# ECONOMICS FOR ENGINEERS

L-1 (12.08.2022) (11:00-12:00 p.m.)

- What is economics?

→ The process of management of house, Resource allocation, assuming country as a house.

(→ Financial as well as human Resources)

- Why management is required?

Due to limited resources, efficient utilisation of resources.

To maximize the profit (increasing output selling price through marketing) or to minimize the cost (reduce expenditure / reduce factors of production) [raw materials, labour expenditure

- Market price is the sum of cost, tax, transport, advt. cost + seller's profit.
- Expenditure/cost of production is the sum of all the factors.

- In module 1,2 we will study behavior pattern of a single consumer w.r.t. the changes in different type of market situations.

- Two types of market situations:

(i) Normal market situation: balanced

& (ii) Uncertain market situation

(output are not sure to the consumer)

e.g.:
- Types of games (Lottery, Gambling ...)
- Investments (Policies, Schemes ...)
- Secondary market (secondary sales ...)

(due to lack of information between the buyers and the sellers)

M-3: Owner's profit is dependent on
- share holder's money
- manager's managing skills
- Labourer's working etc...

M-4: Seller's point of view

M-5: Investments.

- There are two markets:
  - Perfect combination market
  - Imperfect combination market (any deviation to perfect comb^n market)

- Profit: expenditure deducted from income
- Exact profit: profit as a function of time period.

- Single consumer's behavior pattern: Demand of a consumer

It must fulfil three conditions:

(i) It must be the need/requirement of the consumer.

(ii) The consumer must have the ability to buy it.

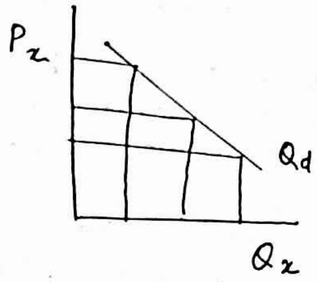
(iii) The consumer must have the willingness to pay for it.

- Without ability and willingness to pay, a requirement can't be termed as demand.

- Quantity Demand is the number of units a consumer demands.
- The sum of all individuals' quantity demand is termed as market demand.

- Demand basically refers to the price and quantity demand relationship. In general, there is an inverse relationship. (Downward sloping curve).

L-2 (13.08.2022) (09.00 - 10.00 a.m)



(Demand Curve)
→ Graphical form
→ $Q_x = f(P_x)$
→ $Q_x = a - bP_x$

- Demand curve is the graphical form representation of price-quantity demand relationship, however the tabular form representation is known as demand schedule.

$$Q_x = f(P_x, I, q_x, T, P_y)$$

- Factors affecting/influencing quantity demand ($Q_x$)

(inv.) • Price of that particular commodity ($P_x$)
(dir.). Income of the consumer (I)
(dir.). Quality of the product ($q_x$)
(dir.). Taste and preference of the consumer (T)
• Price of the related goods ($P_y$)
depends
where 'y' stands for all other goods than 'x'
→ may be substitute (e.g: tea-coffee)
or complementary (both reqd simultaneously, e.g: car-petrol)

- Law of Demand:

Assuming all other factors are constant, the inverse relationship between the price and quantity demand of a particular product is known as "Law of Demand."

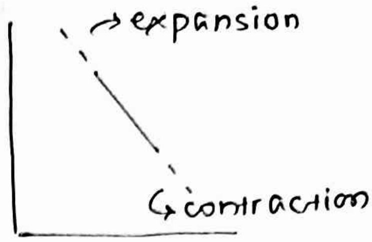
(There are some goods which won't prove Law of demand)

- Exceptional case of Law of demand:

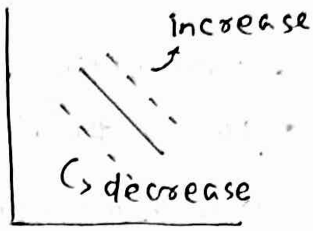
(i) Necessity good: salt, medicines
(ii) Luxurious good (Veblen goods): diamond
(iii) Giffen good (inferior goods)
→ (When a consumer is consuming poor quality product, and price increasing still doesn't decrease consumption)
e.g: bread.

## Shifting of demand curve:

(i) Expansion and contraction of the demand curve. (change within that curve, due to change in the price of that product)




(ii) Increase and decrease in demand curve. (create a new demand curve by shifting the demand curve upward/downward) (due to change in other factors than price)




**Qn** Individual A's quantity demand, $Q_{x_A} = 40 - 2P$ (P → price)
Similarly, $Q_{x_B} = 25.5 - 0.75P$
& $Q_{x_C} = 36.5 - 1.25P$
Find out the market demand.

**Ans:** The market demand for product 'x' is given by

$$Q_{x_M} = Q_{x_A} + Q_{x_B} + Q_{x_C}$$
$$= (40 - 2P) + (25.5 - 0.75P) + (36.5 - 1.25P)$$
$$= 102 - 4P \quad \text{.. (Ans.)}$$

* **Why the demand arises?** (To satisfy user's utility)
  * The level of satisfaction of a consumer by some expenditure for the consumption of a required product is called 'utility'.
  * There are two types of utility:
    (i) Cardinal Utility Approach
    (• classical economics, utility represented by numerical value)
    (ii) Ordinal Utility Approach
    (• comparison between different types of goods is shown in order to make a priority (rank of preferences))

## Cardinal Utility Approach:

There are two laws, discussed in Cardinal Utility Approach.
(a) Law of deminishing marginal utility (Gossen's First Law)
(b) Law of equimarginal utility (Gossen's second Law)

L-3 (20.08.2022) (09:00-10:00 a.m.)

- **Marginal Utility**
  Marginal utility defines the change in total system due to any additional change.
  (Change in total situation due to additional units)

e.g.:

| $U_x$ (unit) | $TU_x$ (Total unit of consumption) | $MU_x$ → Marginal utility = $\frac{\partial U}{\partial x}$ |
|---|---|---|
| 1 | 15 | 15 |
| 2 | 25 | 10 |
| 3 | 30 | 5 |
| 4 | 30 | 0 |

$TU_x$ → overall view

$MU_x$ → small unit changes are identeficable

Marginal utility is a better measure than total units.
(e.g.: Marginal profit, Marginal cost)

- Total utility goes on increasing, however marginal utility decreases.

★ Law of demineshing marginal utility:

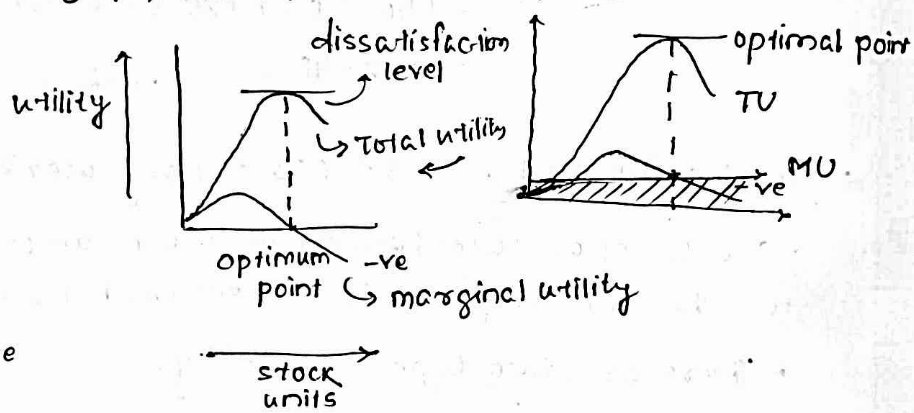
→ With increase in stock of each additional a particular product, the marginal utility is decreasing whereas the total product utility is increasing.

→ Total utility will increase till the point where $MU \neq 0$ ↳ marginal utility is not equal to zero

→ At the 'optimum point' or 'maximum point' of total utility, marginal utility will be equal to zero.
i.e. $MU = 0$

→ When total utility will start decreasing, marginal utility will be negative.

TU max, MU = 0      TU ↑, MU ↓, +ve      TU↓, MU -ve




★ As Gossen's first Law is based on one type of good only, criticising that point, Gossen's second Law was introduced, which is based on utilities of more than one product.

★ Law of Equimarginal utility:

→ A consumer must have to spend all his money income (no savings) in different types of goods in such a way that the level of satisfaction from each good must be equal.

i.e. $MU_x = MU_y = MU_z \ldots$

'x', 'y' & 'z' are different types of goods.

The condition for equimarginal utility is

$$\boxed{\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = \frac{MU_z}{P_z} = M}$$

where M is the total money income.

$P_x$, $P_y$ & $P_z$ are respective price for goods 'x', 'y' & 'z'.

e.g: Let us consider a simple system of two goods: 'x & y'.

| U | $MU_x$ | $MU_y$ |
|---|---|---|
| 1 | 20 | 24 |
| 2 | 18 | 21 |
| 3 | 16 | 18 |
| 4 | 14 | 15 |
| 5 | 12 | 9 |
| 6 | 10 | 3 |

$P_x = 2$
$P_y = 3$
$I = M = 24$
↳ Total income of the consumer.

Find out the unit of consumption of ~~prod~~ 'x' & 'y' which will equalize the level of satisfaction from both 'x' & 'y'.

sol:

| U | $MU_x$ | $MU_y$ | $\frac{MU_x}{P_x}$ | $\frac{MU_y}{P_y}$ |
|---|---|---|---|---|
| 1 | 20 | 24 | 10 | 8 |
| 2 | 18 | 21 | 9 | 7 |
| 3 | 16 | 18 | 8 | 6 |
| 4 | 14 | 15 | 7 | 5 ✓ |
| 5 | 12 | 9 | 6 | 3 |
| 6 | 10 | 3 | 5 | 1 |

Among equalized levels, '8' gives the consumption $3x + 1y$
with an expenditure $= 3(2) + 1(3) = 9$.

Similarly, maximum commodities will be consumed
when expenditure = income = 24

At level '5', level of satisfaction, $6x + 4y$ gives expenditure $= 6(2) + 4(3) = 24$
Which is the consumption condition that satisfies equimarginal utility.
-- (Ans)

L-4 (25.08.2022) (03:00-04:00pm)

+ Ordinal/modern utility Approach:

(For maximization of level of satisfaction)

We need:
(i) Level of satisfaction of consumer for goods
(ii) Income of the consumer

Utility, $U = f(x, y)$
where 'x' & 'y' are two goods

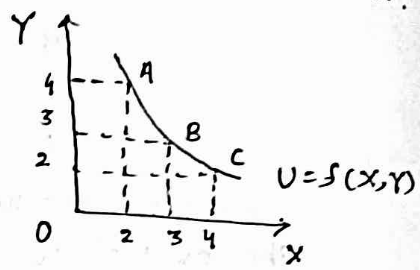
Income, $I = P_x X + P_y Y$
'$P_x$' & '$P_y$' are respective price
& 'X' & 'Y' are respective number of units consumed.

- To find out the consumer equilibrium point, we require both utility function and income function.
- Utility function can be measured through indifference curve approach (IC)

- Income function of the consumer can be represented through budget line (BL).

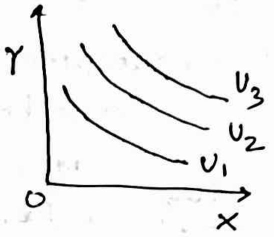
## Indifference Curve: (Graphical Representation)

Indifference curve is the combination of different types of goods that each point of the curve will give equal level of satisfaction to the consumer.




(Each point contains same units of goods)
↳ will give equal level of satisfaction

→ If we join more than one indifference curves simultaneously, the combination is known as "indifference map".

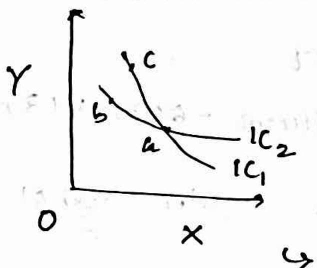



(Indifference map)

## Properties of Indifference Curve:

- Each point of the IC will give equal level of satisfaction. (due to trade off between 'x' & 'y')
- IC must be convex to origin.
  - monomer/single good case (straight line)
  - more than two goods: concave
- Higher the IC, higher will be the level of satisfaction.
- Two ICs will never intersect each other.
- It will never touch both the 'X' & 'Y'-axis simultaneously.

[ In trade-off condition,
 When the consumption of good 'x' is increasing, consumption of good 'y' must decrease. ]




In $IC_1$, $a = c$

In $IC_2$, $a = b$

But $c > b$ (as c is at a higher plot than b)

↳ So, two ICs never intersect.

- The slope of the indifference curve is known as Marginal Rate of Substitution $\left(M.R.S._{xy} = \frac{MU_x}{MU_y}\right)$

$$MU_x = \frac{\partial U}{\partial x}, \quad MU_y = \frac{\partial U}{\partial y} \quad \therefore \frac{MU_x}{MU_y} = \frac{\partial Y}{\partial X} = \text{slope of the IC}$$

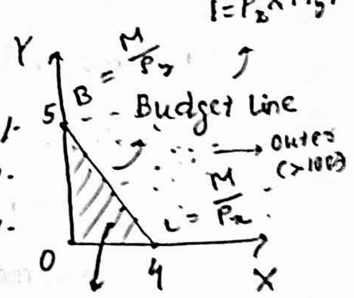
## Budget Line:

- The slope of the budget line $= \frac{P_x}{P_y}$
- The budget line shifts depending on
  - (i) change in price of goods
  - (ii) change in total income

$I = P_x X + P_y Y$

Suppose,
income → $M = 100/-$
$P_x = 25/-$
$P_y = 20/-$

Slope $= \frac{P_x}{P_y}$

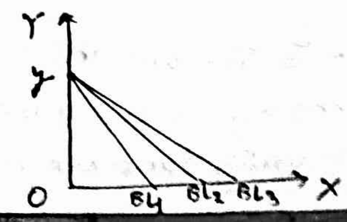



Budget space (<100/-)

### (i) Change in price of goods:

(as of good 'x',

the position of BL at $\overrightarrow{OY}$ will remain fixed, though position on $\overrightarrow{OX}$ will vary.



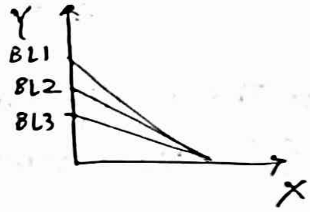
for instance, in the graph, taking $BL_2$ as reference, $BL_1$ will be new position when price of 'x' increases & $BL_3$ will be new position when price of 'x' decreases.

(b) of good 'y'

the position over $\overrightarrow{OX}$ remains the same.

the position over $\overrightarrow{OY}$ is displaced downwards with increase in price of 'y'.

the position over $\overrightarrow{OY}$ is displaced upwards with decrease in price of 'y'.




(ii) change in total income:

With change in total income, the budget line is shifted parallel.

with increase, it goes higher.

with decrease, goes lower.

$I(BL_2) > I(BL_1)$

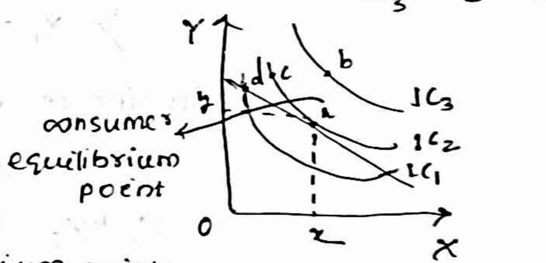
$I(BL_3) < I(BL_1)$


* Consumer Equilibrium Point:

The possible maximum level of satisfaction is given at the consumer equilibrium point.

condition: slope of IC = slope of BL

$IC_3 > IC_2 > IC_1$




- There are two conditions of consumer equilibrium point:

(i) The slope of indifference curve must be equal to the slope of budget line

i.e. $\dfrac{MU_x}{MU_y} = \dfrac{P_x}{P_y}$ [At consumer eqm point, the units pair of 'x' & 'y' gives maxm level of satisfaction]

(ii) At the point of equilibrium, IC must be convex to origin.

Example:

Suppose the utility function is given as

$$U = X^{3/4} Y^{1/4} \quad \text{—(1)}$$

Price of good 'x' is 6/-

Price of good 'y' is 3/-

Total income 'I' is 120/-

sol$^n$: The income function is given by

$$120 = 6X + 3Y. \quad \text{—(2)}$$

$$MU_x = \frac{\partial U}{\partial X} = \frac{3}{4} X^{-1/4} Y^{1/4} \quad , \quad MU_Y = \frac{\partial U}{\partial Y} = \frac{1}{4} X^{3/4} Y^{-3/4}$$

$$\therefore \frac{MU_x}{MU_Y} = 3X^{-1}Y = \frac{6}{3} \Rightarrow X = \frac{3Y}{2}$$

Substituting value of 'X' in eq$^n$(2),

$$6\left(\frac{3Y}{2}\right) + 3Y = 120$$

$$\Rightarrow 3Y = \frac{120}{4} = 30$$

$$\Rightarrow Y = 10.$$

$\boxed{\text{Ans: } X = 15, Y = 10}$

$$\therefore X = \frac{3Y}{2} = 15.$$

Q. The utility function is $U = \sqrt{X_1 X_2}$, $P_{x_1} = 5$, $P_{x_2} = 2$, $M = 500$ —(1)

Sol$^n$: The income function will be

$$500 = 5X_1 + 2X_2 \quad —(2)$$

$$MU_{x_1} = \frac{\partial U}{\partial X_1} = X_2 \cdot \frac{1}{2\sqrt{X_1 X_2}}, \quad MU_{x_2} = X_1 \cdot \frac{1}{2\sqrt{X_1 X_2}}$$

$$\therefore \frac{MU_{x_1}}{MU_{x_2}} = \frac{X_2 \frac{1}{2\sqrt{X_1X_2}}}{X_1 \frac{1}{2\sqrt{X_1X_2}}} = \frac{X_2}{X_1} = \frac{P_{x_1}}{P_{x_2}} = \frac{5}{2}$$

$$\Rightarrow X_1 = \frac{2}{5}X_2$$

Cons. eq$^n$ point factors
- Price
- Income
- Substitution

Substituting in eq$^n$(2),

$$500 = 2X_2 + 2X_2$$

$$\Rightarrow 4X_2 = 500$$

$$\Rightarrow X_2 = 125$$

$\boxed{\text{Ans: } X_1 = 50, X_2 = 125}$

$$\therefore X_1 = \frac{2}{5} 125 = 50. \quad \text{..(Ans)}.$$

→ L-5 (26.08.2022) (11:00-12:00)

The change in consumer equilibrium point refers to the movement of combination of goods. It depends on:

(i) Price Effect:

Change in quantity demand due to change in price of the commodity.

$$PE = -\frac{\partial q_x}{\partial P_x}$$

(ii) Income Effect:

Change in quantity demand of good 'x' due to change in income of the consumer.

$$IE = \frac{\partial q_x}{\partial I}$$

(iii) Substitution Effect:

Change in quantity demand due to change in price of the good assuming level of satisfaction as constant.

$$SE = -\frac{\partial q_x}{\partial P_x}\Bigg|_{U=\bar{U}}$$

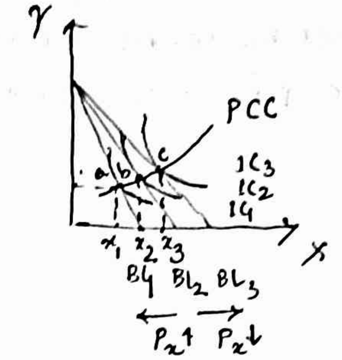
## Price Effect:

$x_2 x_1$ shift = PE

$x_1 x_3$ = PE

$x_2 x_3$ = PE

(change in quantity/units due to change in price)




Price Consumption Curve is the combination of all the equilibrium points that changes due to Price Effect.

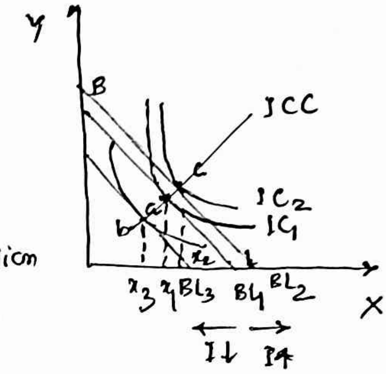
## Income Effect:

ab = IE

bc = IE

ac = IE

(change in equilibrium point is a result of shift in budget line or income)




Income consumption Curve is the combination of all the equilibrium points that change due to Income Effect.

## Substitution Effect:

Assuming level of satisfaction as constant through money adjustment process.

(some compensation is provided to the consumer to maintain level of satisfaction or if income is more, extra money is not utilized in consumption beyond the initial level of satisfaction). <u>reduction</u>

This compensation ($I\downarrow$) & reduction ($I\uparrow$) is managed through imposition of subsidy and tax respectively.

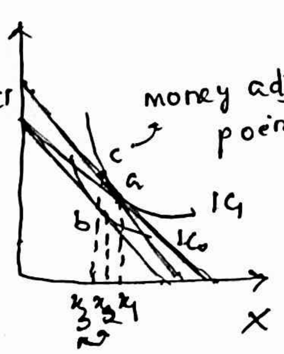
100%

ab price effect

bc IE

ac SE

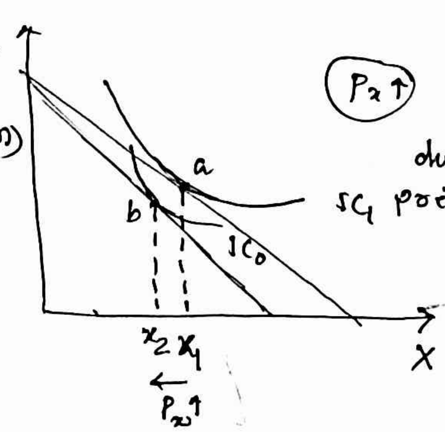
PE = IE + SE



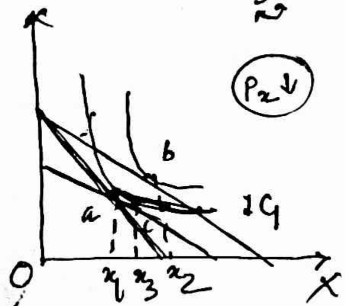

money adjustment point

(Substitution)

(compensation)




due to IC1 price effect




ab = PE

bc = IE

ac = SE

(reduction)

$x_1 x_2$ = PE

$x_2 x_3$ = IE

$x_1 x_3$ = SE

$x_1 x_2 = x_3 x_2 + x_1 x_3$

$\Rightarrow \boxed{PE = IE + SE}$ → Slutsky Equation

or $-\frac{\partial q_x}{\partial P_x} = \frac{\partial q_x}{\partial I} - \frac{\partial q_x}{\partial P_x}\Big|_{U=\bar{U}}$

Assignment:1

Prove the decomposition of price effect into income and substitution effect by taking the case of decrease in price and increase in price of a particular good.

Name
Regd. No
Stappled
A4/VSSUT Paper
05:09:2022

→ Completed

→ L-6 (03.09.2022)

→ Elasticity Approach:

→ It measures the degree of responsiveness of quantity demand due to change in other factors.

→ There are three types of elasticity demand:

(i) Price elasticity demand
(ii) Income elasticity demand
(iii) Cross elasticity demand

→ Definitions:

- Price elasticity demand represents the percentage change in quantity demand due to percentage change in price of the commodity. ($e_p$).
- Income elasticity demand represents the percentage change in quantity demand due to percentage change in income of the consumer. ($e_i$).
- Cross elasticity demand represents the percentage change in quantity demand of good y due to change in price of good 'x'. ($e_c$)

→ The elasticity value varies between zero to infinity.

For price elasticity demand,

there exist five approaches between 0 to ∞ elasticity range:

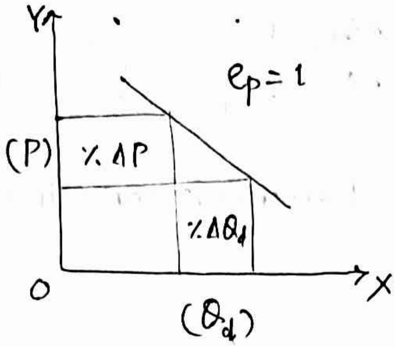
(1) When ep value = 0, it is known as perfectly inelastic demand.
(2) When ep value = 1, it is known as unitary elastic demand.
(3) When ep value = ∞, it is known as perfectly elastic demand.
(4) When ep value lies between 0 to 1, it is known as inelastic demand.
(5) When ep value lies between 1 to ∞, it is known as elastic demand.

→ In a demand curve,

e = ∞ ~ Perfectly elastic
e = betⁿ 1 to ∞ ($\% \Delta Q_d > \% \Delta P$) ~ Elastic
e = 1 ($\% \Delta Q_d = \% \Delta P$) ~ Unitary Elastic
e = betⁿ 0 to 1 ($\% \Delta Q < \% \Delta P$) ~ Inelastic
e = 0 (Quantity demand doesn't change with ΔP) ~ Perfectly inelastic

(1) When $e_p = 1$, (unitary elastic)

It means percentage change in quantity demand must be equal to percentage change in price of the commodity.




Here,

$\% \Delta P = \% \Delta Q_d$

(elasticity demand = 1)

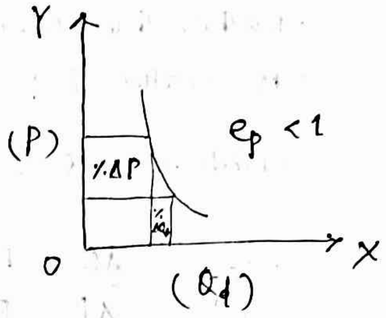
(2) When $0 < e_p < 1$, (inelastic)

It states that the percentage change in quantity demand must be less than percentage change in price.

Here,

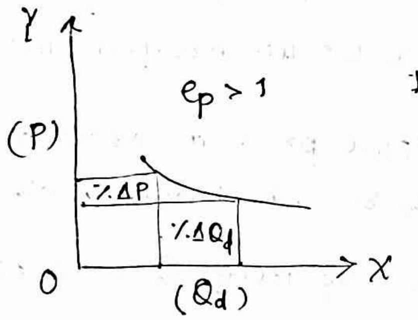
$\% \Delta Q_d < \% \Delta P$

(elasticity demand < 1)




(3) When $1 < e_p < \infty$, (elastic)

It states that the percentage change in quantity demand must be greater than percentage change in price.




Here,

$\% \Delta Q_d > \% \Delta P$

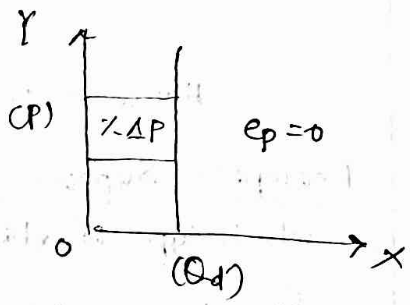
(elasticity demand > 1)

(4) When $e_p = 0$, (perfectly inelastic)

It represents the approach where no change in quantity demand takes place w.r.t. change in price.

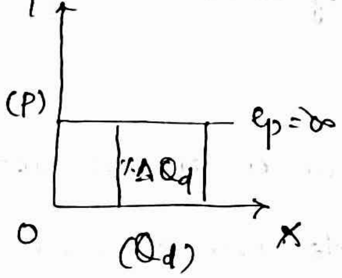
$\% \Delta Q_d = 0$ w.r.t. $\% \Delta P$

(elasticity demand = 0)




(5) When $e_p = \infty$, (perfectly elastic)

In case of infinite value of $e_p$, a small or negligible change in price can change the quantity demand to a large extent.




$\% \Delta Q_d >> \Delta P$

(elasticity demand = $\infty$)

* The absolute value in elasticity (changes) is taken.

* There are three methods to measure the elasticity approach:

(1) percentage method
(2) Midpoint method
(3) point method

$\Delta Q_d = Q_2 - Q_1$

$\% \Delta Q_d = \frac{\Delta Q_d}{Q_i} \times 100$

(1) Percentage method:

$$e_p = \frac{\% \Delta Q_d}{\% \Delta P} = \frac{\Delta Q_d / Q_d}{\Delta P / P} = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q_d} \Rightarrow \boxed{e_p = \frac{\Delta Q_d}{\Delta P} \times \frac{P}{Q_d}}$$

Similarly, $\boxed{e_i = \frac{\Delta Q_d}{\Delta I} \times \frac{I}{Q_d}}$ & $\boxed{e_c = \frac{\Delta Q_{d_x}}{\Delta P_y} \times \frac{P_y}{Q_{d_x}}}$

→ This method is not accurate sometimes. So, for big data, mid-point method is used.

(2) Midpoint method :

- Rather than taking original price, we take mid value.
- Mid-value of $P = \frac{P_1+P_2}{2}$
- Mid-value of $Q = \frac{Q_1+Q_2}{2}$

$\therefore \boxed{e_p = \frac{\Delta Q}{\Delta P} \times \frac{P_1+P_2}{Q_1+Q_2}}$, $\boxed{e_i = \frac{\Delta Q}{\Delta I} \times \frac{I_1+I_2}{Q_1+Q_2}}$ & $\boxed{e_c = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_{y_1}+P_{y_2}}{Q_{x_1}+Q_{x_2}}}$

- For big-data, we use mid-point method.

Example:1 Suppose price increases from 4 to 6, Quantity demand changes from 120 to 80. Which type of elasticity does it have?

↳ The price elasticity demand is, $e_p = \frac{120-80}{6-4} \times \frac{4}{120}$ $\left(\frac{\Delta Q}{\Delta P} \times \frac{P}{Q}\right)$

$= \frac{2}{3}$ i.e. $0 < e_p \leq 1$.

Hence, it is an instance of inelastic demand.

Example:2 Suppose price decreases from 6 to 4, $Q_d$ changes from 120 to 80, which type of elasticity does it have?

↳ The elasticity demand is, $e_p = \frac{120-80}{6-4} \times \frac{6}{120}$

$= \frac{3}{2}$ i.e. $1 < e_p < \infty$

Hence, it is an instance of elastic demand.

Qn.1 When price decreases from 6 to 4, Qd increases from 80 to 120, use midpoint method to find elasticity type?

Soln: $e_p = \frac{120-80}{6-4} \times \frac{6+4}{80+120}$ $\left[\frac{\Delta Q}{\Delta P} \times \frac{P_1+P_2}{Q_1+Q_2}\right]$

$= \frac{40}{2} \times \frac{10}{200} = 1$

↳ Unitary elastic.

Qn.2 A consumer purchases 80 units of commodity when its price is Rs. 1 per unit and purchases 48 units of commodity when its price is Rs. 2 per unit. What is the price elasticity demand of commodity using midpoint method?

Sol$^n$: The elasticity demand is, $e_p = \frac{\Delta Q_d}{\Delta P} \times \frac{P_1+P_2}{Q_1+Q_2}$

$$= \frac{80-48}{2-1} \times \frac{1+2}{80+48}$$

$$= \frac{32 \times 3}{128} = \frac{3}{4}, \quad 0 < e_p < 1$$

↳ Inelastic demand.

Qn.3 Seller wants to declare price Rs. 150 to Rs. 142.5 and its present sale is 2000m, $e_p = 0.7$. It asks you to find out whether there is increase in total revenue or not?

Sol$^n$: We know, $e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$

$$\Rightarrow 0.7 = \frac{\Delta Q}{7.5} \times \frac{150}{2000}$$

$$\Rightarrow \Delta Q = \frac{7.5 \times 2000 \times 0.7}{150} = 70$$

Initial, price = 150 Rs.
Quantity demand = 2000 m
∴ Revenue = 150 × 2000 = 3,00,000 —(1)

Final, Price = 142.5 Rs.
Quantity demand = 2000m + ΔQ = 2070 m
∴ Revenue = 142.5 × 2070 = 2,94,975 —(2)

From (1) & (2), we can conclude that,
there is a decrease in total revenue. — (Ans)

› L.7 (08.09.2022) (03:00-04:00 pm)

Ex.1 Suppose $Q = 720 - 25P$ (demand function)
where 'Q' stands for Quantity demand
& 'P' stands for Price.
If price = 15 Rs., find the type of elasticity.

Sol$^n$:

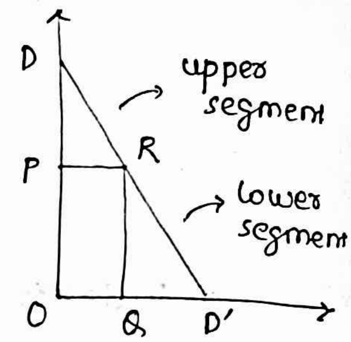
$$\therefore e_p = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \boxed{\frac{1}{b} \times \frac{P}{Q}}$$ — considering slope $b = \frac{\Delta P}{\Delta Q}$

$$= \frac{1}{25} \times \frac{15}{720 - 25(15)}$$

$$= \frac{\cancel{3}}{5 \times \cancel{345}_{115}} = \frac{3}{575} \simeq 0.00174$$

→ Inelastic demand.

* **Point method:** (To find out the elasticity for a point on linear curve)




elasticity demand, $e_p = \dfrac{\text{Lower segment}}{\text{Upper segment}}$

Here, $b = \dfrac{PD}{PR}$ is the slope (in $Q_x = a+bx$)

Original Price, $P = OP$
Original $Q_d$, $Q = OQ$

$$e_p = \underbrace{\frac{1}{b} \times \frac{P}{Q}}_{\text{slope method}} = \frac{1}{\frac{PD}{PR}} \times \frac{OP}{OQ} = \frac{\overset{(=OQ)}{PR}}{PD} \times \frac{OP}{OQ} = \frac{OP}{PD} = \frac{D'R}{RD} = \frac{\text{lower segment}}{\text{upper segment}}$$

* **Income elasticity demand:**

The percentage change in quantity demand w.r.t. percentage change in income of the consumer.

$$e_i = \frac{\Delta Q}{\Delta I} \times \frac{I}{Q} \quad , \quad e_i = \frac{\Delta Q}{\Delta I} \times \frac{I_1+I_2}{Q_1+Q_2} \qquad Q_x = a+bI, \; e_i = (b)^{-1} \times \frac{I}{Q} = \frac{1}{b} \times \frac{I}{Q}$$

↳ percentage method ↳ mid-point method $\qquad b = \left(\dfrac{\Delta Q}{\Delta I}\right)^{-1} = \dfrac{\Delta I}{\Delta Q}$

Q. If consumer's income increases from Rs 300 to Rs. 350, due to this increase, the consumption increases from 25 to 35 unit. Using mid-point method find out income elasticity demand.

Sol$^n$: Given that, $I_1$ = Rs. 300, $I_2$ = Rs. 350 $\quad \Delta I = 50 \;, I_1+I_2 = 750$

$Q_1 = 25$, $Q_2 = 35$ $\quad \Delta Q = 10 \;, Q_1+Q_2 = 60$

$$\therefore e_i = \frac{\Delta Q}{\Delta I} \times \frac{I_1+I_2}{Q_1+Q_2} = \frac{10}{50} \times \frac{650}{60} = 2.1667 \left(\frac{13}{6}\right). \text{ -(Ans)}$$

↳ elastic

* **Cross elasticity demand:**

The percentage change in quantity demand of good x w.r.t. percentage change in price of another good 'y'.

$$e_c = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x} \quad , \quad e_c = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_{y_1}+P_{y_2}}{Q_{x_1}+Q_{x_2}} \quad , \quad Q_x = a - by \quad e_c = \frac{1}{b} \times \frac{P_y}{Q_x}$$

↳ percentage method ↳ mid-point method $\qquad$ where $b = \dfrac{\Delta P_y}{\Delta Q_x}$

Qn2 If price of coffee increases from Rs.45 to Rs.55 per pack of 250g. As a result, the consumer's demand for tea decreases from 600 to 800 packets of 250g. Find out cross elasticity demand between tea & coffee using mid-point method.

Sol$^n$:

$Q_{tea_1} = 600$ packets $\quad P_{coffee_1} = $ Rs. 45

$Q_{tea_2} = 800$ packets $\quad P_{coffee_2} = $ Rs. 55

$\Delta Q_x = 200 \quad \Delta P_y = 10$

assuming tea as 'x' $\quad$ assuming coffee as 'y'

$$\therefore e_c = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_{y_1} + P_{y_2}}{Q_{x_1} + Q_{x_2}}$$

$$= \frac{200}{10} \times \frac{100}{1400} = \frac{10}{7} = 1.43 \quad \text{(elastic)}$$

Qn3 If the demand function is $Q_c = 100 + 2.5 P_t$ → Price of tea

↳ Quantity of coffee

Find the cross elasticity demand when price of tea increases to Rs.50.

Sol$^n$:

$$e_c = \frac{\Delta Q_x}{\Delta P_y} \times \frac{P_y}{Q_x}$$

As, slope $= \frac{\Delta P_y}{\Delta Q_x} = 2.5$

$\Rightarrow \frac{\Delta Q_x}{\Delta P_y} = \frac{1}{2.5}$

$$= \frac{1}{2.5} \times \frac{50}{125}$$

$$= 0.16$$

↳ inelastic demand

$Q_c = 100 - 2.5 P_t$

$e_c = \cancel{2.5} \times \frac{50}{25}$

$= 5$

## Relationship between total expenditure and price elasticity demand:

Total expenditure, TE = P × Q → no. of units of consumables

↳ price per unit

- → when $e_p > 1$, due to fall in price, total expenditure will increase.
- → when $e_p > 1$, due to rise in price, total expenditure will decrease.
- → when $e_p < 1$, due to fall in price, total expenditure will decrease.
- → when $e_p < 1$, due to rise in price, total expenditure will increase.
- → when $e_p = 1$, due to fall in price, total expenditure will remain constant
- → when $e_p = 1$, due to rise in price, total expenditure will remain constant

* Relationship between total expenditure and ~~income~~ income elasticity:

$$e_i = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta I}{I}} = \frac{\Delta Q}{Q} \times \frac{I}{\Delta I} = \frac{\Delta Q \times P}{Q \times P} \times \frac{I}{\Delta I} = \frac{\Delta TE}{TE} \times \frac{I}{\Delta I}$$

$$\Rightarrow e_i = \frac{\Delta TE}{TE} \times \frac{I}{\Delta I} \quad \alpha \quad \frac{\Delta TE}{\Delta I}$$

→ proportion of income spent

→ increased income

→ If proportion of income spent on a good remains same, as income increased, $e_i = 1$.

→ If proportion of income spent on a good is greater than increased income ~~1~~, $e_i$ will be greater than '1'. ($e_i > 1$)

→ If proportion of income spent on a good is less than increased income, $e_i$ will be less than '1'. ($e_i < 1$)

L - (09.09.2022) (11:00-12:00 pm)

From a linear demand function, taking the co-efficient value 'b', we can calculate $e_p$, $e_i$ and $e_c$.

e.g: $e_p = b \cdot \frac{P}{Q}$, $e_i = b \cdot \frac{I}{Q}$, $e_c = b \cdot \frac{P_y}{Q_x}$

Ex $Q_x = a + bP_x$, $b = \frac{\Delta Q_x}{\Delta P_x}$

* Consumer behavior under risk and uncertain situation:

→ Outcomes are not known to the consumer, but under risk situation, we can estimate the probability of each outcome. But under uncertain condition, probabilities can not be estimated.

That's why uncertainty is more dangerous than risks.

→ Under both the situation of risk and uncertainty, the outcomes are not known to the consumer (success/failure) but under the case of risk the probability of each outcome can be estimated or predicted by using the consumer's own experience or the past situation of that game.

Under uncertain situation, the outcomes are not known to consumer as well as the probabilities of each outcome cannot be estimated.

→ Considering a risk market, mainly three types of fields arise:

(i) Type of Game (Gambling, Lottery)

(ii) Field of investment (Policies, dealing with bond market, stock market)

(iii) Secondary market (Lack of information of the buyer & seller)

→ level of satisfaction varies based on income of the consumer, if the cost is favorable w.r.t. income. (expected income)
→ Dependent on expected level of satisfaction.

* Which type of consumer would prefer to participate in type of game?
* If they are participating, what will be the level of satisfaction?
* From which game they will be more profited?

* Type of Game:

→ Why most of the people aren't preferring/ willing to participate, in a fair game, even if - the game is based on 50-50 odds.

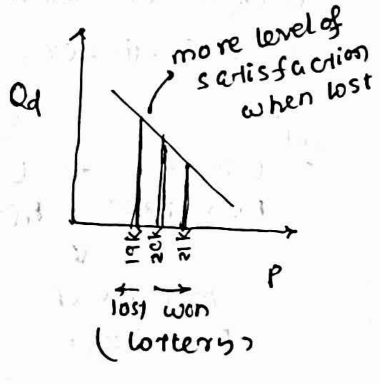
This is known as St. Petersburg Paradox.

→ To explain this Petersburg paradox, Bernulli gave this hypotheses on the following three points:

(i) The same amount of money can give different level of satisfaction to different consumer depending upon their level of income.
(ii) It is assumed that, the expectation or utility from the losing amount of money is always greater than the utility of gaining amount of money
(iii) All the decisions of the consumer must be based on expected utility of the consumer rather than the expected income of the game.

• L - (10.09.2022) (09:00-10:00 a.m)

To calculate expected Money income of the consumer:




$E(M) = r.W + (1-r).F$

'r' stands for the probability of getting success
'W' stands for Winning amount
'1-r' is the probability of getting failure
'F' stand for failure amount

$E(U) = r.U(W) + (1-r)\,U(F)$
↳ Expected utility.

• Neumann Morston

→ The consumer should participate in the game if E(M) becomes positive & E(U) becomes positive.

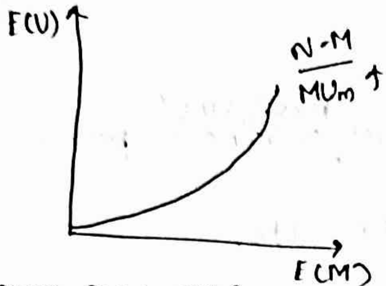
→ In general, on the basis of decision under risk market, all the consumers are categorized in three groups by using utility index (this is known as N-M utility index):

(i) Risk-lover / Risk-seeker consumer → prefer making such investments
(ii) Risk-averse consumer (Risk avoider) → invest depending upon situation
(iii) Risk-neutral consumer → Happy with the stock they have

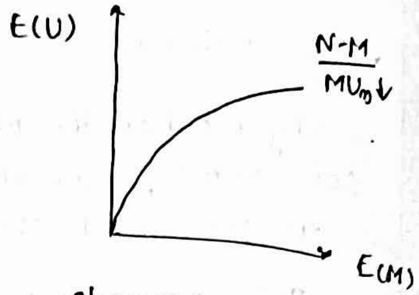
→ For risk-lover consumer, marginal utility of money is always increasing. (with increase in income, investment desire will increase)
→ For risk-averse consumer, M.U.M. is decreasing.
→ For risk-neutral consumer, Marginal utility is constant.

* when we try to earn money using some amount from our stock money, it is called investment.

proportionate change in utility is greater than change in income

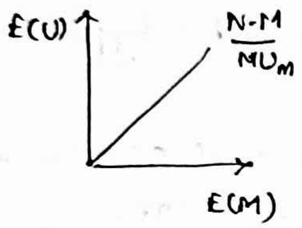



(Risk-lover consumer)




change in utility < change in income

(Risk-averse consumer)




(Risk-neutral consumer)

* expected profit = probability × winning amount

[Tip: Put data in matrix form]

Ex1 Whether a farm should use fertilizer for land or not? when effect of fertilizer is dependent on rainfall. Probability of rainfall is 50%. The profit of farmer will be Rs. 5000 if he uses fertilizer & there is rainfall, lack of rainfall in this case will result a profit of Rs. 2500. If he isn't using fertilizer, then expected income is Rs. 3500.

Sol.

R → Rainfall
N.R. → No Rainfall

| C | R | N.R. |
|---|---|---|
| UF | Rs. 5000 | Rs. 2500 |
| NUF | Rs. 3750 | Rs. 3750 |

UF ← Use of Fertilizer
NUF → Not use of Fertilizer

Using Fertilizer,
expected income will ~~become~~

$$E(M) = 0.5\,(5000) + (1-0.5)\,(2500)$$
$$= 2500 + 1250$$
$$= Rs.\ 3750$$

Without using fertilizer,

$$M = Rs.\ 3750$$

So, a risk-lover will go for using fertilizer.
& a risk-averse consumer will not fertilize.

Qn.1 By making an investment of Rs. 50 Lakh, if the manager will get success, the gaining amount will be Rs. 175 Lakh. The probability of getting success is 0.25. The utility index of the manager is given by

| M | U |
|---|---|
| -50 | -10 |
| 50 | 10 |
| 150 | 25 |
| 175 | 35 |
| 200 | 37.5 |

Find out whether the manager will participate in such investment or not?

Sol$^n$: $E(M) = 0.25 \times 175 + 0.75 \times (-50)$

$= 6.25$ (positive)

$E(U) = 0.25 \times U(175) + 0.75 \times U(-50)$

$= 0.25(35) + 0.75(-10)$

$= 8.75 - 7.5$

$= 1.25$ (positive)

↳ risk-lover consumer will invest.

* How to calculate the expected profit?

↳ by taking probability × expected profit amount.

$\mathcal{E}(\pi) = \sum P_i x_i$

$\bar{X} = \sum P_i X_i$

→ The co-efficient of variation measure the degree of risk among different type of projects.

$CV = \dfrac{\sigma}{\bar{X}}$ $\sigma$ → standard deviation $= \sqrt{(X-\bar{X})^2 \cdot P_1}$

$\bar{X}$ → expected profit

Co-efficient of variation.

Qn.2 $U = 100M - M^2$

Which type of consumer is it?

Ans:

$\dfrac{\partial U}{\partial M} = 100 - 2M$

↳ with increase in M, $\frac{\partial U}{\partial M}$ (Marginal utility) decreases

⇒ It is a risk-averse consumer.

Qn.3 A manager of a form has to find out in which of the two products he should invest and the market studies, estimated the net value of all user profit under three possible state of economy (different type of market situations)

| | A: Pr | A: π | B: Pr | B: π |
|---|---|---|---|---|
| Boom period ← B | 0.2 | 50 | 0.2 | 30 |
| Normal market situation ← N | 0.5 | 20 | 0.4 | 20 |
| Time of Recession ← R | 0.3 | 0 | 0.4 | 10 |

Pr → Probability

π → profit

Find out which one would he invest on?

(a) Find out if the utility function is $U = 100M - M^2$, determine the manager's objective is to maximize profit irrespective of risk, in which product he should invest?

(b) What is the level of risk involved in its investment?

(c) If the manager's objective is to maximize utility, in which product he should invest?

Sol$^n$(a) Expected profit of A,

$$E(M) = 0.5 \times 20 = 10 \text{ (greater)}$$

Expected profit of B,

$$E(M) = 0.4 \times 20 = 8$$

Hence under normal market condition, he will invest on 'A'.

Sol$^n$(c) Utility of A,

$$U_A = 100(20) - 20^2$$
$$= 2000 - 400$$
$$= 1600$$

Utility of B,

$$U_B = 100(20) - 20^2$$
$$= 1600$$

He can invest in A or B as the utility is the same for both.

Sol$^n$(b) Coefficient of variation $= \frac{\sigma}{\pi}$

For A, $(X - \bar{X})_A = 20 - 10 = 10$

$(X - \bar{X})^2 = 100$

↳ expected profit

↳ original profit

$$(\text{Standard deviation})_A = \sqrt{(X - \bar{X})_A^2 \, P_A}$$
$$= \sqrt{100 \times 0.5}$$
$$= \sqrt{50}$$

For A, $CV = \frac{\sqrt{50}}{10} = 0.707$

$$(\text{Standard deviation})_B = \sqrt{(X - \bar{X})_B^2 \, P_B}$$
$$= \sqrt{(20-8)^2 \times 0.4}$$
$$= \sqrt{57.6}$$

for B, $CV = \frac{\sqrt{57.6}}{8} = 0.949$

↳ Higher risk involved.

21

L - 10 (16.09.2022)(1100-12:00)

(a)

| | A | | | B | | | |
|---|---|---|---|---|---|---|---|
| | $P_i$ | $x_i$ | $\bar{X}_i$ | $P_i$ | $x_i$ | $\bar{X}_i$ | |
| B | 0.2 | 50 | 10 | 0.2 | 30 | 6 | → A Boom period |
| N | 0.5 | 20 | 10 | 0.4 | 20 | 8 | → A Normal period |
| R | 0.3 | 0 | 0 | 0.4 | 10 | 4 | → invest on B under Recession period |

$\bar{X} = \sum P_i X_i = 20$ $\quad \bar{X} = \sum P_i X_i = 18$ → overall

∴ (Ans)

(b)

| | $X - \bar{X}$ A | $X - \bar{X}$ B | $(X_i - \bar{X})^2 P_i$ | $(X_i - \bar{X})^2 P_i$ |
|---|---|---|---|---|
| B | $50 - 20 = 30$ | $30 - 18 = 12$ | $900 \times 0.2 = 180$ | $144 \times 0.2 = 28.8$ |
| N | $20 - 20 = 0$ | $20 - 18 = 2$ | $0 \times 0.5 = 0$ | $4 \times 0.4 = 1.6$ |
| R | $0 - 20 = -20$ | $10 - 18 = -8$ | $400 \times 0.3 = 120$ | $64 \times 0.4 = 25.6$ |
| | | | $\sigma_A^2 = 300$ | $\sigma_B^2 = 56$ |

$\sigma_A = \sqrt{300} = 17.32$

$\therefore (CV)_A = \frac{\sigma_A}{\bar{X}} = \frac{17.32}{20} = 0.866$

A contains higher level of risk

(risk ∝ CV)

$\sigma_B = \sqrt{56} = 7.48$

$\therefore (CV)_B = \frac{\sigma_B}{\bar{X}} = \frac{7.48}{18} = 0.416$

∴ (Ans)

(d) considering the period of boom, measure the risk level for product A & B.

Sol:

For A, $X = 50$, $\bar{X} = 10$, $P = 0.2$

$$\therefore (CV)_A = \frac{1}{10}\sqrt{(40)^2 \cdot 0.2} = 4\sqrt{0.2} = 1.789$$

For B, $X = 30$, $\bar{X} = 6$, $P = 0.2$

$$\therefore (CV)_B = \frac{1}{6}\sqrt{(24)^2 \cdot 0.2} = 4\sqrt{0.2} = 1.789$$

Hence, 'B' has same level of risk as 'A'

(c) Under boom period, $U_A = 100(50) - 50^2$
$= 2500$

Similarly,

| | $U_A$ | $U_B$ | $E(U_A) = U_A \times P_i$ | $E(U_B) = U_B \times P_i$ |
|---|---|---|---|---|
| B | 2500 | 2100 | 500 | 420 |
| N | 1600 | 1600 | 800 | 640 |
| R | 0 | 900 | 0 | 360 |
| | | | $\Sigma E(U_A)_i = 1300$ | $\Sigma E(U_B)_i = 1420$ |

The manager should invest on product 'B' in order to maximize utility.

Qu. An oil drilling company offers the opportunity of investing 5000 Rs. with 20% probability of return of 20,000 Rs. if drilling operation is successful, and if it will be a failure (oil is not found) the individual loss is equal to the investment amount.

(a) Find out expected return from that investment.
(b) calculate expected return from that investment.
(b) The utility schedule of three individual is given, then find out who will invest in this oil drilling operation.

| | -5K | 0 | 5K | 10K | 15K | 20K |
|---|---|---|---|---|---|---|
| $U_A$ | -5 | 0 | 4 | 7 | 9 | 10 |
| $U_B$ | -5 | 0 | 5 | 10 | 15 | 20 |
| $U_C$ | -5 | 0 | 6 | 13 | 21 | 30 |

Sol$^n$(a) $E(M) = \frac{20}{100}$ (Rs. 20000) + (1 - 0.2) (-Rs. 5000)

$= 4000 + (-4000)$

$= 0$

is the expected return.

Sol$^n$(b) $E(U_A) = 0.2\ U_A(20000) + 0.8\ U_A(-5000)$

$= 0.2 \times 10 + 0.8 \times (-5)$

$= 2 - 4 = -2$ (-ve) 'A' will not invest in this project,

$E(U_B) = 0.2\, U_B(20000) + 0.8\, U_B(-5000)$

$= 0.2 \times 20 + 0.8(-5)$

$= 4 - 4 = 0$

Individual 'B' will not invest.

- buying policy
  ↳ risk-lover
- consumption of insurance
  ↳ risk-averse
- A consumer can behave both as risk-lover & risk-averse under different conditions.

$E(U_C) = 0.2\, U_C(20000) + 0.8\, U_C(-5000)$

$= 0.2 \times 30 + 0.8(-5)$

$= 6 + (-4) = 2$ (+ve)

Individual 'C' will invest in this project.

CL - 11 (23.09.2022) (11:00 - 12:00)

→ A consumer can simultaneously behave as risk-lover, risk-averse and risk neutral. It is based/dependent on the activity. We cannot term any of these exactly.

→ Criticising this point, on the basis of age group, some behavior were analyzed. The (Fredmann Sevage) F-S hypothesis was introduced.

▸ F-S hypothesis:

Assuming the life time of a consumer is 75 years, it is assumed that at the initial time period or the initial age group, the consumer behaves as a risk averse consumer to increase the amount of savings.

→ Again at the middle age group, the consumer behaves as a risk-lover or risk-seeker consumer by making different type of investments.

→ Again at the end of period, the consumer behaves as a risk-averse consumer.

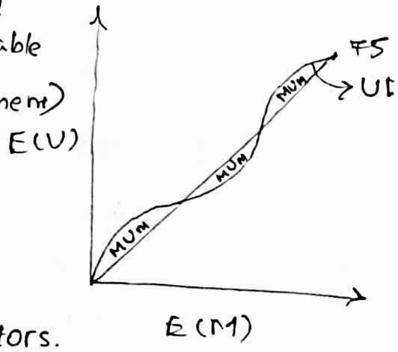
▸ Production Function: → Short run, → Long run

(Factors of production) → Land (L), → Labour (La), → Capital (K); Fixed, Variable (as per our requirement)

→ Q

(technical rel'ship between input & output)

* We calculate time period for conversion of short → long run
* time period can be considered short or long depending upon size of farm
* short run (time period isn't enough to change some factor) ⇒ contains both fixed & variable factors.
* long run production function's factors are variable.




The short run production function contains both fixed factor & variable factor whereas long run production function contains only variable factors.

$Q = (L, \overline{La}, K)$ → fixed → short run

$Q = (L, La, K, R)$ → long run

The cost function will be of two types:

(a) short run cost function

variable cost (for variable factors)
fixed cost (for fixed factors)

(b) long run cost function

variable cost

* cost/expenditure is the sum of payment for all the factors of production.
* Market price = cost + adv. exp + tax ...
* Always market price > cost

Terms: (Factors to check the efficiency of the farm)

(i) Q = TP (Total Product)

(ii) $MP_L$ (Marginal Product of Labour)

$$MP_L = \frac{\partial Q}{\partial L}$$ (change in total output due to change in labours)
→ to check the productivity of labour

(iii) $MP_K$ (Marginal Product of capital)

$$MP_K = \frac{\partial Q}{\partial K}$$ (change in total output

(iv) $AP_L$ (Average product Labour)

$$AP_L = \frac{Q}{L}$$ (Total product divided by labours)

(v) $AP_K$ (Average Product capital)

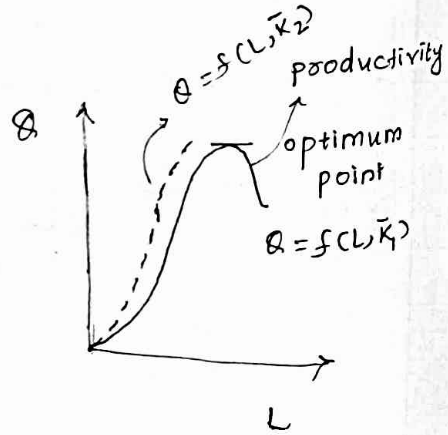
$$AP_K = \frac{Q}{K}$$

(vi) E (Elasticity)
→ Elasticity output of the factors of production.

Example:

| L | Q | $MP_L$ | $AP_L$ |
|---|---|---|---|
| 1 | 70 | - | 70/1 |
| 2 | 180 | 110 | 180/2 |
| 3 | 250 | 70 | 250/3 |
| 4 | 250 | 0 | 250/4 |
| 5 | 200 | -50 | 200/5 |

$$E_L = \frac{MP_L}{KP_L}$$




with the same labour, with more use in fixed factor, the TP curve shifts upward.

↳ Elasticity output of factors of production:

Percentage change in output due to percentage change in the factors of production.

* Elasticity output of labour = $E_L = \dfrac{\frac{\Delta Q}{Q}}{\frac{\Delta L}{L}} = \dfrac{\Delta Q}{\Delta L} \times \dfrac{L}{Q}$

$$\Rightarrow E_L = MP_L \times \frac{1}{AP_L} = \frac{MP_L}{AP_L} \Rightarrow \boxed{E_L = \frac{MP_L}{AP_L}}$$

Similarly, Elasticity output of capital, $\boxed{E_K = \dfrac{MP_K}{AP_K}}$

Qn If the production function of a farm is

$$Q = L^{0.75} K^{0.25}$$

$MP_L = ?$

Sol:

$$MP_L = \frac{\partial Q}{\partial L} = 0.75\left(\frac{K}{L}\right)^{0.25}$$

Qn If the farm is using 10000 capital, what will be the production function?

Sol:

$$Q = L^{0.75} (10000)^{0.25}$$

$$= 10 L^{0.75}$$

$$MP_L = \frac{\partial Q}{\partial L} = \frac{7.5}{L^{0.25}} \qquad AP_L = \frac{Q}{L} = \frac{10 L^{0.75}}{L} = \frac{10}{L^{0.25}}$$

Qn If the production function $Q = 6L^2 - 0.4L^3$ where 'L' is Labour. Findout $MP_L$ & $AP_L$.

Sol:

$$MP_L = \frac{\partial Q}{\partial L} = 12L - 1.2L^2$$

$$AP_L = 6L - 0.4L^2$$

↳ Findout at what value of 'L', total output will be maximum? 10

Sol:

$$\frac{\partial Q}{\partial L} = 0 \Rightarrow 12L - 1.2L^2 = 0$$

$$\Rightarrow L^2 = 10L$$

$$\Rightarrow L = 10$$

↳ findout the value of 'L' that will maximize the average product.

Sol:

$$\frac{\partial (AP_L)}{\partial L} = 6 - 0.8L = 0 \Rightarrow L = \frac{6}{0.8} = 7.5$$

L-12 (27.10.2022) (03:00-04:00 p.m)

short run: both fixed & variable factors
long run: variable factors

consumer eqm point on page: 7

* Producer equilibrium point:

diff → output or cost constant (2 ways) ; income constant (1 way)

- $U = f(x,y)$ → preferences & choices
- $I = P_x X + P_y Y$ → income
- Pair $(x, y)$ that'll maximize level of satisfaction with given income and

Output, $Q = f(L, K)$ — L: Labour, K: Capital

$C = wL + rK$

($w$: wage rate) ($r$: payment for capital)

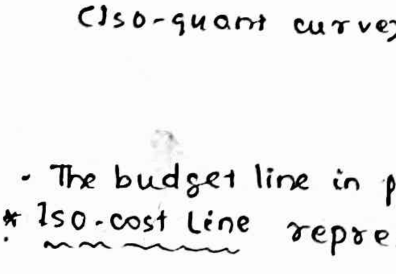
Maximize output with given cost.

* Profit maximization: cost minimization with constant output
  output maximization with constant cost.

How many units of factors (Labour and capital) should a farm use to
(i) maximize output with ~~cost~~ constant.
or (ii) minimize cost with output constant.

- The indifference curve in producer eqm is known as 'iso-quant curve'.

* Isoquant Curve is the combination of different types of factors of production that each point represents equal amount of output.



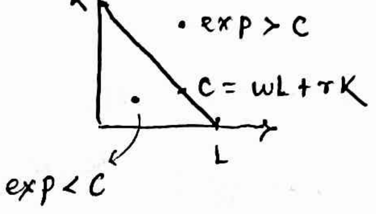
(Iso-quant curve)

→ Higher the isoquant curve, higher is the output amt.
→ Two isoquant curve cannot intersect each other. (never)
→ slope of isoquant curve is known as MRTS (Marginal Rate of Technical Substitution).

$$MRTS = \frac{\partial K}{\partial L} = \frac{\partial Q/\partial L}{\partial Q/\partial K} = \frac{MP_L}{MP_K}$$

- The budget line in producer eqm is known as 'iso-cost line'.

* Iso-cost Line represents the cost & expenditure of the farm.

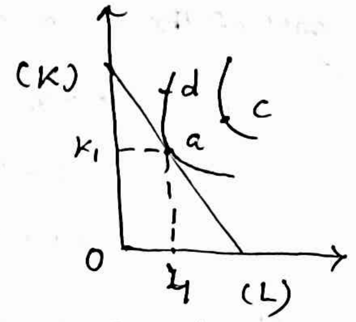



→ Isocost line shifts parallel only with change in total expenditure and cost.
→ Slope of the isocost line = $\frac{w}{r}$ $\left(\frac{\text{price for labour}}{\text{price for capital}}\right)$

→ For producer eqm point, two conditions are:

(i) Slope of isoquant must be equal to slope of isocost line.

i.e. $$\frac{MP_L}{MP_K} = \frac{w}{r}$$

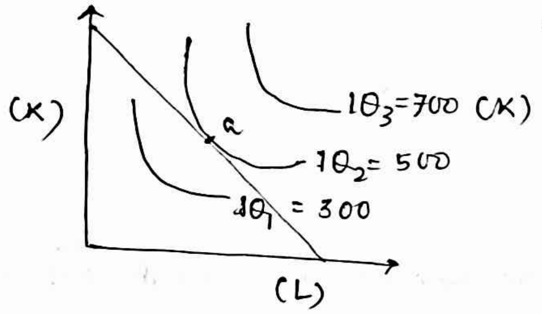



(producer eqm point)

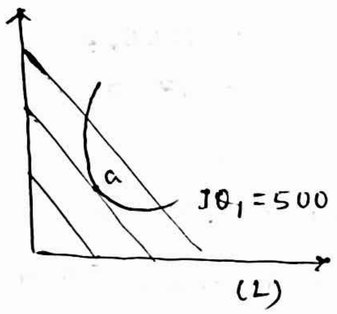
optimal factors of prodⁿ : $(L_1, K_1)$
input

(ii) At the point of eqm, isoquant must be convex to origin.

(isocost line should be tangential to the isoquant curve)




(Output maximization with cost constant)




(cost minimization with output constant)

Qn If the production function of the farm i.e. $Q = 100K^{0.5}L^{0.5}$, where 'K' & 'L' are the factors of production. Find out optimal input combination of farm is producing 1444 unit of output when wage rate = 30 and the payment for capital is 40 Rs. per unit.

(ii) Find out the cost of production.

Solⁿ:
$$Q = 100K^{0.5}L^{0.5}$$

$$MP_L = \frac{\partial Q}{\partial L} = 50K^{0.5}L^{-0.5}$$

$$MP_K = \frac{\partial Q}{\partial K} = 50K^{-0.5}L^{0.5}$$

$$\therefore \frac{MP_L}{MP_K} = \frac{K}{L} = \frac{w}{r} = \frac{30}{40}$$

$$\Rightarrow K = \frac{3}{4}L$$

Output function: $Q = 100K^{0.5}L^{0.5}$

$[C = wL + rK]$ — cost

$$\Rightarrow 1444 = 100K^{0.5}L^{0.5} \quad \text{—(1)}$$

cost function:

$$C = 30L + 40K$$

$$1444 = 100\left(\frac{3}{4}L\right)^{0.5}L^{0.5}$$

$$\Rightarrow 1444 = 100\frac{\sqrt{3}}{2}\sqrt{L^2} = \frac{100\sqrt{3}}{2}L$$

$$\Rightarrow 1444 = \frac{173.2}{2}L$$

$$\Rightarrow L = \frac{2 \times 1444}{173.2} = 16.67$$

$$K = \frac{3}{4} \times 16.67 = 12.5025$$

$$\therefore C = 30 \times 16.67 + 40 \times \frac{3}{4} \times 16.67 = 1000.2$$ ..(Ans)

Q4) If cost of the farm is Rs. 1200, find the output.

$C = wL + rK$

$\Rightarrow 1200 = 30L + 40K$

$= 30L + 40 \times \frac{3}{4} L$

$\Rightarrow 40 \times 30 = L(60)$

$\Rightarrow L = 20.$

$1200 = 600 + 40K$

$\Rightarrow 40K = 600$

$\Rightarrow K = 15.$

$\therefore$ Output, $Q = 100 K^{0.5} L^{0.5}$

$= 100\sqrt{15}\sqrt{20}$

$= 100\sqrt{300}$

$= 1000\sqrt{3}$

$= 1732.$ ∴ (Ans.)

L-13 (03.11.2022) (03:00-04:00 p.m)

**Short Run Production Function** (only variable factors contribute to the change in output)

→ The short run production function is known as 'Law of variable proportion'.

→ There are three stages of variable proportion:

(i) Increasing stage of production

(ii) Decreasing stage of production

(iii) Negative stage of production

**Long Run Production Function** (All variable: each contributes to the change in output)

→ The long run production function is known as law of 'return to scale' and there are three types of return to scale: (proportionate change in output due to change in input)

(i) Increasing Return to Scale

(ii) Decreasing Return to Scale

(iii) Constant Return to Scale.

**Increasing Return to Scale (IRS)**

→ Proportionate change in output must be greater than proportionate change in input.
• e.g: 2(input) gives 3(output) ($\because 3 > 2$)

**Decreasing Return to Scale (DRS)** → will increase but in less proportion

→ Proportionate change in output must be less than proportionate change in input.
• e.g: 2(input) gives 1.5(output) ($\because 2 > 1.5$)

**Constant Return to Scale (CRS)**

→ Proportionate change in output must be equal to proportionate change in input.
• e.g: 2(input) gives 2(output)

Ex: $Q = K^{0.5} L^{0.5}$ → exponents of factors → we can calculate wheather it is IRS, DRS or CRS.

Let $Q = K^{\alpha} L^{\beta}$

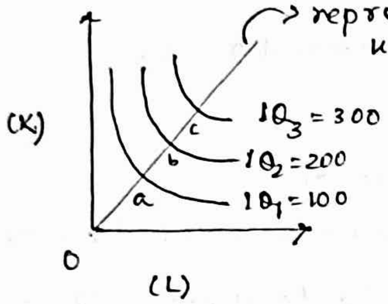
if $\alpha+\beta > 1$, Increasing Return to Scale
i.e. sum of exponents is greater than '1'.

If $\alpha+\beta<1$, Decreasing Return to Scale
i.e. when sum of exponents is less than '1'.

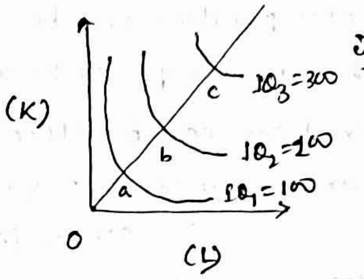
If $\alpha+\beta = 1$, Constant Return to Scale
i.e. when sum of exponents of factors is equal to '1'.

Fixed factor is unable to be recovered
↳ General shut Down

→ represents the unit of use of factors of production

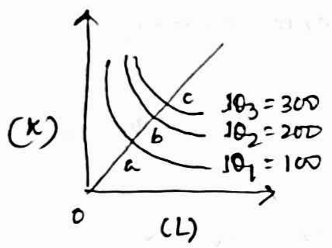



if $oa = ob = oc$
it is a case of constant return to scale




if $oa < ob < oc$
it is a case of Decreasing Return to Scale

↳ (using more factors for producing the same amount of output)




if $oa > ob > oc$
it is a case of increasing return to scale

↳ (uses less factor for same units of production)

## Law of variable Proportion:

By considering average product, marginal product and total product of a farm, all the production process are categorized into three groups:

→ The first stage is known as 'increasing stage of production', where all the three curves average product (AP), marginal product (MP) & total product (TP) are in increasing stage. (all are increasing)

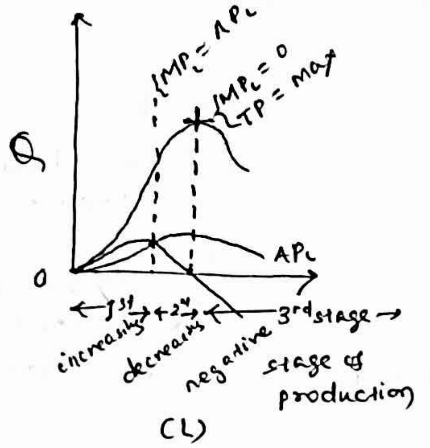
→ The second stage is known as 'decreasing stage of production', where both the average product and marginal product are decreasing and total product is increasing at a decreasing rate.

→ The third stage is known as 'negative stage of production', where marginal product is negative, and both total product & average product are decreasing.

When total product achieves its maximum, $MP = 0$
Beyond that, total product decreases (beyond optimum point),
for it $MP < 0$
i.e. marginal product is negative.

How much unit the farm is producing at a particular time ] TP

$\frac{Q}{L}$ ] AP $\quad \frac{dQ}{dL}$ ] MP




→ The first stage of production starts from the beginning to the point where AP = MP.

→ The second stage starts from the point where AP = MP till the point MP ≠ 0

→ The rest part is known as third stage of production or negative stage of production.

(Ans. Why?)

Qn At which stage a producer prefers to (produce constantly) stay ?

Ans: 2nd stage or decreasing stage of production.

(i) Total product reaches its optimum or maximum ..

(ii) Whether output is zero or its maximum, fixed cost remains the same.

→ The fixed cost can be efficiently used (minimum fixed cost per unit) at the maximum point. (along with efficient use of variable factors).

$$\text{cost} = \text{fixed cost} + \text{variable cost}$$

However, at 1st stage, only variable factors can be efficiently used.

## Production Zone

→ The second stage of production is known as 'Production zone' or 'Zone of Operation' because in the second stage

(i) total output reaches its optimum or maximum point.

(ii) both the fixed factor & variable factor can be efficiently used.

(For these two reasons, the second stage is used by industrials/factories to stay)

→ In the first stage, only variable factors can be efficiently used, when fixed factors remain unutilized.

→ In the third stage of production, both fixed factor & the variable factor cannot be efficiently used.

→ Sum of payment for all the factors of production → cost or expenditure

e.g.: $Q = f(L, \bar{K})$

Short run; $L$ → variable cost; $\bar{K}$ → Fixed cost

Short run production i - v

(i) $STC = TVC + TFC$

STC: Short run Total cost

TVC: Total variable cost, expenditure for variable factors

TFC: Total fixed cost expenditure for fixed factors

(ii) Average cost = $\dfrac{\text{Total cost}}{\text{Output unit}} = \dfrac{TC}{Q} = \dfrac{TVC}{Q} + \dfrac{TFC}{Q}$

(iii) $AVC = \dfrac{TVC}{Q}$ (iv) $AFC = \dfrac{TFC}{Q}$

(v) Marginal cost, $MC = \dfrac{\partial C}{\partial Q}$

$= \dfrac{\text{change in cost}}{\text{change in output}}$

* For long run production,

$LTC = TVC$

$AC = AVC$

$AFC = 0$ as $TFC = 0$

$MC = \dfrac{\partial VC}{\partial Q}$

L-14 (04.11.2022) (11:00-11:50 a.m)

(i) Short run Total Cost (STC)
(Total cost in short run production function)

(ii) Total Fixed Cost (TFC)
(Payment for all fixed factors)

(iii) Total variable Cost (TVC)
(sum of payment for all variable factors)

(iv) Total Average cost (TAC)
(per unit cost, Total cost/Q) output

(v) Average fixed cost (AFC)
(per unit fixed cost, TFC/Q)

(vi) Average variable cost (AVC)
(per unit variable cost, TVC/Q)

(vii) Marginal cost (change in total cost due to change in output: $\partial C/\partial Q$)

• In long run cost function, fixed factor = 0
so fixed cost is also zero.

• Which cost will decrease with increase in output? → AFC
• Which cost will increase with increase in output? → TAC (Not always)

• AVC : Almost same proportion

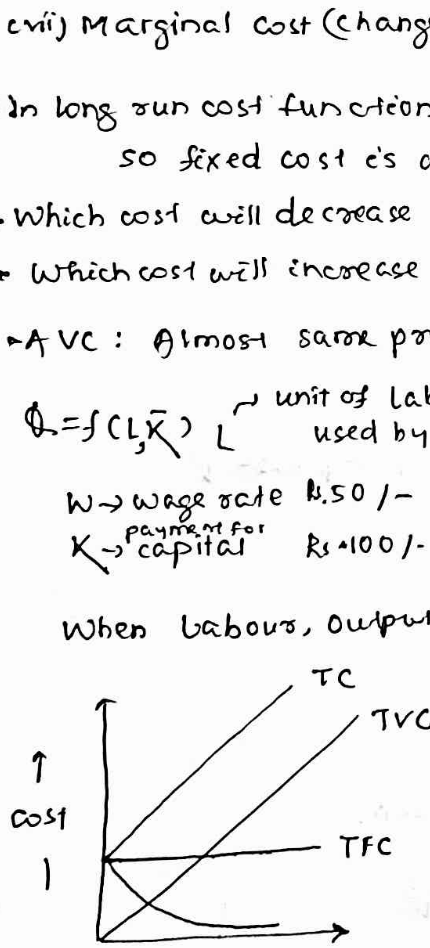
$Q = f(L, \bar{K})$ L → unit of labour used by farm   Q → unit of output produced by farm

W → wage rate Rs.50/-
K → capital (payment for capital) Rs.100/-

When labour, output:

AVC → TVC/Q, AFC → TFC/Q, TVC = W.L, TC = TFC + TVC

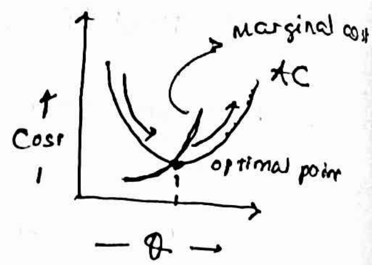
| AVC | AFC | L | Q | TFC | TVC | TC |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 100/- | 0 | 100 |
| 50/15 | 100/15 | 1 | 15 | 100/- | 50 | 150 |
| 100/30 | 100/30 | 2 | 20 | 100/- | 100 | 200 |
| 150/45 | 100/45 | 3 | 45 | 100/- | 150 | 250 |
| | | 4 | 60 | 100/- | 200 | 300 |
| | | 5 | 75 | 100/- | 250 | 350 |




TVC & TC aren't always linear
still are upward sloping.
(Fluctuation in price, rather than a linear graph gives a curve)

* AFC will not be zero

→ The average cost is always a 'U' shaped curve in both short run & long run function. At the initial stage, the cost will decrease due to increase in output and after the optimal point, the cost will increase due to increase in output.




→ The optimal point is known as the minimum cost point.

e.g.: per unit cost will go on decreasing for a new machine. When it needs maintenance, beyond that optimal point, the per unit production cost goes on increasing.

→ The marginal cost will cut the average cost at its optimal point (minimum point) from below.

- When marginal cost is greater than average cost, average will increase. i.e. $MC > AC$, $AC\uparrow$
- When marginal cost is less than average cost, average cost is decreasing. i.e. $MC < AC$, $AC\downarrow$
- When marginal cost is equal to average cost, average cost remains constant.

**Q.** Suppose the cost function of a farm i.e. $C = 8 + 4q + q^2$ (C → cost, q → output)

What is the farm's fixed cost? → 8

Find out average variable cost & marginal cost.

**Solⁿ:**

$TVC = 4q + q^2$ $\qquad$ $TFC = 8$

$AVC = \frac{4q+q^2}{q} = 4+q$ $\qquad$ $AFC = \frac{8}{q}$

$\therefore TAC = \frac{8}{q} + 4 + q$

$\therefore MC = 4 + 2q \quad \left(\frac{\partial}{\partial q}(8+4q+q^2)\right)$

**Q.** If the TVC of a farm is given: $TVC = 200q - 9q^2 + 0.25q^3$
The total fixed cost = 150 Lakh. Then find out

(i) Total cost function
(ii) Marginal cost function
(iii) Average Variable Cost function
(iv) Average Total cost function
(v) at what output, AVC & MC will be minimum.

**Solⁿ:**

$TC = 1{,}50{,}00{,}000 + 200q - 9q^2 + 0.25q^3$

$MC = \frac{\partial}{\partial Q}(TC) = 200 - 18q + 0.75q^2$

$AVC = \frac{200q - 9q^2 + 0.25q^3}{q} = 200 - 9q + 0.25q^2$

$AFC = 1{,}50{,}00{,}000 / q$

$ATC = \frac{15000000 + 200q - 9q^2 + 0.25q^3}{q} = AFC + AVC$

→ MC will be min at $\frac{\partial}{\partial Q}(MC) = -18 + 0.75 \times 2q \Rightarrow \boxed{q = \frac{18}{1.50} = 12}$

→ AVC will be minimum where $\frac{\partial}{\partial Q}(AVC) = 0 \Rightarrow -9 + 0.50q = 0 \Rightarrow \boxed{q = \frac{9}{0.50} = 18}$

When the farm is producing 18 units of output, average variable cost will be minimum, 12 units of output, MC will be minimum.

Q. A farmer producing hockey stick with the production function
$$Q = 2\sqrt{KL}$$
where 'K' & 'L' are the factors of production used by the farm.
If the farm is using 100 units of capital as a fixed factor & the rent for capital is 1 Rs./unit & payment for Labour is 4 Rs./unit. Calculate short run

(a) total & average cost function

(b) If it is producing 25 units of sticks, what is the TC, AC & MC?

Sol$^n$: cost function, $C = wL + rK$

$K = 100$, $w = 4$, $r = 1$

$\Rightarrow C = 4L + 1 \times 100$

$\Rightarrow C = 4L + 100$

From the production function:

$$Q = 2\sqrt{KL} \Rightarrow \left(\frac{Q}{2}\right)^2 = KL \Rightarrow L = \frac{Q^2}{4K} = \frac{Q^2}{400}$$

$$\therefore C = \frac{4Q^2}{400} + 100$$

$$\Rightarrow C = \frac{Q^2}{100} + 100$$ .. cost function in terms of output.

$$AC = \frac{1}{Q}\left(\frac{Q^2}{100} + 100\right) = \frac{Q}{100} + \frac{100}{Q}$$ .. (a) ans

It is producing 25 units, i.e. $Q = 25$

$$\therefore TC = \frac{(25)^2}{100} + 100 = 6.25 + 100 = 106.25$$

$$AC = \frac{TC}{Q} = \frac{106.25}{25} = 4.25$$

$$\& \ MC = \frac{\partial(TC)}{\partial Q} = \frac{Q}{50} = \frac{25}{50} = 0.5$$ .. (b Ans)

L-15 (05.11.2022) (10:00 - 11:00 a.m.)

* Long run cost function:

In long run fixed factors don't exist.

The long run cost function contains 'n' number of short run cost function, that each point of the long run can be considered as a short run function.

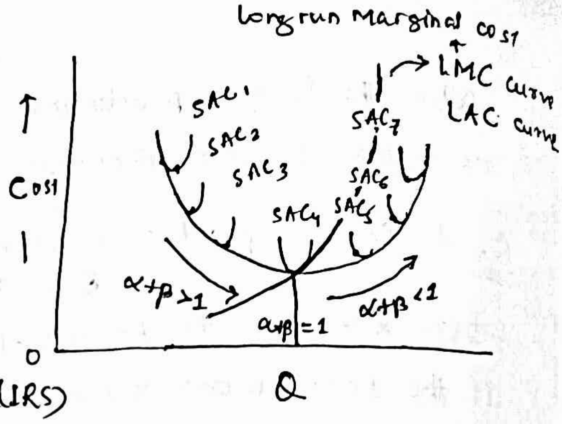
That's why long run cost curve is known as 'envelope curve'.

→ The average cost curve is always a 'U' shaped curve in both short run and long run cost function.

(Reason: Output ↑s till optimum, with further production maintenance... cost will increase)

(Long Run Average Cost)

→ Before the optimal point of the LAC curve, (the SAC curve will be tangent to the LAC before its optimal point.)

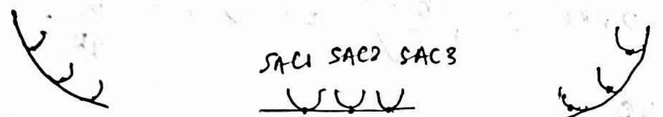



all the SAC curves will tangent it before their respective optimal points. This is known as 'stage of increasing return to scale'(IRS) ($\alpha+\beta>1$).

(Cost ↑ means we're using more units of factors of production)

→ After the optimal point of LAC, all the SAC curves will tangent it after their respective optimal points. This is known as stage of 'decreasing return to scale' (DRS) ($\alpha+\beta<1$).

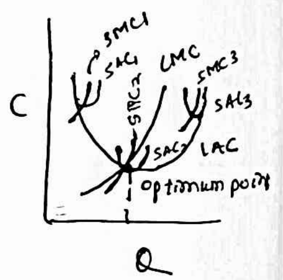
→ At the optimal point of LAC, the optimal point will be same for both the LAC curve & SAC curve based on 'constant return to scale' (CRS) ($\alpha+\beta=1$).




IRS → LAC is a downward sloping curve

CRS → LAC is a straight line

DRS → LAC is an upward sloping curve.




when LMC > LAC, LAC is increasing (decreasing return to scale)
LMC < LAC, LAC is decreasing, (increasing return to scale)
LMC = LAC, LAC remains constant. (constant return to scale)

* Homogeneous cost function: $\alpha+\beta=1$
& Cobb-Douglas Production Function:

Technology ✓
(Acknowledge) ✗

$$Q = AL^{\alpha}K^{\beta}$$

CD

(Types of cost:

(i) Opportunity cost:

→ The next best alternative cost

e.g: → if you are choosing 100L, 1000K will be sacrificed. This is known as opportunity cost. (Sacrifice for choosing the best alternative)

(ii) Accounting Cost: (Explicity Cost)

→ Expenditures made overall (for all kind of factors: labour wages, resource expenses etc...)

(Implicity cost
Expenditure of your own (self-carried expenses))

(iii) Economic Cost: (Explicity + Implicity)

→ It includes both explicity cost & implicity cost.

(iv) Sunk Cost: e.g: (depreciation value) ← some amt. is reduced ← sale in secondary market ← shutdown of farm.

→ Which we cannot recover. (The fixed cost more specifically) e.g: Machines bought after ↑

(v) Depreciation Cost:

→ The initial value - $\underbrace{\text{salvage}}$ value

↳ At the end of the period, if you're selling a product in secondary market, how much do you get..

→ cost & production-return to scale are inversely related.

L-16 (11.11.2022) (11:00-12:00)

## Module-V

- Profit Loss Calculation

(Total income - expenditure) → +ve profit / → -ve loss

→ Ignoring time period, we cannot calculate the 'exact' profit, or loss. (of a project)

- financial or nonfinancial planning
- industrial
- machine implementation

e.g.: Investing Rs. 1000 for 5 years & getting the same as return is a case of loss due to increased time value of money.

→ In the case market is decreasing, it doesn't necessarily refer to a case of loss.

→ Used in banking / non-banking sectors & in farm / industrial sectors to calculate the profit & loss for their investments.

**NOTE**

- Exact amount of profit/loss requires time period to be calculated.
- Calculate the time value of money (money value w.r.t. different time periods)
- Amount of money & value of money both are inversely related to each other.

e.g.: 1K $\xrightarrow{5y}$ 5K

Exact profit/loss ≠ 5K - 1K

though = 5K - $\underbrace{5y(1K)}_{\text{time value of money}}$ (exact value of 1K after 5 years)

factors → cash flow diagram / → Compound Interest Rate

### Conversion of Money Value:

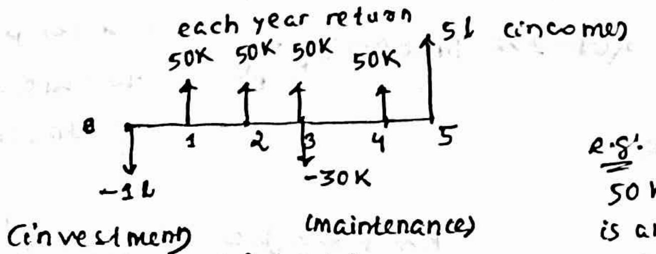
→ The money value can be converted from one time to another time period by using

(i) cash-flow diagram (The first objective of a farm or industrial sector)

(ii) compound interest factors.

### Cash-Flow Diagram:

→ Cash-flow diagram is the graphical representation of all the incomes and expenditures of a project for the total duration or time period.




(i = 5%)

(Cash-Flow Diagram)

e.g.: 50K is an annuity (till a break)

Time period, n = 5 (years)

rate of interest, i = 5%

Draw a line from '0' to 'n'. (horizontal)

→ represents all time period

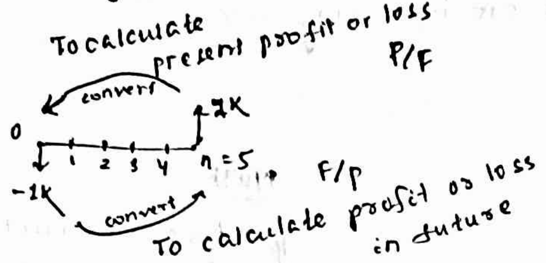
- expenditures (cash-outflow) → draw below the line
- incomes (cash-inflow) → draw above the line

Magnitude of line won't represent the exact scale, still will represent the relativity in between.

→ Use of cash-flow diagram:

will be easy to know
- convert which one?
- convert from which time?

→ Considering a constant time period, we will calculate the profit & loss.




→ There are three methods to evaluate a project by using time value of money:
(plan, policies, machine evaluation etc..)

(i) Present worth (value) method (PW) (Time period 0)
(ii) Future Worth method (FW) (Time period n)
(iii) Annual Worth method (AW) (Each year)

* **Compound Interest Factors:**

There are six compound factors to convert the money amount from one time to another:

"what is the present value when you know the future value with some known rate of interest and time period?" ← P/F (i%, n)

F/P (i%, n)
P/A (i%, n)
A/P (i%, n)
F/A (i%, n)
A/F (i%, n)

→ Above one has to be calculated
The denominator is known

**Annuity value**

When the same amount of money will continue for more than one time period, without any break.

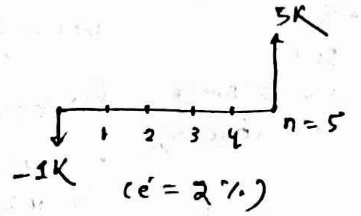
To get Rs. 5K in future, how much you have to deposit each year.

'P' stands for present value
'F' stands for future value
'A' stands for annuity value
'i' stands for rate of interest
'n' stands for time period

* certain formulae or * compound matrix to calculate compound factors.

**Qn** Investment 1K Return 5K ROI 2% Time Period 5y.

Given: n=5, i=2.




(i = 2%)

PW (2%) = -1K + 5K (P/F, 2%, 5)

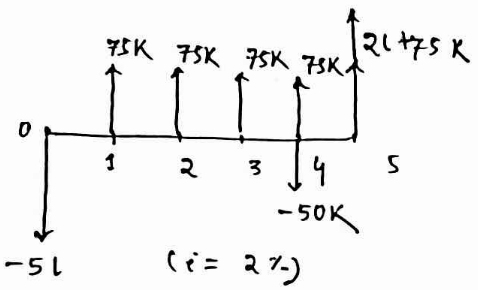
→ positive: case of profit
→ negative: case of loss

FW (2%) = -1K (F/P, 2%, 5) + 5K

Qu Draw a cash-flow diagram.

The buying price of a machine is Rs. 5 lakh. Each year return = 75000 Rs. with the salvage value of Rs. 2 lakh. At the end of 4th year, it requires the maintenance cost of Rs. 50000. If the duration of the machine is 5 years, assuming 2% rate of interest, find out whether the machine should be installed or not on the basis of present worth method.

Sol$^n$:




$(i = 2\%)$

(Cash-Flow Diagram)

$PW(2\%) = -5l + 75K(P/A, 2\%, 5) + 2l\ (P/F, 2\%, 5) - 50K\ (P/F, 2\%, 4)$

(or) $-5l + 75K\ (P/A, 2\%, 4) + 2l\,75K\ (P/F, 2\%, 5) - 50K(P/F, 2\%, 4)$

(or) $-5l + 75K\ (P/A, 2\%, 3) + 2l75K\ (P/F, 2\%, 5) + 25K\ (P/F, 2\%, 4)$

(in sequencial order)

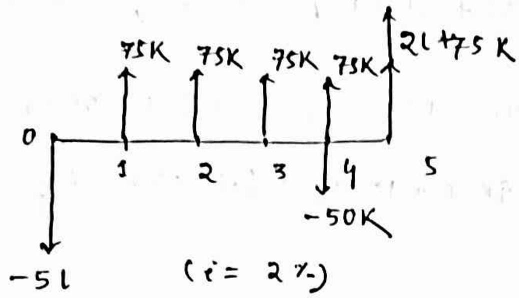
$FW(2\%) = -5l\ (F/P, 2\%, 5) + 75K\ (F/A, 2\%, 3)$
$+ 25K\ (F/P, 2\%, 1) + 2l\ 75K$

duration

Qn. Draw a cash-flow diagram.

The buying price of a machine is Rs. 5 lakh. Each year return = 75000 Rs. with the salvage value of Rs. 2 lakh. At the end of 4th year, it requires the maintenance cost of Rs. 50000. If the duration of the machine is 5 years, assuming 2% rate of interest, find out whether the machine should be installed or not on the basis of present worth method.

Sol$^n$:




(Cash-Flow Diagram)

$$PW(2\%) = -5L + 75K(P/A, 2\%, 5) + 2L(P/F, 2\%, 5) - 50K(P/F, 2\%, 4)$$

$$(\text{or})\ -5L + 75K(P/A, 2\%, 4) + 2L\,75K(P/F, 2\%, 5) - 50K(P/F, 2\%, 4)$$

$$(\text{or})\ -5L + 75K(P/A, 2\%, 3) + 2L75K(P/F, 2\%, 5) + 25K(P/F, 2\%, 4)$$

(in sequencial order)

$$FW(2\%) = -5L(F/P, 2\%, 5) + 75K(F/A, 2\%, 3) + 25K(F/P, 2\%, 1) + 2L\,75K$$

duration

L-17 (12.11.2022) (09.00 - 10.00 a.m)

$$P/F\ (i\%, n) = \frac{1}{(1+i)^n}$$

$n \rightarrow$ time period

$i \rightarrow$ rate of interest (in part values)

$2\% = 0.02 = \left(\frac{2}{100}\right)$ will be taken (not 2)

$$F/P\ (i\%, n) = (1+i)^n$$

$$P/A\ (i\%, n) = \frac{(1+i)^n - 1}{i(1+i)^n}$$

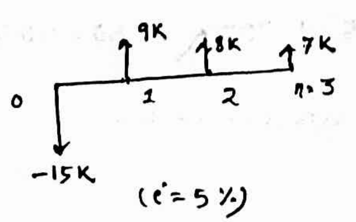
$$F/A\ (i\%, n) = \frac{(1+i)^n - 1}{i}$$

$$A/P\ (i\%, n) = \frac{i(1+i)^n}{(1+i)^n - 1}$$

$$A/F\ (i\%, n) = \frac{i}{(1+i)^n - 1}$$

Qn. The investment amount is Rs. 15000. First year return Rs. 9000. Second year return Rs. 8000, third year return is Rs. 7000. Assuming 5% r.o.i., find out the present worth and future worth. (n = 3)

Sol$^n$:



$$PW(5\%) = -15K + 9K\,(P/F, 5\%, 1) + 8K\,(P/F, 5\%, 2) + 7K\,(P/F, 5\%, 3)$$

$$= -15K + 9K \times \frac{1}{(1+\frac{5}{100})^1} + 8K \times \frac{1}{(1+0.05)^2} + 7K\,\frac{1}{(1+0.05)^3}$$

$$= -15K + 9K\,(0.9524) + 8K\,(0.907) + 7K \times (0.8638)$$

$= 6.8742\,K$ is our amount of profit

$$FW(5\%) = -15K\,(F/P, 5\%, 3) + 9K\,(F/P, 5\%, 2) + 8K\,(F/P, 5\%, 1) + 7K$$

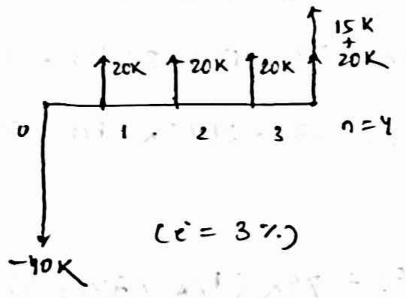
$$= -15K\,(1+0.05)^3 + 9K\,(1+0.05)^2 + 8K\,(1+0.05) + 7K$$

$$= -15K\,(1.157625) + 9K\,(1.1025) + 8K\,(1.05) + 7K$$

$$= 7.958125\,K$$

Qn Investment amount is Rs. 40000. Each year return is Rs. 20000 for four year. Salvage value is Rs. 15000. With 3% r.o.i., calculate present worth. (n=4)

Sol$^n$:




$$PW(3\%) = -40K + 20K\,(P/A, 3\%, 4) + 15K\,(P/F, 3\%, 4)$$

$$= -40K + 20K\,\frac{(1+0.03)^4 - 1}{0.03\,(1+0.03)^4} + 15K\,\frac{1}{(1+0.03)^4}$$

$$= -40K + 20K\,(3.72) + 15K\,(0.8885)$$

$= 47.6675\,K$ is the amount of profit.
(of the project at present time)

Last class qn:

$$PW(2\%) = -5L + 75K\,(P/A, 2\%, 5) + 2L\,(P/F, 2\%, 5) - 50K\,(P/F, 2\%, 4)$$

$$= -500K + 75K\,\frac{(1+0.02)^5 - 1}{(0.02)(1.02)^5} + 200K\,\frac{1}{(1.02)^5} - 50K\,\frac{1}{(1.02)^4}$$

$$= -500K + 75K \times (4.7135) + 200K \times (0.9057) - 50K \times (0.9238)$$

$= -11.5375\,K$ is the amount of loss.

Annual expenditure will be deducted to each

$- Exp\ (A/p,\ i,\ n)$

Annual income will be added to each

$+ Inc\ (A/p,\ i,\ n)$

Annual Profit { As your convenience either find PW or FW, then convert it into annuity value.

$i = i,\ n = 4$

e.g: exp $= -40K,\ n=0$ $\quad 40K\,(A/p) = x$

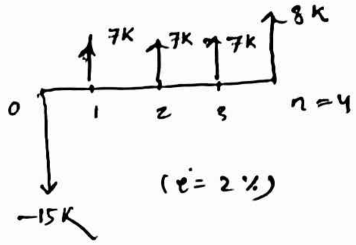
inc $= 15K,\ n=4$ $\quad 15K\,(A/F,\ n=4) = y$

from each year's net amt,
$+y$
$-x$
will be Annual worth

Q. Investment amount is 15000. First three year return Rs. 7000. Last year (4th) return is Rs 8000. With 2% r.o.i. find out annual worth.

Sol$^n$: First let's calculate the present worth

$PW(2\%) = -15K + 7K\,(P/A,\ 2\%,\ 3) + 8K\,(P/F,\ 2\%,\ 4)$




$$= -15K + 7K\,\frac{(1+0.02)^3 - 1}{(0.02)(1.02)^3} + 8K\,\frac{1}{(1.02)^4}$$

$$= -15K + 7K \times (2.884) + 8K \times (0.92385)$$

$$= 12.5788K$$

$$AW(2\%) = (A/P,\ 2\%,\ 4) \times PW(2\%)$$

$$= \frac{(0.02)(1.02)^4}{(1.02)^4 - 1} \times (12.5788)$$

$$= (0.2626)(12.5788)$$

$$= 3.3035K$$

.. (Ans)

Method-2

Let $x = -15K\,(A/p,\ 2\%,\ 3) = -15K\left(\frac{(0.02)(1.02)^3}{(1.02)^3 - 1}\right) = -5.2K$

& $y = 8K\,(A/F,\ 2\%,\ 3) = 8K\left(\frac{0.02}{(1.02)^3 - 1}\right) = 2.614K$

L-18 (17.11.2022) (02:00-04:00 p.m.)

Q. A company is planning to purchase an advanced machine center. Three original manufacturers have responded to its tender whose particulars are tabulated as follows:

| Manufacturer | Down Payment (Rs.) | Yearly equal installment (Rs.) | No. of installments |
|---|---|---|---|
| 1 | 5,00,000 | 2,00,000 | 15 |
| 2 | 4,00,000 | 3,00,000 | 15 |
| 3 | 6,00,000 | 1,50,000 | 15 |

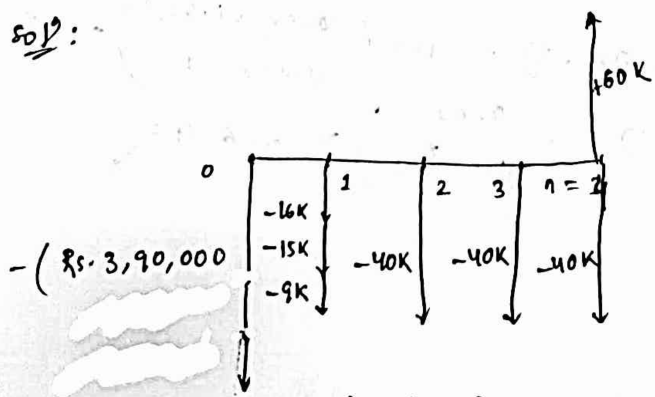
Determine the best alternative based on the annual equivalent method by assuming $i = 20\%$ compounded annually.

Q. A taxi company is analyzing the proposal of buying a car with diesel engine instead of petrol engine. The cars average 60000 km per year with a useful life of 3 year for petrol taxi & 4 year for the diesel taxi.

- Vehicle cost for diesel taxi is Rs. 3,90,000
  & for petrol taxi is Rs. 3,60,000
- Fuel cost per litre Rs. 8 for diesel
  & Rs. 20 for petrol
- Mileage in kmpl 30 for diesel, 20 for petrol
- Annual repair cost Rs. 9000 for diesel, Rs. 6000 for petrol
- Annual insurance premium Rs. 15000 for diesel, same for petrol
- Resale value at the end of vehicle life is Rs. 60000 for diesel & Rs. 90000 for petrol taxi.

Assuming 20% r.o.i. determine which one is preferable by using annual worth method.

Sol^n:



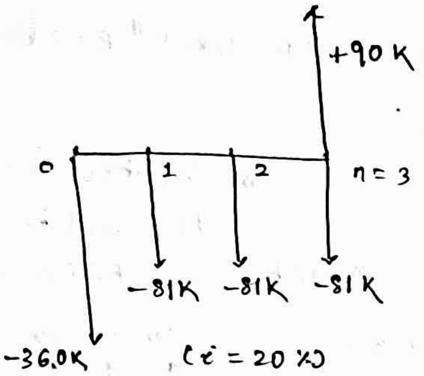

Diesel Taxi: $\dfrac{60000\text{km}}{30\text{ kmpl}} = 2000 \times \text{Rs. }8$
= Rs. 16000 for fuel

Annual cost = Rs. 16K + Rs. 15K + Rs. 9K
= Rs. 40K

($i = 20\%$) (Diesel Taxi)

$$AW(20\%) = -390K\,(A/P,\ 20\%,\ 4) - 40K + 60K\,(A/F,\ 20\%,\ 4)$$
$$= -390K\left(\frac{0.2(1.2)^4}{(1.2)^4 - 1}\right) - 40K + 60K\left(\frac{0.2}{(1.2)^4 - 1}\right)$$

$$= -390K\,(0.386) - 40K + 60K\,(0.186)$$
$$= -179.38K$$




(i = 20%)

(Petrol Taxi)

Petrol Taxi Fuel cost : $\frac{60000 \text{ Km}}{20 \text{ Kmpl}} = 3000\,L \times Rs.20 = 60000$

Total annual cost : $60K + 15K + 6K = 81K$

$$AW(20\%) = -360K\,(A/P, 20\%, 3) + (-81K) + 90K\,(A/F, 20\%, 3)$$
$$= -360K\left(\frac{0.2\,(1.2)^3}{(1.2)^3 - 1}\right) - 81K + 90K\left(\frac{0.2}{(1.2)^3 - 1}\right)$$
$$= -360K\,(0.4747) - 81K + 90K\,(0.2747)$$
$$= -227.1667\,K$$

→ As the expenditure for petrol taxi is greater, the diesel taxi will be preferred.

- Rather than time value of money, there are three other alternatives to evaluate a project:

(i) NPV (Net Present Value) = PW method

(ii) Pay back Period (PBP) ⟶ How many time period is required to recover invested amount

(iii) IRR (Internal Rate of Return)

→ Payback period (method) is based on time period, whereas IRR is based on rate of interest.

( MAPBP (Maximum Acceptable Payback Period) → Maximum time period given to recover the investment amount of money.

→ If PBP is greater than MAPBP, the project will not be selected or be considered as a loss.

→ If PBP is less than MAPBP, it will be selected & considered as a profit.

→ If PBP = MAPBP, it will remain undetermined. (no profit, no loss case)

('will be selected or not' can be found using these, but we won't be able to calculate exact amount of profit or loss for the project.)

Q. Investment amt is Rs. 50K. First year return Rs. 10K. Second year return Rs. 20K. Third year return Rs. 10K. Fourth year Rs. 20K. & fifth year Rs. 10K. MAPBP = 5 year.

it rains

Using payback period, find whether it will be selected or not.

Ans:

PBP = 3 year 6 months.

MAPBP = 5 year

PBP < MAPBP => will be selected

Qn $I = 20K$, $1^{st}$ $R = 10K$. $2^{nd}$ $R = 8K$. $3^{rd}$ $R = 6K$. $4^{th}$ $R = 4K$, $5^{th}$ $R = 2K$.

PBP = 2 year 4 months.

* IRR (Internal Rate of Return)

The rate of interest at which present value or PW = 0.

→ MARR (Minimum Acceptable Rate of Return)

→ If IRR > MARR, the project will be selected.

- If IRR < MARR, it will be rejected.
- If IRR = MARR, it is indeterminant.

→ There are two methods to calculate IRR:

(i) Direct method → put (PW = 0) → (when r.o.i. is not given)

(ii) Trial & error method ↳ (when r.o.i. is given)

$$IRR = LDR + \frac{PW \text{ of } LDR}{PW \text{ of } LDR - PW \text{ of } HDR} \times D$$

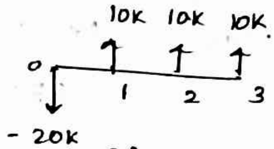
LDR → Lower Discount Rate

HDR → Higher Discount Rate

D → Difference between HDR to LDR (HDR − LDR).

* Without r.o.i. PBP will be less
* With r.o.i., PBP will be more

without r.o.i., PBP = 2 years



$(i = 5\%)$

PW(5%) of 10K at $1^{st}$ year,

$(P/F, 5\%, 1)$

$= \frac{1}{(1.05)} \times 10K = 9.52K$

$(P/F, 5\%, 2) = \frac{1}{(1.05)^2} \times 10K = 9.07K$

$(P/F, 5\%, 3) = \frac{1}{(1.05)^3} \times 10K$

$= 8.638K$

$20K - 9.52K = 10.48K$

$10.48K - 9.07K = 1.41K$

$\frac{1.41}{8.638} \times 12 \simeq 2$

PBP with 5% r.o.i. = 2 years 2 month

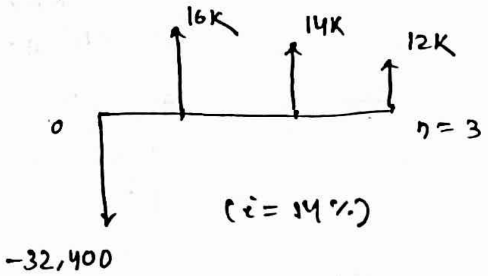
Steps

- First calculate the PW at given r.o.i. (= x suppose)
  - if x > 0 (case of profit, choose r.o.i. more than given) (= y suppose)
  - if x < 0 (case of loss, choose r.o.i. less than given)
- given r.o.i. will be considered as MARR.
- compare with that

Suppose LDR = 10, HDR = 15

$\left(10 + \frac{x}{x - y} \times 5\right)$

Qn The initial investment is Rs. 32,400/-. First year return Rs.16000, $2^{nd}$ year Rs.14000, $3^{rd}$ year: Rs. 12,000. Its working life is expected to 3 years. Calculate IRR assuming minimum rate of return is 14%.




$PW(14\%) = -32{,}400 + (P/F, 14\%, 1) \times 16K + 14K(P/F, 14\%, 2) + 12K(P/F, 14\%, 3)$, where $(P/F) \to \frac{1}{(1+i)^n}$

$= -32.4K + 16K(0.877) + 14K \times (0.769) + 12K \times (0.675)$

$= 0.498\ K$

Let's take $i = 20\%$,

$= -32{,}400 + 16K(P/F, 20\%, 1) + 14K(P/F, 20\%, 2) + 12K(P/F, 20\%, 3)$

$PW(20\%) = -32{,}400 + 16K\left(\frac{1}{(1.2)}\right) + 14K\left(\frac{1}{(1.2)^2}\right) + 12K\left(\frac{1}{(1.2)^3}\right)$

$= -32{,}400 + 16000(0.83) + 14000(0.694) + 12000(0.5787)$

$= -2.4116\ K$

$\therefore IRR = 14 + \frac{498}{498 + 2411} \times 6$

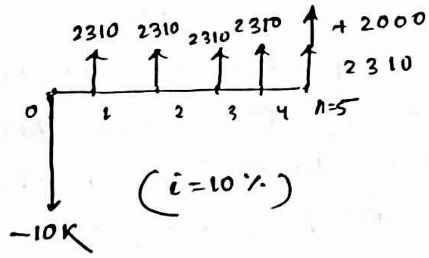
$\Rightarrow IRR = 15.027\ \%$ .. (Ans) (by trial & error method)

IRR > MARR, so it will be selected. (a case of profit).

**Qn.** A capital investment of Rs. 10,000 can produce a uniform annual revenue (income) of Rs. 5310 and the salvage value of Rs. 2000. The annual maintenance cost is Rs. 3000. If the company is willing to accept any project with at least 10% r.o.i., determine whether it will be acceptable or not by using IRR method. (n = 5 year)

**Soln:** Revenue per year = Rs. 5310
Maintenance cost per year = Rs. 3000

Per year gain = Rs. 2310.




$PW(10\%) = -10K + (P/A, 10\%, 5) \times 2310 + (P/F, 10\%, 5) \times 2000$

$= -10K + 2310\left(\frac{(1.1)^5 - 1}{0.1(1.1)^5}\right) + 2000\left(\frac{1}{(1.1)^5}\right)$

$= -10K + 2310(3.79) + 2000(0.62)$

$= -1.44$

let $i = 8\%$.

$PW(8\%) = -10K + (P/A, 8\%, 5) \times 2310 + (P/F, 8\%, 5) \times 2000$

$= -10K + 2310\left(\frac{(1.08)^5 - 1}{0.08(1.08)^5}\right) + 2000\left(\frac{1}{(1.08)^5}\right)$

$= -10K + 2310(3.99) + 2000 \times (0.680)$

$= 578.066$

$\therefore IRR = 8 + \frac{578.066}{578.066 + 1.44} \times 2$

$= 8 + 1.995$

$= 9.995 < 10\%$.

i.e. IRR < MARR

(case of loss).

L-19 (19. 11. 2022) (09:00 - 10:00 a.m)

exact amt. → PW (NPV) AW FW
PBP IRR

can be applied to a private project
→ Taken by a group of people or single person
↳ Maximize their own profit

construction of road
public project → CB approach
→ Run by a govt. (central or state)
→ Main objective: provide social welfare

## Public Project:

To evaluate a public project, cost benefit analysis will be used rather than all other five methods.

→ Public project must be taken by any govt. authority, e.g: local govt., state govt. or central govt., whereas private projects are taken by a group of people or a single people.

→ The main objective of private project is to maximize its own profit, whereas the main objective of public project is to provide social welfare to its citizen.

## Public good:

There are two characteristics of public good.

(→ Both rivalry & excludibility will appear in case of private good)

i) Non-excludibility (You can't exclude anyone to take the benefit of that)

ii) Non-rivalness (We can't claim anyone as our rival)
↳ when one consumes, reduces the availability for others.

## Cost-Benefit Analysis:

If benefit cost ratio $B/C > 1$, it will be selected, $\frac{B}{C} < 1$ will be rejected & $\frac{B}{C} = 1$ will remain indetermined.

CB Analysis → (Total benefit / Total expenditure)

$\frac{B}{C}$ > 1 (profit)
< 1 (loss)
= 1 (indetermined)

→ Benefit to cost ratio (both in the same time)

$\frac{P.B}{P.C}$ → if B → present, C → present
$\frac{A.B}{A.C}$ → if B → annual, C → annual
$\frac{F.B}{F.C}$ → if B → future, C → future should be taken

→ Disbenefit (e.g. air pollution) amount (monetary value) will be deducted from benefit, not to be added in expenditure. (Net benefit = Benefit − Disbenefit)

e.g: (employment is not a monetary amount as benefit)

Qn. A state govt. is planning a hydroelectric project for a river basin. Initial investment: Rs. 80 Lakh. Annual flood control savings: Rs. 30 Lakh, Annual irrigation benefit: Rs. 50 Lakh, Annual recreation benefit Rs. 20 Lakh, Annual operation & maintenance cost: Rs. 30 Lakh. Life of the project, (n) = 50 years. Find out whether the state govt. should implement the project or not assuming 12%. rate of interest.

Soln:

Annual benefit (A.B.) = Rs. 30 Lakh + Rs. 50 Lakh + Rs. 20 Lakh
= Rs. 100 Lakh.

Annual Cost (A.C.) = Rs. 80 Lakh (A/P, 12%, 50) + Rs. 30 Lakh
= (0.1204) Rs. 80 Lakh + Rs. 30 Lakh
= Rs. 39.632 Lakh (Total expenditure)

$\therefore \frac{A.B}{A.C} = \frac{100}{39.632} = 2.5232 > 1$

i.e. benefits are more than expenditure

Hence the govt. should implement that project.

## Cost Effectiveness Analysis: (To find out which work is most effective among multiple alternatives) selected

→ benefit & cost per unit (in terms of o/p)

→ To control the road accident there are three alternatives A, B & C

The initial investment of A: Rs. 15 lakh, B: Rs. 12 lakh, C: Rs. 17 lakh.

Annual maintenance cost for A: Rs. 5 lakh, B: Rs. 6 lakh, C: Rs. 2 lakh.

If govt. implements A, it will control 24 accidents per annum, B: 22 accidents per annum, C: 30 no. of accidents per annum. The validity is for 10 year time period with 2% r.o.i., which one is the most effective work?

Soln:

For A, (15 lakh, 5 lakh, 24)

Bound to found annual expenditure as output can't undergo a conversion

Total annual expenditure = 15 lakh (A/p, 2%, 10) + 5 lakh

= 15 (0.111) + 5 = 6.665 lakh

Total annual expenditure per accident = $\frac{6.665}{24}$ = 0.278 lakh

For B, (12 lakh, 6 lakh, 22)

Total annual expenditure = 12 lakh (A/p, 2%, 10) + 6 lakh

= 12 (0.111) + 6 = 7.332 lakh

Total annual expenditure per accident = $\frac{7.332}{22}$ = 0.333 lakh

for C, (17 lakh, 2 lakh, 30)

Total annual expenditure = 17 lakh (A/p, 2%, 10) + 2 lakh

= 17 (0.111) + 2 = 3.887 lakh

Total annual expenditure per accident = $\frac{3.887}{30}$ = 0.13 lakh

So, the alternative C was found to be most cost effective one & hence should be implemented.

L-20 (24.11.2022) (03:00-04:00 p.m)

## M-4 (Market) for any production.

Main objective: Maximize profit.

→ Which type of good the farm is producing depending upon time period, locality...?

→ How much you need to produce, depending on population?

→ In which way they should be produced with minimum cost?

Market
→ doesn't require any restrictions for category of sellers or buyers.

→ How much units?

→ Determination of price to be prevailed.

Types of market:
(i) Perfect competition market. (consider number of producers or sellers)
(ii) Imperfect competition market. ← Rather than this

↳ no. of buyers & no. of sellers
• such that each one has some alternatives
↳ perfect information about a product known to (i.e. both seller & buyer)
Regarding availability, near future predictions
↳ Homogeneous price
• All sellers are bound to sell in same price. prevail
↳ All are selling homogeneous product.

## Features of Perfect Competition Market:
→ There must be 'N' no. of sellers and 'M' no. of buyers.
→ Perfect information among the buyers and sellers.
→ Homogeneous product (, homogeneous price)
→ All the sellers are price-taker.
charge the prevail price
→ Free-exit & free-entry in the market.

## Imperfect Competition Market:
* There are three types of imperfect competition market:
(i) monopoly market (single seller or one seller & many buyers)
(ii) Duopoly market (Two seller case)
(iii) Oligopoly market (few seller cases, more than 2 but not large)

Rivalry (high rivalness)
→ loss of one is profit of another
e.g: water bottle (pure drinking water manufacturers)

Common market
↓
To avoid the price war, they decide the prevail price to be charged & are bound to it.
(Mutual compromise)

• Price maker
→ They decide the price
→ Monopoly market
→ Maximum profit

→ For oligopoly market,
(1) Limit Pricing Theory (Entry preventing price)
(2) Sales maximization Theory

It will not attract (outsiders) other farms to enter into the market.

↳ Sales max$^n$ > Profit max$^n$ (believed always by most of the economists)

Selling Rs. 50 exp product @ Rs. 60
↓
increased no. of sales

Selling Rs. 90 exp product @ Rs. 100
↓
no. of sales will decrease

• min$^m$ profit sales exist for a long time and attract consumers.
• Sales max$^n$ will increase reputation in the market.
• It will be able to adapt new competitive tactics (new techniques)

The existing farms themselves will be benefited, but outsiders won't.
in this case, Rs. 60
existing farm profit = Rs. 10
outsider profit = Rs. 0
So they won't be investing in this market.

e.g: 1 unit – 50 Rs. exp
4-5 sellers Decided profit – 20 Rs.
Market price – 70 Rs.
If outsider(s) enters(s), total profit for existing farms will decrease, so they won't allow. (potential enterer)
→ For new farms trying to enter, expenditure will be more.
e.g: Rs. 60
Rs. 50 existing exp. + Rs. 10 establishment charge
profit: 10 Rs. (initially)
in near future: Rs. 20 → will attract

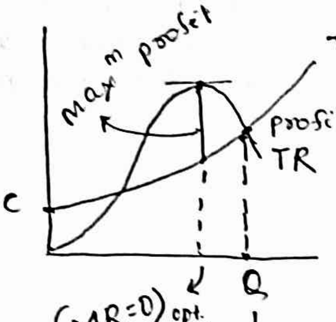
→ To maximize selling, we cannot face loss. (With some minimum profit, sales are maximized)

Total Revenue = Total income at a particular time period $= P \times Q$.

Average Revenue $= \frac{TR}{Q} = P$

Marginal Revenue $= \frac{\partial TR}{\partial Q}$

In perfect combination market,
Price → [ P = AR = MR
AR → Average Revenue
MR → Marginal Revenue

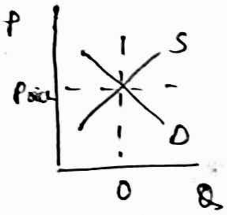



profit = 0, Break Even Point (B-E Point)
at which point Total Revenue = Total cost

Before B-E point, the farm is obtaining profit, beyond it, loss.

Break Even Output
↳ At this output, the farm can maximize profit.

→ Determination of price and output under perfect competition market.




At which point demand of a particular product will be equal to its supply, the market will determine its price & output.

(At which point, demand = supply, output can be determined) → market equilibrium

→ There are two approaches, to determine price & output:

(i) TR & TC approach. (TC > TR, case of loss) (TC = TR BE point)
(ii) MR & MC approach

→ At which point MR = MC, the point is known as profit maximization or equilibrium point.

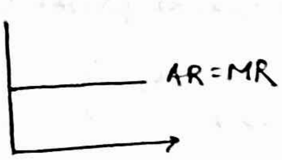
→ At the point of equilibrium, marginal cost must cut marginal revenue from below.

L-21 (26.11.2022) (09:00-10:00 am)

No. of sellers → market
No. of farm → industry

TC = TFC + TVC (short run)
TC = TVC (long run)

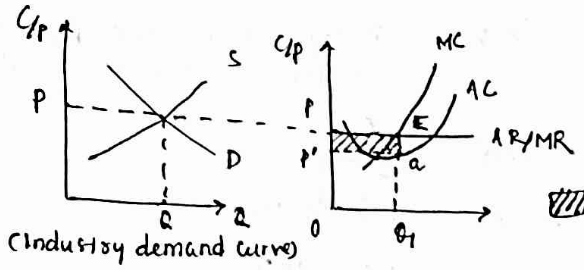
$AC = \frac{TC}{Q}$ ; $MC = \frac{\partial C}{\partial Q}$




For a perfect competition market, AR = MR & is a horizontal line

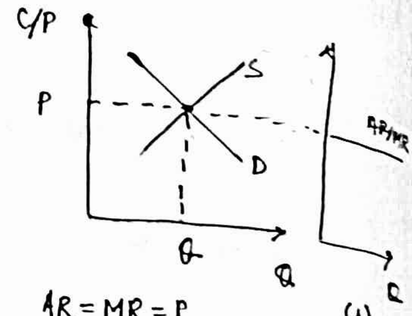
Under imperfect competition, AR & MR both will be downward sloping.

& MR < AR




(case of profit)
( AC < AR )

▨ → total profit of the farm




AR = MR = P

As it is a perfect competition market, other sellers are bound to take the same price.

To calculate profit average cost needs to be introduced & hence cost function is included.

$Q_1 \rightarrow$ output

income : $Q_1E$ = TR

cost : $Q_1a = C$

Profit : aE

Total profit : $aE \times Q = aE \times OQ_1$

$= PP' \times EP$ (PP'Ea)

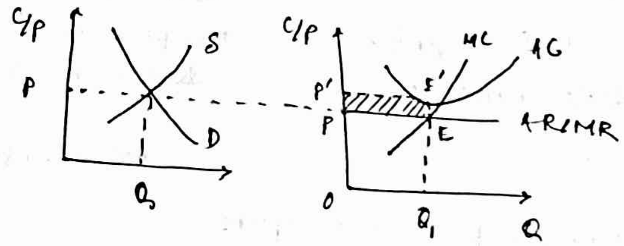
→ first draw industry demand curve, determine eqm point.

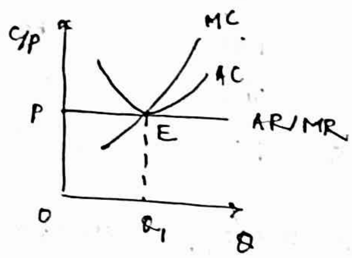
→ Draw the AR/MR line equivalent to homogeneous price.

→ Then cut the MC & find out the output.

→ Then introduce cost function (AC curve).

→ Find total profit considering income per unit, cost per unit & profit per unit.




(case of loss)
(when AC > AR)

Total loss = PP' × PE (PP'E'E)

( AC = AR )
No profit No loss

Per unit revenue : $Q_1E$

Per unit cost : $Q_1E'$

Loss : $Q_1E' - Q_1E$ = E'E

Total loss : $E'E \times Q = E'E \times OQ_1$

$= E'E \times PE$ (PP'E'E)

Per unit revenue : $Q_1E$

Per unit cost : $Q_1E$

(or normal profit)

→ In short run, the farm can obtain normal profit, supernormal profit and loss.

Normal Profit : when AR = AC

Super normal profit : when AR > AC

Loss : AR < AC

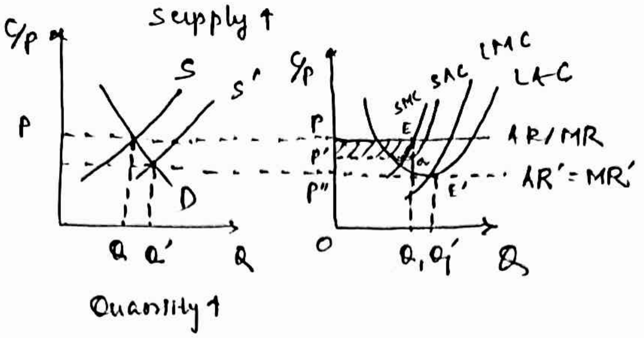
(Time period won't allow entry & exit)

→ automatically balanced market

→ But, in long run, under perfect competition market, the farm can obtain only normal profit because there is free entry & free exit of the farm.

( It will never allow supernormal cost as many farm will enter & income will be distributed → normal profit will be obtained, similarly loss → exit → normal profit )

In long run,
under a temporary supernormal profit consideration
(Supernormal to normal correction)




previous:
revenue: $OQ_1E$
cost: $OQ_1a$
Profit: Ea
Total profit: PP'aE
autobalanced
revenue: $OQ_1'E'$
cost: $OQ_1'E'$
Total profit: 0

→ The minimum point of variable cost is known as shut down point.

**Qn** For a perfectly competitive farm, in short run, the cost function is given $C = 2 + 4Q + Q^2$ (C ↓ cost, Q ↓ output). If price of the product prevailing in the market is Rs. 8, at what level of output, the farm will maximize its profit?

**Sol$^n$:** Total revenue, $TR = 8 \times Q$ (8 → price)

$TC = 2 + 4Q + Q^2$

$\therefore$ Profit, $\pi = TR - TC = 8Q - (2 + 4Q + Q^2)$

$= 4Q - 2 - Q^2$

Profit will be maximized means

$$\frac{\partial \pi}{\partial Q} = 0$$

$\Rightarrow 4 - 2Q = 0$

$\Rightarrow \boxed{Q = 2}$ (At '2' no. of outputs farm will maximize its profit)

[ Total cost $= 2 + 4(2) + (2)^2 = 14$
Total Revenue $= 8 \times 2 = 16$
Profit $= 16 - 14 =$ Rs. 2 ]

MR-MC method:

$MR = 8$

$MC = \frac{\partial C}{\partial Q} = 4 + 2Q$

At maximum output,

$MR = MC$

$\Rightarrow 8 = 4 + 2Q$

$\Rightarrow 2Q = 4$

$\Rightarrow \boxed{Q = 2}$ ($\therefore$ Ans) cost

output. What level of output, the firm will maximize its profit?

Sol$^n$:

price

Total revenue, $TR = 8 \times Q$

$TC = 2 + 4Q + Q^2$

$\therefore$ Profit, $\pi = TR - TC = 8Q - (2 + 4Q + Q^2)$

$= 4Q - 2 - Q^2$

Profit will be maximized means

$$\frac{\partial \pi}{\partial Q} = 0$$

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[ Total cost $= 2 + 4(2) + (2)^2 = 14$

Total Revenue $= 8 \times 2 = 16$

Profit $= 16 - 14 =$ Rs. 2 ]

MR-MC method:

$MR = 8$

$MC = \frac{\partial C}{\partial Q} = 4 + 2Q$

At maximum output,

$MR = MC$

$\Rightarrow 8 = 4 + 2Q$

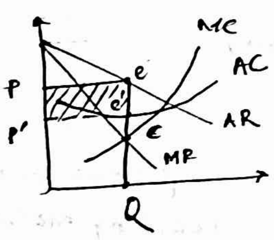
$\Rightarrow 2Q = 4$

$\Rightarrow \boxed{Q = 2}$ ($\therefore$ Ans)

L-22 (01.12.22) (03:00-04:00pm)

Price & Output Determination in monopoly market:

(imperfect competition)



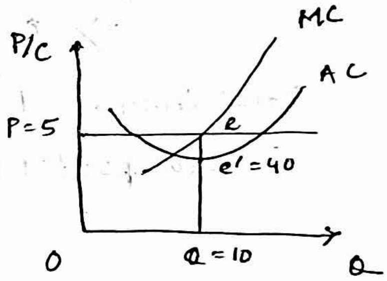

pp'e'e is the total profit

- income $e = P \times Q$
- $exp = e'$
- market price $= P$
- output $= Q$

↳ Profit per unit $ee'$

↳ Total profit $pp'e'e$

Monomoly market will always incur profit.




$e = PQ = 50$

$e - e' = 10$ per unit

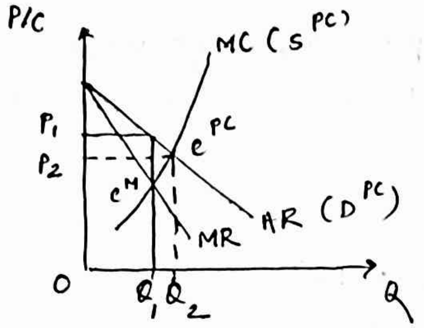
$\therefore$ Total profit $= 10 \times Q = 100$ Rs.

→ Comparision between perfect competition market and monopoly market.

- Under perfect competition market price is lower and output is higher in comparision to monopoly market.

Imp

- The average revenue curve can be considered as downward sloping demand curve and the marginal cost curve can be considered as supply curve under perfect competition market.




$e^M$ is the eqm point for monopoly market with '$Q_1$' output and '$P_1$' price.

$e^{PC}$ is the eqm point for perfect competition market with '$Q_2$' output and '$P_2$' price

$Q_2 > Q_1$ (higher product in PC)

$P_1 > P_2$ (higher price in monopoly)

Ex Suppose the output function is given

$Q = 360 - 20P$

Total cost = $6Q + 0.05Q^2$

Sol$^n$:

$Q = 360 - 20P$

$\Rightarrow 20P = 360 - Q \quad \Rightarrow P = 18 - 0.05Q$

$$\left[\begin{array}{l} \text{Total revenue} = P \times Q = 360P - 20P^2 \\ MR = \frac{\partial}{\partial P}(TR) = 360 - 40P \end{array}\right]$$

$TR = P \times Q$

$= 18Q - 0.05Q^2$

$MR = 18 - 0.1Q$

$MC = 6 + 0.1Q$

Using MR-MC method,

$MR = MC$

$\Rightarrow 18 - 0.1Q = 6 + 0.1Q$

$\Rightarrow 12 = 0.2Q$

$\Rightarrow Q = 60$

$\therefore P = 18 - 0.05 \times 60$

$\Rightarrow P = 15$

$\therefore$ Cost $= 360 + 0.05(3600)$

$= 360 + 180$

$= 540$ Rs. (Total cost)

Total income = $P \times Q = 15 \times 60 = 900$ Rs.

$\therefore$ Total profit = $900 - 540 = 360$ Rs. -- Ans)

Syllabus over
(said by Ma'am)

L-23 (02-12-22) (01:00-12:00)

1st Unit

(1) Demand, Utility, Elasticity Demand → long type
(Type of elasticity demand) - 3
(Type of price elasticity demand) - 5
or income
or cross

What is elasticity demand?
formula.
Explain Types
Don't forget to draw the graphs.

(2) Law of equimarginal Utility (Also known as consumer eqm point)
↓
Cardinal / Classical
equalize

(3) Diminishing marginal Utility (Gossen's first law)
(with ↑ in cons. MU ↓s)
Relationship between total utility & marginal utility. (Graphical or Tabular form)

short type: (a) Law of Demand
Exceptions : At least you have to prove two (with example)
(b) Factors affecting quantity demand → Long Type
↳ Demand
↳ Quantity demand
↳ function
↳ individual factor's relationship is explained.
(c) Elasticity Demand
(d) Diff. between CUA & OUA.
(e) Diff - between D.M.U. & E.M.U.
single pdt multiple pdt.

& Determinants of elasticity demand:
(factors affecting elasticity)
(a) Proportionate of the income spent on the good. (income ↑ cons. of lux goods ↑)
(b) Type of good (availability of the product)
(e.g: seasonal product)
(c) Future expectation

→ Fall in price
equivalent → reduce consumer income

2nd Module

(5) Decomposition of PE into IE & SE → Compensating Variation Principle
Price increase

(1) Properties of indifference curve (prove each of the properties)
• convex nature due to trade-off between x & y
(2) Consumer equilibrium point (conditions - each 4 marks) 2nd order diff < 0
(3) Risk uncertainty approach • NM Utility Index ← Risk lover, Risk averse, Risk neutral
(construct)
E(I) → E(U) graph
(4) Revealed Preference Theorem
(Determination of law of demand and indifference curve)

Coefficient of variation
↳ Degree of Risk
Utility Max^n
Profit Max^n

Short type:

(a) Risk & Uncertainty
(b) Risklover, averse, neutral consumer
(c) Properties of budget line
(d) MRS
(e) Slutsky equation (P-09)
(f) ICC, PCC
(g) St. Petersburg paradox, Bernoulli Hypothesis
(h) FS-Hypothesis
(i) Certainty equivalence

(Skip Markowitz theorem)

$PE \rightarrow \frac{\Delta Q_x}{\Delta P_x}$

$PED \rightarrow \frac{\Delta Q_x}{\Delta P_x} \times \frac{P_x}{Q_x}$

3rd Module

Long type →
(1) Short Run Production function (Law of variable proportion)
(2) Long Run PF (Law of Return to Scale) (change in o/p due to change in i/p)

→ Which point?
→ why called so?
→ Use of factors of production (eff. or ineff.)

(4) Producer eq^m point

(3) Derivation of Average cost curve → (SAC & LAC) U-shaped
Marginal cost curve → (SMC & LMC)

$\frac{\partial C}{\partial Q}$ TC/Q

Short Type:
(1) Costs AFC, TVC, MC, AC
(2) Why U-shaped?
(3) Which cost decreases with increase in output? → AFC
(4) Isoquant, Isocost
(5) Envelope curve.. LAC..?
(6) Cobb-Douglas Pr. Func
(7) homogeneous cost func
(8) Opportunity Cost, other types of costs

Break-Even point
- TR-TC
- MR-MC

4th Module

(1) Determination of price and output under perfect comp. market.
(2) Determination of price and output under monopoly market
(3) Comparision between PC and M

Graph, explanation

Short type
(a) Features of monopoly market
(b) Features of perfect comp market
(c) Condition to determine eq^m point, consider average cost,
(d) oligopoly, monopoly, duopoly
(e) Limiting price, sales max^m

5th Module

(1) Time value of money : PW, FW, AW

(2) How to calculate IRR? IRR

(3) Evaluation of public project    CB-analysis
CE-analysis

short type:

(a) Payback Period, IRR

(b) Diff between private & public project

(c) Compound Factors

(d) CB-Analysis, CE-Analysis

- Numerical or
- Steps with example

IRR → Direct method
→ Try & error method.