2.00 \\ 1.25 \\ 1.25 \end{array} \right]$	
Direct labor						
Variable overhead						
CM	<u>6</u>		<u>3</u>		<u>0.50</u>	

Formula

The fixed costs associated with the manufacture of these three products are \$75,000 per year.

Required:

Determine the number of units of each product that would be sold at the break-even point.

$$BE \text{ units} = \frac{FC}{CM/unit}$$

Overall CM $1(\$6) + 4(\$3) + 8(\$0.50) = \22

$$CM/unit = \frac{\$22}{13} = \$1.69231$$

$$BE \text{ units} = \frac{FC}{CM/unit} = \frac{\$75,000}{\$1.69231} = 44,319 \text{ units}$$

	<u>A</u>	<u>M</u>	<u>G</u>
	$\frac{1}{13}$	$\frac{4}{13}$	$\frac{8}{13}$
	x 44,319	44,319	44,319
BE units	<u>3,410</u>	<u>13,637</u>	<u>27,274</u>

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The following information has been assembled by the sales department and the production department.

	<u>A</u>	<u>M</u>	<u>G</u>
Sales price (per unit)	\$15.00	\$10.00	\$5.00
Material cost	5.00	4.00	2.00
Direct labor	2.00	1.50	1.25
Variable overhead	2.00	1.50	1.25

The fixed costs associated with the manufacture of these three products are \$75,000 per year.

Required:

Determine the number of units of each product that would be sold at the break-even point.

$$\text{Weighted average CM} = [(15 - 9)(1) + (10 - 7)(4) + (5 - 4.50)(8)] / (1 + 4 + 8) = \$1.69231$$

$$\text{BE} = \$75,000 / 1.69231 = 44,319 \text{ total units}$$

$$A = 44,319 \times (1/13) = 3,410$$

$$M = 44,319 \times (4/13) = 13,637$$

$$G = 44,319 \times (8/13) = 27,274$$

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Application

Difficulty: Medium

Learning Objective: 4

Topic Area: Multiproduct CVP Analysis

88. Stanley Clipper, now retired, owns the Campus Barber Shop. He employs five (5) barbers and pays each a base rate of \$500 per month. One of the barbers serves as the manager and receives an extra \$300 per month. In addition to the base rate, each barber also receives a commission of \$3 per haircut. A barber can do as many as 20 haircuts a day, but the average is 14 haircuts per day. The Campus Barber Shop is open 24 days a month. You can safely ignore income taxes. Other costs are incurred as follows:

Advertising	\$200 per month
Rent	\$400 per month
Barber Supplies	\$.90 per haircut
Utilities	\$175 per month plus \$.35 per haircut
Magazines	\$ 25 per month
Cleaning Supplies	\$.15 per haircut

Stanley currently charges \$8 per haircut.

Required:

- (a) Compute the break-even point in (1) number of haircuts, (2) total sales dollars, and (3) as a percentage of capacity.
 (b) In March, 1,400 haircuts were given. Compute the operating profits for the month.
 (c) Stanley wants a \$2,160 operating profit in April. Compute the number of haircuts that must be given in order to achieve this goal.
 (d) If 1,500 haircuts are given in April, compute the selling price that would have to be charged in order to have \$2,160 in operating profits.

S	1	
	8	
VC	3	commission
	0.90	supplies
	0.35	utilities
4.40	0.15	supplies
	<hr/>	
CM	3.60	

$$(a)(1) \frac{FC}{CM/unit} = \frac{\$3600}{\$3.60} = 1,000 \text{ haircuts}$$

$$(a)(2) 1000 \text{ haircuts} \times \$8/hc = \$8,000 \text{ BE sales dollars.}$$

$$(a)(3) \frac{1000 \text{ haircuts}}{5 \text{ barbers} \times 20 \text{ max hc per day} \times 24 \text{ days per month}} = 41.67\% \text{ of capacity.}$$

$$(b) 1400 \text{ hc} - 1000 \text{ BE} = 400; 400 \times \$3.60 = \$1,440 \text{ profit.}$$

$$(c) \frac{(\$3600 + \$2160)}{\$3.60} = 1,600 \text{ haircuts}$$

$$(d) [(\$SP - 4.40) \times 1500] - 3600 = \$2160; SP = \$8.24/hc$$

FC	500 (\$5)	wages
	300	mgr.
	200	adv.
\$3,600	400	rent
	175	util
	25	Magazines
	<hr/>	
NI		

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- In March, 1,400 haircuts were given. Compute the operating profits for the month.
- Stanley wants a \$2,160 operating profit in April. Compute the number of haircuts that must be given in order to achieve this goal.
- If 1,500 haircuts are given in April, compute the selling price that would have to be charged in order to have \$2,160 in operating profits.

$$\text{Fixed costs} = 5(\$500) + \$300 + \$200 + \$400 + \$175 + \$25 = \$3,600$$

$$\text{Variable costs} = \$3.00 + \$0.90 + \$0.35 + \$0.15 = \$4.40 \text{ per haircut}$$

$$(a) (1) \$3,600 / (\$8 - 4.40) = 1,000 \text{ haircuts}$$

$$(2) 1,000 \times \$8.00 = \$8,000$$

$$(3) 1,000 / (5 \times \overset{14}{14} \times 24) = \del{59.2\%} \quad 41.67\%$$

$$(b) [(\$8.00 - 4.40) \times 1,400] - \$3,600 = \$1,440$$

$$(c) (\$3,600 + \$2,160) / (\$8.00 - 4.40) = 1,600 \text{ haircuts}$$

$$(d) [(\$SP - 4.40) \times 1,500] - 3,600 = 2,160; SP = \$8.24 \text{ per haircut.}$$

93 ^{medium} Zuma, Inc. is considering the introduction of a new music player with the following price and cost characteristics:

Sales price \$ 125 each
 Variable costs 75 each
 Fixed costs 180,000 per year

Projected sales are 7,500 units per year.

Required (consider each question independent of each other):

- (a) What will the operating profit be?
- (b) What is the impact on operating profit if the selling price per unit decreases by 15%?
- (c) What is the net income if variable costs per unit increase by 15% and Zuma has a 38% tax rate?

	<u>1</u>	<u>7500</u>	<u>1</u>	<u>7500</u>
S	\$ 125	\$ 937,500	(125 x .85) = 106.25	
VC	75	562,500	75	
CM	50	375,000	31.25	234,375
FC	180,000	180,000		- 180,000
NI		\$ 195,000 (a)		54,375 (b) (195,000 - 54,375) ----- 140,625 ↓ 72% drop

(c)	<u>1</u>	<u>7500</u>		
S	125	\$ 937,500		
VC	(75 x 1.15) = 86.25	646,875		
CM	38.75	290,625		
FC	180,000	- 180,000		
NI _{BT}		110,625		
38% tax		- 42,037.50		
NI _{AT}		\$ 68,587.50		

93. Zuma, Inc. is considering the introduction of a new music player with the following price and cost characteristics:

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Variable costs	75	each
Fixed costs	180,000	per year

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Required (consider each question independent of each other):

- (a) What will the operating profit be?
- (b) What is the impact on operating profit if the selling price per unit decreases by 15%?
- (c) What is the net income if variable costs per unit increase by 15% and Zuma has a 38% tax rate?

(a) $[(\$125 - 75)7,500] - 180,000 = \$195,000$

(b) $[(\$106.25 - 75)7,500] - 180,000 = \$54,375$, a decrease of 72%

(c) $\{[(\$125 - 86.25)7,500] - 180,000\}(1 - .38) = \$68,587.50$

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Analysis

Difficulty: Medium

Learning Objective: 1

Learning Objective: 2

Topic Area: Cost-Volume-Profit Analysis

96. *hard*

You have been provided with the following information regarding the York Manufacturing Company:

			1	30,000	
Sales price	\$ 50	S	50		
Variable manufacturing cost per unit	(24)	VC	30		
Fixed manufacturing costs per unit	12	CM	20	600,000	40% CM ratio
Variable marketing cost per unit	(6)	FC	15	450,000	
Fixed administrative costs per unit	3	NI	5	150,000	
				(a)	

This information is based on forecasted sales of 30,000 units.

Required:

- (a) What are the expected operating profits for the upcoming year?
- (b) What is the break-even point in units?
- (c) If \$160,000 of operating profits is desired, how many units must be sold?

(b)
$$\frac{450,000}{20} = 22,500 \text{ units} = \frac{FC}{CM/unit}$$

(c)
$$\begin{array}{r} S \quad 1,525,000 \\ VC \\ \hline 40\% \text{ CM} \quad 610,000 = 40\% \\ FC \quad 450,000 \\ \hline NI \quad 160,000 \end{array}$$

Handwritten notes for (c): A bracket connects the CM and FC lines, with a note $\div \$50 = 30,500 \text{ units}$. An arrow points from the NI line up to the FC line.

96. You have been provided with the following information regarding the York Manufacturing Company:

Sales price	\$ 50
Variable manufacturing cost per unit	24
Fixed manufacturing costs per unit	12
Variable marketing cost per unit	6
Fixed administrative costs per unit	3

This information is based on forecasted sales of 30,000 units.

Required:

- (a) What are the expected operating profits for the upcoming year?
- (b) What is the break-even point in units?
- (c) If \$160,000 of operating profits is desired, how many units must be sold?

(a) $[(\$50 - 24 - 6) \times 30,000] - ((12 + 3) \times 30,000) = \$150,000$

(b) $\$450,000/\$20 = 22,500$ units

(c) $(\$450,000 + 160,000)/20 = 30,500$ units

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Application

Difficulty: Hard

Learning Objective: 1

Learning Objective: 2

Topic Area: Cost-Volume-Profit Analysis

hard
99. Craddock sells three products. Last month's results are as follows:

	P1	P2	P3	Total
Revenues	\$150,000	\$225,000	\$225,000	600,000
Variable costs	60,000	210,000	120,000	390,000
	<u>90,000</u>	<u>15,000</u>	<u>105,000</u>	<u>210,000</u>
				FC 225,000

35% (a)

Total fixed costs are \$100,000 marketing and \$125,000 administrative.

Required:

- (a) What was the contribution margin ratio?
- (b) What sales volume does Craddock need to achieve a \$100,000 monthly profit?
- (c) What will profits be if Craddock increases sales by 20%?

(b) S \$928,571 ←

VC

CM $325,000 \div 35\%$

FC $\frac{225,000}{}$

NI $100,000$

(c) CM $210,000 \times 1.20 = 252,000$

- FC 225,000

NI 27,000

99. Craddock sells three products. Last month's results are as follows:

	<u>P1</u>	<u>P2</u>	<u>P3</u>
Revenues	\$150,000	\$225,000	\$225,000
Variable costs	60,000	210,000	120,000

Total fixed costs are \$100,000 marketing and \$125,000 administrative.

Required:

- (a) What was the contribution margin ratio?
- (b) What sales volume does Craddock need to achieve a \$100,000 monthly profit?
- (c) What will profits be if Craddock increases sales by 20%?

(a) $(\$600,000 - 390,000)/600,000 = 35\%$

(b) $(\$225,000 + 100,000)/35\% = \$928,571$

(c) $(\$600,000 - 390,000) \times 1.2 = \$252,000 - 225,000 = \$27,000$

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Analysis

Difficulty: Hard

Learning Objective: 1

Learning Objective: 4

Topic Area: Multiproduct CVP Analysis

100. The Scottso Corporation has budgeted fixed costs of \$225,000 and an estimated selling price of \$24 per unit. The variable cost ratio is 40% and the company plans to sell 48,000 units in 2010.

Required:

- Compute the break-even point in units.
- Compute the margin of safety (in units) for 2010.
- Compute the expected operating profit for 2010.

		48,000	BE		MOS
%	1	<u>1,152,000</u>	375,000	=	777,000
\$	24				
40% VC			225,000	←	
60% CM	14.4	<u>691,200</u>	225,000	÷ 60%	
FC	225,000	<u>225,000</u>	<u>225,000</u>		
NI		\$466,200	0		
		(c)			

$$(a) \frac{FC}{CM/unit} = \frac{225,000}{14.4} = \boxed{15,625 \text{ units}}$$

$$(b) \begin{array}{l} \text{Actual Units} - \text{BE units} = \text{MOS units} \\ 48,000 - 15,625 = \boxed{32,375 \text{ units}} \end{array}$$

$$(c) \boxed{\$466,200}$$

100. The Scottso Corporation has budgeted fixed costs of \$225,000 and an estimated selling price of \$24 per unit. The variable cost ratio is 40% and the company plans to sell 48,000 units in 2010.

Required:

- (a) Compute the break-even point in units.
- (b) Compute the margin of safety (in units) for 2010.
- (c) Compute the expected operating profit for 2010.

(a) $BE = \$225,000 / (\$24 - .40 \times \$24) = 15,625$ units

(b) Margin of safety = $48,000 - 15,625 = 32,375$ units

(c) $48,000 \times (\$24 \times .6) - \$225,000 = \$466,200$

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Application

Difficulty: Medium

Learning Objective: 1

Topic Area: Cost-Volume-Profit Analysis

102. The sales manager of Acme Enterprises is considering expanding sales by producing three different versions of their product. Each will be targeted by the marketing department to different income levels and will be produced from three different qualities of materials. After reviewing the sales forecasts, the sales department feels that 40% of units sold will be the original product, 35% will be new model #1 and the remainder will be new model #2.

The following information has been assembled by the sales department and the production department.

	40% <u>Original</u>	35% <u>Model #1</u>	25% <u>Model #2</u>
Sales price (per unit)	\$100.00	\$70.00	\$50.00
Material cost	45.00	30.00	20.00
Direct labor	20.00	15.00	10.00
Variable overhead	15.00	11.25	7.50
	<u>20.00</u>	<u>13.75</u>	<u>12.5</u>

The fixed costs associated with the manufacture of these three products are \$175,000 per year.

Required:

Determine the number of units of each product that would be sold at the break-even point.

	40%	35%	25%	
CM	20	13.75	12.5	
	<hr/>	<hr/>	<hr/>	
weighted CM	8	+ 4.8125	+ 3.125	= 15,9375

FC

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The following information has been assembled by the sales department and the production department.

	<u>Original</u>	<u>Model #1</u>	<u>Model #2</u>
Sales price (per unit)	\$100.00	\$70.00	\$50.00
Material cost	45.00	30.00	20.00
Direct labor	20.00	15.00	10.00
Variable overhead	15.00	11.25	7.50

The fixed costs associated with the manufacture of these three products are \$175,000 per year.

Required:

Determine the number of units of each product that would be sold at the break-even point.

$$\text{Weighted average CM} = (100 - 80)(.4) + (70 - 56.25)(.35) + (50 - 37.50)(.25) = \$15.9375$$

$$\text{BE} = \$175,000 / 15.9375 = 10,980 \text{ total units}$$

$$\text{Original} = 10,980 \times 40\% = 4,392 \text{ units}$$

$$\text{Model \#1} = 10,980 \times 35\% = 3,843 \text{ units}$$

$$\text{Model \#2} = 10,980 \times 25\% = 2,745 \text{ units}$$

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Application

Difficulty: Medium

Learning Objective: 4

Topic Area: Multiproduct CVP Analysis

105. The Spice House packages horseradish and mustards in a factory that can operate one, two or three shifts. The product sells for \$10 a case and has variable costs of \$4 per case. Fixed costs are related to the number of shifts that are operated, with the estimated costs as follows:

	<u>Daily volume</u>	<u>Fixed Costs</u>
1 shift	0 – 2,000	\$3,000
2 shifts	2,001 – 4,000	\$5,700
3 shifts	4,001 – 6,000	\$8,200

Required:

- (a) Determine the break-even point(s).
- (b) If Spice House can sell all it can produce, how many shifts should be operated?

105. The Spice House packages horseradish and mustards in a factory that can operate one, two or three shifts. The product sells for \$10 a case and has variable costs of \$4 per case. Fixed costs are related to the number of shifts that are operated, with the estimated costs as follows:

	<u>Daily volume</u>	<u>Fixed Costs</u>
1 shift	0 – 2,000	\$3,000
2 shifts	2,001 – 4,000	\$5,700
3 shifts	4,001 – 6,000	\$8,200

Required:

- (a) Determine the break-even point(s).
 (b) If Spice House can sell all it can produce, how many shifts should be operated?

1 shift = $\$3,000 / (10 - 4) = 500$ cases: break-even

2 shifts = $\$5,700 / 6 = 950$ cases: break-even

3 shifts = $\$8,200 / 6 = 1,367$ cases: break-even

Spice House will break-even at any shift level

(b) 1 shift: $2,000 \times 6 - 3,000 = \$9,000$

2 shift: $4,000 \times 6 - 5,700 = \$18,300$

3 shift: $6,000 \times 6 - 8,200 = \$27,800$

Spice House will maximize profits by operating 3 shifts

AACSB: Analytic

AICPA: FN-Decision Making

Bloom's: Synthesis

Difficulty: Hard

Learning Objective: 4

Topic Area: Alternative Cost Structures