

Econ 30010
Intermediate Microeconomic Theory

Answers for Entry Deterrence Worksheet

Model Information

Inverse demand is $P = 200 - q_1 - q_2$

Cost of capacity needed per unit of output, $r = 49$

Cost of labor needed per unit of output, $w = 70$

F_1 = fixed cost for firm 1

F_2 = fixed cost for firm 2 incurred in firm 2 enters

Step 1. Derive the best responses for each firm assuming that firm 1 has no sunk capacity costs. Set up a graph with q_1 and q_2 plotted on each axis. Graph each firm's best response functions from this step using dashed lines. Calculate the Cournot equilibrium implied by these best response functions. Label this equilibrium as point A in your graph.

$$MR_1(q_1, q_2) = 119 \text{ implies } 2q_1 + q_2 = 81. \quad MR_2(q_1, q_2) = 119 \text{ implies } q_1 + 2q_2 = 81.$$

Cournot equilibrium given these best response is $(q_1^A, q_2^A) = (27, 27)$.

Step 2. Derive firm 1's best response assuming that only labor costs are variable. Add this function to your graph again using a dashed line. Calculate the Cournot equilibrium using firm 1's best response function from this step and firm 2's best response function from step 1. Label this equilibrium as point B in your graph.

$$MR_1(q_1, q_2) = 70 \text{ implies } 2q_1 + q_2 = 130$$

Cournot equilibrium using firm 1's best response in this step with firm 2's best response in step 1 is $(q_1^B, q_2^B) = (179/3, 32/3)$.

Step 3. Explain how firm 1's choice of capacity allows it to induce any point on firm 2's best response between A and B. (Ignore the issue of whether or not firm 2's profits are non-negative for now.)

By choosing a capacity that falls in between q_1^A and q_1^B , firm 1 effectively commits to producing at least up to capacity. This commitment is similar to being able to move first as in a Stackelberg competition.

Step 4. Calculate the Stackelberg equilibrium given firm 2's best response function from step 1 when firm 1 is the leader. Label this equilibrium as point S on your graph. Calculate firm 1's profits at this equilibrium.

$$\text{From step 1, } q_2^{BR}(q_1) = (81 - q_1)/2.$$

Then, $\pi_1(q_1, q_2^{BR}(q_1)) = (81 - q_1)q_1/2 - F_1$.

The Stackelberg equilibrium is $(q_1^S, q_2^S) = (40.5, 20.25)$. $\pi_1^S = \pi_1(q_1^S, q_2^S) = (40.5)^2/2 - F_1$.

Step 5. What is the smallest amount of capacity firm 1 can choose that would cause firm 2 to stay out of the market? Explain. Calculate firm 1's profits assuming it invests in the minimal amount of capacity that will deter entry.

The smallest capacity that will deter entry corresponds the firm 1 quantity above which firm 2's profit will be negative.

Since $\pi_2(q_1, q_2^{BR}(q_1)) = (81 - q_1)^2/4 - F_2$, π_2 will be non-negative only if $q_1 \leq 81 - 2\sqrt{F_2}$. Thus, $K_1 = 81 - 2\sqrt{F_2}$ is the smallest capacity that can deter entry. Deterred entry with this capacity implies $(q_1^D, q_2^D) = (81 - 2\sqrt{K_1}, 0)$ and $\pi_1^D = \pi_1(q_1^D, q_2^D) = 2\sqrt{F_2}(81 - 2\sqrt{F_2}) - F_1$.

Step 6. Show that entry is strategically deterred if F_2 equals 100 and show that entry occurs if F_2 equals 25.

$F_2 = 100$: To deter entry, K_1 must be at least 61 which is greater than the Stackelberg capacity of 40.5. With $K_1 = 61$, $\pi_1^D - \pi_1^S = 400$ entry would be strategically deterred except for one remaining issue. With $K_1 = 61$, firm 2 knows the equilibrium with entry would be at point B which implies $q_1 = 59 \frac{2}{3}$ and this is not sufficient to deter entry. Given that the maximum quantity firm 1 would produce in an equilibrium with entry, F_2 would have to be at least 113.78 before entry is strategically deterred.

$F_2 = 25$: To deter entry, K_1 must be at least 71. With $K_1 = 71$, $\pi_1^D - \pi_1^S = -110$ so firm 1 will earn higher profit investing in $K_1 = 40.5$ and having entry occur.

