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Economics Assignment 4
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ECON5107: Industrial Organization Assignment #4

1 Entry Deterrence in Capacity Setting Games

Answer to (1)

Denote the profit, output of firm i π_i and q_i, respectively.

$$\begin{aligned}
&\pi_1 = (12 - q_1)q_1 - q_1 \\
&\frac{d\pi_1}{dq_1} = 11 - 2q_1 = 0 \iff q_1 = \frac{11}{2} \\
&\frac{d^2\pi_1}{dq_1^2} = -2q_1 < 0 \\
&\implies q_1^m = \frac{11}{2}
\end{aligned}$$

Now firm 2 faces a demand curve: $p = \frac{13}{2} - q_2$.

$$\begin{aligned}
&\pi_2 = (\frac{13}{2} - q_2)q_2 - q_2 \\
&\frac{d\pi_2}{dq_2} = \frac{11}{2} - 2q_2 \implies q_2^* = \frac{11}{4},\ \max \pi_2 = \frac{121}{16}
\end{aligned}$$

So when E is larger than $\frac{121}{16}$, firm 2 will not enter the market even if firm 1 sets a monopoly price. $\hat{E} = \frac{121}{16}$.

Answer to (2)

The demand curve that firm 2 faces: $P = (12 - q_1) - q_2$.

$$\begin{aligned}
&\pi_2 = [(12 - q_1) - q_2]q_2 - c_2q_2 \\
&\frac{\partial\pi_2}{\partial\pi_2} = (11 - q_1) - 2q_2 = 0 \iff q_2 = \frac{11 - q_1}{2} \\
&\frac{\partial^2\pi_2}{\partial q_2^2} = -2 < 0 \\
&\implies q_2^*(q_1) = \frac{11 - q_1}{2}
\end{aligned}$$

Firm 2's optimal output when entering the market is: $q_2^*(q_1) = \frac{11-q_1}{2}$.

Firm 1, as the the first mover, seeks to maximize $\pi_1 = (12 - q_2^*(q_1) - q_1)q_1 - q_1$

$$\frac{d\pi_1}{dq_1} = \frac{11 - 2q_1}{2} = 0 \iff q_1 = \frac{11}{2}$$
$$\frac{d^2\pi}{dq_1} = -1 < 0$$
$$\implies q_1^s = \frac{11}{2}$$

The optimal output is $\frac{11}{2}$.

Answer to (3)

Given q_1, as illustrated above, firm 2's optimal output when entering the market is: $q_2^*(q_1) = \frac{11-q_1}{2}$. The maximized profit of entering the market is $(\frac{11-q_1}{2})^2 - E$. Firm 2 will not enter the market $\iff E > (\frac{11-q_1}{2})^2 \iff q_1 > 11 - 2\sqrt{E}$.

Firm 1 now has to decide whether or not to let firm 2 in the market. If firm 1 lets firm 2 in the market, as we have illustrated above, the optimal output will be $\frac{11}{2}$, while the profit $\pi_1^{2\text{in}} = \frac{121}{8}$. If firm 1 wants to deter entrance, it must set an output greater than $11 - 2\sqrt{E}$.

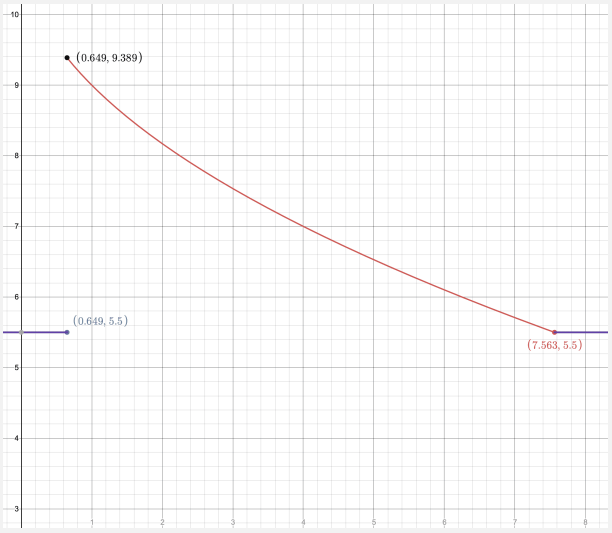
Notice that $11 - 2\sqrt{E} < q_1^m = \frac{11}{2}$ whenever $E > \frac{121}{16} = 7.5625$. Hence, if E is greater than $\frac{121}{16}$, firm 1 can simply set the monopoly output $q_1^m = \frac{11}{2}$ to deter entry and $\pi_1^{2\text{out}} = \frac{121}{4}$. This is coherent to the answer in (1).

Now if $E \leq \frac{121}{16}$, the optimal output of deterring firm 2's entry is $11 - 2\sqrt{E}$ plus an arbitrary small number. As we see in (1) (the case that firm 2 is not in the market), $\frac{d\pi_1}{dq_1} < 0$ whenever $q_1 > \frac{11}{2}$ so firm 1's optimal output should be as close to $\frac{11}{2}$ as possible under the constraint $q_1 > 11 - 2\sqrt{E} \geq \frac{11}{2}$, which leads to the statement. In this case, $\pi_1^{2\text{out}} = (11 - 2\sqrt{E})2\sqrt{E} = 22\sqrt{E} - 4E$. $\pi_1^{2\text{out}} \geq \pi_1^{2\text{in}} = \frac{121}{8} \iff 0.64876 \leq E \leq 22.03874$. But $E \leq 7.5625$, hence $0.64875 \leq E \leq 7.5625$. If $E < 0.64875$, firm 1 would rather let firm 2 in the market. We summarize the results below:

$$q_1^{\text{best}} = \begin{cases} \frac{11}{2} & E < 0.64875 \\ 11 - 2\sqrt{E} + \epsilon & 064875 \leq E \leq \frac{121}{16} = 7.5625 \\ \frac{11}{2} & E > \frac{121}{16} \end{cases}$$

$[\tilde{E}, \hat{E}] = [0.64875, 7.5625]$ and $q_1^d = 11 - 2\sqrt{E} + \epsilon$ where ϵ is a very small positive number.

Answer to (4)



The horizontal axis is E while the vertical axis is q_1^{best}. The graph we we have is not inverse U-shaped. It is instead divided into three segments with the middle segment being a little U-shaped. The first and second segments are separated (at $E = 0.64876$) according to firm 1's decision of deterring firm 2's entrance or not. The second and third segments are separated (at $E = \frac{121}{16}$) according to whether or not the entrance cost is large enough that firm 1 can simply produce at the monopoly output level. The middle segment is decreasing since as E increases, the required q_1 to deter entrance decreases and q_1 decreases in a lower rate.

2 Honest Tea

Answer to (1)

Yes. According to the principle of declining marginal utility, each additional more sugar contribute less and less of the taste, and at the optimal taste, less sugar added will contribute to lose nothing in terms of taste. Consumer save calories and the manufacturer saves cost of ingredient. Thus, the best bottled tea is not the one that tastes the best.

Answer to (2)

Honest Tea's market category can be defined as bottle tea that tastes like tea, freshly brewed and barely sweetened (compared to other market competitors). It focuses on the vacuum between water and sugary drinks.

Answer to (3)

Yes, because at the start, they had observed the potential market opportunity and exploited the unoccupied space of the market at that time, targeting those who wants healthy and not-too-sweet beverages.

Answer to (4)

Honest Tea will not continue to succeed but remain its marketing ranking in the beverage industries. The reason is that established competitors can quickly roll out new products directly competing with it. Bigger brand can achieve the same quality with less cost, while reaching a bigger audience.