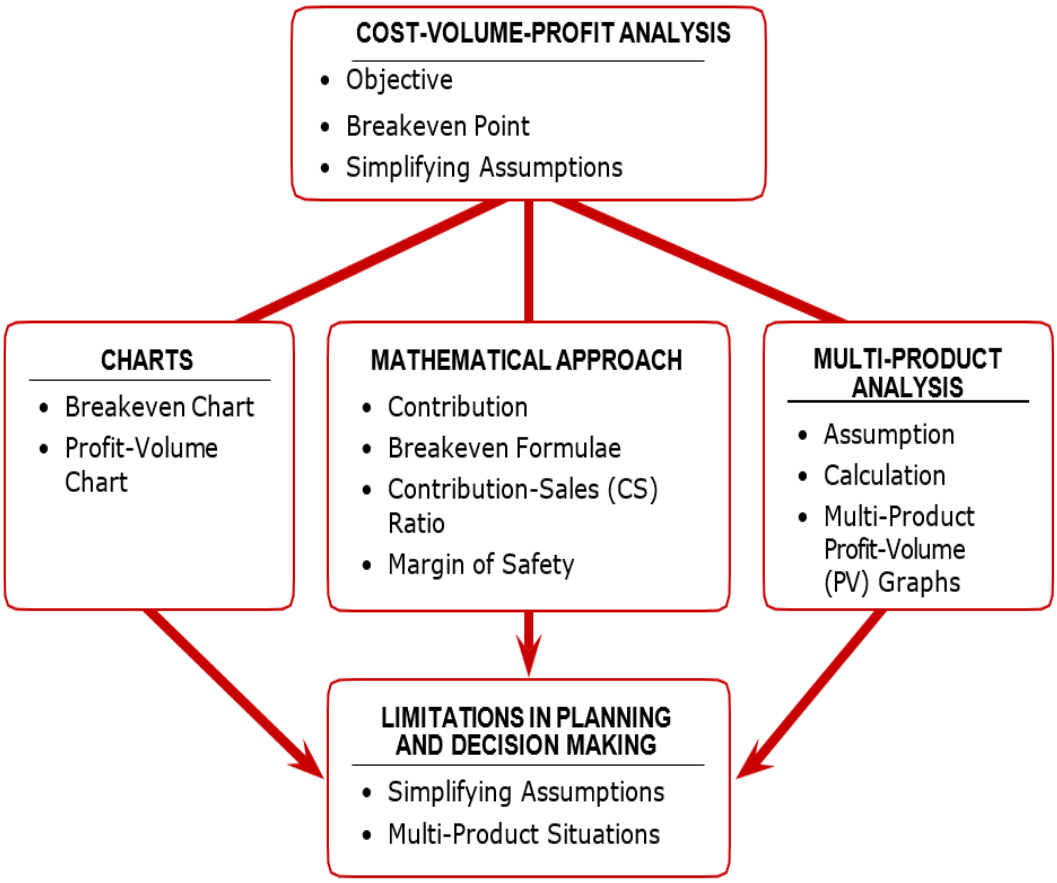
# Chapter 5 Cost volume profit (CVP) analysis

## Visual Overview



# 1. A Recap of Basic CVP Analysis

Cost volume profit (CVP)/break-even analysis looks at the effects of differing levels of activity on the financial results of a business by examining the relationship between sales volume and profit.

Marginal costing

Revenue

-Vriable cost

Contribution

-Fixed cost

Profit

1.1 Break-even analysis

Contribution per unit = unit selling price – unit variable costs

Profit = sales volume × contribution per unit – fixed costs

**Breakeven point = activity level at which there is neither profit nor loss**

**= fixed costs/Contribution per unit**

Contribution/sales (C/S) ratio = (contribution/sales)× 100%

Note：C/S ratio also called P/V ratio

Profit=sales*C/S ratio - fixed cost

**Sales revenue at breakeven point = fixed costs ÷ C/S ratio**

**Margin of safety (in units) = budgeted sales units – breakeven sales units**

**Margin of safety (as %) = (Budgeted sales-breakeven sales)/(Budgeted sales) x 100%**

**Sales volume to achieve a target profit = (Fixed cost+Target profit)/(Contirbution per unit)**

**Sales revenue to achive a target profit =(fixed cost + target profit)/ c/s ratio**

Example 1: Break even point and margin of safety

A company makes and sells a single product. The selling price is $12 per unit. The variable cost of making and selling the product is $9 per unit and fixed costs per month are $240,000.

The company budgets to sell 90,000 units of the product a month.

***Required:***

(a) What is the budgeted profit per month and what is the break even point in sales units?

(b) What is the margin of safety?

(c) What must sales be to achieve a monthly profit of $120,000?

**Solution:**

**(a)**Break even point in units of sale = $240,000/$3 per unit = 80,000 units per month

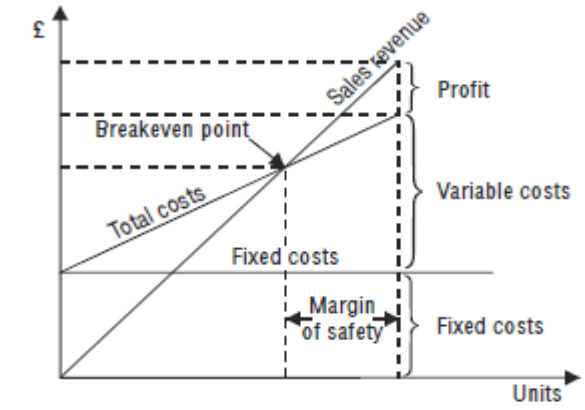
**(b)** Margin of safety = (90,000 – 80,000)/90,000 = 11.1%

**(c)** To achieve a profit of $120,000, total contribution must be $(240,000 + 120,000) = $360,000.

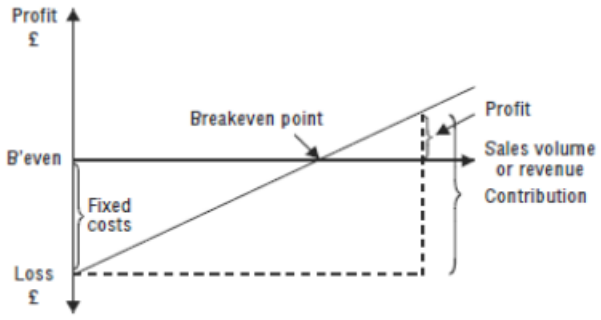
Sales must be $360,000/$3 per unit = 120,000 units (or $360,000/0.25 = $1,440,000 in sales revenue).

1.2 Break even, and P/V charts

- Breakeven chart




- Profit/volume (P/V) chart




The gradient of the straight line is the contribution per unit(if the horizontal axis is measured in sales units)

# 2. Break Even Analysis in a Multi-product Environment

2.1Breakeven point for multiple products

**A constant product sales mix must be assumed**. In other words, we have to assume that whenever x units of product A are sold, y units of product B and z units of product C are also sold.

- Break even point = $\frac{Fixed\ costs}{Weighted\ \ average\ \ unit\ contribution}$
- Break even point for sales revenue= $\frac{Fixed\ cost}{Weighted\ Average\ \ C/S\ ratio}$

Note: Weighted average contribution per unit= $\frac{Total\ contributions}{Total\ units}$

Weighted average C/S ratio = $\frac{Total\ contribution}{Total\ revenue}$

- Margin of safety (%) = $\frac{Budgeted\ sales - Breakeven\ sales}{Budgeted\ sales}$
- Sales revenue to earn a required profit = $\frac{Required\ \ profit + Fixed\ costs}{Weighted\ average\ C/S\ ratio}$

Example 3: Break even point & margin of safety for multiple products

PL produces and sells two products, M and N. Product M sells for $7 per unit and has a total variable cost of $2.94 per unit, while Product N sells for $15 per unit and has a total variable cost of $4.40 per unit. The marketing department has estimated that, for every five units of M sold, one unit of N will be sold.

The organization's fixed costs per period total $123,600.Budgeted sales revenue for next period is $300,000, in the standard sales mix.

**Required:**

(1)Calculate the breakeven point for PL.

(2)Calculate the margin of safety in terms of sales revenue and also as a percentage of budgeted sales revenue.

(3)The organisation wishes to earn a profit of $61,800 next month. Calculate the required sales value of each product in order to achieve this target profit.

**Solution**

**Method 1:**

**Step 1** Calculate the **weighted average contribution per unit**

| | M | N |
|---|---|---|
| | $ per unit | $per unit |
| Sales price | 7.00 | 15.00 |
| Variable cost | 2.94 | 4.40 |
| Contribution | 4.06 | 10.60 |

**Step 2** Calculate revenue and contribution per mix of 5 units of M and 1 unit of N.

| | Contribution | | Revenue | |
|---|---|---|---|---|
| | Per unit | Total | Per unit | Total |
| | $ | | $ | $ |
| Product M (5 units) | 4.06 | 20.30 | 7 | 35 |
| Product N (1 unit) | 10.60 | 10.60 | 15 | 15 |
| | | 30.90 | | 50 |

Weighted average C/S ratio = $30.90/$50 = 61.8% or 0.618

**Step 3** Calculate break even point (total)
= Fixed costs ÷ Weighted average C/S ratio
= $123,600/0.618
= $200,000 in sales revenue.

**Step 4** Calculate break even sales for each product.
M = $200,000 × (35/50) = $140,000
Sales price per unit = $7
Therefore breakeven point in units = $140,000/$7 = 20,000 units.

N = $200,000 × (15/50) = $60,000
Sales price per unit = $15
Therefore breakeven point in units = $60,000/$15 = 4,000 units.

**Step 5** Calculate the margin of safety
= Budgeted sales – Breakeven sales

= $300,000 – $200,000 = $100,000, in the standard sales mix
As a percentage: ($300,000 – $200,000) /$300,000 = 33.33% of budgeted sales

**Step 6** Calculate required total revenue
= Required contribution / C/S ratio
= ($61,800+123,600) / 0.618
= $300,000

**Step 7** Calculate required sales from each product: see Step 2 for proportions
Required sales of M = 35/50 x $300,000= $210,000
Required sales of G = 15/50 x $300,000 = $90,000

**Method 2:**
**Step 1** Calculate the **weighted average contribution per unit**

| | M | N |
|---|---|---|
| | $ per unit | $ per unit |
| Sales price | 7.00 | 15.00 |
| Variable cost | 2.94 | 4.40 |
| Contribution | 4.06 | 10.60 |

| | $ |
|---|---|
| Contribution from sale of 5 units of M (× $4.06) | 20.30 |
| Contribution from sale of 1 unit of N | 10.60 |
| Contribution from sale of 6 units in standard sales mix | 30.90 |

**Weighted average contribution per unit** = $30.90/6 = $5.15 per unit.

**Step 2** Calculate the break even point in units.
Fixed costs/Weighted average contribution per unit = $123,600/$5.15 = 24,000 units.
These are in the ratio 5:1; therefore break even is at the point where 20,000 units of M are sold (= 24,000 x 5/6) and 4,000 units of N are sold (= 24,000 x 1/6).

**Step 3** Calculate the break even point in sales revenue.
20,000 units of M at $7 + 4,000 units of N at $15 = $140,000 + $60,000 = $200,000

2.2 Changing the product mix

As the products have different C/S ratios, any changes in the product range (ie additional products offered or products discontinued) will have an impact on the break even point.

For example, if products are sold in a constant mix and a new product is introduced that increases the weighted C/S, then the break even point will fall. The break even point will also fall if the product with the lowest C/S ratio is discontinued.

2.3 Multi-product PV chart

PV Chart for multiple products can be drawn if a constant product sales mix is assumed.

The P/V chart can show information about each product individually.

**2.3.1 Products in sequence**

**Example 5:**

The products have the following information about contribution ,sales,and C/S ratio:

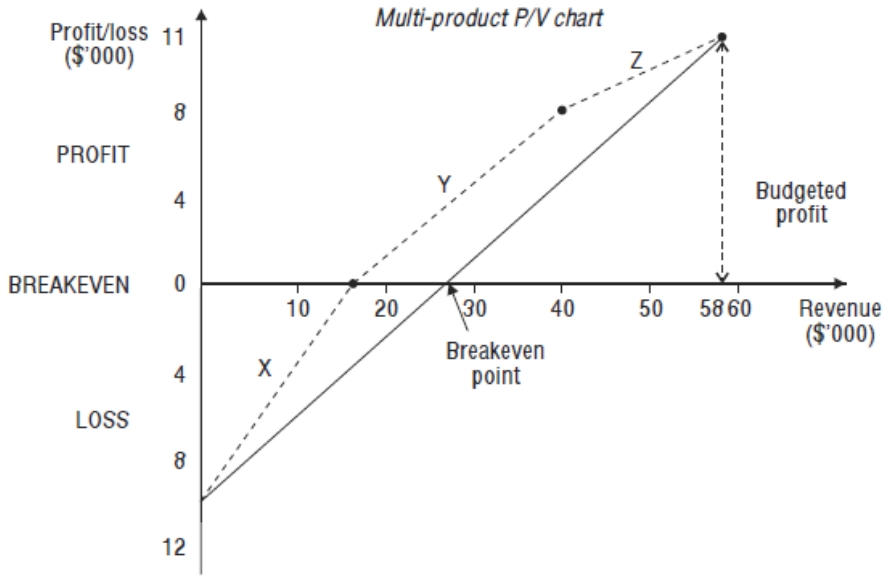
| | Contribution | Sales | C/S ratio |
|---|---|---|---|
| | $ | $ | % |
| Product X | 10,000 | 16,000 | 62.50 |
| Product Y | 8,000 | 24,000 | 33.33 |
| Product Z | 3,000 | 18,000 | 16.67 |
| Total | 21,000 | 58,000 | 36.21 |

Total fixed cost is 10,000.

In this example, product X will be plotted first, then product Y and finally product Z. A **dotted line** is used to show the **cumulative profit/loss and the cumulative sales** as each product's sales and contribution in turn are added to the sales mix.

| *Product* | *Cumulative sales* | *Cumulative profit* |
|---|---|---|
| | $ | $ |
| Nil | 0 | (10,000) |
| X | 16,000 | 0 |
| X and Y | 40,000 | 8,000 |
| X, Y and Z | 58,000 | 11,000 |

Multi-product P/V charts can also be produced whereby each product is plotted individually, allowing the profitability to be compared. They show a profit or loss line rather than the cost and revenue lines and often two profit or loss lines are drawn. First, a straight line assuming a constant mix between the products and second, a bow shaped line where products are plotted in order of profitability, ie products are plotted in the order of their contribution/sales ratio.




2.4 Limitation and advantage of CPV analysis

Limitations

Break even analysis is a useful technique for managers as it can provide simple and quick estimates. It is a form of sensitivity analysis and is therefore useful for assessing risk surrounding the estimate of sales volume.

It does, however, have a number of limitations as it assumes that:

- If there are multiple products, they are sold in constant mix
- All costs can be split into fixed and variable elements
- Fixed costs are constant
- Variable cost per unit is constant
- Selling price is constant
- Inventory levels are constant (sales volume = production volume)

**Advantages**

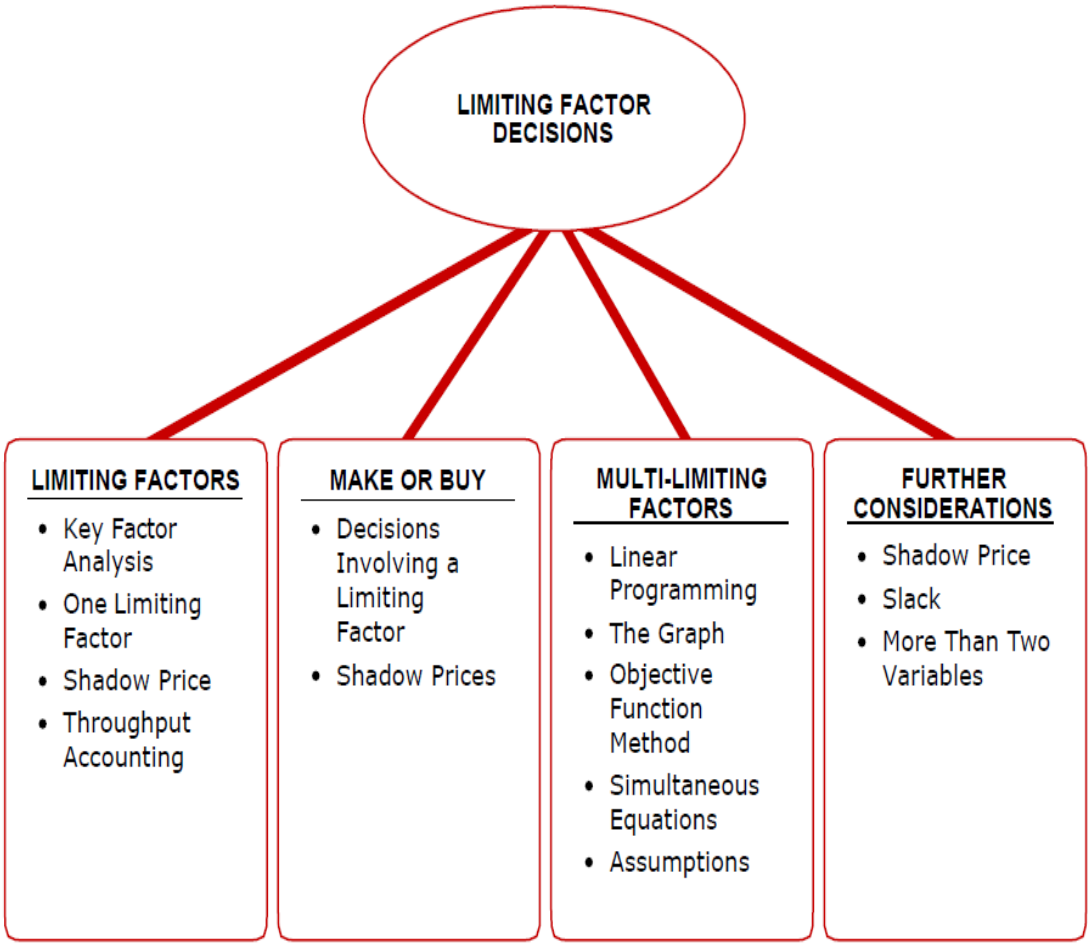
- **Graphical** representation of cost and revenue data (break even charts) can be more easily understood by non-financial managers.
- Multi-product PV charts enable the user to see easily the relationship between (c)revenue and profit. Breakeven revenue can also be seen.
- Identifying the most and least profitable products should lead to improved decision-making.
- Highlighting the break even point and the margin of safety gives managers some **indication of the level of risk** involved.

## Summary

- The breakeven point is the level of activity at which a company makes neither profit nor loss. To break even a company needs to sell enough units to cover its fixed and variable costs.
- A breakeven chart which shows how total costs and total revenues vary with output. The profit-volume chart shows how profit varies with output.
- The following formulae are all easily derived and are **not** provided in the exam:
  - Breakeven point = Fixed cost/Contribution per unit
  - C/S ratio = Contribution per unit / Sale price
  - Breakeven revenue = Fixed cost / C/S ratio
- In multi-product situations, a standard or per-determined product mix must be assumed to remain constant. Breakeven revenue can then be calculated by dividing fixed costs by a weighted average C/S ratio.
- The usefulness of CVP analysis is limited by the simplifying assumptions that have to be made to make it work.

# Chapter 6 Limiting factor analysis

## Visual Overview



# 1. Limiting Factors

In the short term, sales demand may be greater than productive capacity. For example, output may be restricted by a shortage of:

- labour;
- materials;
- machinery; or
- factory space.

It is important to note that the final limiting factor is always maximum sales demand.

1.1 Identify the **limiting factor**.

To find this calculate how many units of each resource is required to produce sufficient quantities of each product to meet *maximum* demand. If a resource is insufficient to meet maximum demand, it is a limiting factor.

**Example 1 Limiting Factor Identification**

Company A uses two materials in production, Material J and Material K.

Material J is restricted to 12,000 kg, while Material K is restricted to 24,000 kg.

The demand and material use for Product A, B, and C are shown in the table below.

| **Product** | **A** | **B** |
|---|---|---|
| Kg of K per unit | 4 | 1 |
| Kg of J per unit | 4 | 2 |
| Maximum Demand | 3000 | 4000 |

Given the above data, the total kg of Material K demanded to meet maximum demand is 22,000 kg, which is less than the available material K of 24,000 kg.

The total kg of Material J demand to meet maximum demand is 28,000 kg, which is more than the 12,000 kg of Material J available.

Material J is the limiting factor.

# 2. One Limiting Factor

If there is only one limiting factor, then the production plan can be determined by following steps.

- Identify the scarce resource.
- Calculate the contribution per unit for each product.

  = sales price – unit variable cost
- Calculate the **contribution per unit scarce resource** for each product.

  $=\frac{contribution\ per\ unit}{scarce\ resource\ per\ unit}$
- Rank the products in order of the result from 3.
- Allocate the resources using this ranking.

**Example 2**

Cotton ltd produces three products P1, P2, P3. The maximum machine hours per week are 1000 hours,which is the limiting factor, What is the optimal production plan?

| | P1 | P2 | P3 |
|---|---|---|---|
| Selling price | 250 | 240 | 200 |
| Variable cost | (130) | (130) | (100) |
| Fixed cost | (80) | (80) | (80) |
| Profit | 40 | 30 | 20 |
| Demand per week | 60 | 60 | 60 |
| Machine hour per unit | 12 | 10 | 5 |

**STEP 1. Calculate the contribution per unit for each product**

| | P1 | P2 | P3 |
|---|---|---|---|
| Selling price per unit | 250 | 240 | 200 |
| Variable cost per unit | (130) | (130) | (100) |
| Contribution per unit | 120 | 110 | 100 |

**STEP 2. Calculate the contribution per unit of the scarce resource for each product**

| | P1 | P2 | **P3** |
|---|---|---|---|
| Machine hour per unit | 12 | 10 | 5 |
| Contribution per machine hour | $10 | $11 | $11 |

**STEP 3. Rank the products in order of the result from Step 3.**

**P3>P2>P1**

**STEP 4. Allocate the resources using this ranking**

| Production schedule | machine hour per unit | Hrs available | $contribution per unit |
|---|---|---|---|
| | | **1000** | |
| P3 produce maximum 60 units | 5 | (300) | $20 |
| P2 produce maximum 60 units | 10 | (600) | $11 |
| P1 produce with remaining | 12 | 100 | $10 |
| 100/12=8 units | | 96 | |

# 3. Make or Buy Decisions and Scarce Resources

The decision rule is to ranking in the priority of costing saving per liming factor by make in house.

Cost saving per limiting factor $= \frac{buy\ in\ price - unit\ variable\ cost\ to\ make}{limiting\ facotr\ per\ unit}$

**Example 3:make or buy decision with scare resource**

MM manufactures three components, S,A and T, using the same machines for each. The budget for the next years calls for the production and assembly of 4,000 of each component. The variable production cost per unit of the final product is as follows.

| | Machine hours | Variable cost |
|---|---|---|
| | | $ |
| 1 unit of S | 3 | 20 |
| 1 unit of A | 2 | 36 |
| 1 unit of T | 4 | 24 |
| assembly | | 20 |
| | | 100 |

Only 24,000 hours of machine time will be available during the year,and a subcontractor has quoted the following unit prices for supplying components:S $29; A $40; T $34.

**Required**

Advise MM

**Solution:**

| | S | A | T |
|---|---|---|---|
| | $ | $ | $ |
| Sales price of buying | 29 | 40 | 34 |
| Variable cost of making | 20 | 36 | 24 |
| cost saving by making | 9 | 4 | 10 |
| Machine hrs per unit | 3hr | 2 hr | 4hr |
| Cost saving per machine hr | 3 | 2 | 2.5 |
| Making rank | 1 | 3 | 2 |

## Exercise 1 Make or Buy

A company requires three components, X, Y and Z, for use in the manufacture of its main product, the Galaxia. The company can make these components or it can buy them externally. All three components require Material B in their manufacture. Monthly supplies of Material B are restricted to 8,000 kg.

| **Product/Component** | **X** | **Y** | **Z** |
|---|---|---|---|
| Units required each month | 2,000 | 2,500 | 4,000 |
| Variable cost to make ($ per unit) | 10 | 12 | 14 |
| Buy-in price ($ per unit) | 13 | 17 | 16 |
| Number of kg of B used per unit | 3 | 2 | 1 |

## Required:

**Determine which products/components the company should make and which it should buy.**

# 4. Multiple Limiting Factors

In situations in which more than one factor is limited, an alternative approach is used to determine the optimal production so as to maximise contribution (and therefore profit). This technique is linear programming:
Follow these steps when you are trying to solve a problem using the graphical method:

**Step 1** Define variables. For example, x = Number of units of output of one of the products and y = Number of units of output of the other product.

**Step 2** Formulate the *objective* function, either to maximise contribution or to minimise cost. Remember to use contribution, not profit.

**Step 3** Express *constraints* in terms of inequalities (including non-negativity). Constraints (limiting factors) may include resource constraints, production constraints and/or levels of demand.

**Step 4** Plot **all** constraints on a graph and identify the *feasible region*.

**Step 5** Draw ISO contribution line to Solve the optimal production plan
Moving the ISO contribution line to a point which an iso-contribution line is furthest from the origin on the edge of the feasible region.

**Example 4**
Soft company makes 2 products in 3 departments. Details are shown below:

| | Product A | Product B | Available hours |
|---|---|---|---|
| | Hours per unit | Hours per unit | |
| Department R | 10 | 15 | 18,000 |
| Department S | 5 | 15 | 12,000 |
| Department T | 15 | 8 | 15,000 |
| Contribution per unit | 8 | 12 | |

Product A have a receive a order for 200units.
Formulate a linear program and find the optional product plan.

**STEP 1: Define the variables (x, y)**
Let: X = units of product A Y = units of product B

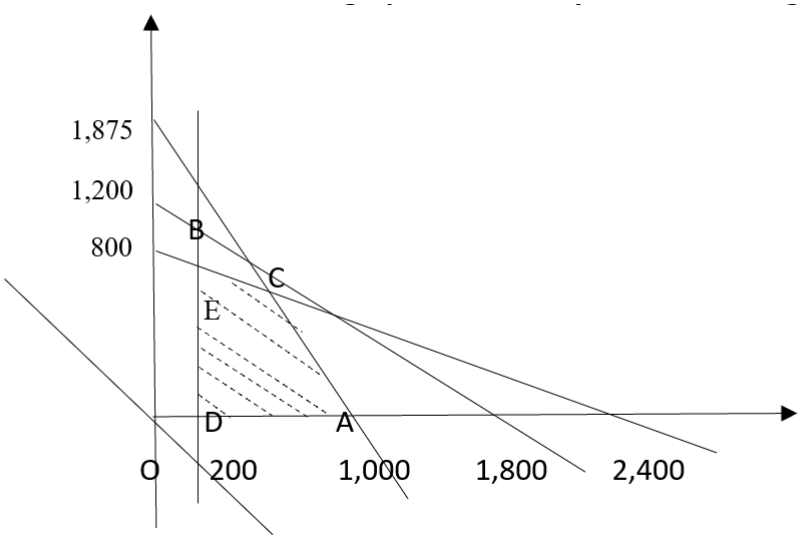
**STEP 2:** Formulate the *objective* function

$$\begin{cases} 10X + 15Y \le 18{,}000 \\ 5X + 15Y \le 12{,}000 \\ 15X + 8Y \le 15{,}000 \\ X \ge 200 \\ Y \ge 0 \end{cases}$$

**STEP 3: Objective function**

Maximum : 8X +12 Y=C

**STEP 4:** Plot **all** constraints on a graph and identify the *feasible region*




**The feasible region is DACE**

**STEP 5: Optimum production point-draw ISO contribution line**

Move the contribution line ,maximize contribution is shown by lines furthest from the origin on the edge of the feasible region.

we could ensure the optimum production point is C

$$\begin{cases} 5X + 15Y = 12000 \\ 15X + 8Y = 15000 \end{cases}$$

$$\begin{cases} X = 697 \\ Y = 568 \end{cases}$$

Contribution = 697×8 + 568×12 = 12384

# 5.Calculate the Shadow Price

The shadow price of a limiting factor is the the **additional contribution** that would be generated if **one more unit of the limiting factor** were to become available at its original cost。.

Shadow price=New total contribution - Original total contribution

The shadow price represents the maximum **premium** over the normal price the company would be prepared to pay for each additional unit.

The maximum price for additional scarce resource that can be paid is the sum of the normal price and shadow price.

Example 5

The optimal solution of the above constraints is x = 697, y = 568. Calculate the shadow price for additional hour available in department S.

$$\begin{cases} 5X + 15Y \le 12001 \\ 15X + 8Y \le 15000 \end{cases}$$

$$\begin{cases} X = 697.25 \\ Y = 567.65 \end{cases}$$

New contribution= 697.25×8 + 567.65×12 = 12389.8

Shadow price=New total contribution - Original total contribution

=12389.8-12384

=5.8

Calculate the shadow price for additional hour available in department T

$$\begin{cases} 5X + 15Y \le 12000 \\ 15X + 8Y \le 15001 \end{cases}$$

$$\begin{cases} X = 697.38 \\ Y = 567.54 \end{cases}$$

New contribution = 697.38 × 8 + 567.54 × 12 = 12389.52

Shadow price= 12389.52-12384 = 5.52

# 6. Slack

Slack occurs when **maximum** availability of a resource or other constraining factor is **not used.**slack is the amount of the unused resource .

Non-critical constraints will have zero shadow prices as slack exists already.

6.1 Implications of slack and surplus

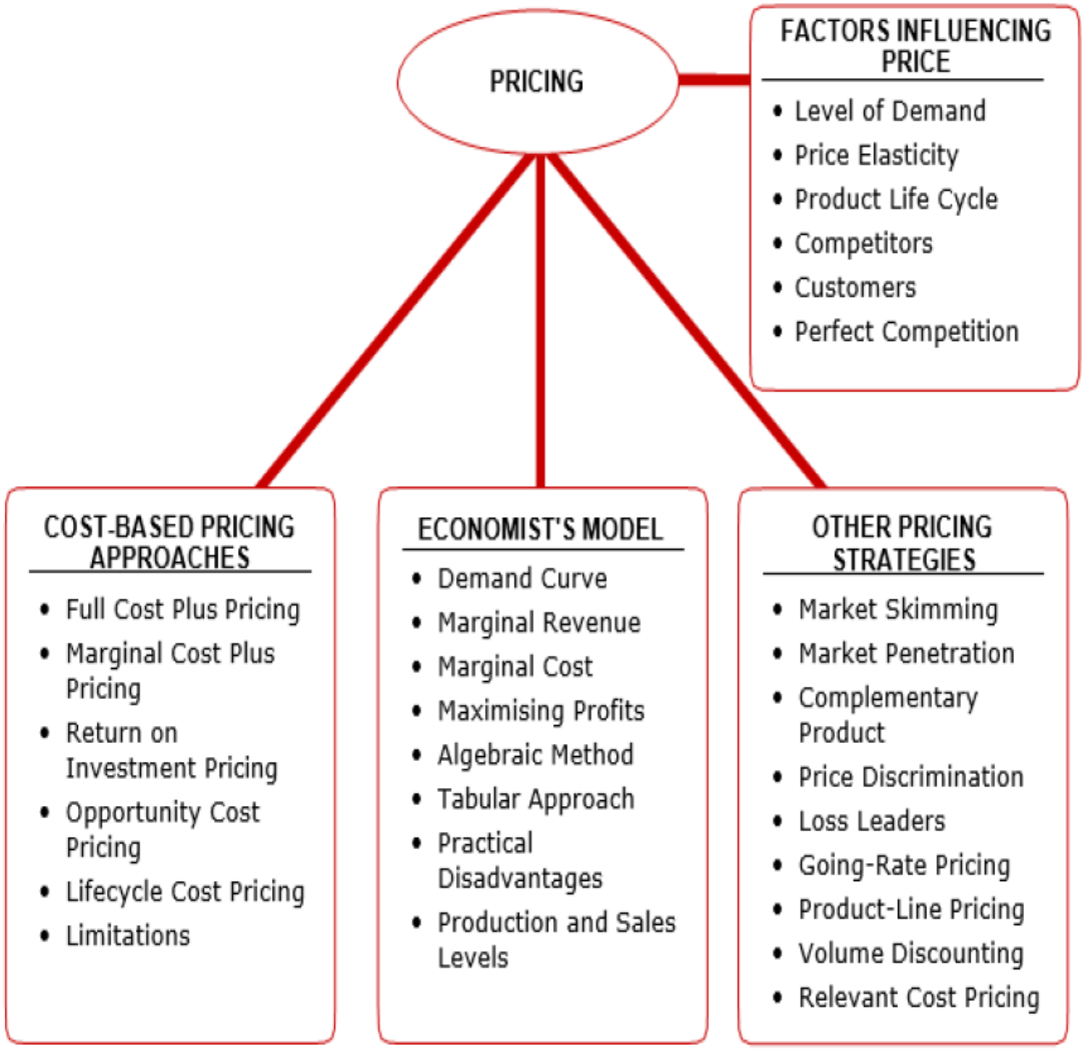
| | High slack | Low slack |
|---|---|---|
| Problem | Inefficient use of resource | The resource could become a binding constraint |
| How to solve? | Reallocated resource | Material: additional suppliers<br>Labour: recruitment |

## Summary

- Where factors of production are scarce, production decisions have to be made to maximise **contribution** (and hence profit) given limited resources.
- Where **one** resource is scarce, the approach is to **rank** products by **contribution** generated per unit of scarce resource ("key factor").
- For make or buy decisions, the method is to **rank** products by **saving** per unit of scarce resource.
- Where there is more than one constraint, use linear programming:
  - Define variables.
  - Define the objective function (usually to maximise contribution).
  - Formulate constraints.
  - Plot constraints on a graph and identify the feasible area.
  - Use a sample contribution line to find the point on the feasible region which generates the highest contribution (i.e. is furthest form the origin).
  - Solve the equation(s) for the optimal point in (5.) to specify the corresponding values of the variables.
  - Answer the question. Maximum profit **MUST** be calculated as maximum contribution less total fixed overheads **never** using unit profit.
- The **shadow price of** a resource is the amount by which contribution would be increased if one more unit of the scarce resource were available.
- **Slack** arises where the company does not use all of the resource available. Slack can be calculated as resource available less resource used.

# Chapter 7 Pricing decisions

## Visual Overview



# 1. Pricing Policy

1.1 Influences on price

- Demand
- Quality
- Competitors
- Substitutes
- Inflation
- Ages of the product
- Disposable incomes

1.2 Competition

If a rival cuts its prices in the expectation of increasing its market share, a firm has several options.

(a) It will **maintain its existing prices** if only a small market share would be lost, so that it is more profitable to keep prices at their existing level.

(b) It may **maintain its prices but respond with a non-price counterattack**. the firm will be securing or justifying its current prices with a product change, advertising, or better back-up services.

(c) It may **reduce its prices.** This should protect the firm's market share so that the main beneficiary from the price reduction will be the consumer.

(d) It may raise its prices and respond with a non-price counterattack. A price increase would be based on a campaign to emphasize the quality difference between the firm's and the rival's products.

# 2.Demand Curve

Economic theory argues that the **higher the price** of a good, the **lower** will be the **quantity** demanded.

When demand is linear the equation for the demand curve is:

**P = a – bQ**

where P = the price

Q = the quantity demanded

a = the price at which demand would be nil

b = $\frac{Changes\ in\ price}{Changes\ in\ quantity}$

The constant is calculated as follows:

$$a = \$ \text{(current price)} + \left(\frac{\text{Current quantity at current price}}{\text{Changes in quantity when price is changed by } \$b}\right) \times \$b$$

Example 1: Deriving the demand equation

The current price of a product is $12. At this price the company sells 60 items a month. One month the company decides to raise the price to $15, but only 45 items are sold at this price. Determine the demand equation, which is assumed to be a straight line equation.

Solution:

P = a – bQ

Step 1 Find the price at which demand would be nil

$$a = \$ \text{(current price)} + \left(\frac{\text{Current quantity at current price}}{\text{Changes in quantity when price is changed by } \$b}\right) \times \$b$$

a = $12 + [(60/15) x $3] = $24

Step 2 Calculate b

$$b = \frac{\text{Changes in price}}{\text{Changes in quantity}}$$

$$b = \frac{\$15-\$12}{60-45}$$

b = 0.2

Step 3 Check the equation

P = 24 – 0.2Q

# 3. Determine the Profit-maximizing Selling Price

3.1 Determine the profit-maximizing selling price:using equation

If we assume that there is a demand curve with the equation P = a – bQ, TR=PQ=aQ-bQ2, and a total cost function TC = FC + VC per unit *Q, we can determine the profit-maximizing price for the product.

**Profits are maximized where marginal cost (MC) = marginal revenue (MR).**

***Formulation:***

When P = a – bQ

R= PQ= aQ - bQ^2

**MR = a – 2bQ**

where P = the price

Q = the quantity demanded

a = the price at which demand would be nil

b = $\frac{Change\ in\ price}{Change\ in\ quantity}$

**MC = variable cost per unit**

The following step-by-step approach can be applied to most questions:

**Step 1** Establish the demand equation (find the values for 'a' and 'b').

**Step 2** Obtain a value for MR from the demand curve. MR = a – 2bQ

**Step 3** Establish MC (the marginal cost). This will simply be the variable cost per unit.

**Step 4** To maximize profit, equate MC = MR to find Q.

**Step 5** Substitute Q into the demand function and solve to find P (the optimum price).

**Step 6** Calculate the maximum profit

Example 2

T company makes one product. Its current selling price is $180. At this price 2000 units are demanded per annum.

Fixed costs per annum are $130000 and variable cost per extra unit is $72.

T has estimated that each successive increase in price of $10 annual demand will be reduced by 100 units. Alternatively, for each $10 reduction in price, demand will increase by 100 units.

Required:

Calculate the optimum output, price and maximum profit, assuming that if prices are set within each $10 range there will be a proportionate change in demand.

***Step 1:*** Establish the demand equation

***P = a – bQ***

b = $\frac{Change\ in\ price}{Change\ in\ quantity} = \frac{10}{100} = 0.1$

180 = a - 0.1×2000

a = 380 P = 380 - 0.1Q

***Step 2:*** Obtain a value for MR

MR = 380-0.2Q

***Step 3: Establish the marginal cost MC which simply is the variable cost per unit.***

MC = $72

***Step 4: To maximize profit, equate MC and MR then to find Q***

MC = MR Q=1540 units

***Step 5: Substitute Q into the price equation to find the optimum price.***

P = 380 - 0.1×1540 = $226 per unit

***Step 6: Calculate the maximum profit.***

1540 × 226 - 1540 × 72 - 130000 = $107160

**Exercise**

1.Market research into demand for a product indicates that when the selling price per unit is $145, demand in each period will be 5,000 units; if the price is $120, demand will be 11,250 units. It is assumed that the demand function for this product is linear. The variable cost per unit is $27.

What selling price should be charged in order to maximize the monthly profit?

$ [ ]

# 4. Price Elasticity of Demand

The price elasticity of demand (PED) is the **degree** of **sensitivity of demand** for a good to **changes in the price** of that good.

The following graph can be used to illustrate the calculation of the PED:

PED at point 1 = $\frac{\%\ change\ in\ demand}{\%\ change\ in\ price}$

Example 3: Price elasticity of demand

The price of a good is $1.20 per unit and annual demand is 800,000 units. Market research indicates that an increase in price of 10 cents per unit will result in a fall in annual demand of 75,000 units. What is the price elasticity of demand between prices of $1.20 and $1.30 per unit?

Solution:

Annual demand at $1.20 per unit is 800,000 units.

Annual demand at $1.30 per unit is 725,000 units.

% change in demand = (75,000/800,000) x 100% = 9.375%

% change in price = (0.10/1.20) x 100% = 8.333%

Price elasticity of demand = (–9.375/8.333) = –1.125

Ignoring the minus sign, price elasticity is 1.125.

**4.1 The value of demand elasticity**

The value of demand elasticity may be anything from zero to infinity.η(0,∞）

Demand is perfectly inelastic η=0.

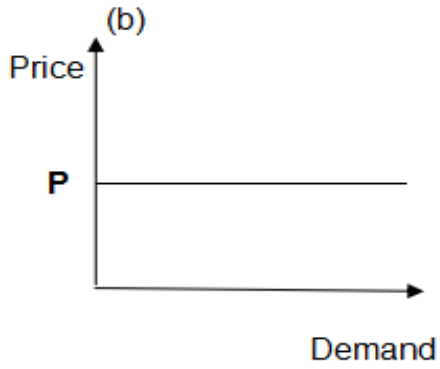
Perfectly elastic demand η=∞.

Demand is referred to as inelastic if η＜1，the quantity demand falls by smaller percentage than the percentage increase in price.

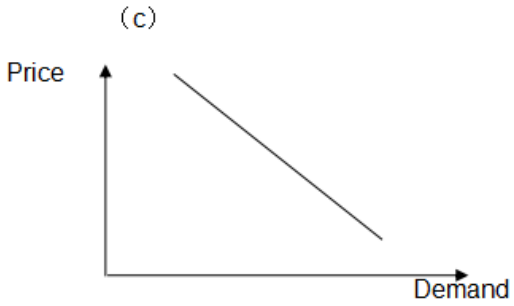
Demand is elastic if η＞1，demand falls by a large percentage than the percentage rise in price。

Perfectly inelastic

Perfectly elastic demand




Inelastic& elastic




**4.2 The relationship between PED and the price strategy**

**Demand is 'elastic'.** Total revenue increases when **price is reduced.** Total revenue increases when price is decreased. Therefore, price increases are not recommended but price cuts are recommended.

**Demand is 'inelastic'**. **Price increases** are recommended but price cuts are not.

Exercise:

2.The following statements have been made about price elasticity of demand.

(1)When sales demand is inelastic, a company can increase profits by raising the selling price of its product.

(2)Price elasticity of demand is measured as the amount of change in sales price (measured as a percentage of the current sales price) divided by the amount of

change in quantity demanded (measured as a percentage of the current sales volume).

**Which of the above statements is/are true?**

A. 1 only

B. 2 only

C. Neither 1 nor 2

D. Both 1 and 2

3.The demand for a product at its current price has a price elasticity greater than 1.0 (ignoring the minus sign). Which of the following statements must be correct?

(1)A reduction in the sales price will increase total revenue.

(2)A reduction in the sales price by x% will result in a percentage increase in sales demand which is greater than x%.

(3)An increase in the selling price will increase total profit.

A. Statements 1 and 2

B. Statements 1 and 3

C. Statements 2 and 3

D. Statements 1,2 and 3

# 5. Price Strategies

The price to be charged for a product or service is often one of the most important decisions made by business organizations. There are a number of alternative pricing strategies.

### 5.1 Cost plus pricing

The price of the product is calculated by adding an appropriate profit mark up to the products cost. This cost could be:

-Absorption / full cost pricing (including ABC)

-Marginal cost pricing

-Life cycle costing pricing

-Relevant cost pricing

-Return on investment pricing

5.1.1 Advantages

- Easy,quick,and cheap to apply.
- The cost of collecting market information on demand and competitor's activity are avoided.

**5.1.2 Disadvantages of cost-based accounting**

- They ignore external factors such as demand and competition (see s.4).
- They are unlikely to maximise profit, revenue or market share as mark-ups are subjective.
- They may result in prices completely different from those charged by competitors.
- Using a cost basis may underestimate the features in the product that are attractive to customers and could justify a higher price.

**Exercise 4 Cost Plus and Target ROI**

A golf club manufacturer is about to launch a new product, the Wild Thing Driver.

Buildings and equipment needed for production will cost $2,000,000, and working capital requirements are estimated at $10 per unit per annum.

Expected sales levels are 40,000 units per annum. Variable production costs are $30 per unit.

Fixed production costs will be $300,000 per annum and fixed non-production costs will be $100,000 per annum.

Required:

a.Calculate selling price using:

Full cost plus 20%.

Marginal cost plus 40%.

Target ROI of 10%.

b.If ***actual*** sales are only 20,000 units and selling price was set using full cost plus 20%, calculate profit for the year.

### 5.2 Market skimming pricing

Definition

Market skimming is often used when a product is launched. **A high price is set initially,** which generally means that demand will be low. However, a large profit margin can be made during this stage.

Later, when the early adopter segment of the market is satisfied, **the price may be lowered** so that sales can be made to a larger market segment.

Market skimming is most likely to be used in the following situations:

- To launch a new product into a market where there is **no existing competition.** This is typically a "breakthrough" product. Examples of breakthrough products include the car, penicillin, laptop computer, Windows operating system, ATM and iPad. Breakthrough services include the Internet and online shopping.
- **The product confers some status on the customer**. For example, when mobile phones were first launched commercially in the 1980s, the cost of a handset was about $2,500. Having a mobile telephone was a symbol of importance.
- **The product has a short lifecycle,** and it is desirable to recover the development costs as quickly as possible.
- The strength of demand and the sensitivity of demand to price are **inelastic.**

### 5.3 Market penetration pricing

Definition

**Penetration pricing** is a policy of **low price**s when a product is first launched in order to obtain strong demand for the product as soon as it is launched on the market. Low prices should encourage bigger demand.

A penetration pricing policy may be appropriate in the cases below.

- For **commodity-type products** where there are many existing products available. The only way to break into the market is to sell for a lower price than the existing products.

- For **price-sensitive products** (i.e. a small reduction in price is expected to result in a large increase in demand).This high price elasticity of demand is discussed in more detail in s.4.2.
- For **products where economies of scale exist** (i.e. if large quantities are produced the cost per unit falls significantly).

### 5.4 Price discrimination

Definition

**Price discrimination** is the practice of charging **different prices** for the **same product** to different groups of buyers

The price discrimination may be appropriate in the cases below.

**By market segment**:items such as cinema tickets and hairdressing service are often available at lower price to old-age pensioners,students or juveniles.

**By product version**.such as the top of the range model carries a price much in excess of the cost of provision of extra.

**By place**.theatre seats are usually sold according to their location .

**By time** : off-peak travel bargains,hotel price, air ticket

### 5.5 Complementary product pricing

If an organization makes and sells complementary products, it may wish to decide the selling prices for the products in a single pricing policy decision.

Eg. tennis ball and tennis racket

| **Example 4 Complementary Products** |
| --- |
| Printers for computers are often sold at a relatively low price; once a particular model of printer has been acquired, the user has to buy a particular print cartridge. The price of the print cartridges is then relatively high because a large margin can be made on them. Consumers have no choice but to buy those cartridges unless they invest in a new printer. |

### 5.6 Going-Rate Pricing

This simply means charging the prevailing market price. This approach might be used in competitive markets (i.e. where charging above market price would lead to a loss of the majority of customers and selling below market price would not bring additional customers).

Going-rate pricing is common for homogeneous products that have very little variation (e.g. commodities such as aluminium or beef).

### 5.7 Product line pricing

Some products are related because they are sold to the same customer or through the same outlets. Product-line pricing involves setting the price of the products in the product line together.

### 5.8 Volume discounting

Many organisations offer discounts to customers who buy a certain number of products. In retail stores, for example, it is quite common to see "buy one, get one for 50%".

### 5.9 Relevant cost pricing

Special orders may require a relevant cost approach to the calculation of the price. A Relevant cost pricing, also referred to as opportunity cost pricing, is often used for one-off contracts or orders. **The relevant cost of the contract is calculated, and then a mark-up added to get the price**

Relevant costs can be used to arrive at a **minimum tender price** for a one-off tender or contract. The minimum price should be equal to the total of all relevant cash flows.

## Summary

- Cost plus pricing methods involve adding a given margin to the cost of a product. The cost may be the marginal cost, the full cost or even the relevant cost.
- Full cost plus pricing is a *long-term* pricing strategy. It ensures that prices cover all variable and fixed costs.
- Opportunity cost (relevant cost) pricing is suitable for *short-term* pricing decisions.
- A significant weakness of cost plus methods of pricing is that they take no account of demand.
- Marginal revenue is the increase in total revenues resulting from selling one more unit of a product or service.
- For exam purposes, marginal cost is equal to variable cost per unit (at least until full capacity is reached).
- A business maximises its profit when marginal revenue equals marginal cost.
- Pricing is a strategic decision and different pricing strategies are applied in different circumstances (e.g. when demand for one product is linked to demand for another).
- The price elasticity of demand is a measure of the degree of sensitivity of demand for a good to changes in the price of that good