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MY NOTE BOOKS

Q3) Two firms + Imperfect substitutes :->>

$q_1 = 50 - P_1 + P_2$ } demand equations of
$q_2 = 50 - P_2 + P_1$ } two firms.

for now, $m = MC = 0 = AC$ (for both firms)

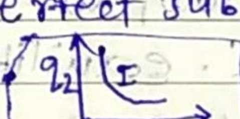
(a) from the equations, we can say that given goods are substitutes, because, as we can see in eq^n $q_1 = 50 - P_1 + P_2$, as price of good-2 (P_2) increases quantity demanded for good-1 (q_1) increases. This is because coefficient of P_2 in eq^n of q_1 is (+ve).

→ and similarly, as price of P_1 increases, q_2 also increases.

∴ we can say that, good 1 & 2 are substitutes.

⇒ In other words, cross-price elasticity of these goods are positive due to above described reason. Therefore also, they are substitute goods.

→ Also, both product has different price and quantity demanded for each good will depend on utility & price of each good. So, they could not be perfect substitute if they have ~~ff~~ indifference curve like this:



(b) Now, both firms best response function can be found using following method: ~~of price~~

π_1 = firm-1 profit $= (P_1 - m)\, q_1$
$= (P_1 - 0)(50 - P_1 + P_2)$
$= 50P_1 - P_1^2 + P_1P_2$

for profit maximizing condition,

$\frac{\partial \pi_1}{\partial P_1} = 50 - 2P_1 + P_2 = 0 \therefore 2P_1 = P_2 + 50$

∴ Its best response function: $\boxed{P_1 = \frac{1}{2}P_2 + 25}$ ← (1)

∴ Similarly,

→ for, firm-2 : profit, $\pi_2 = (P_2 - m) q_2$

$= (P_2 - 0)(50 - P_2 + P_1)$

$= 50P_2 - P_2^2 + P_1 P_2$

∴ for profit maximization,

$\frac{\partial \pi_2}{\partial P_2} = 0 = 50 - 2P_2 + P_1$

$\therefore 2P_2 = P_1 + 50$

∴ Firm-2's best response function,

$\boxed{P_2 = \frac{1}{2}P_1 + 25}$ — ②

∴ And for equilibrium as per Nash-Bertrand method,

solving eqns ① & ② for P_1 & P_2 : $25 + \frac{1}{2}\left[\frac{1}{2}P_1 + 25\right] = P_1$ ∴ $3P_1 = 150$ ∴ $P_1 = 50$

∴ $P_2 = 25 + 25 = 50$

∴ Equilibrium price : $\boxed{P_1 = P_2 = 50 \text{ units}}$ and ③

and qty. for each firm : $\boxed{q_1 = q_2 = 50 - 50 + 50 = 50 \text{ units}}$ ← ④

∴ eqn ①, ②, ③ & ④ are answers.

(c) now, we suppose, $m_1 = 10$

∴ equilibrium and response function would change.

∴ for firm-1, $\pi_1 = (P_1 - m_1) q_1$

$= (P_1 - 10)(50 - P_1 + P_2)$

$= 50P_1 - P_1^2 + P_1 P_2 - 500 + 10P_1 - 10P_2$

→ for firm-1 profit maximization : $= 60P_1 - P_1^2 + P_1 P_2 - 500 - 10P_2$

$\frac{\partial \pi_1}{\partial P_1} = 0 \Rightarrow 60 - 2P_1 + P_2 = 0$

$\therefore \boxed{P_1 = \frac{P_2}{2} + 30}$

→ And for firm-2, response function will be same as eqn ② in part (b) : $\boxed{P_2 = \frac{1}{2}P_1 + 25}$

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∴ On solving these eqns. for P_1, P_2 by substitution,

$$P_1 = \frac{1}{2}\left(\frac{1}{2}P_1 + 25\right) + 30$$

$$\therefore P_1 = \frac{P_1}{4} + \frac{25}{2} + 30$$

$$\therefore 3P_1 = 50 + 120 = 170$$

Equilibrium prices :→ $\therefore \boxed{P_1 = 56.67 \text{ units}}$ & $P_2 = \frac{1}{2}(56.67) + 25$

$\therefore \boxed{P_2 = 53.33}$ units.

and Equilibrium qtys :→

$$\boxed{\begin{aligned} q_1 &= 50 - 56.67 + 53.33 = 46.66 \text{ units.} \\ \& \; q_2 &= 50 - 53.33 + 56.67 = 53.34 \text{ units} \end{aligned}}$$

∴ Equilibrium price of P_1 increases from 50 to 56.67 units.

" " " P_2 " " 50 to 53.33 units.

" qty. of q_1 decreases " 50 to 46.66 units.

& " " " q_2 increases " 50 to 53.34 units.

→ If ~~they~~ both firms sell perfect substitutes, only good having less price will be sold. Therefore, only firm-2 will sell good 2 at 53.33 dollar unit price and, firm-1 will be out of the market and not be able to sell product or good 1 due to its higher price of 56.67 dollar units. And firm-2 will capture entire market.