Practice Set 5 – KEY
Strategic Competition

This set contains practice material for your own use. It is highly recommended to work on the problems on your own. Do not just read the provided solutions. Instead, try to solve the problems and use the solutions only when you are stuck. Reading problems that someone else has solved has the same value on your preparation like watching someone running a marathon on TV and then expecting to be able to run it, too! If you have questions on this set, please ask your section's teaching assistant.

1. Firm 1 and firm 2 compete by setting quantities. Market demand is $p = 14 - Q$. Each firm has zero fixed costs and constant $MC = 2$.

   (a) Find the Cournot reaction functions for the two firms.

   Firm 1 sees the demand as $p = 14 - q_1 - q_2$ or $p = (14 - q_2) - q_1$. Marginal revenue will be: $MR = 14 - q_2 - 2q_1$ (double gradient only for q_1 that the firm controls). $MR = MC$ or $14 - q_2 - 2q_1 = 2$ or $q_1 = (12 - q_2)/2$, which is the reaction function for firm 1. Because the firms are identical and symmetric (they face the same demand and cost) the reaction function for firm 2 will be the symmetrical: $q_2 = (12 - q_1)/2$.

   (b) Find the Cournot equilibrium quantities and price.

   We already know that in the end it will be $q_1 = q_2$. Substituting q_1 for q_2 in firm's 1 reaction function yields: $q_1 = (12 - q_1)/2$ or $q_1 = q_2 = 4$. From the demand we can calculate the price consumers are willing to pay for 8 total units of output as: $p = 14 - 8$ or $p = 6$.

   (c) Find the profit for the two firms under Cournot competition.

   Since MC is constant and FC is zero, we can figure that $AC = MC$ (each additional unit has the same cost as the previous unit, thus each unit's cost is the same). Profit for firm 1 can be calculated as $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (6 - 2) \cdot 4$ or $\Pi_1 = 16$. Because firms are symmetric, $\Pi_2 = 16$.

   (d) Find the quantities and price if the two firms collude.

   If firms collude, the demand for the cartel will be $p = 14 - Q$, where Q is the total quantity. Marginal revenue will be $MR = 14 - 2Q$. $MR = MC$ implies $14 - 2Q = 2$ or $Q = 6$. That is, $q_1 = q_2 = 3$. From the demand curve the price can be calculated as $p = 14 - 6$ or $p = 8$.

   (e) Find the profit for the two firms under collusion.

   Profit for firm 1 can be calculated as $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (8 - 2) \cdot 3$ or $\Pi_1 = 18$. Because firms are symmetric, $\Pi_2 = 18$.

   (f) If firm 1 produces its collusion quantity, what is the quantity that maximizes firm's 2 profit?

   Firm's 2 reaction function is $q_2 = (12 - q_1)/2$. If $q_1 = 3$, then $q_2 = (12 - 3)/2$ or $q_2 = 4.5$.

   (g) What will be the price, if firm 2 cheats?

   If firm 2 cheats, it will produce $q_2 = 4.5$. The total quantity will be $Q = 3 + 4.5$ or $Q = 7.5$. The price at which this quantity can be absorbed in the market is $p = 14 - 7.5$ or $p = 6.5$.

   (h) What will be the profit for each firm, if firm 1 colludes and firm 2 cheats?

   Profit for firm 1 is $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (6.5 - 2)3$ or $\Pi_1 = 13.5$.
   Profit for firm 2 is $\Pi_2 = (p - AC) \cdot q_2$ or $\Pi_2 = (6.5 - 2)4.5$ or $\Pi_2 = 20.25$.

   (i) If firm 1 believes that firm 2 is going to cheat, what quantity maximizes firm's 1 profit and what would be the price?

Firm's 1 reaction function is $q_1 = (12 - q_2)/2$. If firm 1 suspects that $q_2 = 4.5$, it will set quantity $q_1 = (12 - 4.5)/2$ or $q_1 = 3.75$. Total quantity will be $Q = q_1 + q_2$ or $Q = 3.75 + 4.5$ or $Q = 8.25$. From the demand curve: $p = 14 - 8.25$ or $p = 5.75$.

(j) What will be the profit for each firm if firm 2 cheats, while it believes that firm 1 will not cheat; and firm 1 cheats, while it believes that firm 2 will cheat?

Profit for firm 1 is $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (5.75 - 2)3.75$ or $\Pi_1 = 14.0625$.
Profit for firm 2 is $\Pi_2 = (p - AC) \cdot q_2$ or $\Pi_2 = (5.75 - 2)4.5$ or $\Pi_2 = 16.875$.

(k) Order all possible outcomes of competition, collusion, and cheating starting from the one that yields the highest profit to firm 1. Include Bertrand competition in the comparison.

   i. *Firm 1 and firm 2 collude but firm 1 (alone) cheats [$\Pi_1 = 20.25$].*
   ii. *Firm 1 and firm 2 collude [$\Pi_1 = 18$].*
   iii. *Firm 1 and firm 2 collude, firm 1 cheats but firm 2 suspects it and adjusts its quantity accordingly [$\Pi_1 = 16.875$].*
   iv. *Firm 1 and firm 2 compete in a Cournot way [$\Pi_1 = 16$].*
   v. *Firm 1 and firm 2 collude, firm 2 cheats but firm 1 suspects it and adjusts its quantity accordingly [$\Pi_1 = 14.0625$].*
   vi. *Firm 1 and firm 2 collude but firm 2 (alone) cheats [$\Pi_1 = 13.5$].*
   vii. *Firm 1 and firm 2 compete in a Bertrand way [$\Pi_1 = 0$].*

2. Firm 1 and firm 2 compete by setting *prices*. Market demand is $p = 14 - 2Q$. Each firm has zero fixed costs and constant $MC = 2$. Find the price, the profit maximizing quantities, and the profits for the two firms.

   If firms compete in a Bertrand way, $p = MC = 2$. We can use the demand curve to calculate what quantity will be sold in the market at $p = 2$ as $2 = 14 - 2Q$ or $2Q = 12$ or $Q = 6$ or $q_1 = q_2 = 3$. Profit for firm 1 will be $\Pi_1 = (p - AC) \cdot q_1$ or $\Pi_1 = (2 - 2) \cdot 3$ or $\Pi_1 = 0$. Firm 2 will earn zero-profit as well.

3. Explain what it means that "a Monopolistically Competitive firm has *excess capacity* at the L-R equilibrium" and that "Monopolistic Competition allows for more than optimal firms to survive in the L-R".

   The long-run equilibrium quantity for the monopolistically competitive firm (q_{LR}) is lower than the quantity for which LAC is minimum (q^*). This means that the technology of the firm (given by LAC) would be more cost efficient if the firm produced q^*, yet the firm produces less (q_{LR}). Thus, we can say that the monopolistically competitive firm has more capacity (q^*) than it uses (q_{LR}).

   If this market had less firms in the L-R, each remaining firm would have to produce a higher quantity than q_{LR}. If enough firms were removed from the market, quantity per firm would eventually increase to its efficient level (q^*). In other words, at the L-R equilibrium of monopolistic competition, each firm cannot produce q^* because too many firms have entered the market.

4. In the kinked-demand model, if a $1 price decrease from the prevailing price causes an increase in quantity demanded equal to 100 units, what should you expect for a $1 price increase over the prevailing price?

   In the kinked-demand model, demand is more elastic above the prevailing price and less elastic below the prevailing price. This means that a $1 increase in price causes a higher loss in sales than the gain in sales from a $1 decrease in price. Therefore, we should expect the $1 increase in price will cause quantity demanded to decrease by more than 100 units.

5. A radio commercial includes the message: "*Buy now before prices go up in October!*". Explain how can this message facilitate collusion.

The message gives the heads up to other sellers that the seller who sends the message is intending and committing to increase prices. Other sellers may take this as an invitation to all together increase prices in October.

6. A radio commercial includes the message: "*If you find a better price, we will pay you back the difference double*". Explain how can this message facilitate collusion.

   In this message the firm commits that it will start a price war in case other firms cut prices. Competitors who will hear this message will not want to cut their prices. If they do, they will have to deal with an even bigger price cut from the firm who published the message. The advertisement serves as a commitment to this threat. Since it is announced publicly to the customers, the seller will have to honor it if another seller cuts prices. In other words, the other sellers must consider the threat credible.

7. A radio commercial includes the message: "*We will give you the same price that we give to our own employees, no one gets a lower price than you!*". Explain how can this message facilitate collusion.

   The firm commits to rivals that it does not secretly cut prices. If this firm now offers a secret price cut to some customer and gets caught, based on this clause, it will have to compensate all other customers who got higher prices. This will cause massive damages to the firm. By publishing this message to customers, the firm effectively commits that it will not cut prices from what it charges now.