Chapter - 1
Consumers

★ → CONSUMER BEHAVIOUR

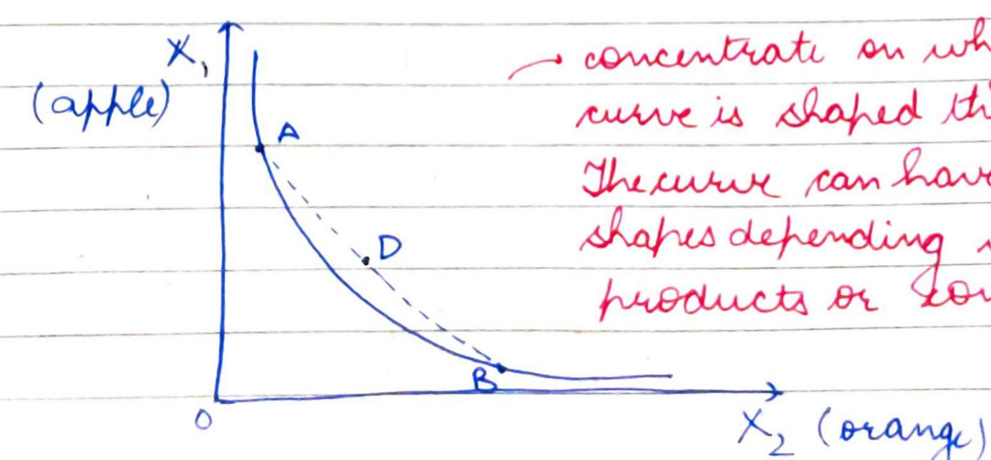
→ ORDINAL THEORY

- The theory which aims to quantify the desire of a consumer for a particular product is ordinal theory.

- It basically includes the following attributes of a consumer:

1. non-satiety - The property of a consumer, where she/he is not satisfied with the amount of product that is given is called non-satiety

2. Convex-preference - consider 2 products: apple and orange. We will graph a curve on a apples vs. oranges, given which a consumer will be happy/satisfied. This curve is believed to be convex in nature



→ concentrate on why the curve is shaped this way. The curve can have different shapes depending on both products or consumers now consider 2 points A and B, and if we take a weighted average, then the average will always be more desirable

$$\boxed{t(A) + (1-t)B > A \text{ or } B}$$

3. Complete — completeness in a consumer is when she/he decides to stick to a specific preference of products. The more the number of products the greater the confusion. But if a consumer takes a decision, she/he is likely to stick to it later on.

4. Transitivity — consider 3 products x, y, z. If preference is

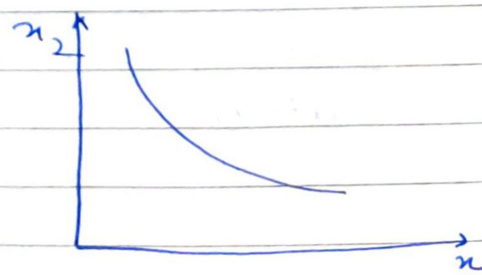
$x > y$ & $y > z$, then $x > z$ for sure.

NOTE: Alfred Marshall and Paul Samwilliamson contributed to the ordinal theory.

→ TOTAL AND MARGINAL UTILITY

- $U = U(x_1, x_2)$

Total utility



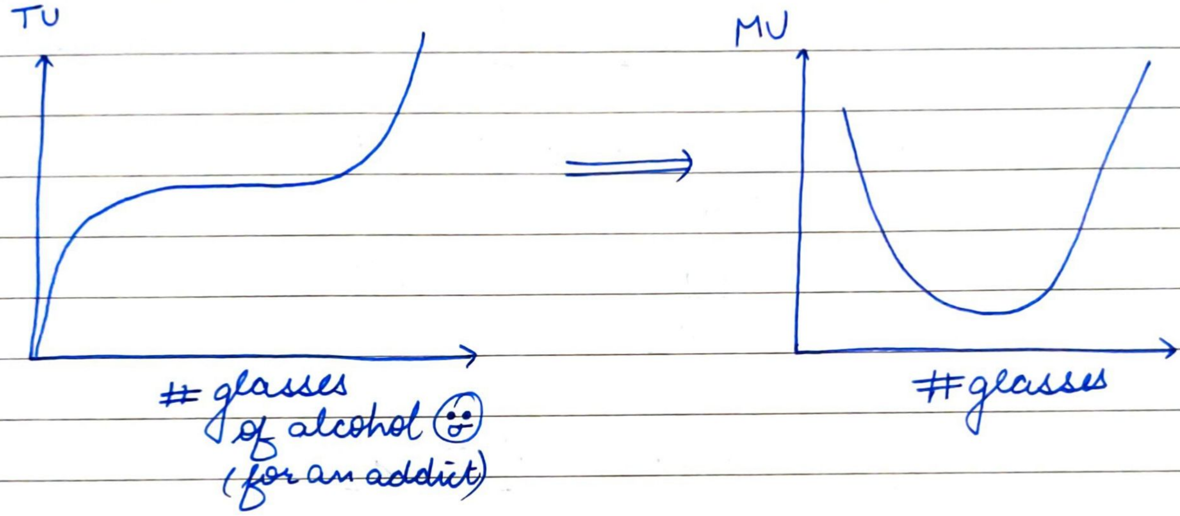
$dU = U_1 dx_1 + U_2 dx_2$

$0 = U_1 dx_1 + U_2 dx_2$ → Total utility becomes const. for indifference curve $\therefore dU = 0$

$$\Rightarrow \frac{dx_2}{dx_1} = -\frac{U_1}{U_2}$$

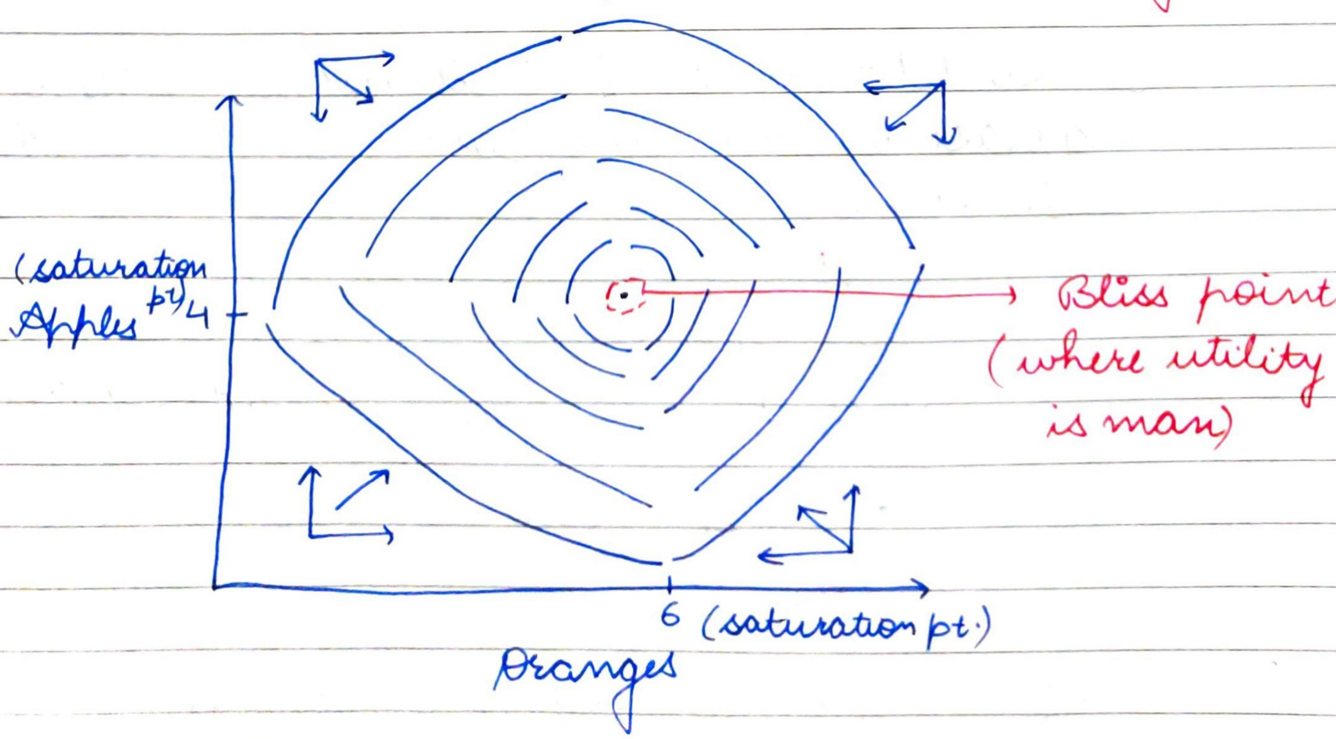
U_i = Marginal utility
$i = 1, 2$

marginal utility (for a product) is the slope of total utility vs the product curve



marginal utility of $x_1 = \frac{\partial U}{\partial x_1}$

- Actual Utility Curve for Apples vs. Oranges



- In above graph, if we plot utility ~~of~~ on z axis, we get a quasi-concave curve.

- Consider

$$U = x_1^{\alpha} x_2^{\beta} \quad ; 0 < \alpha, \beta < 1$$

$$U_1 = \frac{\partial U}{\partial x_1} = \alpha x_1^{\alpha-1} x_2^{\beta}$$

$$U_2 = \frac{\partial U}{\partial x_2} = \beta x_1^{\alpha} x_2^{\beta-1}$$

$$U_{11} = \alpha(\alpha-1) x_1^{\alpha-2} x_2^{\beta}$$

$$U_{12} = \alpha\beta x_1^{\alpha-1} x_2^{\beta-1}$$

$$U_{22} = \beta(\beta-1) x_1^{\alpha} x_2^{\beta-2}$$

~~To~~ To determine if U is quasi concave or quasiconvex, we form a Bordered Hessian

B_1

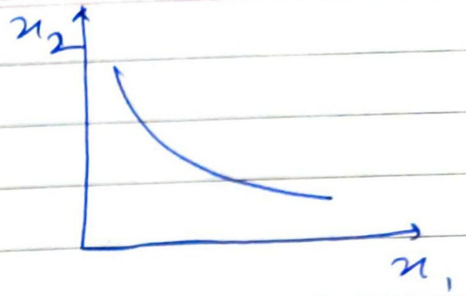
$$\begin{vmatrix} 0 & -U_1 & -U_2 \\ -U_1 & U_{11} & U_{12} \\ -U_2 & U_{21} & U_{22} \end{vmatrix} \Rightarrow \text{Bordered Hessian}$$

B_2

If $\left.\begin{matrix} B_1 \leq 0 \\ B_2 \geq 0 \end{matrix}\right]$ curve is quasiconcave

(If no equality sign, $B_1 < 0$ & $B_2 > 0$, curve is strictly quasiconcave)

~~n~~ now, for a curve like
$U = U(x_1, x_2)$



$$dU = U_1\,dx_1 + U_2\,dx_2$$

$$\frac{dx_2}{dx_1} = \frac{-U_1(x_1, x_2)}{U_2(x_1, x_2)} \qquad -(i)$$

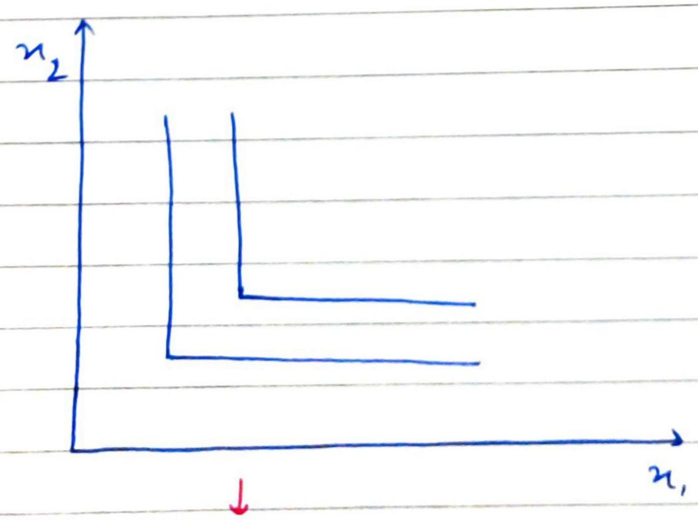
$$\boxed{\frac{d^2x_2}{dx_1^2} > 0}$$

now we will diff. (i) w.r.t. x_1

$$\frac{d^2x_2}{dx_1^2} = -\frac{\left[U_2 U_{11} - U_1 U_{21}\right]}{U_2^2}$$

- Other types of indifference curves

a)

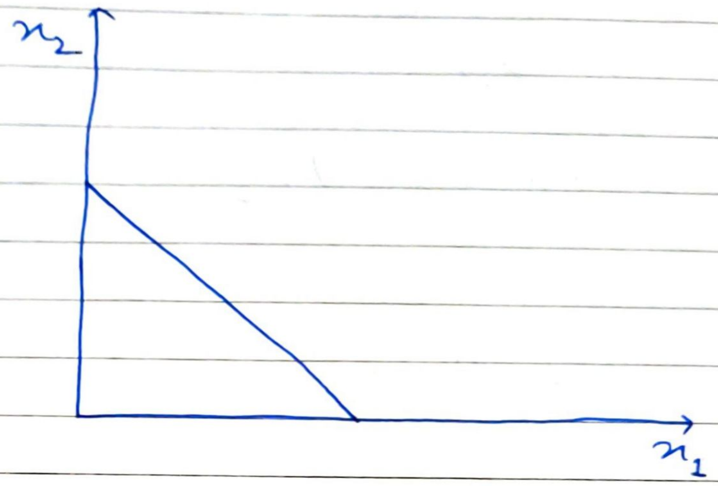


Leontieff curve

↓

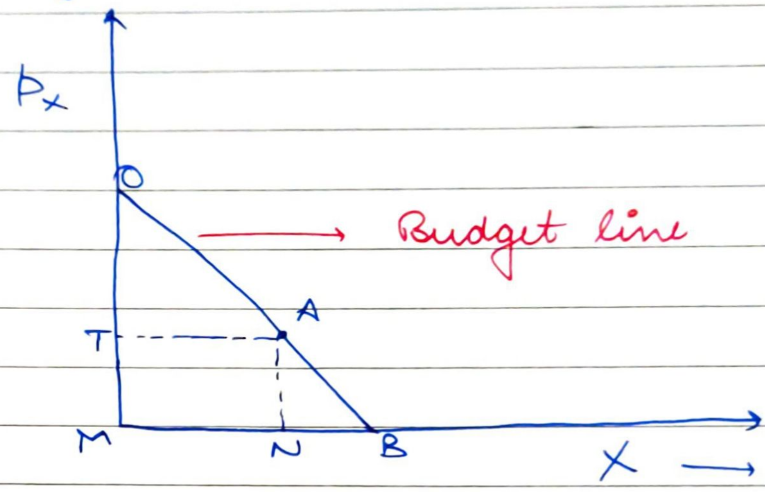
Perfect complements (x_1 & x_2)

b)



Perfect substitutes

• In graph for price vs quantity,



Now if we need to find elasticity at point A,

$$\boxed{E = \frac{\Delta X}{\Delta P_x} \times \frac{P_x}{X}}$$

$$= \frac{BM}{MO} \times \frac{MT}{MN}$$

$$\Rightarrow \boxed{E = \frac{BA}{AO}}$$

When A in mid, $E=1$

Above A $E>1$

Below A $E<1$

at B, $E=0$

at O, $E=\infty$

- If Q is demand & M is ~~Price for a product~~ income of the consumer.

$$\frac{\partial Q}{\partial M} \times \frac{M}{Q} > 1 \implies \text{Luxury good}$$

$$\frac{\partial Q}{\partial M} \times \frac{M}{Q} < 0 \implies \text{Inferior good}$$

$$0 < \frac{\partial Q}{\partial M} \times \frac{M}{Q} < 1 \implies \text{normal good}$$

Q→ $M = p_x X + p_y Y$ given. Prove that both X and Y can't be luxury goods. (p_x & p_y are consts.)

Ans. ~~$\partial M = p_x \partial X + p_y \partial Y$~~

~~$\implies p_x \frac{\partial X}{\partial M} + p_y \frac{\partial Y}{\partial M} = 1$~~

Taking derivative on both sides

$$dM = p_x dX + p_y dY$$

~~$\implies \frac{dM}{M} = p_x \frac{dX}{M}$~~

$$\implies 1 = p_x \frac{dX}{dM} + p_y \frac{dY}{dM}$$

$$\implies 1 = \frac{p_x X}{M} \frac{dX}{dM} \times \frac{M}{X} + \frac{p_y Y}{M} \frac{dY}{dM} \times \frac{M}{Y}$$

$$\Rightarrow \quad 1 = \eta_x \frac{p_x X}{M} + \eta_y \frac{p_y Y}{M}$$

Let $\frac{p_x X}{M} = \alpha$ then $\frac{p_y Y}{M} = 1-\alpha$

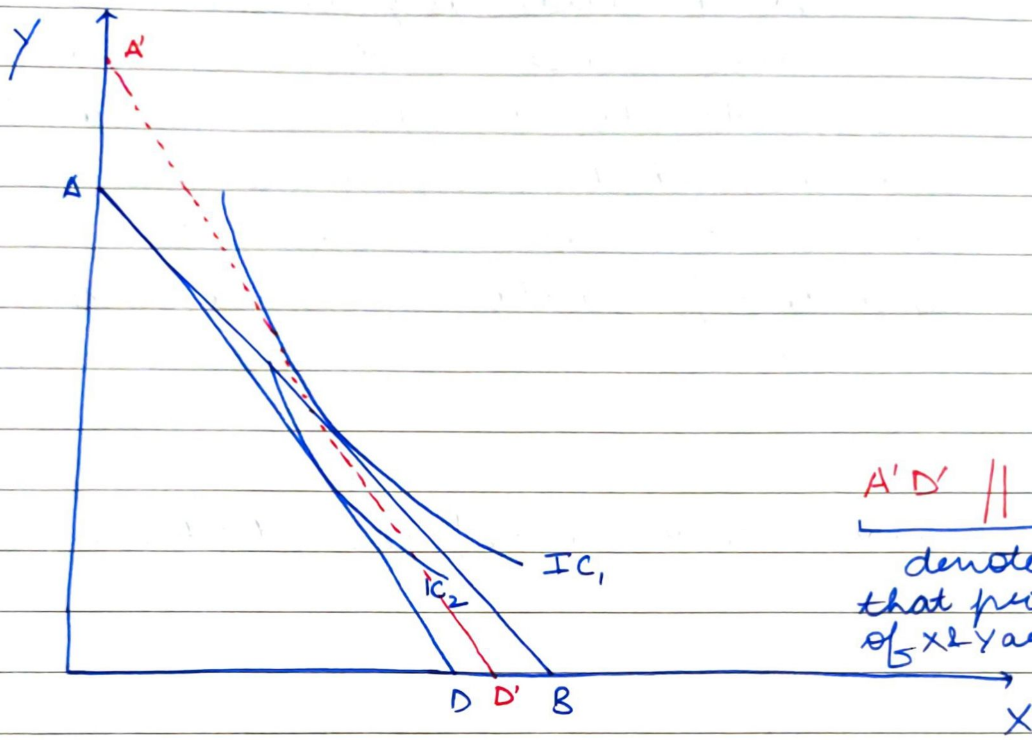
$$\therefore \quad 1 = \eta_x \alpha + \eta_y (1-\alpha)$$

$\therefore$ Clearly η_x & η_y can't both be >1 or else the eqⁿ won't hold. $\therefore$ both can't be luxury. Hence, proved.

* → SUBSIDY

- There are different theories as to in what manner, subsidies can be given to the consumers: in cash or in kind.
- Microeconomic theories by Slutskey and Hick proved that cash form of subsidy can be better.
- Consider 2 products X and Y. We have a budget line as per ~~over~~ the income of consumer & an indifference curve. Where the indifference curve touches the budget line, it is called optimum point.

AB – Budget line (Initial)



A'D' || AD
denotes that prices of X & Y are same for these lines

- now consider price of x increases, then we have new budget line and consequently new IC

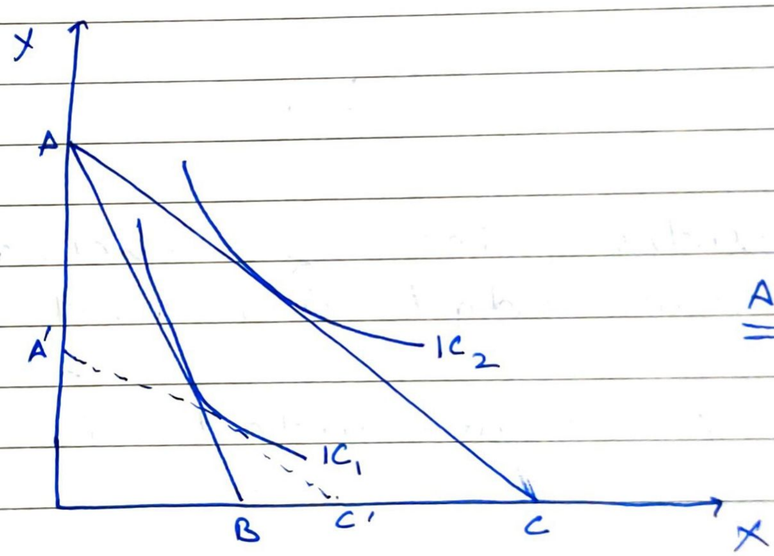
AD- new budget line after hike in X

- Hicksian theory suggests that we give that amount of money to the consumer as subsidy such that the new budget line after subsidy will touch original IC_1.

A'D' - new budget line after subsidy

- The theory also applies on fall of prices in which case govt' increases taxes. This needs to be done because, there is a limited supply of the product, ie we don't have unlimited reserves to cope up with increasing demands ∴ ~~Prices~~ demand needs to be taken down. eg- oil.

∴ we have a representation like

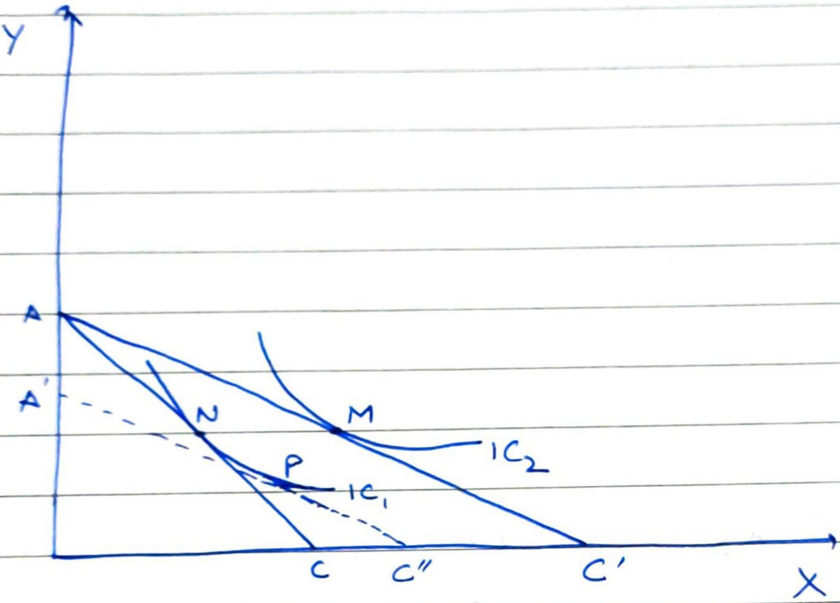


$A'C' \parallel AC$

IC_1 = old IC

IC_2 = new IC after price change (no tax hike)

· consider the previous case



$\overrightarrow{NM} = \overrightarrow{NP} + \overrightarrow{PM}$

$\overrightarrow{NM}$ → price effect

$\overrightarrow{NP}$ → substitution effect

$\overrightarrow{PM}$ → Income effect → price of products is const.

$$\boxed{\left.\frac{\partial x}{\partial p_x}\right|_{p_y \text{ and } M \text{ are constant}} = \text{price effect}}$$

PROOF: (First read note on next page)

Lagrange eq^n

$$v = \underbrace{f(q_1, q_2)}_{\text{utility function}} + \lambda \underbrace{[y_0 - p_1 q_1 - p_2 q_2]}_{\text{budget line}}$$

$$\frac{\partial v}{\partial q_1} = v_1 = \overset{\frac{\partial f}{\partial q_1}}{f_1} - \lambda p_1 = 0 \qquad (i)$$

$$\frac{\partial v}{\partial q_2} = v_2 = f_2 - \lambda p_2 = 0 \qquad (ii)$$

$$\frac{\partial v}{\partial \lambda} = v_3 = y_0 - p_1 q_1 - p_2 q_2 = 0 \qquad (iii)$$

proof continued 3 pages later

~~Proof continued~~

NOTE: consider $f(q_1, q_2) = q_1 q_2$

Que: $U = x_1^{1/3} \, x_2^{2/3}$; $p_1 = 5$ & $p_2 = 3$ $y = 100$

Find optimal value ~~demand~~ of x_1 and x_2

Ans: $v = x_1^{1/3} x_2^{2/3} + \lambda(y - p_1 x_1 - p_2 x_2)$

$$\frac{\partial v}{\partial x_1} = v_1 = \frac{1}{3} x_1^{-2/3} x_2^{2/3} - \lambda p_1 = 0$$

$$\frac{\partial v}{\partial x_2} = v_2 = \frac{2}{3} x_2^{-1/3} x_1^{1/3} - \lambda p_2 = 0$$

$$\frac{\partial v}{\partial \lambda} = v_3 = y - p_1 x_1 - p_2 x_2 = 0$$

$$\cancel{x_2^{2/3} = 3\lambda p_1 / x_1^{2/3}}$$

$$\cancel{x_2 = (3\lambda p_1 / x_1^{2/3})^{3/2}}$$

$$\cancel{y - p_1 x_1 - (3\lambda p_1)^{3/2} p_2 / x_1 = 0}$$

$$\cancel{x_1 = \frac{y}{p_1 + (3\lambda p_1)^{3/2} p_2}}$$

$$\frac{1}{3} x_1^{-2/3} x_2^{2/3} = \lambda p_1$$

$$\frac{2}{3} x_2^{-1/3} x_1^{1/3} = \lambda p_2$$

$$\Rightarrow \quad \frac{x_2}{2x_1} = \frac{p_1}{p_2}$$

$$\Rightarrow \quad x_2 = 2x_1 \frac{p_1}{p_2}$$

$$y - p_1 x_1 - \cancel{p_2}\, 2 x_1 \frac{p_1}{\cancel{p_2}} = 0$$

$$\Rightarrow \quad \cancel{y} \quad \boxed{x_1 = \frac{y}{3p_1}}$$

$$\boxed{x_2 = \frac{2y}{3p_2}}$$

→ Demand curves

$$\cancel{\lambda p_1 = \left(\frac{1}{3}\right)\left(\frac{2}{3}\right)^{2/3} \left(\frac{1}{3}\right)^{2/3}}$$

$$\frac{1}{3}\left(\frac{\cancel{3p_1}}{\cancel{y}}\right)^{2/3}\left(\frac{2\cancel{y}}{\cancel{3}p_2}\right)^{2/3} = \lambda (p_1)^{1/3}$$

$$\Rightarrow \quad \lambda = \frac{2}{3}^{2/3}\left(\frac{1}{p_2}\right)^{2/3}\left(\frac{1}{p_1}\right)^{1/3}$$

λ is called Marshallian.

PROOF: contd

we take derivative of (i), (ii) and (iii)

(iv) $f_{11}\,dq_1 + f_{12}\,dq_2 - p_1\,d\lambda = \lambda\,dp_1$

(v) $f_{21}\,dq_1 + f_{22}\,dq_2 - p_2\,d\lambda = \lambda\,dp_2$

(vi) $-p_1\,dq_1 - p_2\,dq_2 + 0 = -dy_0 + q_1\,dp_1 + q_2\,dp_2$

using cramer's rule

$$dq_1 = \frac{\begin{bmatrix} \lambda dp_1 & f_{12} & -p_1 \\ \lambda dp_2 & f_{22} & -p_2 \\ -dy_0 + q_1 dp_1 + q_2 dp_2 & -p_2 & 0 \end{bmatrix}}{D}$$

$$dq_1 = \frac{\lambda dp_1 D_{11} + \lambda dp_2 D_{12} + (-dy_0 + q_1 dp_1 + q_2 dp_2) D_{13}}{D}$$

For income effect $dp_1 = dp_2 = 0$

$$\frac{\partial q_1}{\partial y_0} = -\frac{D_{13}}{D} \longrightarrow \text{Income effect} \Rightarrow dp_1 = dp_2 = 0$$

For substitution effect

$$U = f(q_1, q_2)$$

$$dU = 0 = f_1\,dq_1 + f_2\,dq_2$$

$$\Rightarrow \frac{dq_2}{dq_1} = -\frac{f_1}{f_2}$$

Also income is constant for substitution,

$\therefore \quad p_1 dq_1 + p_2 dq_2 = dy = 0$

$\therefore$ in $\underline{vi}$, $\quad -dy_0 + q_1 dp_1 + q_2 dp_2 = 0$

$\therefore$

since $dp_2 = 0$ (price of q_2 never changes)

$$dq_1 = \frac{\lambda dp_1 D_{11} + \cancel{\lambda dp_2 D_{12}}^{\,0} + (\cancel{-dy_0}^{\,0} + q_1 dp_1 + \dots)}{D}$$

$$\boxed{\left.\frac{dq_1}{dp_1}\right|_{dp_2=0} = \frac{\lambda D_{11}}{D}} \longrightarrow \text{substitution effect}$$

For price effect

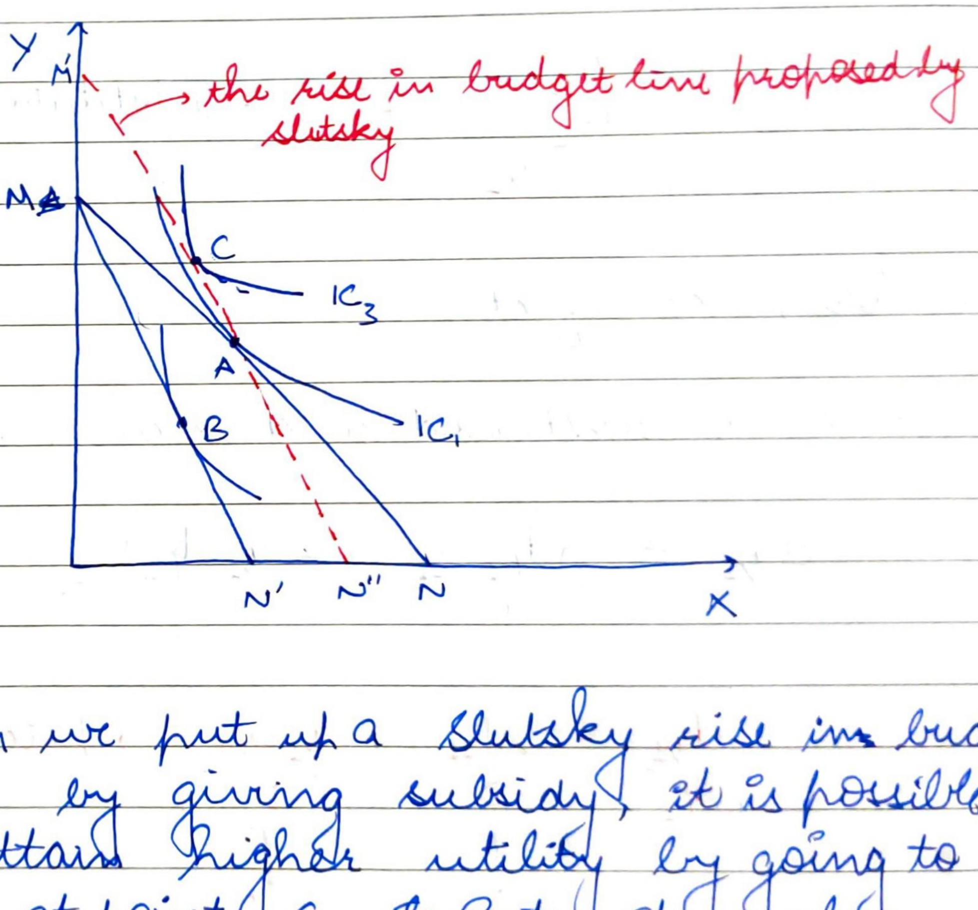
Price of first good and income does not change

$$dq_1 = \frac{\lambda dp_1 D_{11}}{D} + \frac{q_1 dp_1 D_{31}}{D}$$

$$\boxed{\frac{dq_1}{dp_1} = \underbrace{\frac{\lambda D_{11}}{D}}_{\text{substitution effect}} + \underbrace{\frac{q_1 D_{31}}{D}}_{\text{income effect}}} \longrightarrow \text{price effect}$$

→ SLUTSKY THEORY FOR SUBSIDY

- Slutsky suggested that the amount of subsidy to be given should be of that amount such that the consumer can buy the old combination of items

- 

- When we put up a Slutsky rise in budget line by giving subsidy, it is possible to attain higher utility by going to IC_3 at point C. But it is also possible for consumer to stay at A. ∴ the consumer can go at any point b/w A and C. But this movement would only be possible if we have a cash subsidy given to the consumer which increases her/his options. ∴ Cash subsidy for compensating upto point A is ideally better than Hicksian Theory.

- Practically, a gift card is of greater utility to consumer than a specific gift.

Que: $U = x^\alpha y^\beta$ $\quad M = p_x x + p_y y$ $\quad 0<\alpha, \beta<1$

maximising utility w.r.t. budget constraint

Ans: $Z = x^\alpha y^\beta + \lambda(M - p_x x - p_y y)$

$$\frac{\partial Z}{\partial x} = Z_x = \alpha x^{\alpha-1} y^\beta - \lambda p_x = 0$$

$$\frac{\partial Z}{\partial y} = Z_y = \beta y^{\beta-1} x^\alpha - \lambda p_y = 0$$

$$\frac{\partial Z}{\partial \lambda} = Z_\lambda = M - p_x x - p_y y = 0$$

Solving, we get solⁿ

$$x^* = \frac{M\alpha}{(\alpha+\beta)p_x}$$

$$y^* = \frac{M\beta}{(\alpha+\beta)p_y}$$

$\therefore$ max utility $= U^* = (x^*)^\alpha (y^*)^\beta$

$$= \left(\frac{M\alpha}{(\alpha+\beta)p_x}\right)^\alpha \left(\frac{M\beta}{(\alpha+\beta)p_y}\right)^\beta$$

- From answer to previous question

$$\frac{\frac{\partial U^*}{\partial p_x}}{\frac{\partial U^*}{\partial M}} = \frac{\cancel{U^*}\,(p_x)^{\alpha}\,(-\alpha)\,p_x^{-\alpha-1}}{\frac{\cancel{U^*}}{M^{\alpha+\beta}}\,(\alpha+\beta)\,M^{(\alpha+\beta-1)}}$$

$$= \frac{-\alpha M}{p_x(\alpha+\beta)} = -x^*$$

$$\boxed{\frac{\frac{\partial U^*}{\partial p_x}}{\frac{\partial U^*}{\partial M}} = \frac{-\alpha M}{p_x(\alpha+\beta)} = -x^*}$$

demand curve

- Like we maximised U wrt budget, we can also be asked to minimize budget wrt. given U^*

minimize $p_1x_1 + p_2x_2$ subject to $U^* = x_1x_2$

For this we use Lagrange again

$$\mathcal{L} = p_1x_1 + p_2x_2 + \mu\left[U^* - x_1x_2\right]$$

$$\frac{\partial L}{\partial x_2} = p_1 - \mu x_2 = 0$$

$$\frac{\partial L}{\partial x_2} = p_2 - \mu x_1 = 0$$

$$\frac{\partial L}{\partial \mu} = U^* - x_1 x_2 = 0$$

From above eq^{n}s,

$$x_1^* = \sqrt{\frac{p_2}{p_1} U^*}$$

$$x_2^* = \sqrt{\frac{p_1}{p_2} U^*}$$

now we find expenditure (budget) as calculated optimally

$$E^* = p_1 x_1^* + p_2 x_2^*$$

$$\Rightarrow \boxed{E^* = 2\sqrt{p_1 p_2 U^*}}$$

From this,

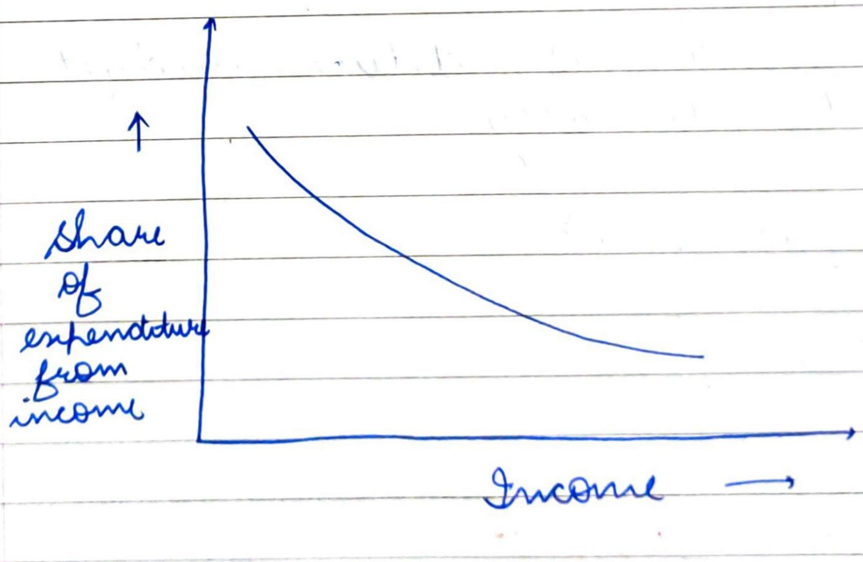
$$\boxed{\frac{\partial E^*}{\partial p_1} = x_1^* = \sqrt{\frac{p_2}{p_1} U^*}}$$ → Shephard's Lemma

→ ENGEL CURVE (INCOME RISE AND CONSUMPTION)

- For a poor man, he/she spends a high % amount of money earned on food.

- But as income rises, that percentage decreases (given that the food requirements are met). If the percentage rises, this shows insufficiency in amount of food for the individual.

- On a society / community level, for a good economy, this percentage (for all the population combined) must decrease with income.



PTO

TW

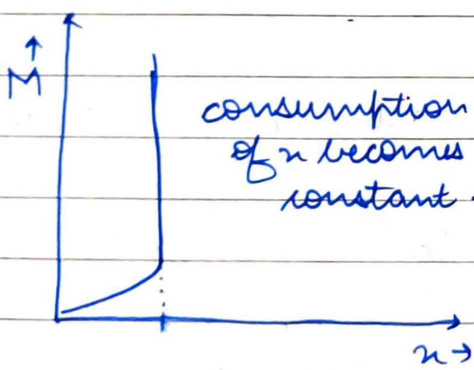
Que: Own price elasticity of $x = 0.3 = \frac{dx}{dp_x}\frac{p_x}{x}$

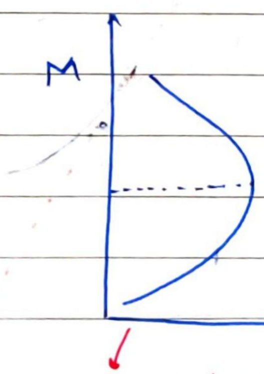
Share of expenditure on $x = 70\% = \frac{p_x x}{M} = 0.7$

Cross price elasticity b/w x and y = ?

$$\frac{dx}{dp_y}\frac{p_y}{x}$$

- Engel curve: It is a curve b/w the income versus consumption of a good for an individual. It can be of different shapes.





more practical

after a certain level of income an individual might find x of lower utility eg- he/she found a better product

Que: Draw a demand curve for which elasticity remains constant.

Ans:

$$\frac{dx}{dp_x}\frac{p_x}{x} = -c$$

Integrating

$$\Rightarrow \ln x = -c\ln p_x + \ln c'$$

$$\Rightarrow x = c'/p_x^{c}$$

$\Rightarrow \; x p_x^c = C'$

CONSUMPTION VS ~~B~~ LEISURE LINE

- $\boxed{pC = M + (24-L)w}$

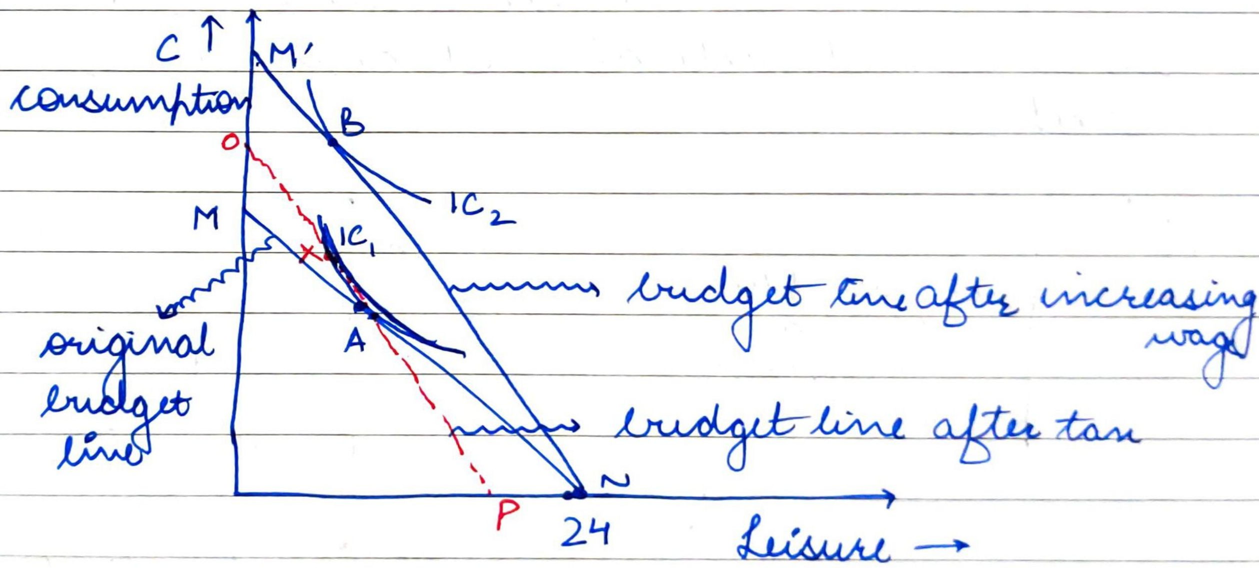
  pC: consumption

  M: money from savings/hereditary

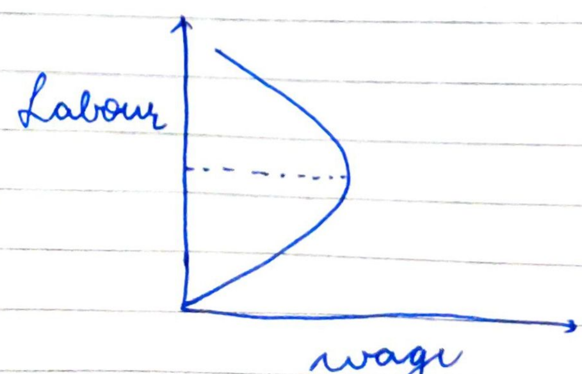
  L = Leisure hours

  w = wage/hour

- Any increase in wage increases consumption



$\left.\begin{array}{l}\vec{AX} \Rightarrow \text{sub}^n \text{ effect} \\ \vec{XB} \Rightarrow \text{Income effect}\end{array}\right\} \Rightarrow \vec{AB} = \text{total effect}$

- 

Que: HW wala

Ans: given

Own price elasticity $= 0.3 = e_x$
share of expenditure on $x = 70\%$
cross price elasticity b/w x and y

now

$$M = p_x x + p_y y \qquad (p_y \ \& \ M \text{ are const})$$

$$\frac{dM}{dp_x} = x + \frac{dx}{dp_x} p_x + \frac{dy}{dp_x} p_y + 0$$

$$0 = x + \frac{dx}{dp_x} p_x + \frac{dy}{dp_x} p_y$$

$$\Rightarrow 0 = 1 + \frac{dx}{dp_x} \frac{p_x}{x} + \frac{dy}{dp_x} \frac{p_y}{x}$$

multiply both sides by $\frac{x p_x}{M}$

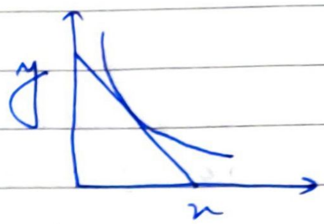
$$0 = \frac{x p_x}{M} + \frac{dx}{dp_x} \frac{p_x^2}{M} + \frac{dy}{dp_x} \frac{p_y p_x}{M}$$

use

$$\alpha \eta_1 + (1-\alpha) \eta_2 = 1$$

- REVISION

i) Indifference curve



$-\frac{P_x}{P_y}$ = slope

ii) Lagrange → Optimization under linear budget constraint.

iii) Demand curve → x, y

iv) Elasticity → price → substitute, complement → cross price elasticity

Elasticity → Income → Inferior, normal, Luxury

v) Engel curve

vi) TE / PE = SE + IE

vii) Backward bending individual labour supply curve

viii) Consumer surplus.

→ EXCEPTIONS TO LAW OF DEMAND

i) Bandwagon effect: every consumer nearly is consuming it, so an individual consumer blindly consumes it. It is also called herd effect. eg- placement chahiye kyuki sabko chahiye

ii) Snob effect: Whatever others ~~a~~ are consuming, an individual does not want it anymore. eg- "I don't wan't placement whatsoever be the case"

iii) Conspicuous consumption (Veblen effect): An individual wants an expensive object just for the sake of things like social status. It is different from bandwagon in terms of price which is not a factor in Bandwagon effect. eg- people buying an expensive phone.

iv) Giffen good: In Ireland, during 1920's potatoes started getting expensive. But since it is a staple diet there, ~~[illegible]~~ demand did not fall. Rather it increased (for not very concrete reasons).

PTO

Chapter-2
Production

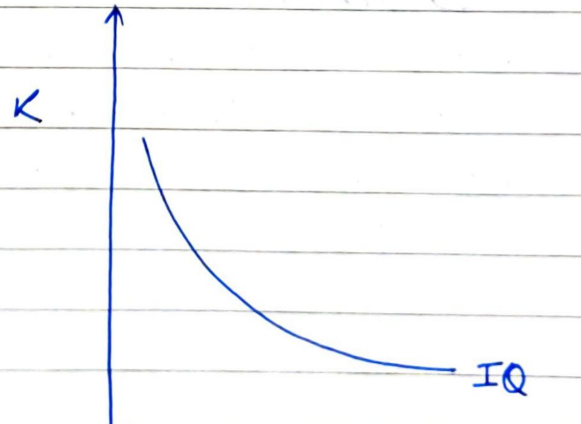
→ ISOQUANT

- Anything which can be used in production of a product can be divided into 2 categories
  K (capital) - (machinery, money, intellect)
  L (labour) - (effort, men/women)

- Output ie production is dependent on these 2 factors

$$Q = f(K, L)$$

- A curve on K vs L graph for which Q ie output remains the same is called isoquant



NOTE: Short run - A period in which we can vary only one of K & L ie there is a constraint
Long run - we can vary both K & L

NOTE: Isoquant is analogous to indifference curve

- $Q = f(K, L)$

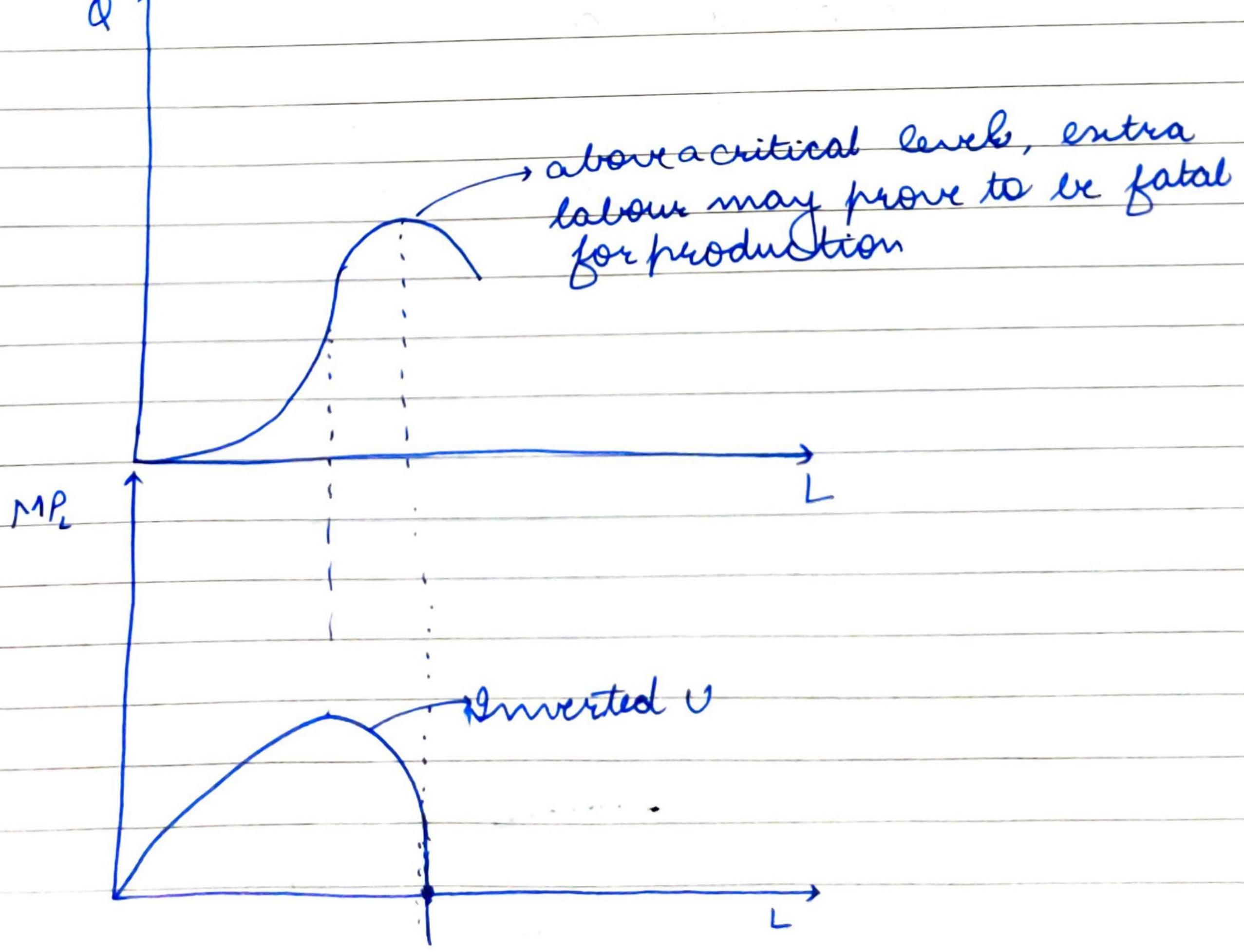
$$dQ = f_K\, dK + f_L\, dL$$

$\boxed{\dfrac{dK}{dL} = -\dfrac{f_L}{f_K}}$ → MRTS (marginal Rate of technical substitution)

$$f_L = \frac{\partial f}{\partial L} = MP_L \rightarrow \text{marginal product of } L$$

$$f_K = \frac{\partial f}{\partial K} = MP_K \rightarrow \text{marginal product of } K$$

- consider the case of short run, lets say K is fixed then lets draw Q vs L & MP_L vs L



- **Average Product**

$$\boxed{AP = Q/L}$$

To draw its graph (vs L), we check

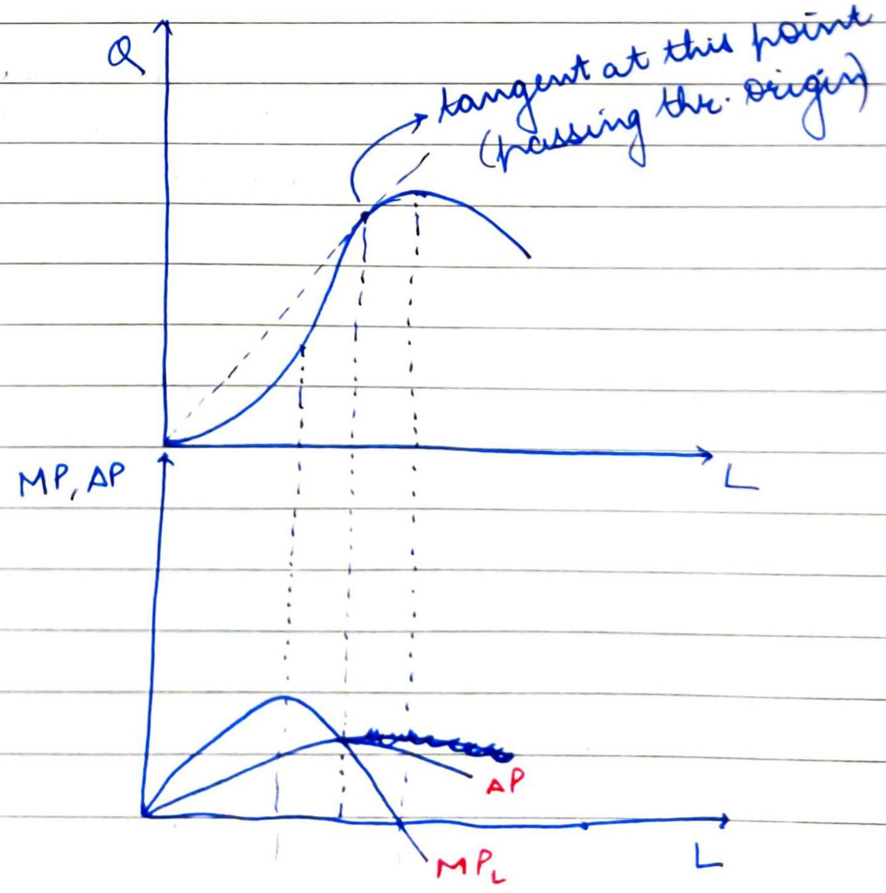
$AP = Q/L$

$$\frac{d(AP)}{dL} = \frac{d(Q/L)}{dL} = \frac{L\frac{\partial Q}{\partial L} - Q\frac{\partial L}{\partial L}}{L^2}$$

$$= \frac{1}{L}\left(\frac{\partial Q}{\partial L} - \frac{Q}{L}\right)$$

$$= \frac{1}{L}\left(MP_L - AP_L\right)$$

$\therefore$ AP reaches max when AP = MP



Que: zone ~~1~~ 3 → $MP_L < 0$

zone 2 → $\frac{dAP}{dL} < 0$

zone 1 → $\frac{dAP}{dL} > 0$

where will you produce?

Ans: not zone 3 because MP_L falls

not zone 1 either because $\frac{dAP}{dL} > 0$ ie we have better production possibility.

∴ we produce in zone 2.

→ RETURN TO SCALE

- It refers to the change in Q w.r.t. change in K & L

- $Q = f(K, L)$

$\lambda^k Q = (\lambda K, \lambda L)$ → $k > 1$ increasing return to scale (IRS)
$k = 1$ Const. Return to Scale (CRS)
$k < 1$ Decrea. Return to Scale (DRS)

HW
Que: Identify IRS, CRS, or DRS for

$Q = K + L^2$

• **NOTE:** $U = \ln x_1 + x_2$, $p_1 x_1 + p_2 x_2 = M$

Quasi-linear utility f^n

$$\mathcal{L} = \ln x_1 + x_2 + \lambda \left[M - p_1 x_1 - p_2 x_2 \right]$$

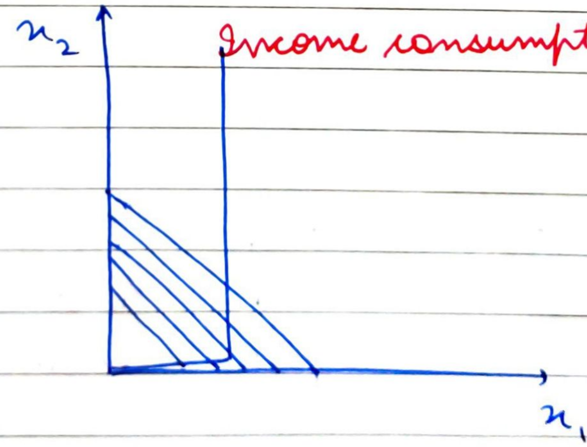
$$\frac{\partial \mathcal{L}}{\partial x_1} = \frac{1}{x_1} - \lambda p_1 = 0$$

$$\frac{\partial \mathcal{L}}{\partial x_2} = 1 - \lambda p_2 = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = M - p_1 x_1 - p_2 x_2 = 0$$

$$\therefore x_1^* = \frac{p_2}{p_1} \quad ; \quad x_2^* = \frac{M - p_2}{p_2}$$

Here x_1^* does not depend on M. The reason for this is the f^n U



NOTE: Like budget constraint for consumer, we have cost constraint for producer.

→ PRODUCTION COSTS

K	L
rent	wage
r	w

$$\boxed{\text{cost } (c) = wL + rK}$$

→ OPPORTUNITY COST

- Consider we have 2 options A & B only one of which we can execute. Then the opportunity cost of B would be equal to what would it cost us to not to execute B.

NOTE: Any producer looks to maximize

$$\underbrace{Q = L^{\alpha} K^{1-\alpha}}_{\text{production}} \quad \text{such that} \quad \underbrace{C = wL + rK}_{\text{cost constraint}}$$

Using Lagrange

$$\mathcal{L} = L^{\alpha} K^{1-\alpha} + \lambda (C - wL - rK)$$

$$\frac{\partial \mathcal{L}}{\partial L} = \alpha L^{\alpha-1} K^{1-\alpha} - \lambda w = 0 \qquad (i)$$

$$\frac{\partial \mathcal{L}}{\partial K} = (1-\alpha) L^{\alpha} K^{-\alpha} - \lambda r = 0 \qquad (ii)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = -wL - rK + C = 0 \qquad (iii)$$

Solving (i), (ii) and (iii)

$$\boxed{L^* = \frac{C\alpha}{w}}$$

$$\boxed{K^* = \frac{C(1-\alpha)}{r}}$$

$$\therefore \boxed{Q^* = \frac{C\,\alpha^{\alpha}\,(1-\alpha)^{1-\alpha}}{w^{\alpha}\,r^{1-\alpha}}} \rightarrow \text{optimal production}$$

Que: $Q = L + 2K$ s.t. $C = wL + rK$

Ans. $\mathcal{L} = L + 2K + \lambda(C - wL - rK)$

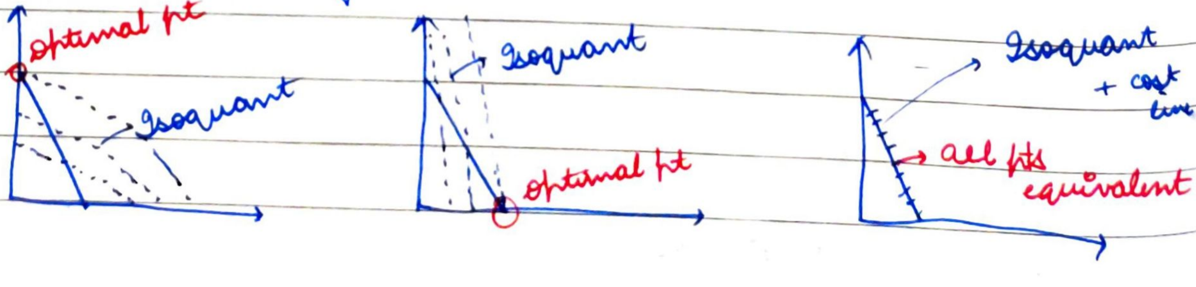
$$\frac{\partial \mathcal{L}}{\partial L} = 1 - \lambda w = 0$$

$$\frac{\partial \mathcal{L}}{\partial K} = 2 - \lambda r = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = C - wL - rK = 0$$

This is unsolvable as such

3 cases may arise



→ COSTS IN BUSINESS

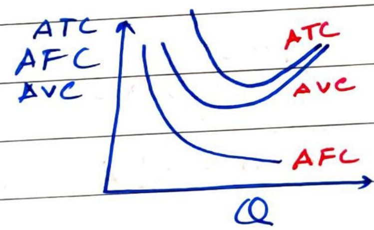
- Before starting a business, there is a fixed cost involved to start it. There is a variable cost after that depending on output.

- Total Cost = Fixed Cost + Variable cost

$$\frac{TC}{Q} = \frac{\overset{(TFC)}{FC}}{Q} + \frac{\overset{(TVC)}{VC(Q)}}{Q} \quad ; \quad Q = \text{Output produced}$$

$$\underbrace{ATC}_{\text{average total cost}} = \underbrace{AFC}_{\text{average fixed cost}} + \underbrace{AVC}_{\text{average variable cost}}$$

- $AFC = \frac{TFC}{Q}$



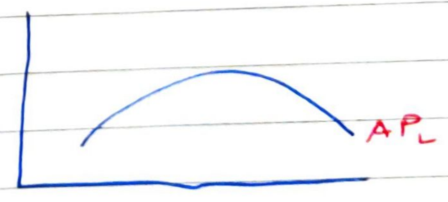
- $TC = wL + \bar{r}K$ (consider K = const for short run)

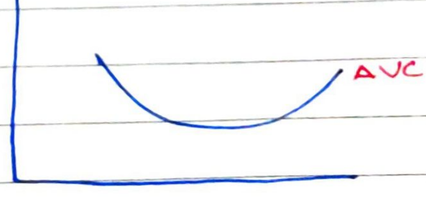
$\Rightarrow TC = TVC + TFC$

$\Rightarrow \frac{TVC}{Q} = \frac{wL}{Q}$

$\Rightarrow AVC = \frac{w}{Q/L}$

$\therefore \boxed{AVC = \frac{w}{AP_L}}$





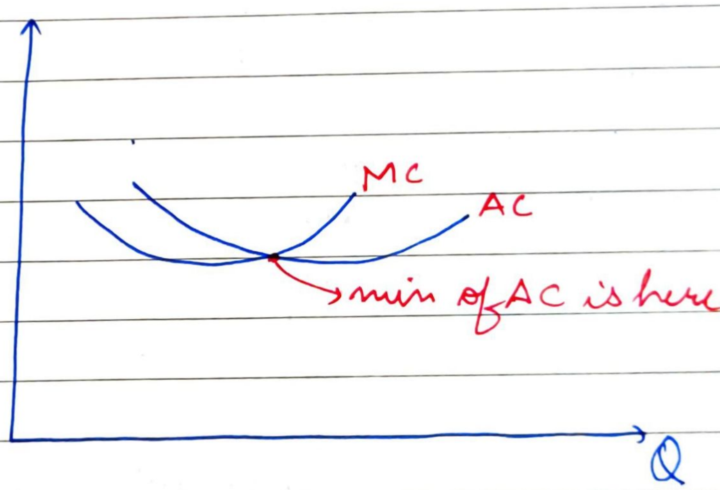
- $MC = \frac{\partial C}{\partial Q}$

$AC = C/Q$

$\underline{AC} = C/Q$

$\Rightarrow \frac{d(AC)}{dQ} = \frac{1}{Q}[MC - AC]$

$$\Rightarrow \boxed{\frac{d(AC)}{dQ} = \frac{1}{Q}[MC - AC]}$$



PROFIT MAXIMIZATION

- Total revenue (TR) $= p \times Q$ ⟶ quantity

  Total cost (TC) $= C(Q) = wL + rK$

- π = profit $= p \times Q - C(Q)$

  $\Rightarrow \pi(Q) = p(Q)\, Q - C(Q)$

For maximizing profit, we take derivative w.r.t. Q

$$\frac{\partial \pi}{\partial Q} = \underbrace{Q\,p'(Q) + p(Q)}_{\text{marginal revenue}} - c'(Q), \text{ where } p'(Q) = \frac{dp}{dQ}$$

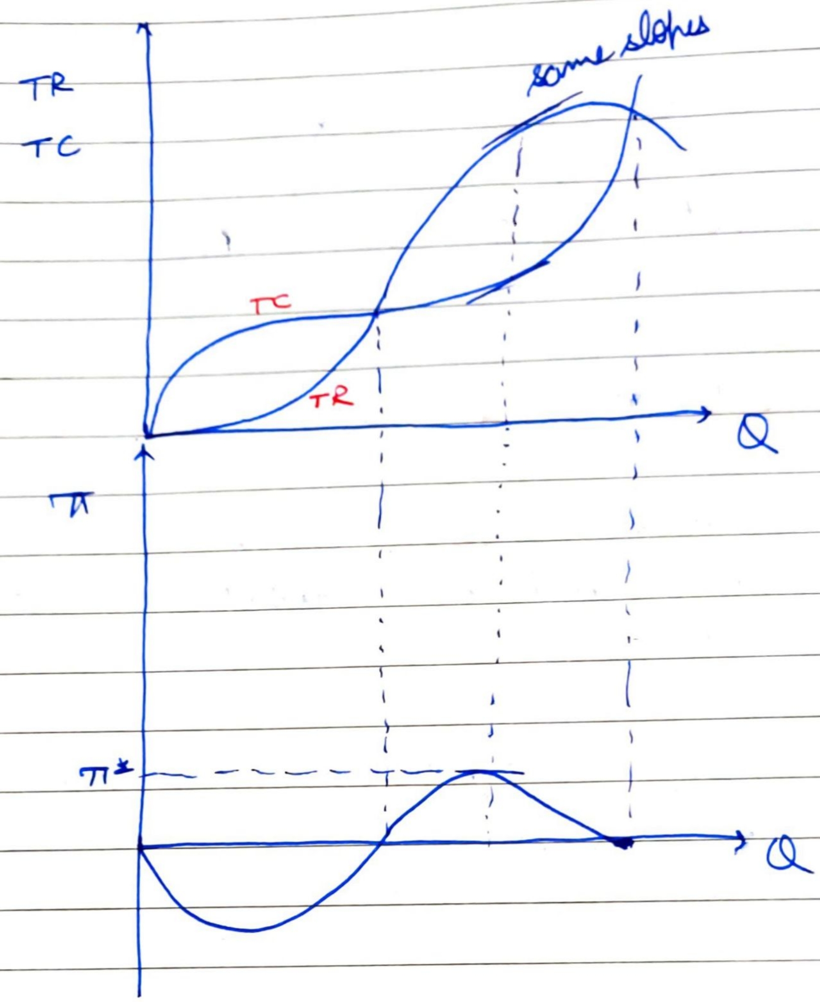
$$c'(Q) = \frac{\partial c}{\partial Q} = MC$$

$$\therefore \frac{\partial \pi}{\partial Q} = MR - MC$$

For ~~minima~~ maxima,

$$0 = MR - MC$$

$\therefore MR = MC$ for maxima



Que: $p = 10 - 5Q$

$C = 10Q + 2Q^2$

Tell optimal profit.

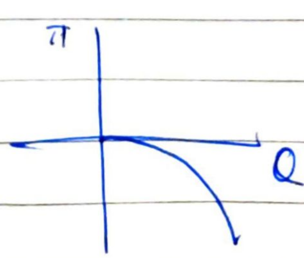
Ans: $\pi = \cancel{10Q} - 5Q^2 - \cancel{10Q} - 2Q^2$

$\pi = -7Q^2$

$\frac{\partial \pi}{\partial Q} = -14Q = 0$

at $Q = 0$

$\therefore \pi = 0$



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Que: Elasticity $= -1.5$

$C = Q^2 - 10Q + 10$

Ans. $\dfrac{dQ}{dp} \times \dfrac{p}{\cancel{q}} = -1.5$

$\Rightarrow \ln Q = -1.5 \ln p + \ln c'$

$\Rightarrow \ln\left(\dfrac{Q}{c'}\right) = -1.5 \ln p$

$\left(\dfrac{Q}{c'}\right) = p^{-1.5}$

$\left(\dfrac{K}{Q}\right)^{2/3} = p$

$\pi = K^{2/3} Q^{1/3} - Q^2 + 10Q - 10$

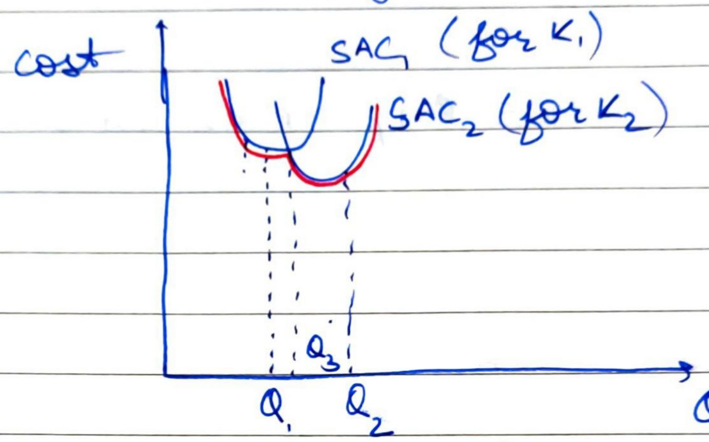
$\dfrac{1}{3}\left(\dfrac{K}{Q}\right)^{2/3} - 2Q + 10 = 0$

solve now (nahi hoga. bahut ganda hai)

PTO

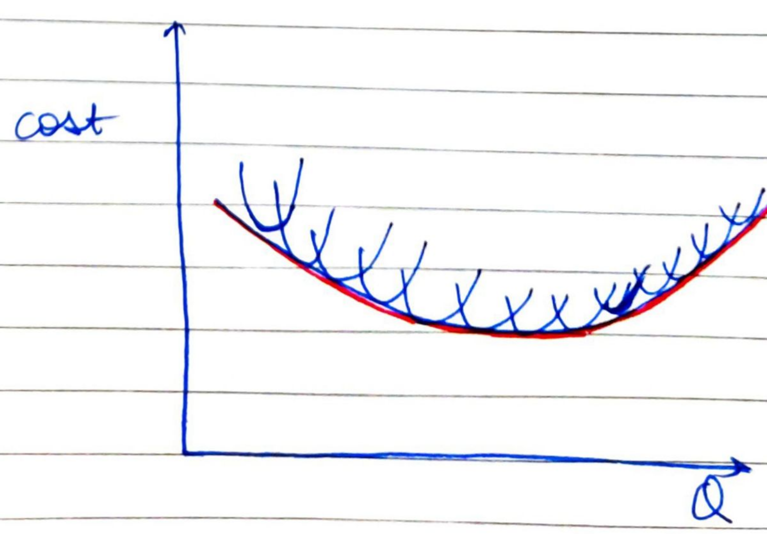
→ LONG RUN PRODUCTION

- For 2 diff. values of K, lets draw short run avg cost curves



If we are allowed to shift b/w these curves, the red one will be preferred.

- ∴ if both L & K are variable, we will have ∞ amt. of such curves and we are allowed to shift b/w them. Thus our long run cost vs quantity will look like



Economies of Scope :

A	B	(2 diff^n locations same product)
Q_1	Q_2	
$C(Q_1)$	$C(Q_2)$	

Total cost by firm $= C(Q_1) + C(Q_2) > C(Q_1 + Q_2)$
producing in diff^n locations   & producing in same location

This is referred as economies of scope i.e., production at one place to minimise cost.

$C(Q_1) + C(Q_2) = C(Q_1 + Q_2)$ doesn't make any diff in term of cost.

Economies of Scale.

$\cancel{I(Q_2)} = IC_{(Q_2)} = C(Q_1, Q_2) - C(Q_1, 0)$

Incremental cost

$$AIC_{Q_2} = \frac{C(Q_1, Q_2) - C(Q_1, 0)}{Q_2}$$

avg incremental cost for production of Q_2.

$$MC = \frac{\partial C}{\partial Q_2}$$

$$Scale = \frac{AIC}{MC} \quad \begin{matrix} < 1 \\ > 1 \\ = 1 \end{matrix}$$

Economies of scale ~~a~~ cost fall if production $\uparrow$.

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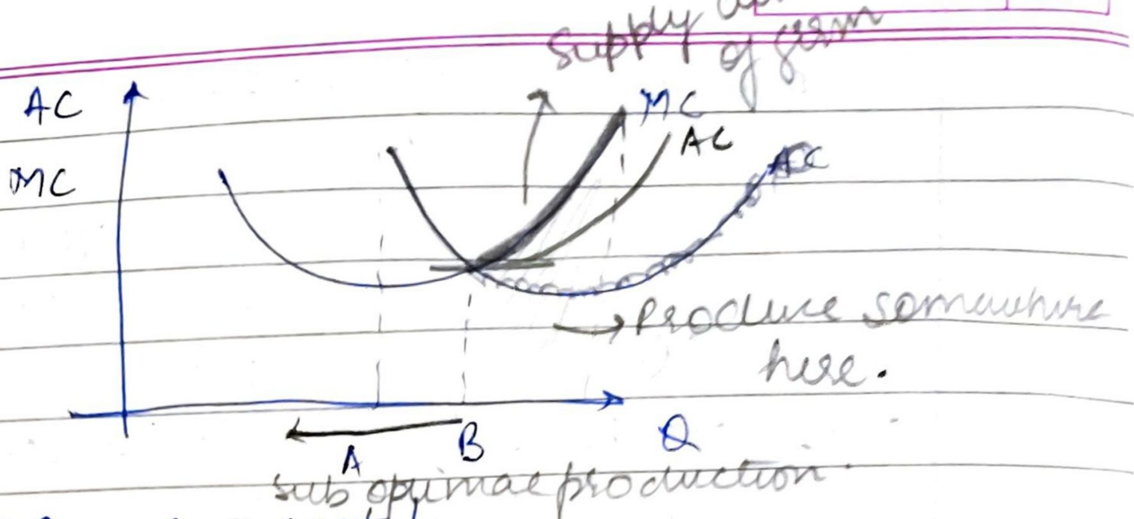


as Q↑ avg cost↓

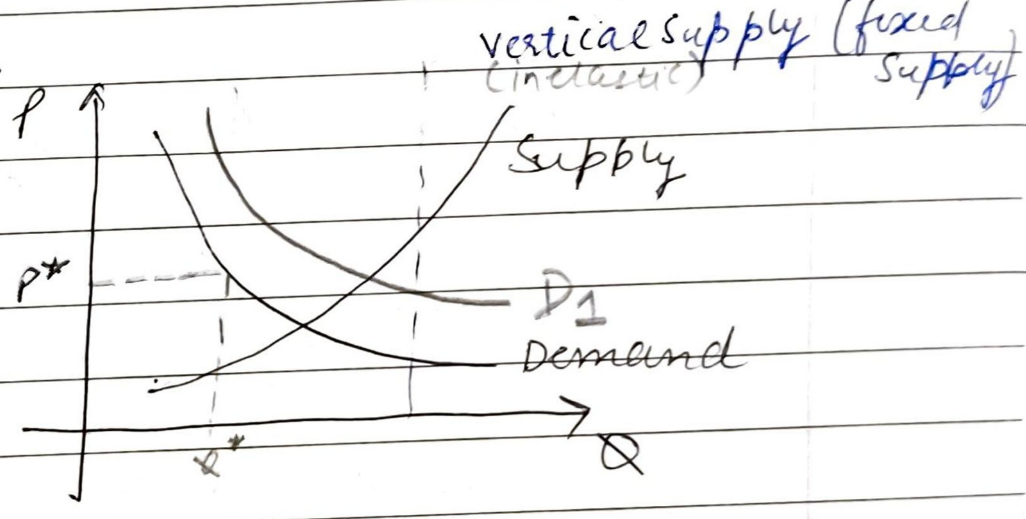
from A to B AC↓ but ratio >1 as Q↑

scale = $\frac{AIC}{MC}$ >1 Economies of scale

<1 diseconomies of scale.

= 1 neither.

Monopoly.



$\frac{dQ}{dP} \times \frac{P}{Q} = 0$ for fixed supply

$(\because dQ = 0)$

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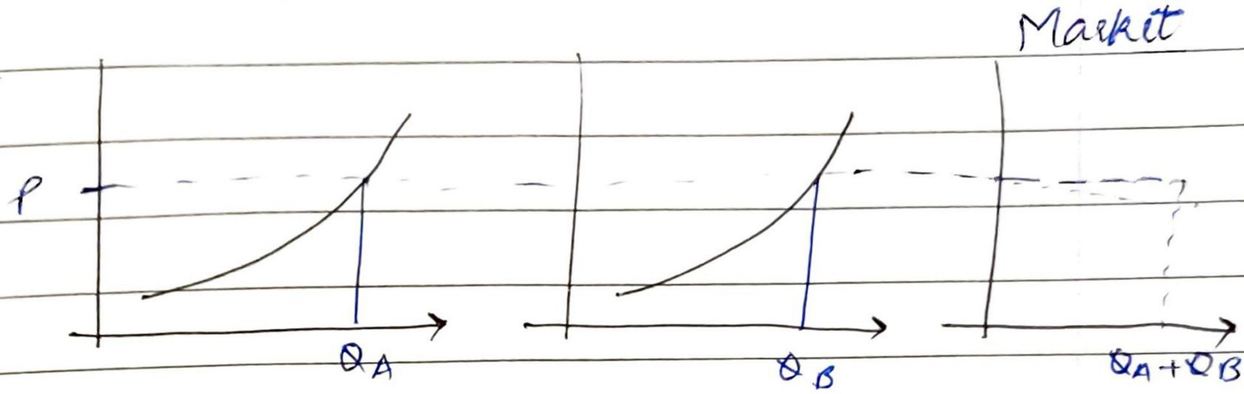
When there are two suppliers.



Q : $Q_D = a - bp$ quantity demanded $\qquad$ $Q_S = c + dp$. Quantity supply.

$$a - bp = c + dp$$

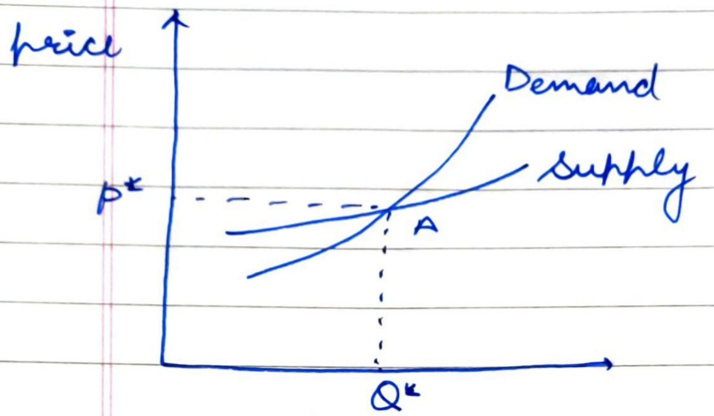
$$\frac{a-c}{b+d} = p. \quad \text{(equilibrium)}$$

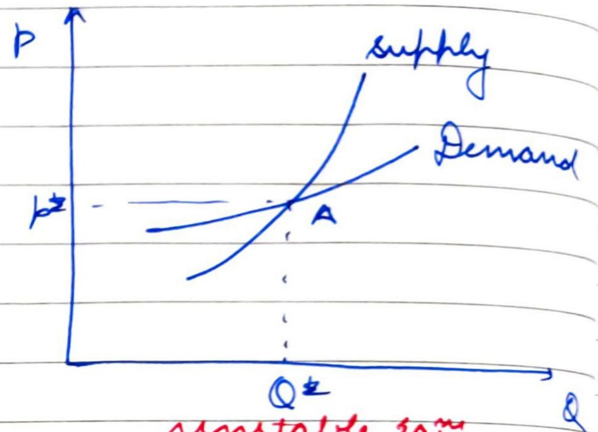
$$Q_D = a - b\left(\frac{a-c}{b+d}\right) \qquad Q_S = c + d\left(\frac{a-c}{b+d}\right)$$

$$Q_D = \frac{ab + ad - ab + bc}{b+d} = \frac{ad+bc}{b+d} \qquad Q_S = \frac{bc+ad}{b+d}$$

cobweb model

- consider situation with +vely sloped demand curve & +vely sloped supply curve





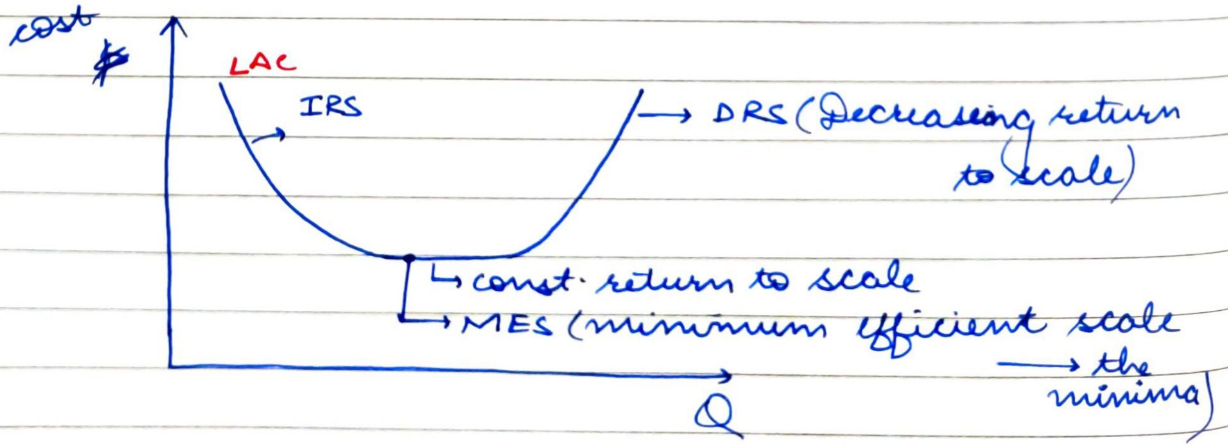
Stable Eq^m
Above A, Demand exceeds ∴ price increases & vice-versa

unstable Eq^m
Above A, demand is low ∴ price decrease must be seen ∴ unstable.

Pending topic

- $C = wL + rK$

$$AC = \frac{wL + rK}{Q} = K(wL + rK)$$



MARKET

- market is controlled by the sellers and their properties

- Perfect competition | monopolistic compⁿ | monopoly

Oligopoly (handful of sellers control the market)

Duopoly (2 sellers)

PERFECT COMPETITION

- PROPERTIES

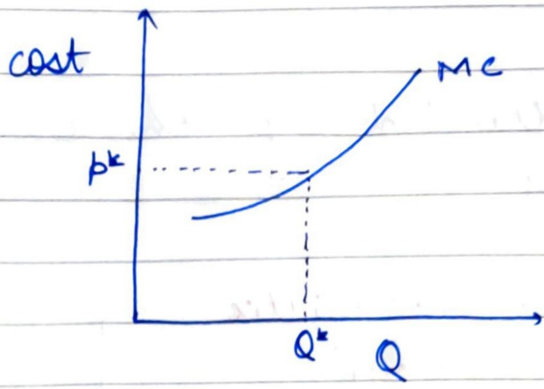
a) anyone can enter or exit the market as sellers freely
b) many sellers
c) perfect information
d) every seller is a price taker (ie no one controls the price)
e) homogenous product

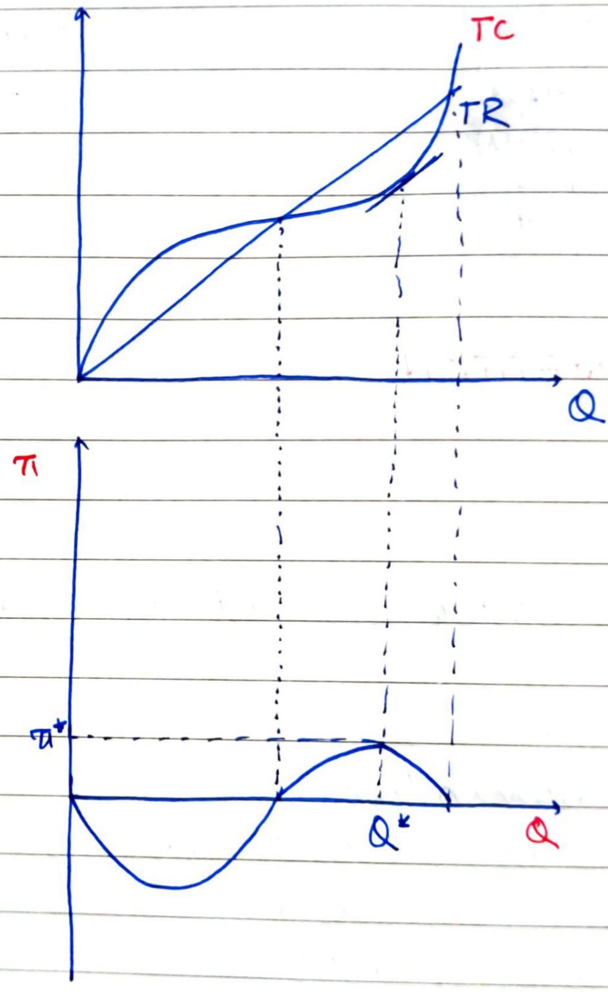
- The price is more or less fixed in such a case for a product. ∴ profit can be written as

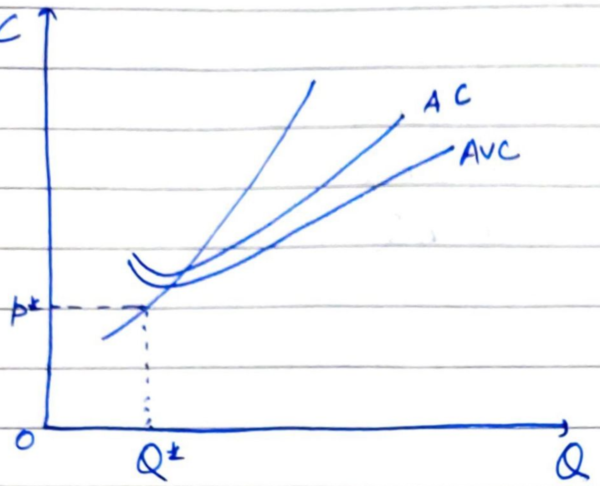
$$\pi = p^* Q - C(Q)$$

$$\therefore \frac{\partial \pi}{\partial Q} = p^* - C'(Q) = 0$$

$$\therefore \boxed{p^* = \frac{\partial C}{\partial Q} = MC}$$


cost
MC
p*
Q*
Q


TC
TR
Q
π
π*
Q*
Q



avg cost

$p > AC \Rightarrow \pi > 0$

$p < AC \Rightarrow \pi < 0$

$p = AC \Rightarrow \pi = 0$

→ MONOPOLY

• PROPERTIES

a) Exclusive Access to resources

b) Patents

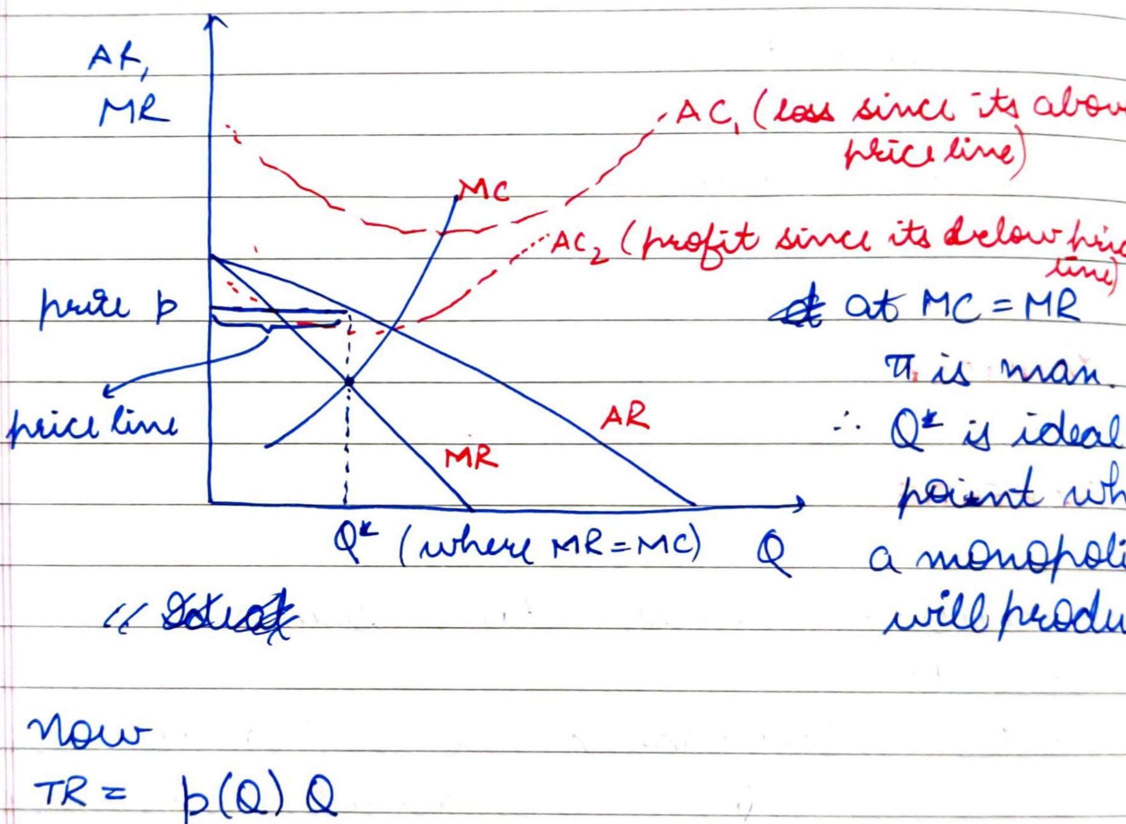
c) Cartel (Discouraging new entrants using methods like bringing down prices artificially even if it gives ~~to~~ you losses)

d) Economies of scale

- $p = a - bQ$

$$TR = pQ = aQ - bQ^2$$
$$MR = a - 2bQ$$
$$AR = a - bQ$$

$TC = C(Q)$
$MC = C'(Q)$



~~at~~ at MC = MR
π is max.
$\therefore$ Q^* is ideal point where a monopolist will produce

" ~~Sdirak~~

- now

$TR = p(Q)\,Q$

$$MR = \frac{d\,p(Q)}{dQ}\,Q + p(Q)\times 1$$

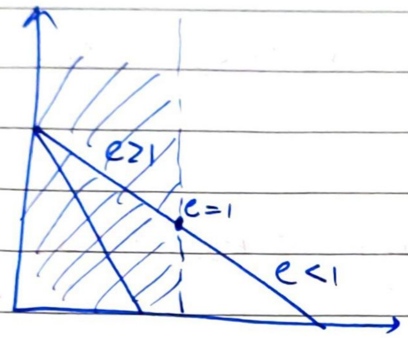
$$MR = p(Q)\left[\frac{dP}{dQ}\,\frac{Q}{P} + 1\right]$$

~~MR = (p(Q)~~

$$\boxed{MR = p(Q)\left[1 - \frac{1}{e}\right]} \quad -(i)$$

NOTE: Break even point: The point of productio where monopolist induces no loss/profit when AC intersects with price line on AR line.

- Above from (i) we can say that a monopolist will like to produce at $e > 1$



$\therefore MC = MR \rightarrow$ this point must be within shaded region

- PRICE DISCRIMINATION

a) First degree - For different ~~no. of~~ units, different prices are charged. Units are released one by one & whoever pays the highest product is sold

b) Second degree - Upto a certain quantity, there is one price after which price starts changing. eg - electricity bill

c) Third degree - Based on biasing among consumers. eg - metro tickets for old people.

- For discrimination consider we have 2 price f^ns $p_1(Q_1)$ & $p_2(Q_2)$

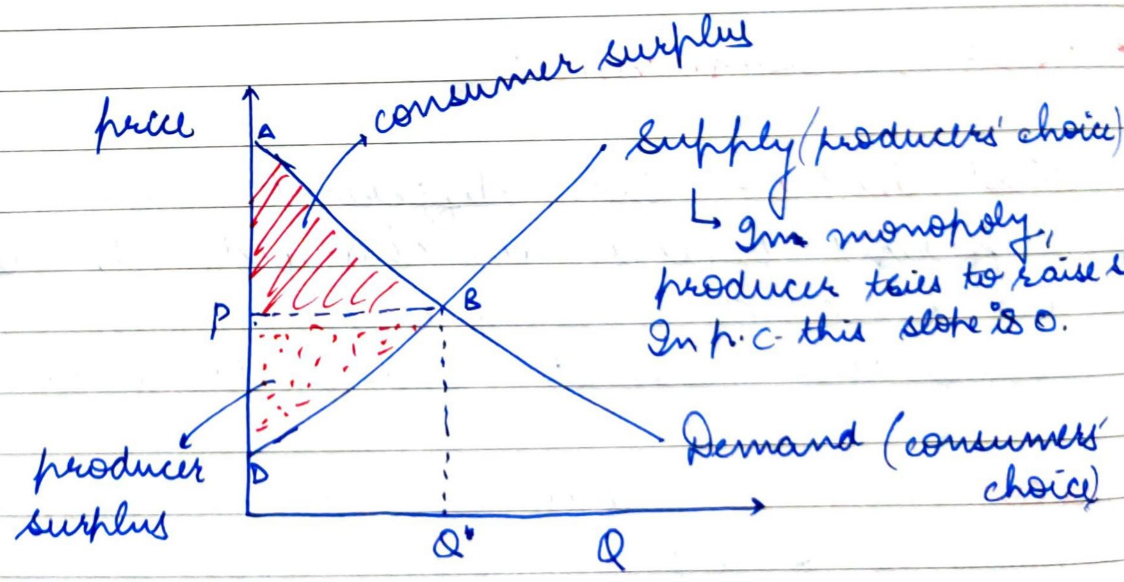
$p_1(Q_1)$ $\quad$ $p_2(Q_2)$ $\quad$ $C(Q_1+Q_2)$

$$\pi = p_1(Q_1)\,Q_1 + p_2(Q_2)\,Q_2 - C(Q_1+Q_2)$$

$$\frac{\partial \pi}{\partial Q_1} = MR_1 = MR_2 = MC$$

$$\Rightarrow p_1\left[1-\frac{1}{e_1}\right] = p_2\left[1-\frac{1}{e_2}\right] = MC$$

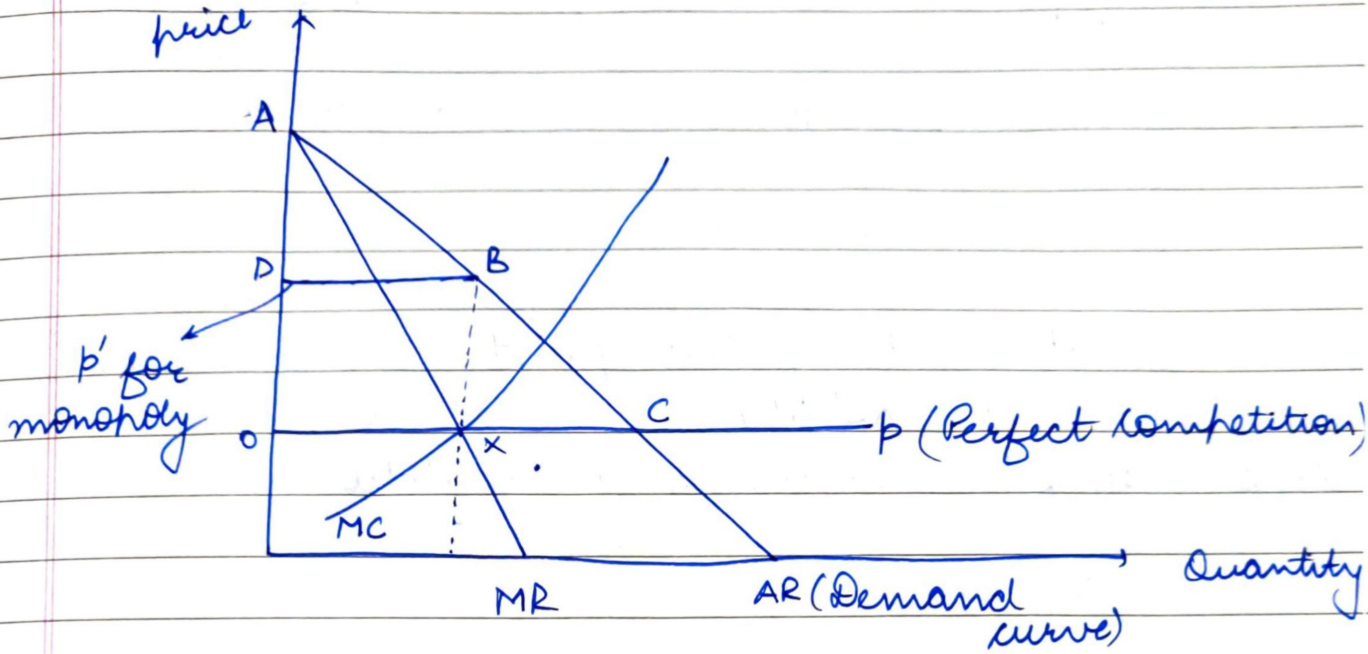
- why monopolistic environment is not beneficial



This is a general scenario.

~~...~~ now,

We'll incorporate 2 situations in below graph perfectly comp. and monopolistic



In perfect comp. consumer surplus was ΔXBC and in monopoly consumer surplus is ΔADB and DOXB becomes producer surplus.

∴ Net surplus in monopoly ADB + DOXB which is less than ΔAOC.

∴ If we see carefully, ΔXBC somehow vanishes from surplus.

- this ΔXBC is called deadweight loss to the economy

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Que: For a product x

$$C = 8x + 100$$

Demand f^ns for 2 groups

$$x_1 = 100 - 0.5p_1 \rightarrow \text{first group of consumers}$$

$$x_2 = 40 - p_2 \rightarrow \text{second group}$$

$$x_1 + x_2 = x$$

What are the prices paid by 2 groups?
& Find elasticity

Ans: Profit maximising condition

$$(MR_1 = MR_2 = MC)$$

$$p_1 = 200 - 2x_1$$

$$p_2 = 40 - x_2$$

Total revenue

$$p_1 x_1 = 200x_1 - 2x_1^2$$

$$p_2 x_2 = 40x_2 - x_2^2$$

$$MR_1 = \cancel{200} \frac{\partial TR_1}{\partial x_1} = 200 - 4x_1$$

$$MR_2 = 40 - 2x_2$$

$$MC = \frac{\partial c}{\partial x} = 8$$

$$8 = 40 - 2x_2$$

$$\Rightarrow x_2 = 16$$

&

$$200 - 4x_1 = 8$$

$$\Rightarrow x_1 = 48$$

$$\boxed{\begin{aligned} \therefore p_1 &= 104 \\ p_2 &= 24 \end{aligned}}$$

Now for elasticities

$$e_1 = \frac{\partial x_1}{\partial p_1} \frac{p_1}{x_1} = -0.5 \times \frac{104}{48} = -1.08$$

$$e_2 = \frac{\partial x_2}{\partial p_2} \frac{p_2}{x_2} = -1 \times \frac{24}{16} = -1.5$$

Que. $p = 100 - 3q + 4\sqrt{A}$

$C = 4q^2 + 10q + A$

A is advertising cost & q is quantity.

maximize profit.

Ans: $\pi = pq - C$

$$\pi = 100q - 3q^2 + 4\sqrt{A}q - 4q^2 - 10q - A$$

$$\Rightarrow \pi = 90q - 7q^2 + 4\sqrt{A}q - A$$

For maximizing, $f(x,y)$ we put $\frac{\partial f}{\partial x} = 0$ & $\frac{\partial f}{\partial y} = 0$ & solve

$$\frac{\partial \pi}{\partial q} = 90 - 14q + 4\sqrt{A} = 0$$

$$\Rightarrow 90 + 4\sqrt{A} = 14q$$

$$\frac{\partial \pi}{\partial A} = \frac{2q}{\sqrt{A}} - 1 = 0$$

$$\Rightarrow A = 4q^2$$

$$90 + 8q = 14q$$

$$\Rightarrow q = 15$$

<u>Find profit with values</u>

<u>Que</u> Long run cost f^n is given by for an individual firm

$$c_i = q^3 - 4q^2 + 8q \quad \rightarrow \text{for all firms}$$

There are n firms

$\therefore$ total product $= n * q$

Demand (total in market)

$$D = 2000 - 100p$$

Find p, q, n.

Ans: $D = n * q$

$\therefore \quad n \times q = 2000 - 100p$

when $p < AC$, ~~profit~~ producer is in loss. $\therefore$ for producer to produce, p should atleast be at AC.

$AC_i = \frac{C_i}{q}$

$\Rightarrow AC_i = q^2 - 4q + 8$

Now we find min of AC

$\frac{dAC_i}{dq} = 2q - 4 = 0$

$\Rightarrow \boxed{q = 2}$

$AC_{min} = 4 - 8 + 8 = 4$

$\therefore p \geq AC_{min}$ for producer to produce

but since we can see that its perfectly competitive,

$p = AC_{min}$

$\therefore \boxed{p = 4.}$

& $n * q = 2000 - 400 = 1600$

$\Rightarrow n = \frac{1600}{2} = 800$

Ques

MONOPOLISTIC COMPETITION

- monopolistic competition is a market structure in which there are many firms selling differentiated products. (ie products may have some difference but it is same type of product.
  eg- mobile phones — 2 different companies

- ~~There are~~

PROPERTIES

- There are few barriers to entry in market
- Some difference in same type of product
- Gives producers a chance to come up with quality products and ~~[illegible]~~ advertisements. eg- improving smartphone advertisements which entice etc.
- act independently & thinking.

NOTE:

OLIGOPOLY (Introduction)

- Oligopoly is a market in which there are a few interdependent firms

→ MONOPOLISTIC COMPETITION: CHARACTERISTICS

- Four distinguishing characteristics

a) Many sellers: There are many sellers which do not take into account rivals' reactions.

b) Product differentiation where the goods that are sold aren't homogeneous

c) Multiple dimensions of competition make it harder to analyze a specific industry, but these methods of competition follow the same two decision rules as price competition.

d) Ease of entry of new firms in the long run: because there are ~~no~~ significant barriers to entry.

→ OUTPUT, PRICE → from slides.

→ GRAPHS → from slides

→ DIFF. B/W MONOPOLY AND MONOPOLISTIC COMP → from slides

→ ADVERTISING → from slides

OLIGOPOLY

- A market structure in which a small number of firms has a large majority of market share is called oligopoly.

- It is similar to a monopoly, except that rather than 1 firm, small no. of firms control the market.

- There is no exact upper limit to the number of firms in an oligopoly.

- But the number of firms are low enough that the actions of one firm significantly impact and influence the others.

- In oligopoly, the previous point is different from monopolistic competition because ~~it~~ in that case firms worry about product quality & make decisions independently. But that is not the case in oligopoly.

- Examples →

a) Google, Microsoft and Apple

b) Pepsi and coca-cola

c) Auto industry

- Products can either be homogenous ~~or~~ or differentiated products

- Interdependence in terms of policies exist.

- Substantial barriers to entry. eg- new softwares need to be different from existing ones & may have very low demand if launched.

- Another example is British Airways and Air France.

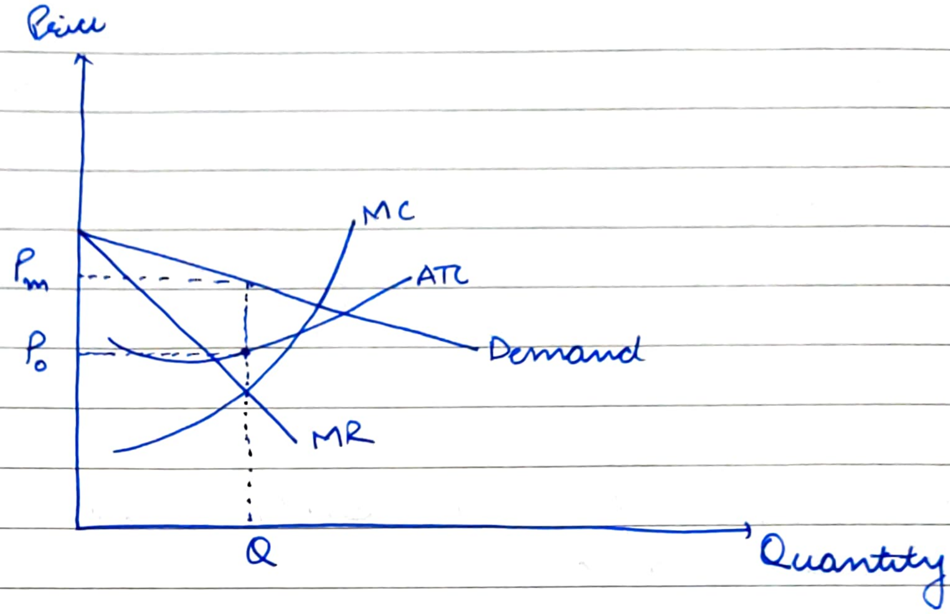
→ COLLUSION AND COMPETITION

- Collusion is when 2 or more firms decide to fix price of a similar product ~~to~~ (eg- a burger) to create a monopolistic situation and ~~to~~ generate positive profit or to prevent entry of other firms.

- Collusion is ~~of~~ illegal, i.e. it can't be drafted as a legal agreement.

- Competition is when firms enter competition and lower prices and come to a point of zero profit.

→ PRICE DETERMINATION FOR OLIGOPOLY



P_m – monopolistic price

P_o – price of zero profit

- In oligopolistic environment, in case of collusion, firms can easily charge at P_m ie monopolistic price.

- In case of competition, oligopolistic firms charge P_o and earn no profit as such.

- Failure of Collusions: Collusions are easy to fail, when firms cheat on each other and slightly cut their prices down to earn more secretly. Collusions are less likely to succeed when,

– secret price or cost cuts are difficult and costly to detect. (Quality changes are difficult to monitor) (lowering of quality is undetectable to both the customers and other firms.)

- market conditions are unstable. (Differences in expectations make it difficult to reach an agreement)
- vigorous anti-trust actions increase the cost of collusion.

- In cases of failure of collusions price may be b/w P_0 and P_m

NOTE: Some oligopolistic markets operate in a situation of price leadership.
A single firm sets industry price and the remaining firms charge the same price as the leader.

→ SWEEZY'S KINKED DEMAND CURVE MODEL OF OLIGOPOLY

- Assumptions:

1. If a firm raises prices, other firms won't follow and the firm loses a lot of business.

2. If a firm lowers prices, other firms follow and the firm doesn't gain much business.

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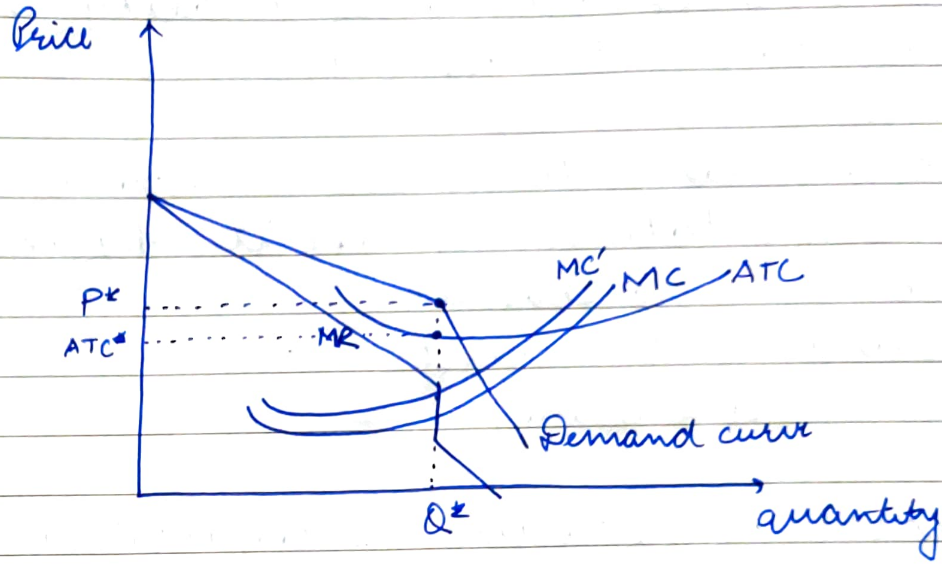

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- If cost (MC) shifts up slightly even then, MC & MR intersect at same quantity. ∴ the price remains same. The reason for this rigidity is that producers are very concerned about the price at which they sell the product since any changes in price may prove heavy to revenue.

- This rigidity of price creates a discontinuity in demand curve

NOTE: Oligopolistic markets show this Sweezy's model, for eg, in case of separate geographic locations of market. The prices in this case are of monopolistic form ie at P*

→ PROFIT POSSIBILITIES FOR OLIGOPOLY

- short run: profit, losses or even breaking even
- long run: profit or breaking even.

→ FOUR FIRM CONCENTRATION RATIO

- It is the sum of % market share of top 4 firms in the market
- read in detail from slides.

→ HERFINDAHL INDEX (H)

- It measures the extent to which a market is dominated by a few firms.
- It is calculated as sum of square of % shares of all firms in the market
- $$H = s_1^2 + s_2^2 + \ldots\ldots + s_n^2$$
- H can be close to 0 in case of many, small firms.

- Justice Department guidelines (US)
- A market is considered concentrated if $H \geq 1800$
- A market is considered unconcentrated if $H < 1000$

* read about concentrated & unconcentrated markets in slides
* read about Horizontal, Vertical and conglomerate merger from slides.

Chapter - 3.
Market Failure

→ DEFINITION

- market failure: is when a market left to itself does not allocate resources efficiently (labour & capital)

or

The condition where the allocation of goods and services by a market is not efficient is called market failure.

→ 4 SORTS OF MARKET FAILURE

a) The abuse of market power, which can occur whenever a single buyer or seller can exert significant influence over prices or output (see monopoly and monopsony)

b) Externalities: when the market does not take into account the impact of an economic activity on outsiders. For example, the market may ignore the costs imposed on outsiders by a firm polluting the environment.

c) Public goods: such as national defence. How much defence would be provided if it were left to the market.
Public goods are non-rivalrous (in consumption) and nonexcludable (its usage is not limited to private entity)

d) where there is incomplete or asymmetric information or uncertainty

→ MARKET DISEQUILIBRIUM DUE TO SURPLUS →

• read from slides & look at graph too

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* → FACTOR MARKETS

→ FACTORS OF PRODUCTION

a) Used to produce output

→ FACTOR MARKET

- A market for a factor of production
- A factor market facilitates the purchase and sale of services of factors of production
- eg- The market for construction workers brings together buyers and sellers of construction workers' services.

NOTE: Derived demand: The demand for an input is derived from demand in output which the input helps to prepare.

NOTE: A firm might be a perfect competitor in the product market and might not be a perfect competitor in the factor market, or vice versa.

PTO

- Four possibilities for factor markets

	Product market	Factor market
a)	Perfectly competitive	not PC
b)	PC	PC
c)	not PC	PC
d)	not PC	not PC

eg- The local water company is the only company in the area & is one of the companies hiring accountants.
In this eg, product market is not PC and factor market is PC.

eg- a small mill town is owned by a textile company. The company is the only employer in town.
In this eg, textile market may be PC but labour market is not PC

→ PRICE TAKING IN FACTOR MARKET →

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Questions

1 Que: Suppose that a typical firm in a monopolistically competitive industry faces a demand curve given by $q = 60 - (1/2)p$, where q is ~~cost~~ quantity sold per week. The firm's MC curve is given by $MC = 60$.

a) ~~How~~ How much will it produce in short run?
b) What price will it charge.

Ans:

a) $q = 60 - p/2$

$\Rightarrow 120 - 2q = p$

$\Rightarrow R = p \times q = 120q - 2q^2$

$MR = \frac{\partial R}{\partial q} = 120 - 4q$

$MR = MC$ for profit max

$\Rightarrow 120 - 4q = 60$

$\Rightarrow q = 15$

b) $p = 120 - 2q$

$\Rightarrow p = 120 - 30$

$\Rightarrow p = 90$

NOTE: Calculate MPP, MRC, MRP per day