LECTURE 5

06 Feb 15

DW – Durbin-Watson ∴ for serial correlation

$DW > d_u$ NO EVIDENCE of SERIAL CORRELATION

if DW is between d_L and d_u the test is indeterminate

$DW < d_L$ EVIDENCE of SERIAL CORRELATION

→ on midterm, will provide table and we will have to determine if correlation or not.

ex. Assume $DW = 1.90$

N = # of observations = 28

k = # of explanatory variables excluding the constant term (ON OUR TABLE)

from table $D_L = 1.1$, $D_u = 1.75$

∴ $1.9 > D_u$ ∴ NO EVIDENCE!

TOTAL COST = TC = TFC + TVC

AVG FIXED COST = $AFC = \frac{TFC}{Q}$

AVG VARIABLE COST = $AVC = \frac{TVC}{Q}$

AVG TOTAL COST = $ATC = \frac{TC}{Q} = AFC + AVC$

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

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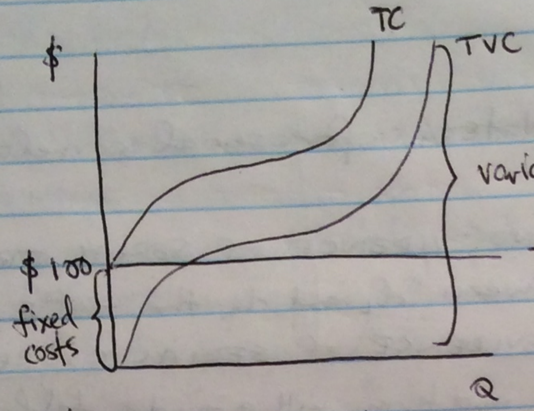
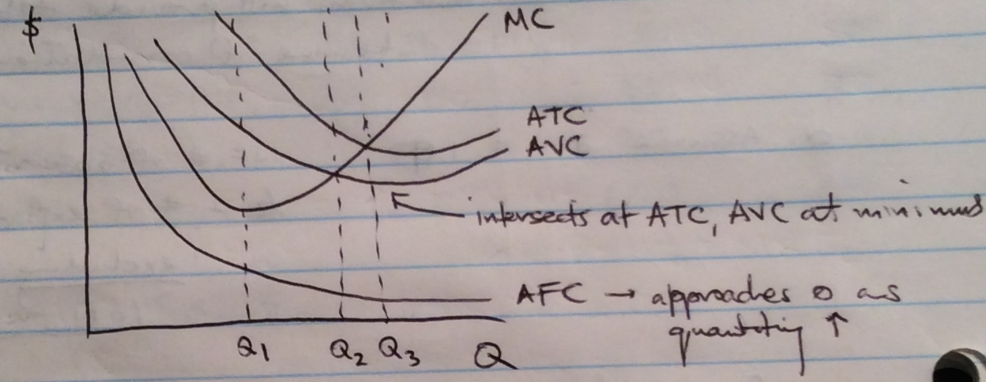
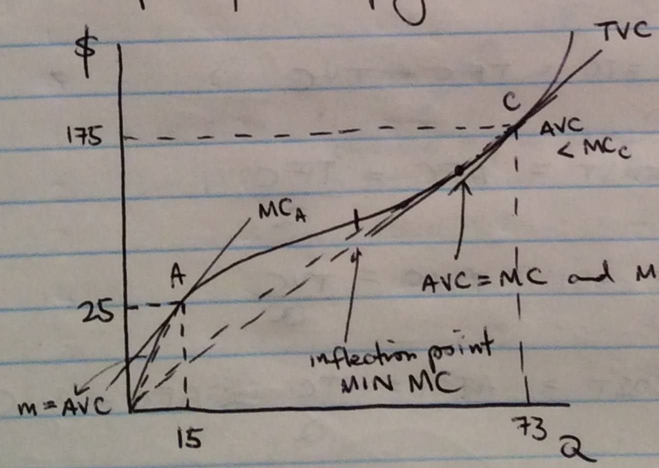




from example (previous page)



AVC = 175/73 = 2.40

MC = 25

$AVC > MC_A$

AVC = the slope of the line joining the point and the origin

MC = slope of the tangent at the point

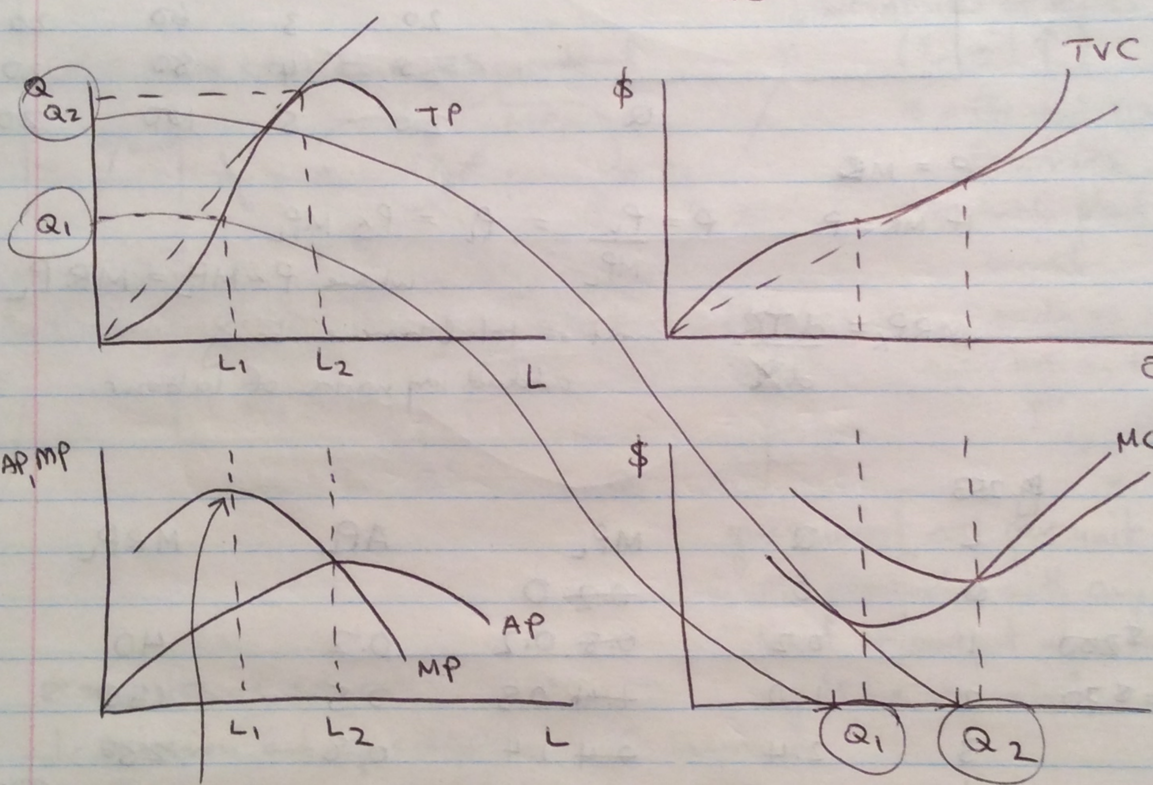
Relationship between price and cost curve

average product

$$AVC = \frac{TVC}{Q} = \frac{P_L \times L}{Q} = \frac{P_L}{\frac{Q}{L}} = \frac{P_L}{AP}$$

marginal product

$$MC = \frac{\Delta TVC}{\Delta Q} = \frac{P_L \times \Delta L}{\Delta Q} = \frac{P_L}{\frac{\Delta Q}{\Delta L}} = \frac{P_L}{MP}$$



LAW of DIMINISHING RETURNS

when AP is max, AVC is minimum

→ as the amount of one input is increased, other inputs held constant, a point is reached where the increase in total product gets smaller

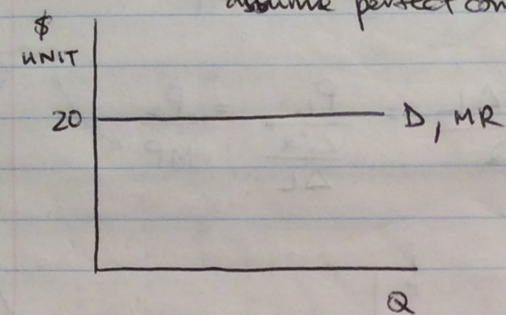
i.e. MP starts to decline

$\pi = TR - TC$ TO MAXIMIZE PROFIT

$MR = MC$

assume perfect competition → have to assume market price

perfect elasticity



P	Q	TR	$MR = \frac{\Delta TR}{\Delta Q}$
20	1	20	20
20	2	40	20
20	3	60	20
20	4	80	20
20	5	100	20

$P = MR$

if $MR = P$ $\quad P = \frac{P_L}{MP_L} = P_L = P \times MP_L$

where $P \times MP_L = MRP_L$

$MRP_X = \frac{dTR}{dX}$ amount of total revenue being added by units of labour.

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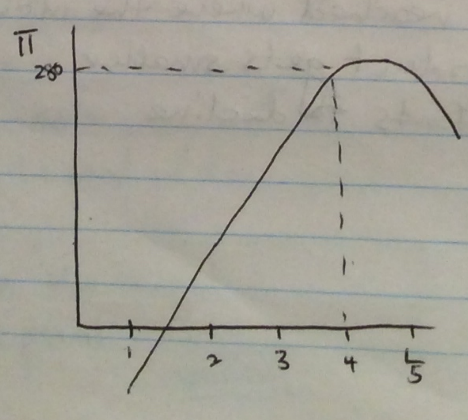
if $P = \$200$

$P_L = \$70$

L	Q	MP_L	AP_L	MRP_L	π
0	0	~~0.2~~ 0			
1	0.2	~~0.8~~ 0.2	0.2	40	-30
2	1.0	~~1.4~~ 0.8	0.5	160	60
3	2.4	~~2.4~~ 1.4	0.8	280	270
4	2.8	~~0.2~~ 0.4	0.7	80	280
5	3.0	0.2	0.6	40	250
6	2.7	-0.3	0.45	-60	120

employ 4 CPAs



CPAs are only contributing $100

(net MRP)

$NMRP_L$

20

80

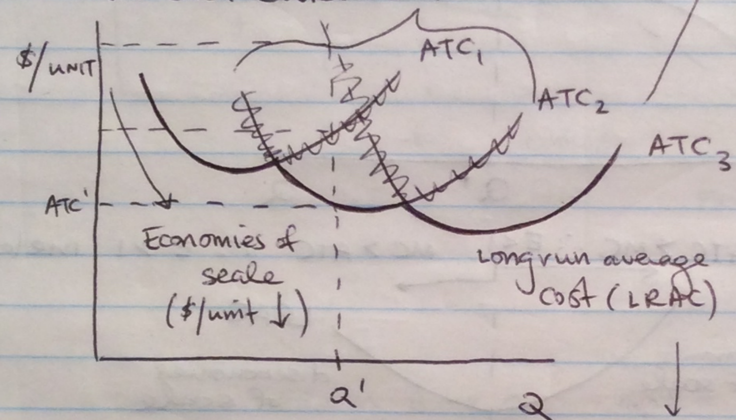
140 ← ∴ 3 CPAs hired

40

20

-30

LONG RUN COST CURVES irrelevant



Diseconomies of scale ($/unit ↑)

3 different sized factories

→ which plant to build

→ depends on demand ∴ how much Q you will produce (e.g. Q')

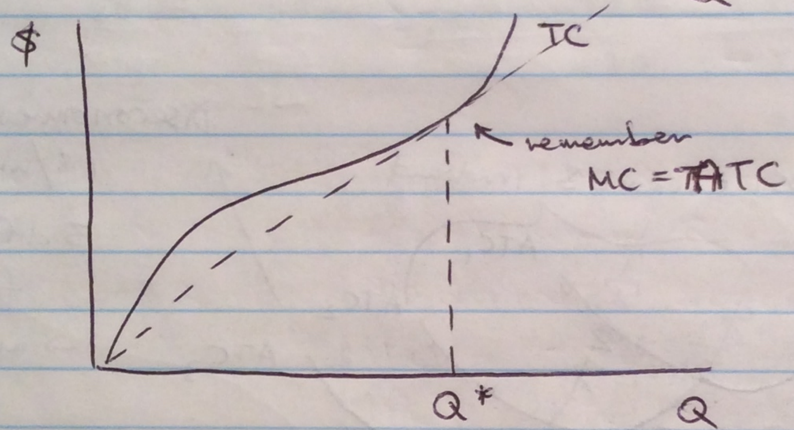
gives lowest cost per unit i.e. ATC associated with any given level of output when all inputs are variable

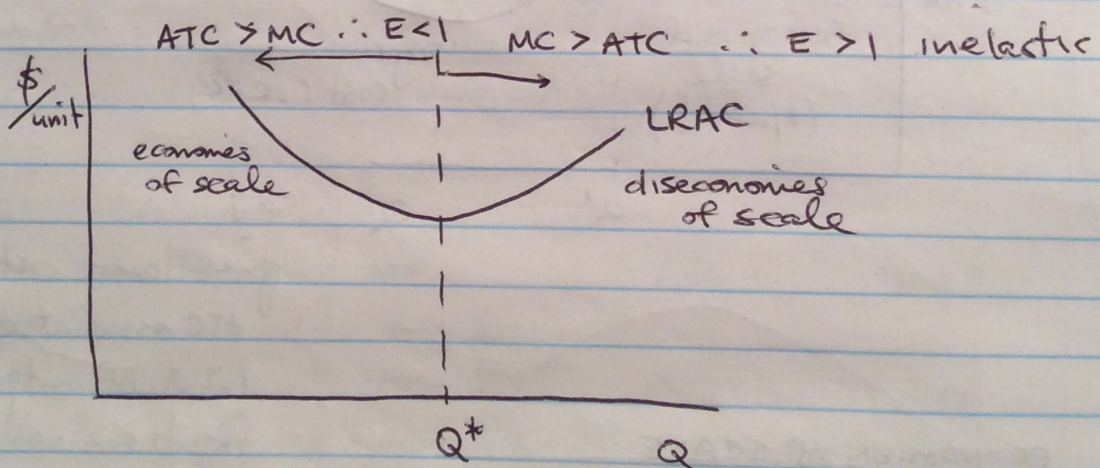
ECONOMIES of SCALE

1. Division and specialization of labour
2. There is a quantitative as well as qualitative change in capital
3. The cost of purchasing and servicing larger pieces of equipment is proportionally less
4. Quantity Discounts

Cost elasticity

$$E_c = \frac{\Delta TC}{\Delta Q} \times \frac{Q}{TC} = \frac{\frac{\Delta TC}{\Delta Q}}{\frac{TC}{Q}}$$





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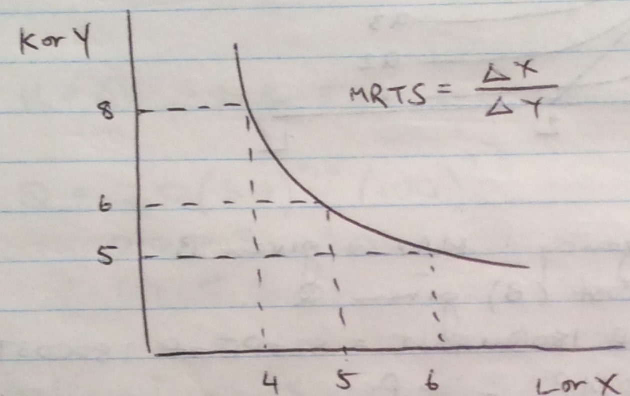
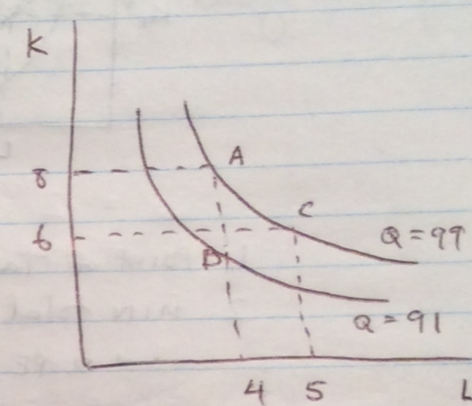
LECTURE 6

ISOQUANT – Locus of the different combinations of two inputs that would produce the same output





FROM A → B $\Delta Q = -8$

$= \Delta K \times MP_K$

$\Delta K \times MP_K = \cancel{\Delta K} \times \frac{\Delta Q}{\cancel{\Delta K}}$

FROM B → C $\Delta Q = \Delta L \times MP_L = 8$

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

slope isoquant is equal to ratio between marginal products $\frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K}$

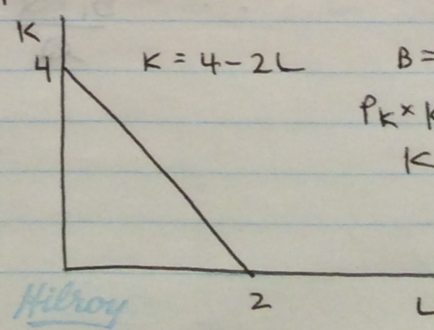
ISO COST – Locus of different combinations of two inputs whose expenditure is the same

budget; same as total cost

$B = \$1,000$

$P_K = 250$

$P_L = 500$



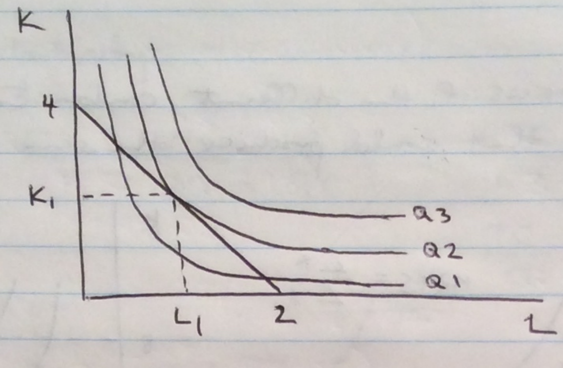
$K = 4 - 2L$

$B = P_K \times K + P_L \times L$

$P_K \times K = B - P_L \times L$

$K = \frac{B}{P_K} - \frac{P_L}{P_K} L$

$= 4 - \frac{500}{250} L$



1. Point of Tangency : MAX Q given B
2. MIN total cost (B) given Q

→ SLOPE of ISOQUANT = SLOPE of ISOCOST

$$-\frac{MP_L}{MP_K} = \frac{-P_L}{P_K}$$

$$\frac{MP_L}{P_L} = \frac{MP_K}{P_K}$$

COBB-DOUGLAS PRODUCTION FUNCTION $Q = b_0 K^{b_1} L^{b_2}$

homogeneous production function ↓ multiply function by a constant and then factor constant out.

$$Q = b_0 (aK^{b_1})(aL^{b_2})$$
$$= a^{b_1+b_2} b_0 K^{b_1} L^{b_2}$$

$b_1 + b_2 > 1$ increasing returns
$b_1 + b_2 < 1$ decreasing returns
$b_1 + b_2 = 1$ constant returns

$$E_K = \frac{\%\Delta Q}{\%\Delta K} = \frac{\Delta Q}{\Delta K} \times \frac{K}{Q}$$
$$= b_1 \left(b_0 K^{b_1 - 1} L^{b_2} \frac{K}{Q}\right)$$

K^{b_1}

$$\therefore = \frac{b_1 \cancel{Q}}{\cancel{Q}} = b_1 \quad \therefore b_1 = \text{elasticity of capital}$$

0.8% change in output for every 1% change in labour

if you double inputs will more than double output

$Q = 20K^{0.5}L^{0.8}$ (increasing returns)

so for 5% change in labour, $5\% \times 0.8 = 4\%$ change in output

$K = 64,\ L = 100$

$Q = 20(64)^{0.5}(100)^{0.8}$
$\quad 20 \times 8 \quad \times 39.8$
$= 6369.7$

double all inputs $\therefore K = 128,\ L = 200$

$Q = a^{b_1+b_2}\, b_0 K^{b_1} L^{b_2}$
$= 2^{(1.3)}(6369.7)$ OR $20(128)^{0.5}(200)^{0.8} = 15{,}684.0$
$= 15{,}684.0$

if $P_K = 500$ & $P_L = 100$
find optimal $\frac{K}{L}$

$\frac{MP_L}{MP_K} \longrightarrow MP_L = \frac{\Delta Q}{\Delta L}$ partial derivative $\qquad \frac{MP_L}{MP_K} = \frac{P_L}{P_K}$

$\frac{MP_L}{MP_K} = \frac{16K^{0.5}L^{-0.2}}{10K^{-0.5}L^{0.8}} = \frac{100}{500} \qquad = \frac{100}{500}$

$= \frac{16K}{10L} = \frac{1}{5} = \frac{1}{8} = \frac{K}{L}$

EXAMPLE 2 (Decreasing Returns)

$$Q = 5K^{0.5}L^{0.3}$$ where $K = 100$, $L = 100$

$= 5(10)(3.98)$ $Q = ?$

$= 199.05$

double all inputs $K = 200$, $L = 200$ $Q = ?$

$$Q = 2^{0.8}(199.05)$$

$= 346.57$

$P_K = 500$, $P_L = 100$ $\frac{K}{L} = ?$

$$\frac{MP_L}{MP_K} = \frac{1.5K^{0.5}L^{-0.7}}{2.5K^{-0.5}L^{0.3}}$$

$$= \frac{1.5K}{2.5L} = \frac{100}{500}$$

$$\frac{K}{L} = \frac{250}{750} = \frac{1}{3}$$

responsible for definitions 1-24

EXAMPLE 3 (CONSTANT RETURNS)

$Q = 15K^{0.8}L^{0.2}$ $\quad K = 50, \; L = 100$

$= 15(50^{0.8})(100^{0.2})$ $\quad Q = ?$

$= 861.52$

DOUBLE all INPUTS $\quad Q = ?$

$Q = 2^1(861.52)$ or $Q = 15(100^{0.8})(200^{0.2})$

$= 1723.05$ $\quad = 1723.05$

$P_K = 600, \; P_L = 200$ $\quad \frac{K}{L} = ?$

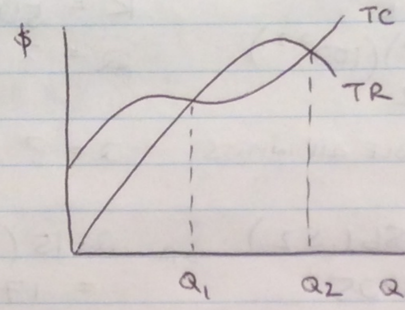
$$\frac{MP_L}{MP_K} = \frac{3K^{0.8}L^{-0.8}}{12K^{-0.2}L^{0.2}} = \frac{P_L}{P_K}$$

$$= \frac{3K}{12L} = \frac{200}{600}$$

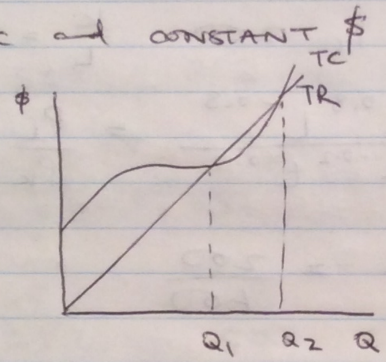
$$\frac{K}{L} = \frac{2400}{1800} \quad \frac{4}{3}$$

COST-VOLUME-PROFIT ANALYSIS or BREAKEVEN ANALYSIS

1. CUBIC TC and DOWNWARD SLOPING D



2. CUBIC TC and CONSTANT $

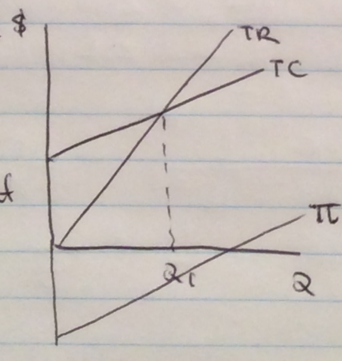


3. PRICE and AVC ARE CONSTANT

TWO UNDERLYING ASSUMPTIONS:

PROBLEMS

1. price is constant
2. AVC is constant
   → implies constant AP



$$AVC = \frac{P_L}{AP}$$

$$TR = TC = TVC + TFC$$

$$P \times Q = AVC \times Q + TFC$$

$$P \times Q - AVC \times Q = TFC$$

$$(P - AVC)\,Q = TFC$$

$$Q = \frac{TFC}{P - AVC}$$

BREAKEVEN FORMULA

$$\pi = TR - TC$$
$$= P \times Q - AVC \times Q - TFC$$
$$= (P - AVC)Q - TFC$$

$$\Delta\pi = (P - AVC)\Delta Q$$

(DOL) DEGREE OF OPERATING LEVERAGE

% change in profit that results from 1% change in units sold.

$$DOL = \frac{\% \Delta\pi}{\% \Delta Q} = \frac{\Delta\pi}{\Delta Q} \times \frac{Q}{\pi}$$

slope of π function

$$= \frac{(P - AVC)\cancel{\Delta Q}}{\cancel{\Delta Q}} \times \frac{Q}{\pi}$$

$$= \frac{P - AVC \times Q}{\pi} = \frac{\pi + TFC}{\pi}$$

EXAMPLE A

DOL @ 100,000 π

A. $Q = \frac{TFC}{P - AVC} = \frac{20,000}{2 - 1.5} = \frac{20,000}{0.5} = 40,000$

$DOL = \frac{\pi + TFC}{\pi} = \frac{100,000 + 20,000}{100,000} = 1.2$

B. $Q = \frac{TFC}{P - AVC} = \frac{40,000}{2 - 1.2} = \frac{40,000}{0.8} = 50,000$

$DOL = \frac{\pi + TFC}{\pi} = \frac{100,000 + 40,000}{100,000} = 1.4$

C. $Q = \frac{TFC}{P - AVC} = \frac{60,000}{2 - 1} = 60,000$

$DOL = \frac{\pi + TFC}{\pi} = \frac{100,000 + 60,000}{100,000} = 1.6$