

Homework #1 (Due on October 1st, 2026)

Total Points 10

Question #1

The table below displays the profits from a price game between Apple and Microsoft.

		Microsoft	
		<i>Low Price</i>	<i>High Price</i>
Apple	<i>Low</i>	(50,50)	(190,0)
	<i>High</i>	(0,425)	(100,150)

Each firm can set either a high price, p_H , or a low price, p_L , where $p_H > p_L > 0$. Solve the following problems.

- Write down Apple's best-response function. Also, write down Microsoft's best-response function.
- Conclude which outcomes of the game constitute a Nash equilibrium.
- Are there outcomes in this game which Pareto dominate the Nash equilibrium outcomes that you found in the previous problem? Prove your result.
- Suppose Apple and Microsoft form a cartel. Which outcome maximizes joint industry profit?

Question #2

Firms *A* and *B* can choose to adopt a new technology (*N*) or to adhere to their old technology (*O*). Formally, firms' action sets are: $t_A \in \{N, O\}$ and $t_B \in \{N, O\}$. The table below exhibits the profit made by each firm under different technology choices.

		Firm B	
		<i>New Technology</i>	<i>Old Technology</i>
Firm A	<i>New</i>	(200,0)	(0,200)
	<i>Old</i>	(50,100)	(100,50)

- Write down the best-response functions of firms *A* and *B*, $t_A = R_A(t_B)$ and $t_B = R_B(t_A)$
- Draw the tree of a two-stage extensive-form game in which firm *A* chooses its technology t_A in stage I, and Firm *B* chooses its t_B in stage II (after observing the choice made by firm *A*). Make sure that you indicate firms' profits at the termination points on the tree. Solve for the *subgame-perfect equilibrium* of this game. Provide a short proof or an explanation justifying your answer.
- Draw the tree of a two-stage extensive-form game in which firm *B* chooses its technology t_B in stage I and Firm *A* chooses its t_A in stage II (after observing the choice made by firm *B*). Solve for the *subgame-perfect equilibrium* of this game. Provide a short proof or an explanation justifying your answer.
- Compare the equilibrium firms' profit levels of the games played in (b) and in (c). Conclude under which game firm *A* earns a higher profit. Briefly explain your answer.

Question #3

Emma and Oscar are deciding whether to engage in outdoor or indoor activities. Assume that both players value being together, but Oscar values it more than Emma.

- Model this situation as a simultaneous-move game.
- Then, model it as a sequential-move game, where Emma moves first.
- Clearly state your assumptions about payoffs (you may use general parameters like a or b).
- Discuss the equilibrium results in each time structure and compare your results.

Question #4

Consider the cost function $TC(Q) \equiv F + cQ$, where $F, c > 0$.

- Calculate and plot the $TC(Q)$, $AC(Q)$ and $MC(Q)$.
- At what output level is the average cost minimized?
- Infer whether this technology exhibits IRS, CRS, or DRS. Explain.

Question #5

In Seattle there is only one shoe repair factory who acts as a monopoly. The inverse demand function for this service is given by $P = 12 - \frac{Q}{2}$, where P denotes the price charged per visit, and Q the quantity demanded for shoe repair.

- Suppose the cost function of this shoe repair factory is given by $C(Q) = 4 + 2Q$. That is, the marginal cost is $c = \$2$ (consisting of her value time and other "communication" expenses), and the fixed cost is $F = \$4$ (say, monthly rent on her office space). Compute and draw the shoe factory's marginal cost and average functions, as well as the marginal revenue function.
- Algebraically compute the shoe factory's profit-maximizing output, price, and profit.
- Compute the price elasticity at the profit-maximizing output.

Question #6

Historically, most of the diamond mines in the world have been controlled by a few companies and governments. Through clever marketing by diamond producers, many consumers have furthermore become convinced that "diamonds are a girl's best friend" because "diamonds are forever." Suppose that the demand for diamond is given by $p = 90 - x$ and suppose further that the monopolist's marginal cost curve is given by $MC = x$.

- Derive the equation for the marginal revenue curve
- What is the profit-maximizing output level x^M ? What is the profit-maximizing price p^M (assuming that the monopolist can only charge a single per-unit price to all consumers)?
- In absence of recurring fixed costs, what is the monopolist's profit?
- What is the consumer surplus and deadweight loss (assuming that demand is equal to marginal willingness to pay)?
- What is the cost function if recurring fixed costs are sufficiently high to cause the monopolist's profit to be zero?