

Problem 1: (Bertrand competition). Total cost function of two firms selling computers is $TC_1 = TC_2 = 15q$. If these two firms compete in prices, what will be the market equilibrium price? What happens if the first firm increases the efficiency of the production and its total cost decreases to $TC_1 = 5q_1$ while the total cost of the second firm is still $TC_2 = 15q_2$?

Problem 2: (Cournot duopoly). Consider a market with two firms, 1 and 2 producing a homogeneous good. The market demand is $P = 130 - 2(Q_1 + Q_2)$, where Q_1 is the quantity produced by firm 1 and Q_2 is the quantity produced by firm 2. The total cost of firm 1 is $TC_1 = 10Q_1$, the one of firm 2 is $TC_2 = 10Q_2$.

- (a) Find the reaction function of both firms.
- (b) Find the equilibrium quantity produced by each firm by solving the system of the two reaction functions you found in (a). Sketch your solution graphically.
- (c) Find the equilibrium price. Find the profit of each firm.
- (d) Suppose that the two firms behave like competitive firms and compete in prices. What will be the quantity they produce and what will be the equilibrium price? Compare your results with (b) and (c). (Hint: use the fact that both firms are equal, so they must produce the same amount)

Problem 3: (Collusive Cournot duopoly). Consider the same duopoly in problem 2. However, now assume that the two firms agree to produce half of the monopoly quantity each.

- (a) Find the quantity Q that maximizes the industry profits.
- (b) Find the equilibrium price in the market.
- (c) Calculate the profits for each firm. Compare your result with the one in problem 2 part (c).

- (d) Now suppose that firm 2 produces half of the monopoly quantity but firm 1 deviates from the agreement and produces according to its reaction function you have found in problem 2 part (a). Show that the deviation of firm 1 is profitable.

Problem 4: (Stackelberg oligopoly). Suppose that the two firms choose quantity, but one firm moves first and the second firm observes firm 1's choice. Firm A enters the market first and decides how many iPhones it will produce. Later firm B enters the market and makes the decision about its own level of production after observing A's level of output. The market demand function is $P = 12 - Q$, total costs of firms are $TC_A = 2Q_A + 12$ and $TC_B = 4Q_B + 1$.

- (a) How many iPhones will each firm produce?
- (b) What will be the market equilibrium price?
- (c) What will be the profit of each firm?
- (d) Compare this to Cournot duopoly outcome.