

Chapter 4

Variable Costing

Cost-Volume-Profit

Break-Even Point

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Chapter 4. Variable costing; Cost-Volume-Profit; Break-Even Point

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Learning Objectives

- *Identify what distinguishes variable costing from absorption costing.*
- *Understand the assumptions underlying cost-volume-profit (CVP) analysis.*
- *Explain the features of CVP analysis and break-even point.*
- *Explain CVP analysis in decision-making.*
- *Apply CVP analysis to a company that produces multiple products.*

Job-costing system Process-costing system Joint product and by-products	<i>Each job is unique. (Manufactured by small batch, product tailored to customer's specific needs).</i>
	<i>Mass production of standardized products or services</i>
	<i>The production of one product makes the production of other products inevitable.</i>
Full / absorption costing Variable costing Activity-Based Costing (ABC) Standard Costs	<i>With this system, all the variable manufacturing costs plus fixed manufacturing overheads are allocated to products.</i>
	<i>With this system, only variable manufacturing costs are assigned to products.</i>
	<i>With this system, activities are used to assign costs to other cost objects such as products or services.</i>
	<i>This system uses expected or budgeted costs rather than actual costs. The variances (the difference between the standard costs and the actual costs) are then recorded periodically.</i>

COST ACCUMULATION SYSTEM

Full / absorption costing

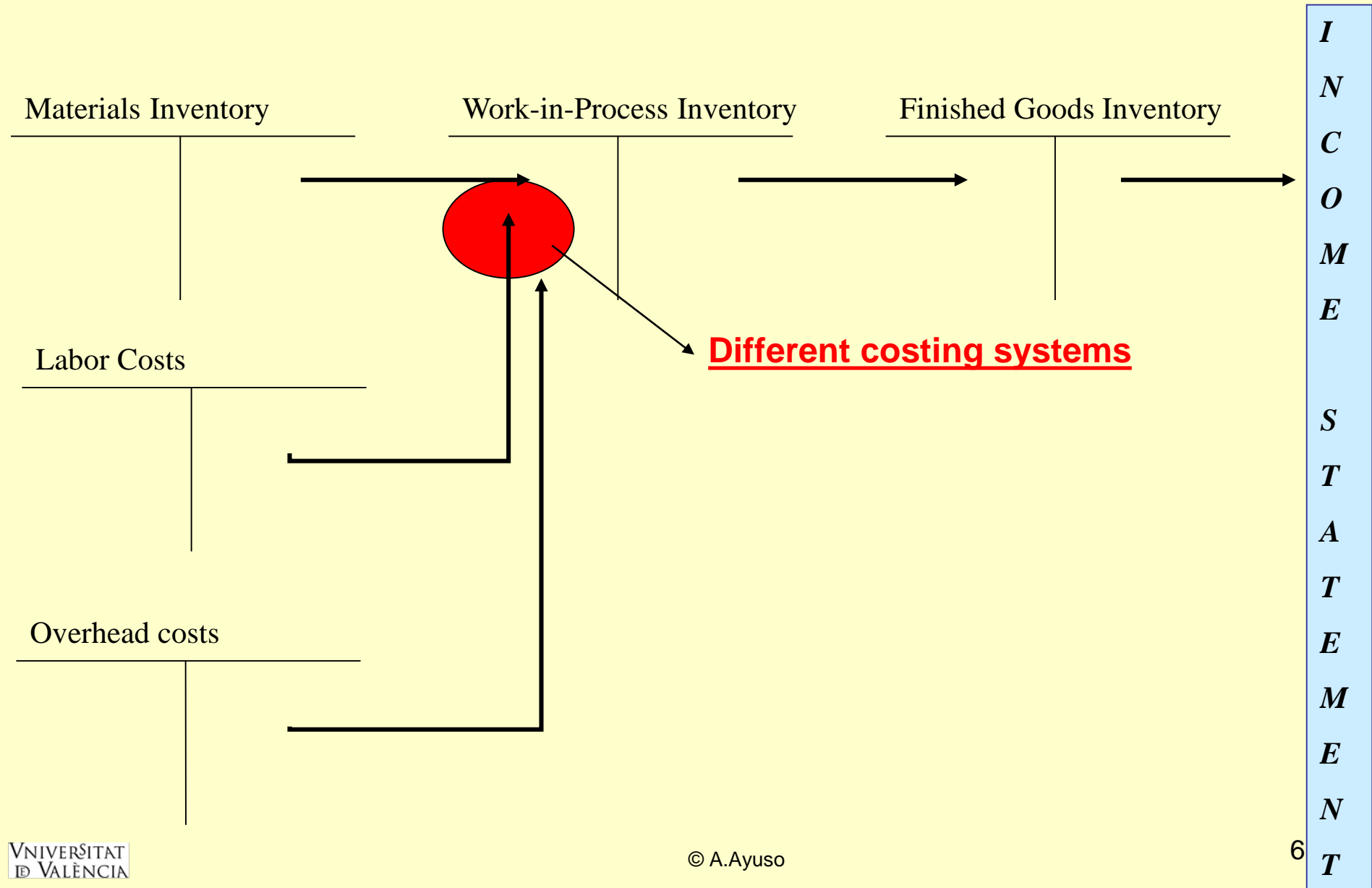
With this system, all the manufacturing costs are allocated to products (variable+ fixed).

Variable costing

With this system, only variable manufacturing costs are assigned to products.

The difference between variable costing and absorption costing stems from the treatment of fixed manufacturing overheads.

General-Ledger T-Accounts Cost Flow (I)



Variable Costing

Work-in-Process inventory

Beginning work in process

Costs of goods manufactured

Manufacturing costs incurred during the period:

Materials used
Manufacturing labor
Overhead manufacturing costs

ONLY VARIABLE MANUFACTURING COSTS

Ending work in process

FIXED MANUFACTURING COSTS ARE TREATED AS COSTS FOR THE PERIOD

Absorption (Full) Costing

Work-in-Process inventory

Beginning work in process

Costs of goods manufactured

Manufacturing costs incurred during the period:

Materials used
Manufacturing labor
Overhead manufacturing costs

**VARIABLE + FIXED (DIRECT + INDIRECT)
MANUFACTURING COSTS**

Ending work in process

VARIABLES + FIXED NON-MANUFACTURING COSTS ARE TREATED AS COSTS FOR THE PERIOD

Income Statement Report on Full costing system

		<i>PRODUCT "A"</i>			
<i>concepts</i>		<i>units</i>	<i>unit cost</i>	<i>\$ Value</i>	<i>%</i>
+	Revenues	10	2000	20,000	100%
-	Cost of Goods Sold	10	1500	15,000	75%
=	Gross Margin	10	500	5,000	25%
Operating Cost (Cost period):					
-	Marketing Department			800	4%
-	Administration Department			300	1.5%
=	Operating income	10	390	3,900	19.5%

Internal Income Statement based on variable costing system

	<i>units</i>	<i>unit cost</i>	<i>\$ Value</i>	<i>%</i>
<i>concepts</i>				
+ Revenues	10	2,000	20,000	100%
- Cost of Goods Sold (variable manufacturing cost)	10	1,000	10,000	50%
= Variable non-manufacturing cost	10	50	500	2.5%
- Contribution margin	10	950	9,500	47.5%
- Fixed manufacturing cost			800	4%
- Fixed non-manufacturing cost			300	1.5%
= Operating income	10	840	8,400	42%

Alternative Income Statement Formats

Youtube video: Absorption (full) versus variable costing system <https://www.youtube.com/watch?v=2e6-Xw9LRIs>

Variable costing system

Revenues		\$1,000
Variable Manufacturing Costs	\$ 250	
Variable Nonmanufacturing Costs	270	520
Contribution Margin		480
Fixed Manufacturing Costs	160	
Fixed Nonmanufacturing Costs	138	298
Operating Income		\$182

Full costing system

Revenues		\$1,000
Cost of Goods Sold (\$250+160)		410
Gross Margin		590
Nonmanufacturing Costs (\$270+138)		408
Operating Income		\$182

Break-even Point

Youtube video: How to find the break-even point in sales and units

<https://www.youtube.com/watch?v=9izg6KyV4HU>

Number of units to be sold to break-even point

Total revenues = Total costs

Operating Income = 0

Contribution
Margin

=

Fixed
costs

CVP analysis is based on several assumptions: (I)

1. Changes in the level of revenues and costs arise only because of changes in the number of product (or service) units produced and sold.
2. Total costs can be divided into a fixed component and a component that is variable with respect to the level of output.
3. When plotted, the behavior of total revenues and total costs is linear (straight-line) in relation to output units within the relevant range and time period.

CVP analysis is based on several assumptions: (II)

4. The unit selling price, unit variable costs, and fixed costs are known and constant.
5. The analysis either covers a single product or assumes that the sales mix when multiple products are sold remains constant as the number of total units sold changes.
6. All revenues and costs can be added and compared without taking into account the time value of money.

CVP analysis is based on several assumptions: (III)

- In some real-world settings, the six above-described assumptions may not hold.
- CVP analysis may still be useful in these situations but the analysis becomes more complex.
- Always assess whether a simplified CVP analysis generates sufficiently accurate predictions of how total revenues and total costs behave.
- Use a more complex approach with multiple revenue drivers, multiple cost drivers, and cost functions that are not linear only if doing so will significantly improve decisions.

Abbreviations

SP = Selling price

VCU = Variable cost per unit

CMU = Contribution margin per unit

CM% = Contribution margin percentage

FC = Fixed costs

Q = Quantity of output units sold

OI = Operating income

Equation Method

Revenues – Variable costs – Fixed cost = Operating Income

↓
(Selling price × Quantity sold)

↓
(Variable unit cost × Quantity sold)

Let Q = the number of units to be sold to break even
Let R = the revenues to be sold to break even

Operating Income = 0

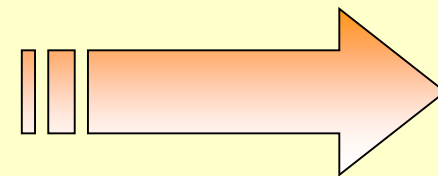
Let Q = the number of units to be sold to break even

$$(SP \times Q) - (VCU \times Q) - FC = OI$$

$$(SP - VCU) \times Q = FC + OI$$

$$CMU \times Q = FC + OI$$

$$Q = \frac{FC + OI}{CMU}$$



$$Q = \frac{FC + OI}{CMU}$$

UNITS FOR A DESIRED PROFIT

Setting $OI = 0$

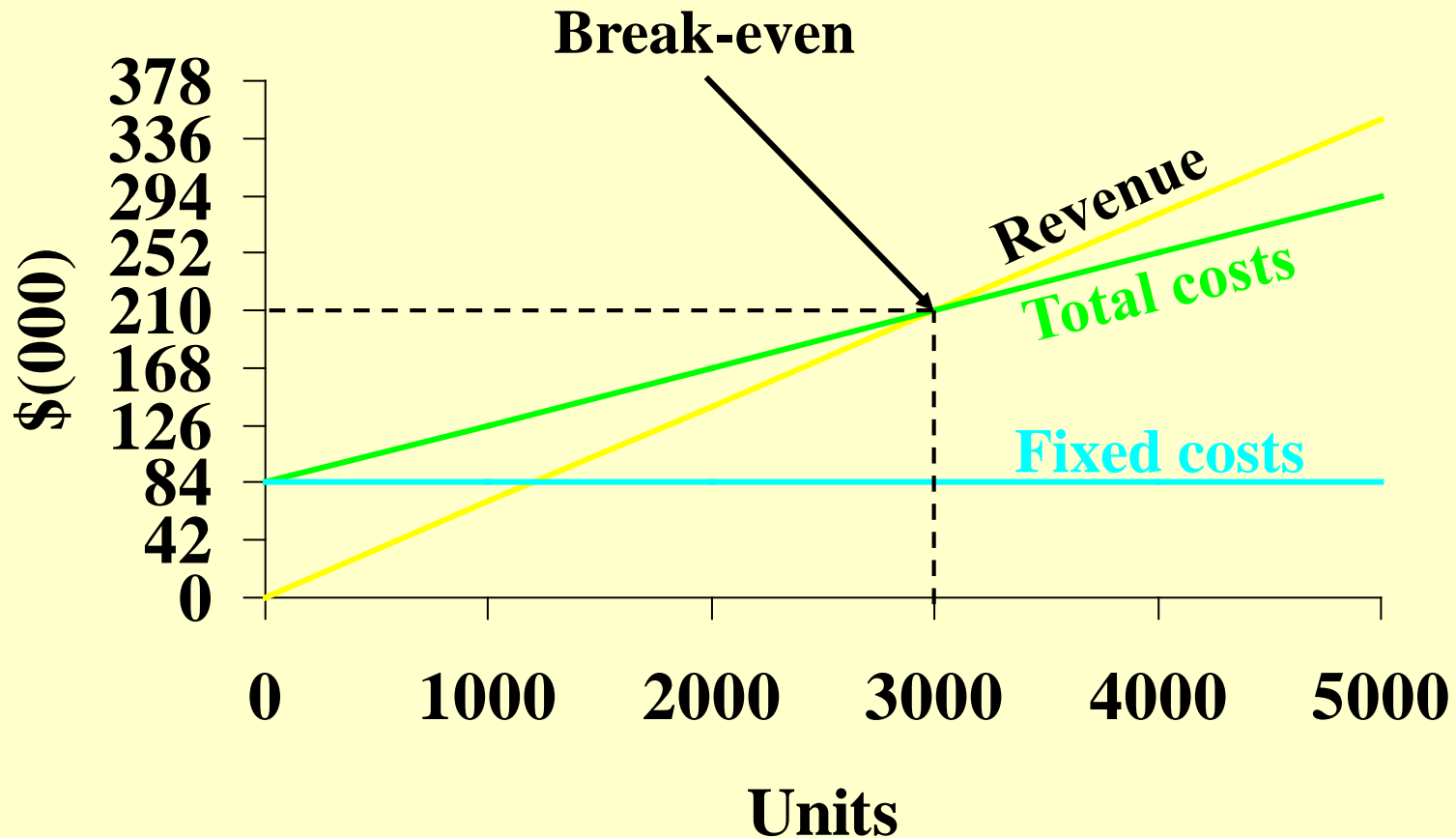
$$Q = \frac{FC}{CMU}$$

BEP NUMBER OF UNITS

$$R = \frac{FC}{CM\%}$$

BEP REVENUES (\$)

Graph Method



Sensitivity Analysis

- CVP provides structure for answering a variety of “what-if” scenarios
- “What” happens to profit “if”:
 - The selling price changes?
 - The volume changes?
 - The cost structure changes?
 - The variable cost per unit changes?
 - The fixed cost changes?

CVP analysis helps managers to plan

CVP analysis helps managers to answer questions

How will raising or lowering our selling price affect the output level?

Should the company reduce the selling price?

How much revenue is needed to earn an operating income of \$30,000?

How should the product be priced?

CVP for Service and Not-For-Profit Organizations

- CVP is not just for merchandising and manufacturing companies.
- Service and not-for-profit organizations need to focus on measuring their output. This is different from the ‘units sold’ we have been dealing with.
- For example, a service agency may measure how many people they help and an airline may measure how many passenger miles they fly.

Margin of Safety (MOS) Defined

- Calculating margin of safety answers a very important question:
- If budgeted revenues are above the break-even point, how far can they fall before the break-even point is reached? In other words, how far can they fall before the company begins to lose money?

Margin of Safety (MOS)

- The margin of safety (MOS) is an indicator of risk. It measures the distance between budgeted sales and breakeven sales:
 - $\text{MOS} = \text{Budgeted Sales} - \text{BE Sales}$
- The MOS ratio removes the firm's size from the output. It is expressed in the form of a percentage:
 - $\text{MOS Ratio} = \text{MOS} \div \text{Budgeted Sales}$

Margin of Safety (MOS)

CURRENT — ***BEP***

€ or \$ → $MOS = \text{REVENUES} - \text{REVENUES}$

\$ 3,000
\$ 8,000
\$ 5,000

Q → $MOS = \text{QUANTITY} - \text{QUANTITY}$

15 Units
40
25

% → $M=S = \frac{M=S (\$)}{\text{Current REVENUES}}$

$37.5\% = \frac{\$3,000}{\$8,000}$

3.3 The break-even point with multiple products

- The formulas presented so far have assumed that a single product is produced and sold. A more realistic scenario is that of multiple products sold in different volumes and with different costs.
- **The Sales-Mix is the proportion in which two or more products are sold.**
- **Assumptions:**
 - The sales mix proportion must be pre-determined.
 - The sales mix must not change within the relevant time period.
- **The same formulas are used. However weighted average contribution margins must be used.**

- The **Sales-Mix** is the proportion in which two or more products are sold.

Sales mix of revenues

STATEMENT	A (75%)				B (25%)				TOTAL 100%			
	Units	Unit C.	Value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	60	200	12,000	100%	40	100	4,000	100%	100	160	16,000	100%

*Sales mix of units.
Proportion 3:2*

Bundle = set = batch = group

Sales mix of revenues

STATEMENT	A (75%)				B (25%)				TOTAL 100%			
	Units	Unit C.	value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	60	200	12,000	100%	40	100	4,000	100%	100	160	16,000	100%
Variable Costs	60	120	7,200	60%	40	70	2,800	70%	100	100	10,000	62.50%
Contribution Margin	60	80	4,800	40%	40	30	1,200	30%	100	60	6,000	37.50%
Fixed Costs											4,500	28.13%
Operating Income											1,500	9.38%

Revenues	% SALES MIX REVENUES	CM%	WACM%
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A	12,000	75%	40	30
B	4,000	25%	30	7.5

37.5

BEP WHOLE
COMPANY
per WAC%

4,500
37.5

120 UNITS A
B

120 75%
120 25%

90 UNITS BEP A
30 UNITS BEP B
120 UNITS BEP COMPANY

Sales mix of units. Proportion 3:2

Bundle = set = batch = group

STATEMENT	A (75%)				B (25%)				TOTAL 100%			
	Units	Unit C.	value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	60	200	12,000	100%	40	100	4,000	100%	100	160	16,000	100%
Variable Costs	60	120	7,200	60%	40	70	2,800	70%	100	100	10,000	62.50%
Contribution Margin	60	80	4,800	40%	40	30	1,200	30%	100	60	6,000	37.50%
Fixed Costs											4,500	28.13%
Operating Income											1,500	9.38%

	Units	BUNDLE PROPORTION	CMU	CM Per Bundle
A	60	3	80	240
B	40	2	30	60
				300

BEP WHOLE
COMPANY
per BUNDLE

4.500
300

15 Bundles A
B

15 3
15 2

45 UNITS BEP A
30 UNITS BEP B
75 UNITS BEP COMPANY

**BEP \$
Whole
Company**

$$R = \frac{FC}{\text{Weighted Average CM \%}} =$$

$$= \frac{FC}{(\text{Sales mix percentage}^A \times \text{CM \%}^A) + (\text{Sales mix percentage}^B \times \text{CM \%}^B)} =$$

$$= \text{BEP \$ Whole Company} \begin{cases} \nearrow \times \text{Sales mix percentage}^A = \text{BEP Product}^A \\ \searrow \times \text{Sales mix percentage}^B = \text{BEP Product}^B \end{cases}$$

3.4 The Segmented Income Statement Report

Youtube video: **Segmented Income Statements**

<https://www.youtube.com/watch?v=q39AzZhpoNQ>

SEGMENTED INCOME STATEMENT REPORT

This is an income statement report that divides fixed costs into traceable costs and common costs for each part of the organization, e.g. company, division, department, product line, product or location.

FIXED

COSTS

TRACEABLE FIXED COSTS

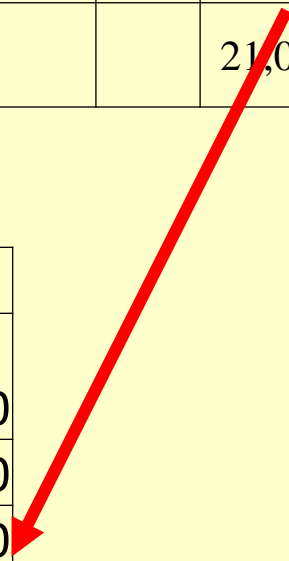
A traceable fixed cost is a fixed cost that is incurred because of the existence of a segment. If the segment had never existed, the fixed cost would not have been incurred, and if the segment were eliminated, the fixed cost would disappear.

COMMON FIXED COSTS

A common fixed cost is a fixed cost that supports the operations of more than one segment but is not traceable in whole or in part to any one segment. Even if a segment were entirely eliminated, there would be no change in a true common fixed cost.

January	A (60%)				B (40%)				TOTAL 100%			
	Units	Unit C.	value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	10,000	6	60,000	100%	5,000	8	40,000	100%	15,000	6.67	100,000	100%
Variable Costs	10,000	3	30,000	50%	5,000	6	30,000	75%	15,000	4.00	60,000	60%
Contribution Margin	10,000	3	30,000	50%	5,000	2	10,000	25%	15,000	2.67	40,000	40%
Fixed Costs											19,000	19%
Operating Income											21,000	21%

	A	B	TOTAL
Traceable (direct) fixed costs	5,000	4,000	9,000
Common fixed costs			10,000
Total			19,000



SEGMENTED INCOME STATEMENT REPORT

January	A (60%)				B (40%)				TOTAL 100%			
	Units	Unit C.	value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	10,000	6	60,000	100%	5,000	8	40,000	100%	15,000	6.67	100,000	100%
Variable Costs	10,000	3	30,000	50%	5,000	6	30,000	75%	15,000	4.00	60,000	60%
Contribution Margin	10,000	3	30,000	50%	5,000	2	10,000	25%	15,000	2.67	40,000	40%
Traceable (Direct) Fixed Costs			5,000	8,33%			4,000	10%			9,000	9%
Segmented Margin			25,000	41,67%			6,000	15%			31,000	31%
Common Fixed Costs											10,000	10%
Operating Income											21,000	21%

	A	B	TOTAL
Traceable (direct) fixed costs	5,000	4,000	9,000
Common fixed costs			10,000
Total			19,000

CRITICAL POINT

$$\text{CRITICAL POINT BY SEGMENT "Q"} = \frac{\text{TRACEABLE(DIRECT) FC}}{\text{CMU}}$$

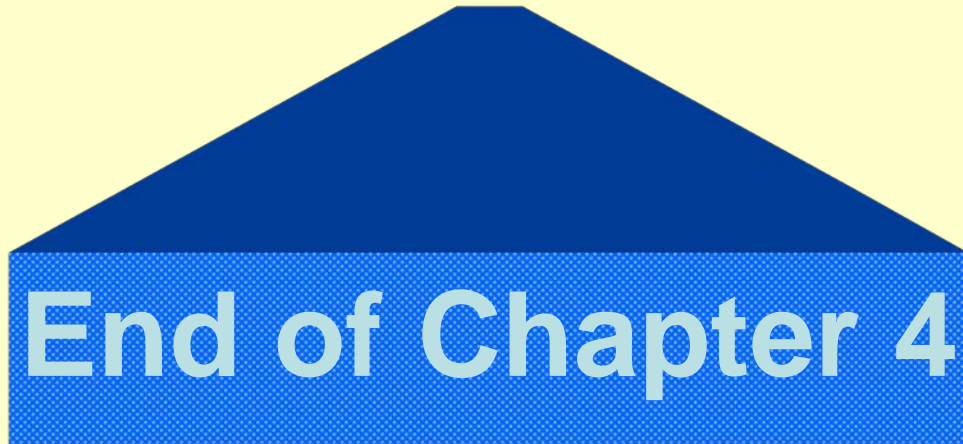
CRITICAL POINT "A"

$$\frac{5,000}{3} = 1,667 \text{ "A"}$$

CRITICAL POINT "B"

$$\frac{4,000}{2} = 2,000 \text{ "B"}$$

	A (60%)				B (40%)				TOTAL 100%			
CRITICAL POINT "A" & "B"	Units	Unit C.	value	%	Units	Unit C.	value	%	Units	Unit C.	Value	%
Revenues	1,667	6	10,000	100%	2,000	8	16,000	100%	3,667	7.09	26,000	100,00 %
Variable Costs	1,667	3	5,000	50%	2,000	6	12,000	75%	3,667	4.64	17,000	65.38%
Contribution Margin	1,667	3	5,000	50%	2,000	2	4,000	25%	3,667	2.45	9,000	34.62%
Traceable (Direct) Fixed costs			5,000	50%			4,000	25%			9,000	34.62%
Segmented Margin			0	0%			0	0%			0	0,00%
Common Fixed Costs											10,000	38.46%
Operating Income											-10,000	- 38.46%



End of Chapter 4

Any questions?

Thank you for your attention.