ECON20005 Assignment 3

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Question 1: Entry Deterrence

1.1

When the firms set quantities simultaneously it is an example of Cournot competition. Since firms A and B are the only ones in the market, $Q = q_A + q_B \implies P = 25 - (q_A + q_B)$.

Firm A has profit $\Pi_A = P \times q_A - c_A \times q_A = (25 - q_A - q_B)q_A - 5 \times q_A = 20q_A - q_A^2 - q_A q_B$.

Maximising with respect to q_A:

$$\begin{aligned} \frac{\partial \Pi_A}{\partial q_A} &= 20 - 2q_A - q_B = 0 \\ q_A &= \frac{20 - q_B}{2} \end{aligned}$$

Since the firms are subject to identical conditions:

$$q_B = \frac{20 - q_A}{2}$$

Substituting B's best response quantity into A's:

$$\begin{aligned} q_A &= \frac{20 - \frac{20 - q_A}{2}}{2} \\ &= \frac{\frac{20 + q_A}{2}}{2} \\ &= \frac{20 + q_A}{4} \\ 0 &= 20 - 3q_A \\ q_A &= \frac{20}{3} \end{aligned}$$

Because the firms face symmetric best response quantities, $q_A = q_B \implies q_B = \frac{20}{3}$. Substituting this back into the profit function:

$$\begin{aligned} \Pi_A = 20q_A - q_A^2 - q_A q_B &= 20 \cdot \frac{20}{3} - \left(\frac{20}{3}\right)^2 - \left(\frac{20}{3}\right)^2 \\ &= \frac{400}{9} \end{aligned}$$

So the equilibrium quantities are $q_A = q_B = \frac{20}{3}$ and the equilibrium profits are $\Pi_A = \Pi_B = \frac{400}{9}$.

1.2

Since B is the second mover, their response will depend on firm A, from Q1.1 we have

$$q_B = \frac{20 - q_A}{2}.$$

Doing backward induction with this, firm A's optimal choice can be found by taking the first order condition of the profit function and setting equal to zero:

$$\begin{aligned}\Pi_A = 20q_A - q_A^2 - q_A q_B &= 20q_A - q_A^2 - q_A\frac{20 - q_A}{2} \\ &= 10q_A - \frac{q_A^2}{2} \\ \frac{\partial \Pi_A}{\partial q_A} = 10 - q_A = 0 \\ q_A = 10\end{aligned}$$

Then to find B's quantity:

$$\begin{aligned}q_B &= \frac{20 - q_A}{2} \\ &= \frac{20 - 10}{2} \\ q_B &= 5\end{aligned}$$

So the total market quantity is $q_A + q_B = 15$, making the market price $25 - 15 = 10$. This means A's profit is:

$$\Pi_A = P \times q_A - c_A \times q_A = 10 \times 10 - (5 \times 10) = 50$$

and B's profits are:

$$10 \times 5 - (5 \times 5) = 25.$$

The equilibrium quantities and profits differ from Q1.1 because as the first mover A is able to commit to producing a larger quantity knowing that the best way for B to respond is by producing less. A partially pushes B out of the market.

1.3

Taking B's profit equation and subtracting the fixed entry cost: $\Pi_B = P \times q_B - c_B \times q_B - F = 20q_B - q_B^2 - q_A q_B - 9$. Importantly, since the derivative of the constant fixed cost is 0, B's best response doesn't change, so substituting in B's best response from Q1.1 in:

$$\begin{aligned}\Pi_B &= 20q_B - q_B^2 - q_A q_B - 9 \\ &= 20 \times \frac{20 - q_A}{2} - \left(\frac{20 - q_A}{2}\right)^2 - q_A \times \frac{20 - q_A}{2} - 9 \\ &= 200 - 10q_A - (100 - 10q_A + q_A^2/4) - 10q_A + q_A^2/2 - 9 \\ &= 91 - 10q_A + q_A^2/4\end{aligned}$$

Therefore for B to not enter the market, $91 - 10q_A + q_A^2/4$ must be less than or equal to 0.

$$\begin{aligned}91 - 10q_A + q_A^2/4 \leq 0 \\ q_A^2 - 40q_A + 364 \leq 0 \\ (q_A - 14)(q_A - 26) \leq 0\end{aligned}$$

Since the equation for Π_B is a positive quadratic, B's profit is 0 or negative for $q_A \in [14, 26]$, so the minimum quantity A can choose to push B out of the market is $q_A = 14$.

1.4

A's profit when B enters the market in Q1.2 is 50. In Q1.3 where A pushes B out of the market, A sells a quantity $q_A = 14$. With A being the only firm in the market, the price is $P = 25 - 14 = 11$, so A's profit is $\Pi_A = 11 \times 14 - 5 \times 14 = 84$. $84 > 50$ so it is profit maximising for A to deter B from entering the market.

Question 2: Twists on the Linear City and Ice-Cream Salesman Models

2.1

2.2

2.3

2.4

Question 3: Rent Seeking for the National Broadband Network

3.1

3.2

3.3

Question 4: The Impact of Omar on Drug Dealing

4.1

4.2

4.3

4.4