COST-VOLUME-PROFIT ANALYSIS

Reading: Costing: An introduction- Colin Drury 4th Ed. Chapter 9.

INTRODUCTION:

- Important for decisions regarding:
    - product pricing
    - accepting/ rejecting sales orders
    - what product lines to promote?
    - what level of output is required to achieve a set level of net profit?

2 forms of CVP analysis;

1. BREAK-EVEN ANALYSIS
2. PROFIT-VOLUME CHARTS

BREAK-EVEN ANALYSIS

- Concerned with how profit is determined by sales volume, sales prices, variable expenses, fixed expenses.
- B/E point = level of activity at which there is neither a profit or a loss.
- 3 approaches used to establish this level of activity;

1. Equation approach
2. Contribution margin p.u approach
3. Contribution margin ratio approach

1. EQUATION METHOD

1.1 Split expenses into - fixed and variable

1.2 Calculate profit

PROFIT = Sales Revenue – Var Exp –Fixed Exps

OR

Sales Revenue = Var Exps + Fixed Exps – Profit

EXAMPLE ;

Ace Co. is considering producing a knife to split open industrial cartons.

SP estimated = £4 per knife

Fixed exps of producing & distributing = £30,000

Variable cost of producing knife = £3 per knife

LET X = No. of knives Ace Co. expects to sell

Then:

Profit = Sales Rev - Var Exps - Fixed Exps

Profit = £4X -£3X - £30,000

What is the expected sales volume?

Say 10,000 knives are expected to be sold

Then:

Profit = £4(10,000) - £3(10,000) - £30,000

= £40,000 - £30,000 - £30,000

= - £20,000 i.e. a LOSS !!!!

This shows that Ace Co. would have a LOSS of £20,000 if it sold 10,000 units of production.

It would be better to know at what level of production can we break even.

Remember;
B/E = point where the sales revenue equal total expenses but no profit / loss is made

Sales rev = Var exps + fixed exps + profit

£4X = £3X + £30,000 + 0

Solve for X

£4X - £3X = £30,000

£1X = £30,000

X = 30,000 units

For Ace Co. to break even it must produce 30,000 knives

B/E point = 30,000 units

OR

B/E sales value = 30,000 units x £4 pu = £120,000

2. CONTRIBUTION MARGIN PER UNIT

Calculation:

Sales price per unit	XX
Variable Exps per unit	(X)
Contribution margin per unit	X

E.g.

For Ace Co.	SP pu	£4
	Var Exps pu	(£3)
	Contribution Margin pu	£1

What does it mean?

The contribution that the production of one unit (knife) makes to fixed costs

After the fixed expenses are covered, the contribution margin per unit represents the increase in profit for each additional unit produced.

What is the B/E point for Ace?

Contribution margin pu = £1 (as above)

$$\text{B/E Sales Volume} = \frac{\text{Total Fixed Costs}}{\text{Contribution Margin pu}}$$

$$\text{B/E Sales Volume} = \frac{£30{,}000}{£1.00} = 30{,}000 \text{ units}$$

Same result as Equation approach!!!!!!

Once B/E has been reached each additional knife sold will increase profit by £1.

i.e. If 30,001 knives are sold the profit of Ace Co. = £1

3. CONTRIBUTION MARGIN RATIO

- Sales volume is not always measured in units

  e.g. Co. that produces a service

- Some situations it is more appropriate to measure sales in *value* terms

- Especially true for Co.'s that produce *multiple* products

- E.g. Proctor & Gamble Co.

  Produces hundreds of diff. Products

  Do we express B/E in terms of units or value?

  Value! Because they have many different units

  Units of Ivory soap not same as units of Crest toothpaste

Example: Using details in Ace Co.

	Per unit	Ratio
Sales Price	£4	100%
Var Exp	£3	75%
Cont Margin	£1	25%

Total Fixed Costs = £30,000

Expresses

- variable exps as a % of SP
- Contribution margin as % SP

Contribution Margin Ratio Represents:
The % of each sales pound that is available to cover the fixed costs and then profits.

EXAMPLE:
Let S = sales value

Then

B/E Sales Revenue = Var Exp ratio x sales revenue + Fixed Exps

S = 75% x S + £30,000

100 % S = 75% x 100% + £30,000

25% S = £30,000

S = £30,000 / 25% = £120,000

IN OTHER WORDS

B/E Sales Revenue

$$= \frac{\text{Fixed Expenses}}{\text{Contribution Margin Ratio}}$$

Which method should be used to calculate break even?

Depends on management preference & data available.

However, if the Co. deals in Multiple products

⇨ then sales volume measured in value terms used

⇨ B/E expressed in sales value not sales units

TARGET PROFIT

CVP analysis can be used to calculate the no of units that need to be sold to achieve a *target profit*

Example:

Assume investment required to produce knives in Ace = £300,000

Management require 8% ROI (£24,000)

What are the req'd units to produce a return of £24,000?

$$X = \frac{\text{Fixed Exps} + \text{Target Profit}}{\text{Contribution margin per unit}}$$

$$X = \frac{£30,000 + £24,000}{£1}$$

X = 54,000 units

CHANGES IN SELLING PRICE (SP)

Should we change price? Customer resistance?, Resulting decrease in demand?

CVP analysis can help!

How?

It can determine how much sales volume can decrease but still achieve target profits

EXAMPLE:

Refer to data re; ACE CO.

Target Profit = £24,000
Mgt considering increase in price = 25p pu to £4.25

With increase in SP
1. how many knives must be sold to break even?
2. How many knives must be sold to achieve £24,000 profit?

SOLUTION:

1.		Original	25p inc
B/E sales		£30,000+£0	£30,000+£0
Units		£1	£1.25
	=	30,000 units	24,000 units

2.			
Sales units		£30K + £24K	£30K+£24K
To earn £24,000		£1	£1.25
	=	54,000 units =	43,200 units

Conclusion:

1. Inc. in SP has reduced B/E from 30k units to 24k units

2. Sales volume required to achieve target profit of £24k has reduced from 54k units to 43.2k units

CHANGES IN VARIABLE COSTS

- Cannot always alter SP
- To inc. profits - reduce costs
- Might use less expensive materials
- Might reduce D.Labour exps by changing production process
- I.E. Change the Variable costs

Ace Co. buys cheeper materials - cheeper by 20p pu

How many knives must be produced/must be sold to

(1) break even, and
(2) to earn target profit (£24,000)

Solution:
20p decrease in V.C increases contrib mar p.u.

	Original	20p decrease In Var Cost
B/E sales units	£30,000+£0 / £1	£30,000+£0 / £1.20
	=30,000 units	=25,000 units

Sales units To earn £24,000	=	£30k + £24k / £1	£30k + £24k / £1.20
	=	54,000 units	45,000 units

Decrease in VC will reduce B/E from 30,000 units to 25,000 units.

Co need only sell 45,000 units instead of 54,000 units to achieve target profit of £24K

Ace Co.
considering inc in advertising costs by £3000

		original	£3k inc in FC
B/E sales units		£30,000 + £0 / £1	£33,000 + £0 / £1
	=	30,000 units	33,000 units
Sales to earn Target Profit	=	£30K + £24k / £1	£33K + £24K / £1
	=	54,000 units	57,000 units

An inc in FC by 10% = inc in B/E volume 10%

Sales required to earn target profit has inc. by 6% - from 54,000 units to 57,000 units

MARGIN OF SAFETY

Diff between the budgeted sales & the B/E sales

Expressed as a % of budgeted sales

Formula:

$$\text{Margin of safety} = \frac{\text{Budgeted sales - B/E sales}}{\text{Budgeted sales}} \times 100\%$$

Assume: B/E sales = £30,000
Budgeted sale = £40,000

$$\text{Margin of safety} = \frac{£40,000 - £30,000}{40,000} \times 100\% = 25\%$$

This means that if sales were 25% less than budget we would break even

Margin of safety shows the risk inherent in the particular sales goal

The higher the margin of safety
⇨ the lower the risk

MULTIPLE CHANGES

Ace Co. considering;
(1) £3,000 inc. in advertising exp
and (2) 25p inc. in SP

	Original	Inc SP & Inc costs
SP pu	£4	£4.25
VC pu	£3	£3.00
Cont Margin pu	£1	£1.25
Fixed costs	£30,000	£33,000
Target profit	£24,000	£24,000

		Original	Inc SP & Inc costs
B/E sales units =		£30k + £0 / £1	£33k + £0 / £1.25
	=	30,000 units	26,400 units
Sales volume To earn target	=	£30k + £24k / £1	£33k + £24K / £1.25
	=	54,000 units	45,600 units

Inc in SP of 25p more than offsets the inc in FC thereby reducing the B/E point to 26,400 units.

Only need to sell 45,600 units to achieve target profit.

ASSUMPTIONS AND LIMITATIONSOF CVP ANALYSIS

1. Total revenue of Co. changes in direct proportion to changes in sales volume

2. Total expenses can be separated into Fixed & Variable costs

3. VC vary in direct proportion to changes in sales volume

4. FC pa do not change within the relevant range

5. For multi-product Co's, sales mix remains constant for all volume levels under consideration

6. Product volume & sales volume are equal
   i.e. there is no stock

7. The analysis applies only to a short-term time horizon

METHOD 2 – PROFIT- VOLUME-CHARTS

Principles of profit-volume charts

- Focuses attention directly on how profit changes as sales volume changes

- The profit-volume graph
  - only profit/ loss on vertical axis
  - Only need two points to plot graph
  - total FC and the B/E can be used

Example:
Ace Co.

Total fixed expenses	=	£30,000
B/E point	=	30,000 units

Horizontal axis	=	Volume	
	=	2 points:	0 sales volume and 30,000 units of sales vol.

Vertical axis =profit/ loss

Horizontal (Sales Vol.)	*Vertical Profit/Loss*	*Graph Point*
0 Units	£4(0) - £3(0) - £30,000 = -£30,000 Loss	A
30,000 Units	£4(30,000) - £3(30,000)- £30,000 = £0	B

The Profit-volume graph is useful to visually summarise the impact of sales volume on profit