Elasticity of supply

$$e_s = \frac{\text{\% change in qty suppy}}{\text{\% change in price of commodity}}$$

$$= \frac{dQ_s}{dP_s} \cdot \frac{P_s}{Q_s}$$

Production

→ Process of converting inputs to outputs, with value addition (Pen making example, Plastic → Pen)

Production
- Long - Run (All are variables)
- Short - Run (certain variables are fixed and certain are variables)

Anything that goes in process of making is input, anything that comes out is output.

Short - Run → 1 acre of land (fixed), can't be changed → Rice
↳ output may be diff

1 Men → Pen → 1 Pen
10 Men → Pen → 10 Pen

Casual Labour is a variable in this case

No. of machines const.

In long run, everything is a variable

Page

Short - Run

$$\underset{\substack{\uparrow \\ \text{Production}}}{Q} = f(\underset{\text{labour}}{L}, \underset{\text{capital}}{\bar{K}}) \leftarrow \text{fixed inputs} \leftarrow \text{Short - Run}$$

long - Run → $Q = f(L, K)$

Assumptions :

① In short run, capital remains inelastic irrespective of output

② There is no change in input price is given.

③ In long run, L can substitute k and vice - versa.

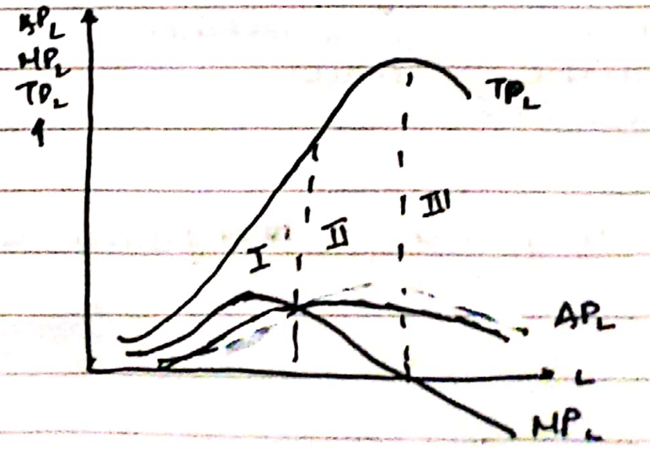
Consider in short-run,

$$Q = -L^3 + 15L^2 + 10L$$

Total Product w.r.t labour → Avg. pdt w.r.t labour → Marginal pdt.

L	$TP_L = Q$	$AP_L = Q/L$	$MP_L = \frac{dTP}{dL} = \frac{dQ}{dL}$
1	---→	---→	---→
2	---→	---→	---→
3	---→	---→	---→
4	---→	---→	---→

law of diminishing marginal return



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In short run, when more and more unit of a variable input is added to a certain amount of fixed input, the output will increase at a constant rate, the remain const. and then decreases.

In stage I : MP_L reaches max., it ends when $MP_L = AP_L$, AP_L is max at the end of stage-1

In stage II : Both MP_L and AP_L are ~~both~~ decreasing, but rate of decrease of MP_L is more. Stage 2 ends with MP_L reaching zero, TP_L is max

In stage III : Everythig is dec. No one wants produce at this stage

Reality - until we reach stage-2, we don't know that we were in stage-1

∴ The production is max (stopped) at the start of stage-2

$$AP_L = -L^2 + 15L + 10$$

$$\frac{dAP_L}{dL} = 0 \quad (\text{At max})$$

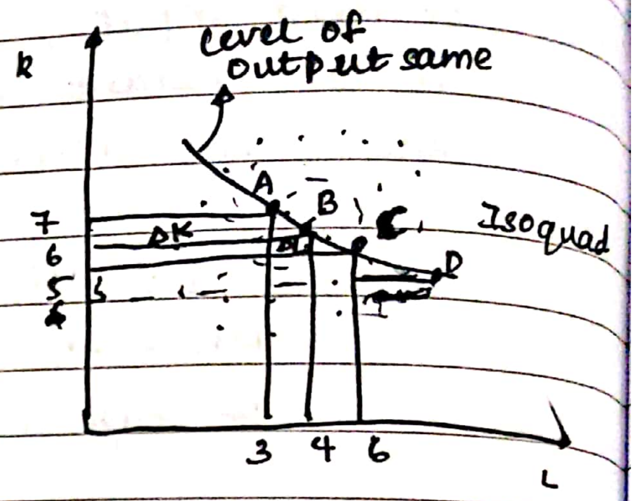
$$-2L + 15 = 0$$

$$L = 7.5$$ Stop production here. (Avg. pdt is max)

Don't worry about this being a float

Long Run,

$Q = f(L, K)$



Each input has (A, B, C) has diff marginal productivity

labour intensive : C > A

labour can substitute capital and vice-versa, upto a certain extent; in a decreasing manner

Isoquad - Equal product curve
↳ Locus of points of two input, producing same output.

① Negatively sloped
② Convex
③ Two isoquads dont intersect
④ Higher isoquad, higher output

On moving from A → B, $-\Delta K \cdot MP_K$ ← loss of output

Gain will be $\Delta L \cdot MP_L$

Since it's isoquad,

$$-\Delta K \, MP_K = \Delta L \, MP_L$$

$$MRT_S = -\frac{\Delta K}{\Delta L} = \frac{MP_L}{MP_K}$$

↓

Marginal Rate of Tech Substitution (Rate at which 1 input is substituted by the other)

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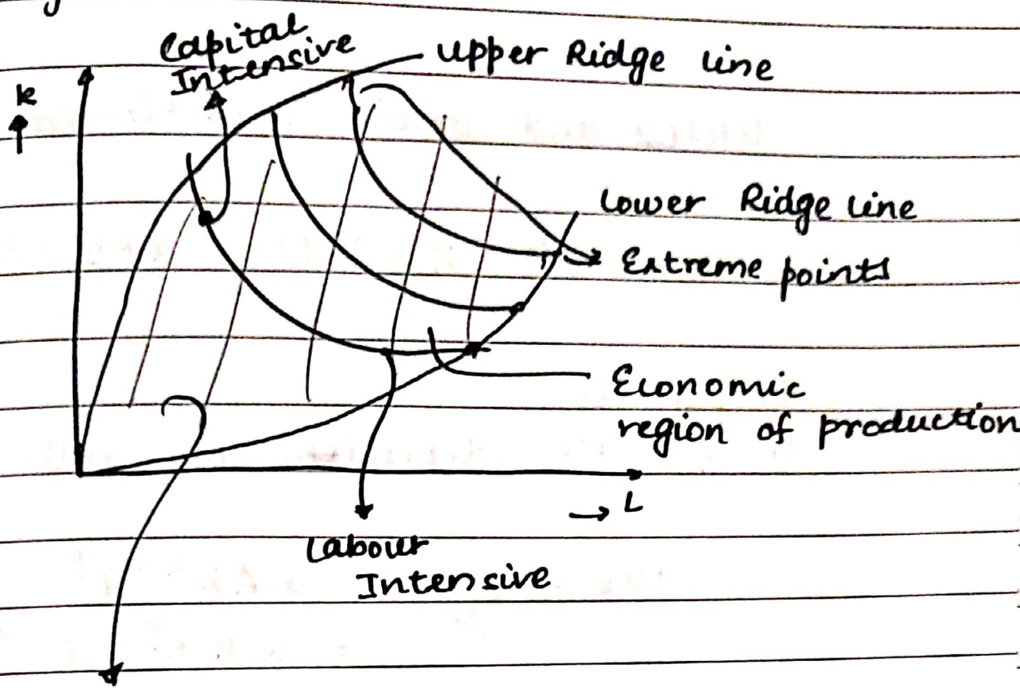
As we move further (after 0), we will no longer be intrested substitute, as for a small change in k, we need large change in L.



Laws of Returns to scale

$Q = \{$

k	L	
1	5	↓ Increasing by 100%
2	10	
4	20	

Cobb Douglas Production fn:

$Q = A k^{\alpha} L^{\beta} \ldots$

$k = xk$, $L = xL$, $Q = yQ$

$Q = A(xk)^{\alpha}(xL)^{\beta} \Rightarrow yQ = A(k)^{\alpha} L^{\beta} x^{\alpha+\beta}$

If, $\alpha+\beta > 1$, $y > x$ output increases by more than x

If $\alpha+\beta=1$, $x=y$ output increases same as x

If $\alpha+\beta<1$, $x<y$ output decreases by x

Unless and until mentioned,

$$Q = A\,k^{\alpha}\,L^{\beta} \qquad \alpha+\beta = 1$$

Properities

① AP, MP dependens on both the inputs

$$MP_k = \frac{dQ}{dk} = \alpha A k^{\alpha-1} L^{\beta}$$
$$= \alpha A k^{\alpha-1} L^{1-\alpha}$$

$$MP_k = \alpha A \left(\frac{k}{L}\right)^{\alpha-1}$$

$$MP_L = \beta A \left(\frac{k}{L}\right)^{1-\beta}$$

② ~~So~~ Generally in industries there is lot of diff b/w k, L, thus we represent in natural log, to avoid error.

$$\ln Q = \ln A + \alpha \ln k + \beta \ln L$$

③ It is homogeneous, degree of homogenity depends on $\alpha+\beta$

④ α = Elasicity of output w.r.t k

$$= \frac{dQ}{dk} \cdot \frac{k}{Q}$$

β = Elasicity of output w.r.t L

$\alpha, \beta \rightarrow$ Distributive share in the output.

Cost
- Fixed
- variable

① Actual cost - whatever we are entering the business with

② Oppurtunity cost - It's not actually a cost. It's the return from next best alternative.

Business Cost, Full cost
- Business Cost: whatever we entering the business with
- Full cost: Includes OC, min. margin we expect to remain in business, BC

Implicit cost, Explicit cost
- Implicit cost: Manager
- Explicit cost: Cost appearing in books of account

Consider you are the owner of a firm, you invest (sacrifice) 20k for the running of the firm, this 20k isn't represent in the books of account, thus it's an implicit cost.

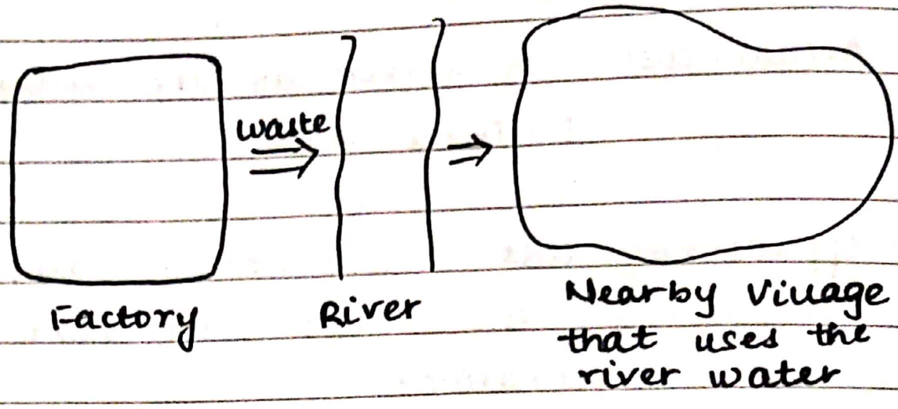
Fixed inputs (Machine) $\longrightarrow$ Fixed cost

variable inputs (Labour) $\longrightarrow$ variable cost

Total cost = TFC + TVC

Private Cost v/s Social Cost ← Private cost + External cost (paid by whole society)

L whatever cost we are entering in a production is private cost



Now, this village gets affected by the polluted river water and spends money in healthcare, government invests money in cleaning of this river (external cost)

$$SC = PC + EC$$

Short Run Cost;

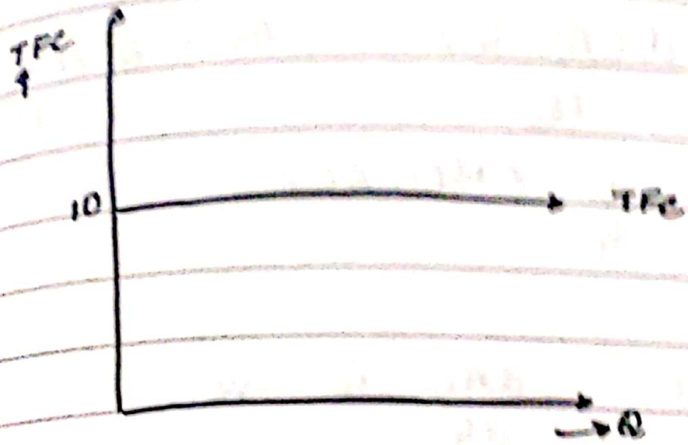
$$TC = \underbrace{10}_{TFC} + \underbrace{6Q - 0.9Q^2 + 0.05Q^3}_{TVC}$$

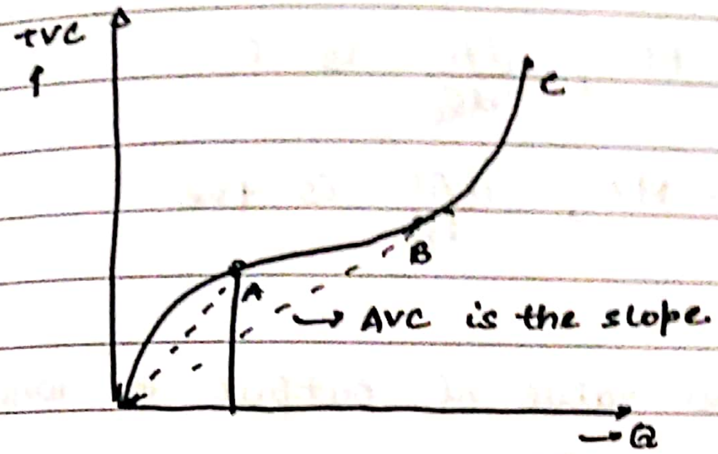
$$TFC = TC|_{Q=0}$$

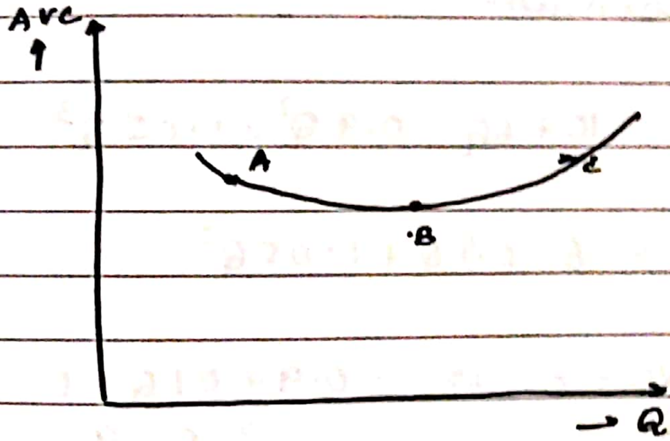
$$\text{Avg cost} = \frac{TC}{Q}$$

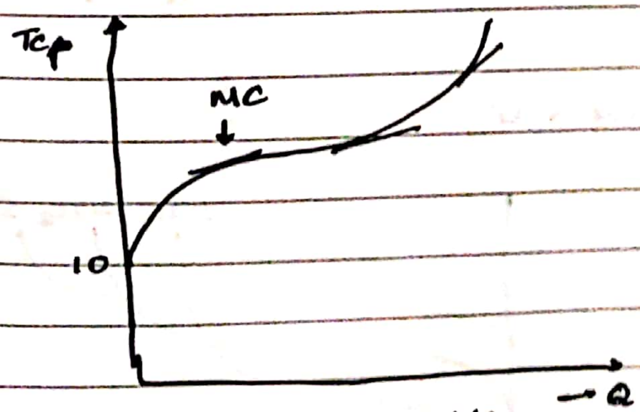
$$AFC = \frac{TFC}{Q} \qquad AVC = \frac{TVC}{Q}$$

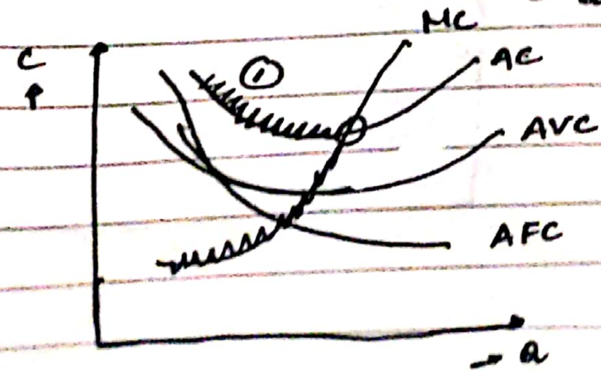
$$MC = \frac{dTC}{dQ}$$


TFC
10
TFC
Q


TVC
C
B
A
AVC is the slope.
Q


AVC
A
C
B
Q


TC
MC
10
Q


C
MC
AC
1
AVC
AFC
Q

$$MC = \frac{d(AC \cdot Q)}{dQ} = AC + Q\frac{dAC}{dQ}$$

$$\frac{dAC}{dQ} = \frac{1}{Q}(MC - AC)$$

① $AC > MC$, $\frac{dAc}{dQ}$ is $-ve$

② $AC = MC$, $\frac{dAC}{dQ}$ is 0

③ $AC < MC$, $\frac{dAC}{dQ}$ is $+ve$

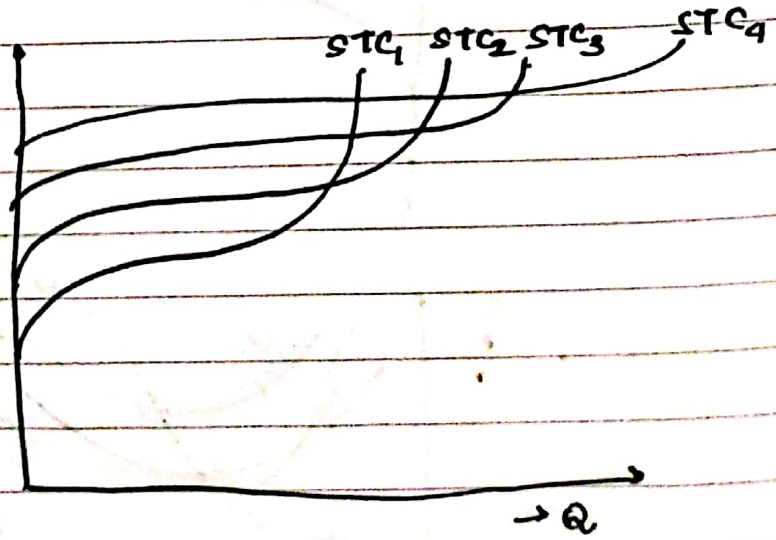
critical value of output is where AVC is minimum

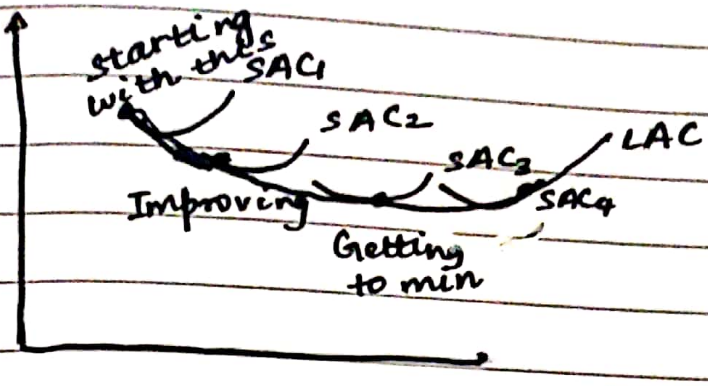
$$TC = 10 + 6Q - 0.9Q^2 + 0.05Q^3$$

$$AVC = 6 - 0.9Q + 0.05Q^2$$

$$\frac{dAVC}{dQ} = 0 \Rightarrow -0.9 + 0.1Q = 0$$
$$\Rightarrow Q = 9$$

In long run,





SAC always lies above LAC