

## **Cost-Volume-Profit analysis**

(Relevant to AAT Examination Paper 3 – Management Accounting)

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### **Introduction**

Cost-volume-profit analysis (CVP) is the study of the effects on future profit of changes in fixed cost, variable cost and sales prices, quantity and mix. It is also known as break-even analysis (CIMA Official Terminology). Break-even means there is neither profit nor loss from the business operation. CVP is a useful management tool used by planners in determining the amount of sales needed to cover all expenses; determining the income level for a desired level of profit; and evaluating and justifying a new marketing strategy.

### **Assumptions**

It is important to know the following assumptions in CVP analysis before we can use it effectively.

- (a) Fixed costs are constant at all levels of output.
- (b) Unit variable cost is the same at all levels of output.
- (c) Unit selling price is constant at all levels of output.
- (d) Production volume and sales volume are the same.
- (e) The estimates of fixed costs and variable costs per unit are certain.
- (f) CVP can only be applied to a single product situation or a group of products with a fixed mix sales ratio.

### **Calculation of break-even point with CVP analysis**

The break-even point can be presented either in terms of units or sales value. The formulae for calculating the break-even point are as follows:

Break-even point (in units):  $\text{Fixed costs (contribution required to breakeven)} \div \text{contribution margin per unit}$

Break-even point (in sales value):  $\text{Fixed costs} \div \text{contribution margin ratio}$

Contribution margin ratio:  $\text{Contribution} \div \text{sales} \times 100\%$

The contribution margin (CM) ratio is a measure of how much contribution is earned from each \$1 of sales.

### **Calculation of margin of safety**

The margin of safety (MOS) is the difference in activity levels between the budgeted activity level and the break-even point. It can be expressed in units, sales value and

as a percentage of the budgeted sales units or value as follows:

Margin of safety (in units): Budgeted sales units – break-even point in units

Margin of safety (in sales value): Budgeted sales revenue – break-even point in sales revenue

Margin of safety (in percentage terms):

(Budgeted sales units – break-even point in units) ÷ budgeted sales units x 100%, or  
(Budgeted sales revenue – break-even point in sales revenue) ÷ budgeted sales revenue x 100%

### Example 1

The marginal costing operating statement of AAT Limited for the year just ended is as follows:

	\$
Sales (5,000 units at \$4 per unit)	20,000
Variable costs (direct materials, direct labour, etc.)	<u>8,000</u>
Contribution	12,000
Fixed cost	<u>7,500</u>
Profit	<u><u>4,500</u></u>

Required:

- (a) Calculate the break-even point.
- (b) Calculate the margin of safety.

Solution:

- (a) Contribution margin per unit =  $\$12,000 \div 5,000 = \$2.4$   
Contribution margin ratio =  $\$12,000 \div 20,000 \times 100\% = 60\%$

Break-even point (in units) = Fixed costs (contribution required to break-even) ÷ contribution margin per unit =  $\$7,500 \div \$2.4 = 3,125$  units

Break-even point (in sales value) = Fixed costs ÷ contribution margin ratio =  $\$7,500 \div 60\% = \$12,500$

- (b) Margin of safety:  
Sales units – break-even point in units = (5,000 units – 3,125 units) = 1,875 units, or

Sales revenue – break-even point in sales revenue =  $\$(20,000 - 12,500) = \$7,500$ , or

(Sales units – break-even point in units) ÷ Sales units x 100% =  $(1,875 \div 5,000)$  units x 100% = 37.5%, or

(Sales revenue – break-even point in sales revenue) ÷ sales revenue x 100% =  $\$(7,500 \div 20,000) \times 100\% = 37.5\%$

## Use CVP for planning in different scenarios

When a company plans to achieve a desired profit during a period, the sales value must cover all costs and leave the target profit. The required contribution will equal the fixed costs plus the target profit. The sales level needed to achieve a target profit can be calculated as follows:

Sales level to achieve a target profit (in units):  $(\text{Fixed costs} + \text{target profit}) \div \text{contribution margin per unit}$

Sales level to achieve a target profit (in sales value):  $(\text{Fixed costs} + \text{target profit}) \div \text{contribution margin ratio}$

Moreover, we can manipulate the variables (selling price, units sold, variable costs and fixed costs) so as to help plan different scenarios.

### Example 2

AAT Limited is now planning for the coming year. Assume that the unit selling price, contribution margin ratio and fixed cost will be the same as in Example 1.

Required:

Calculate:

- The sales level to achieve a target profit of \$22,500.
- The selling price to be charged to earn a profit of \$22,500 on sales of 10,000 units.
- The additional sales volume required to meet \$5,700 additional fixed promotion expenses to maintain the original profit.

Solution:

- Sales level to achieve the target profit:  
 $(\text{Fixed costs} + \text{target profit}) \div \text{contribution margin per unit}$   
 $= \$ (7,500 + \$22,500) \div \$2.4 = 12,500 \text{ units, or}$   
  
 $(\text{Fixed costs} + \text{target profit}) \div \text{contribution margin ratio}$   
 $= \$ (7,500 + 22,500) \div 60\% = \$50,000$
- Let SP be the unit selling price, then  
 $(10,000 \times \text{SP}) \times 60\% - \$7,500 = \$22,500$   
 $6,000 \text{ SP} = \$30,000$   
 $\text{SP} = \$5$   
Selling price to be charged: \$5 per unit
- Let Q be the units sold, then  
 $(\$4 \times Q) \times 60\% - \$7,500 - \$5,700 = \$4,500$   
 $2.4Q = 17,700$   
 $Q = 7,375$   
Additional sales volume required:  $(7,375 - 5,000) \text{ units} = 2,375 \text{ units.}$

**Example 3 (AAT Paper 3 Management Accounting, June 2010, Modified)**

The operating statement relating to the latest financial year of Hercules Manufacturing Limited is as follows:

	\$'000	\$'000
Sales (22,000 units)		3,300
Direct materials	726	
Direct labour	374	
Production overheads	<u>798</u>	
		<u>1,898</u>
Gross profit		1,402
Selling overheads		<u>1,042</u>
Net profit		<u>360</u>

The variable production overheads were \$9 per unit while the variable selling overheads were \$11 per unit.

Required:

- (a) Calculate the contribution margin per unit and the margin of safety in units for the latest financial year.
- (b) The company has a capacity of 30,000 units per year. Management is not happy with the financial performance for the last year, and two courses of action for the coming year were proposed in the recent management meeting.
  - (i) The sales manager believed that unit volume would increase by 30% with the incurrence of \$200,000 on advertising.
  - (ii) The general manager considered that full capacity could be reached if the selling price were cut by 10%. In addition, the direct material cost would be reduced by 5% following a minor modification of the specification of the product.

Prepare the budgeted operating statement for the coming year in columnar format, using a contribution margin approach, under each alternative.

Solution:

- (a) Units sold: 22,000 units

	Total	Per unit
	\$'000	\$
Sales	<u>3,300</u>	<u>150</u>
Variable costs:		
Direct materials	726	33
Direct labour	374	17
Production overheads: variable (\$9 × 22,000)	198	9
Selling overheads: variable (\$11 × 22,000)	<u>242</u>	<u>11</u>
	<u>1,540</u>	<u>70</u>

Contribution	<u>1,760</u>	<u>80</u>
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Break-even point in units:

$$\$ (798,000 - 198,000 + 1,042,000 - 242,000) \div \$80 = 17,500 \text{ units}$$

Margin of safety:

$$(22,000 - 17,500) \text{ units} = 4,500 \text{ units}$$

(b) Budgeted operating statement for the coming year

	(i) \$'000	(ii) \$'000
Sales (150 × 22,000 × 1.3; 150 × 0.9 × 30,000)	<u>4,290.0</u>	<u>4,050.0</u>
Less: Direct materials (726,000 × 1.3; 30,000 × 33 × 0.95)	943.8	940.5
Direct labour (374,000 × 1.3; 30,000 × 17)	486.2	510.0
Production overheads: variable (198,000 × 1.3; 30,000 × 9)	257.4	270.0
Selling overheads: variable (242,000 × 1.3; 30,000 × 11)	<u>314.6</u>	<u>330.0</u>
	<u>2,002.0</u>	<u>2,050.5</u>
Contribution	<u>2,288.0</u>	<u>1,999.5</u>
Less: Production overheads: fixed	600.0	600.0
Selling overheads: fixed (800 + 200; 800)	<u>1,000.0</u>	<u>800.0</u>
	<u>1,600.0</u>	<u>1,400.0</u>
Net profit	<u>688.0</u>	<u>599.5</u>

### Graphical approach of CVP analysis

A graphical approach may be preferred where a simple overview is sufficient, or where there is a need to avoid a detailed, numerical approach when, for example, the recipients of the information have no accounting background.

Graphical presentation of CVP analysis can be in the form of a break-even chart, a contribution chart or a profit/volume chart. However, graphical methods are seldom examined in long questions.

### References:

Yeung Chi Hung, *AAT Paper 3 Management Accounting*, First Edition 2011, Prentice Hall

Colin Drury, *Management and Cost Accounting*, 7<sup>th</sup> Edition 2008, South-Western

Andy Tak-ming Li & Patrick Kin-wai Ho, *BAFS in the New World, Accounting – Elective Part 2 Cost Accounting*, First Edition 2010, Pilot Publishing Company Ltd.