The homework is due on Wednesday, December 9 at 4pm. Each question is worth 0.8 points.

**Question 1** A monopolist sells a product in two different markets. Demand in the first market is \( Q = 120 - 2P \). Demand in the second market is \( Q = 120 - 8P \). The firm’s cost function is given by \( C(Q) = 10Q \).

(a) Suppose the firm can charge different prices in the two markets. Determine the prices and the firm’s profit.

(b) Now suppose that the firm must charge the same price in both markets. What is the firm’s profit now.

(c) Determine the total change in surplus (consumer + firm) between (a) and (b).

**Question 2** Suppose there are 100 households whose demand for electricity is given by \( Q = 40 - P \). The local power company has a constant marginal cost of 2, and a fixed cost of 10,000.

(a) Suppose the power company charges a price per unit of electricity that maximizes profits. Determine the price, the demand of each household, and the company’s profit (Recall that you must use aggregate demand of all 100 households. \( Q = 40 - P \) is the demand of a single household).

(b) Now suppose that the power company uses two part pricing. It selects a price \( P \) per unit and a fixed fee \( F \) that maximizes profit. Determine \( P \), \( F \), and the firm’s profit (Now you must use individual demand \( Q = 40 - P \) to determine \( P \) and \( F \). Of course, in order to determine profits you must use the fact that there are a total of 100 such households.)

(c) Determine the efficiency gain from using two-part pricing instead of a price per unit. This efficiency gain is measured by the sum of the following: (a) the change of firm profits; (b) the change of consumer utility (see your class-notes).

(d) Now suppose that the government wants to regulate the power company. In particular, the government wants (a) production to be efficient and (b) firm profits to be zero. This objective can be achieved by charging a fixed fee \( F \) in addition to a price per unit \( P \). Determine \( F \) and \( P \).

**Question 3** Suppose there are three firms producing the same product. The firm’s cost functions are \( C_1(Q) = 10Q \), \( C_2(Q) = 18Q \) and \( C_3(Q) = 12Q \). Demand for the product is given by \( Q(P) = 1,000 - 10P \). Determine the equilibrium price, each firm’s market share, and each firm’s profit. Note: The market shares will not be the same since marginal costs differ.
Question 4 Suppose there are two firms. The demand for firm 1’s product is given by 
\[ Q_1(P_1, P_2) = 10 - P_1 + 0.5P_2, \]
and the demand for firm 2’s product is 
\[ Q_2(P_1, P_2) = 10 - P_2 + 0.5P_1. \]
Both firms have cost functions 
\[ C(Q) = 2Q. \]

(a) Suppose that each firm charges a price per unit that maximizes profits taken the price of the other firm as given. Determine \( P_1, P_2, Q_1, Q_2 \) and each firm’s profit.

*Hint:* Determine the price elasticity of demand for each firm, and then use the formula that \( MC = P_i(1 + 1/\epsilon'_p) \), where \( \epsilon'_p \) is the price elasticity of demand for firm \( i \)’s product and \( P_i \) is the price firm \( i \) charges. You get two equations in two unknowns, \( P_1, \) and \( P_2 \) which you can solve.

(b) Now suppose that both firms use two-part-pricing, i.e., each firm \( i \) charges a fixed fee \( F_i \) and a price per unit \( P_i \) that is equal to marginal costs (charging a price equal to marginal cost is still optimal in this setting). Determine \( F_i, P_i, \) and the firm’s profit.

Question 5 There are 200 firms in an industry. Half of the firms use newer technology resulting in a cost function \( c(Q) = 200 + Q^2 \), while the the remaining firms’ cost functions are \( c(Q) = 200 + 2Q^2 \). Market demand is \( Q_D(P) = 3,450 - 40P. \) The industry is competitive (i.e., \( P = MC. \))

(a) Determine the equilibrium price and quantity and the profits of both types of firms, assuming perfect competition.

(b) Now suppose that the firms with the inferior technology exit the market (their profit in (a) should be negative). Determine the new equilibrium price, quantity and firm profits (again, assuming perfect competition).

(c) Determine the loss to the consumers when the high-cost firms exit the market (recall that the area underneath the inverse demand curve \( P(Q) \) between two values \( Q_1 \) and \( Q_2 \) measures the benefit to all consumers from increasing consumption from \( Q_1 \) to \( Q_2 \)).

(d) Taking the effect of firm profits into account determine by how much welfare increases or decreases when the high-cost firms exit the market.

(e) Should the government subsidize the industry such that all producers will remain in the market? Your answer should be based on the argument in (d). Does your answer change if the high-cost firms are domestic firms and the low-cost firms are foreign, and all the demand for the product is from domestic consumers only?

Question 6 Suppose a market demand function is given by 
\[ Q_D(P) = 1,000 - 10P. \]
The product can be produced with a cost function 
\[ C(Q) = 10,000 + 20Q. \]

(a) Determine \( Q \) and \( P \) and the firm’s profit if there is a single firm.

(b) Determine total output \( Q \), the equilibrium price, and the profit of each firm if there are two firms (i.e., a Cournot oligopoly).
(c) Determine $Q$, the equilibrium price, and the profit of each firm if there are 10 firms.

(d) Determine the welfare gain or loss between situations (a) and (b).

**Question 7** A firm has a cost function $c(Q) = 10Q$. The demand function is given by $Q_D(P) = 40 - 2P$. Determine the following graphically, using the attached grid.

1. The firm’s marginal revenue curve (assuming the firm is a monopolist).
2. The monopolist’s optimal $P$ and $Q$.
3. $P$ and $Q$ if the market were competitive, i.e., there are many firms with cost function $c(Q) = 10Q$.
4. The total net-benefit of consumers from the competitive market.
5. The total net loss in industry profits from the competitive market.
6. The total surplus from the competitive market.
$P, \text{ Costs}$