Practice Problem Set 3

Monopoly (C.25), Oligopoly (C.28)

Question 3.1

Massive Dynamic is a monopoly that sells a special drug that enhances brainpower to two markets: Pulau North and Pulau South. The demand for the drug in the two markets are given by $P_N = 15 - Q_N$ and $P_S = 25 - Q_S$ respectively. Massive Dynamic's (total) cost function is given by $C = 5 + 3Q$, where $Q = Q_N + Q_S$.

i) Suppose Massive Dynamic can sell its product in Pulau North and Pulau South at different prices, what will these prices be? What are the equilibrium quantities sold?

ii) Suppose the government passes a law that forbids Massive Dynamic from charging consumers in Pulau North and Pulau South different prices, what are the new equilibrium prices and quantities sold?

iii) Does the regulation increase or decrease Massive Dynamic's profit?

Answer

i) Massive Dynamic's profit function is given by

$$\begin{aligned}\pi &= P_N \cdot Q_N + P_S \cdot Q_S - C(Q) \\ &= (15 - Q_N) \cdot Q_N + (25 - Q_S) \cdot Q_S - (5 + 3Q_N + 3Q_S)\end{aligned}$$

It is clear that $MC = 3$, $MR_N = 15 - 2Q_N$, $MR_S = 25 - 2Q_S$.

Set $MR = MC$, we get $Q_N = 6$, $Q_S = 11$. So $P_N = 9$, $P_S = 14$, $\pi = 152$.

ii) Now Massive Dynamic has to treat Pulau North and Pulau South as if they are one market. Notice that while the law requires Massive Dynamic to sell in Pulau North and Pulau South at the same price, if Massive Dynamic set a price higher than \$15, there will be no demand in Pulau North.

Hence, we have 2 cases to consider.

Case 1: If $P > 15$, Massive Dynamic sells in Pulau South only and the demand for the drug is $Q = Q_S = 25 - P_S$

Case 2: If $0 \leq P \leq 15$, Massive Dynamic sells in both Pulau North and Pulau South and the demand for the drug is $Q = Q_N + Q_S = 15 - P_N + 25 - P_S = 40 - 2P$ since $P_N = P_S = P$.

Consider Case 2 first. If Massive Dynamic sells in both markets, its profit function is given by

$$\begin{aligned}\pi &= PQ - C(Q) \\ &= (20 - Q/2) \cdot Q - (5 + 3Q)\end{aligned}$$

Hence $MC = 3$, $MR = 20 - Q$. Set $MR = MC$, we get $Q = 17$, so $P = 11.5$, $Q_N = 3.5$, $Q_S = 13.5$, $\pi = 139.5$.

We have to worry about Case 1 because Massive Dynamic may find it more profitable to give up the Pulau North market and sell in Pulau South only by charging a price higher than 15.

We know from Part i) that if Massive Dynamic treats Pulau South as an isolated market, the profit maximizing price that it should charge is $P_S = 14$, and it will sell $Q_S = 11$, fetching a profit of $\pi_S = P_S Q_S - 5 + 3(0 + Q_S) = 116$

Since $P_S = 14$ is the profit maximizing price, Massive Dynamic's profit will be lower if it charges Pulau South customers a price above \$15. Notice that even at the profit maximizing price $P_S = 14$, $\pi_S = 116 < \pi = 139.5$. Hence there is no reason for Massive Dynamic to sell in Pulau South only. Case 2 prevails and Massive Dynamic should sell in both markets.

iii) Profit falls from 152 to 139.5.

Question 3.2

Gerald is the sole owner of a mineral water spring. It costs Gerald \$2 per litre to bottle mineral water from the spring. The inverse demand curve for Gerald's mineral water is $p = \$20 - 0.2q$, where p is the price per litre and q is the number of litres sold.

i) Write down an expression for profits as a function of q. Find the profit-maximizing choice of q for Gerald.

ii) What price does Gerald set (per litre of mineral water) if he produces the profit-maximizing quantity? How much profit does he make?

iii) Suppose, now, that Gerald's neighbor, Brandy finds a mineral spring that produces mineral water that is just as good as Gerald's water, but that it costs Brandy \$6 (per litre) to get water out of the ground and bottle it. Total market demand for mineral water remains as before. Suppose that Gerald and Brandy each treats the other's quantity decision as given. What is the equilibrium output for Brandy? What is the equilibrium price?

Answer

i) $\pi = (20 - 0.2q)q - 2q$ and $q = 45$.

ii) $p = \$11$ and $\pi = \$405$.

iii) It should be clear that Gerald and Brandy are Cournot competitors (since "each treats the other's quantity decision as given").

Let q_1 and q_2 denote Gerald's and Brandy's production respectively. Gerald's profit function is $pq_1 - 2q_1 = (20 - 0.2q_1 - 0.2q_2)q_1 - 2q_1$. The first order condition is $20 - 0.4q_1 - 0.2q_2 = 2$. Brandy's profit function is $pq_2 - 6q_2 = (20 - 0.2q_1 -$

$0.2q_2)q_1 - 6q_1$. The first order condition is $20 - 0.2q_1 - 0.4q_2 = 6$. From the two first order conditions, we can calculate that $q_1 = 36.66$, $q_2 = 16.66$, $p = \$9.33$.

Question 3.3

Ben&Jerry's and Haagen Dazs are duopolists in the market for ice cream. They face a downward-sloping market linear demand curve. Each firm has an identical marginal cost that is independent of output. The two firms engage in Cournot competition. Indicate how the following will affect Ben&Jerry's and Haagen Dazs' reaction functions, and the equilibrium quantities produced. Explain briefly.

i) Doctors begin to recommend that all students should eat ice cream regularly.

ii) A main ingredient of Ben&Jerry's and Haagen Dazs' ice cream is sugar. The price of sugar goes up.

iii) Ben&Jerry's total fixed cost increases (but it is still profitable to produce).

Answer

i) Demand increase, both reaction functions will shift to the right, equilibrium quantities will be higher for both firms.

ii) Marginal cost increases for both firms, both reaction functions will shift to the left, equilibrium quantities will be lower for both firms.

iii) Fixed cost does not affect firms' reaction functions, thus there is no change.