

Industrial Economics

TA Session 1 — Problem Handout

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Session Overview

This handout contains the problems we will work through in TA Session 1.

- **Problem Set I (Monopoly):** Problems 4 and 7.
- **Problem Set II (Static Oligopoly):** Problems 1, 2, 6, and 7.

Problem Set I — Monopoly

Exercise A (PS I, Problem 4) — Two-Period Monopoly with Learning-by-Doing

Consider a monopolist that produces a single good. The monopolist sells the good in two consecutive periods, $t = 1$ and $t = 2$. The demand for the good is $q_t = 1 - p_t$. Marginal (and average) cost is equal to c in $t = 1$, where $0 \leq c < 1$, and to $c - \lambda q_1$ in $t = 2$, where $0 < \lambda < 1$.

- (i) Based on the provided information, do you think that demands and costs of the two periods are dependent or independent?
- (ii) Find the prices that the monopolist charges in each period (assume that the discount factor is 1).
- (iii) Compute the Lerner index and the elasticity of demand in equilibrium for both periods. Discuss your findings.

Exercise B (PS I, Problem 7) — Third-Degree Price Discrimination

Purple Dream has the monopoly on the production of purple light-emitting diodes (LEDs). It faces geographically separated markets, denoted A and B. The demands on these two markets are respectively given by $q_A = 1 - p_A$ and $q_B = \frac{1}{2} - p_B$. Transport and production costs are set to zero.

- (i) Assume that the firm chooses to set a **uniform price** across the two markets. What is the profit-maximising uniform price? What are the quantities sold on the two markets at this price?
- (ii) Assume that the firm uses **third-degree price discrimination**. What are

- the profit-maximising prices and quantities on the two markets?
- (iii) Calculate consumer surplus and profit under a uniform price and under third-degree price discrimination. Compare these two situations and comment on the result.
- (iv) Does the result that you have found in part (iii) hold generally? How would the results change if $q_B = \frac{1}{3} - p_B$?

Problem Set II — Static Oligopoly

Exercise C (PS II, Problem 1) — Cournot Oligopoly vs. Monopoly

The market demand for a particular product is given by $p(Q) = 25 - Q$, where Q is the total quantity.

- (i) Assume that the product is produced by a **single firm**. The total production cost faced by the firm is $C(Q) = 4Q$. Find the quantity that the firm will produce, the price that it will charge, and the profit that it will make in equilibrium.
- (ii) Assume now that the same product is produced by **two firms**, firm 1 and firm 2. The total production cost faced by each firm i ($i = 1, 2$) is $C(q_i) = 4q_i$. The two firms choose their quantities *simultaneously and separately*. Find the quantity that each firm will produce, the price in the market, and each firm's profit in equilibrium.
- (iii) Compare cases (i) and (ii) in terms of total quantity, market price, and consumer surplus.

Exercise D (PS II, Problem 2) — Cournot Oligopoly with Asymmetric Marginal Costs

Consider two firms that produce a homogeneous good and choose their quantities *simultaneously and separately*. The demand function is $P = a - q_1 - q_2$, where q_1 and q_2 are the quantities of firm 1 and firm 2 respectively. The cost functions are $C_1(q_1) = c_1q_1$ and $C_2(q_2) = c_2q_2$, where $c_1 < c_2$ and $c_2 < (a + c_1)/2$.

- (i) Find the Nash equilibrium of the game. What are the market shares of the two firms?
- (ii) Given your answer to (i), find the equilibrium profits, consumer surplus, and total surplus (welfare).

Exercise E (PS II, Problem 6) — Bertrand Oligopoly with Asymmetric Costs

Consider a market with a duopoly in which the firms choose their prices *simultaneously and separately*. Market demand is $D(p) = 10 - p$. If a firm chooses a lower

price than its competitor it supplies the whole market; if both firms choose the same price they share the market equally. The total costs of firm 1 and firm 2 are $C_1(q_1) = q_1$ and $C_2(q_2) = 4q_2$ respectively. Find the Nash equilibrium prices as well as the equilibrium profits and output of each firm.

Exercise F (PSII, Problem 7) — Bertrand Oligopoly with Differentiated Products

Suppose a market consists of two firms, firm 1 and firm 2, who are Bertrand competitors. Firm 1 makes and sells good 1 and firm 2 makes and sells good 2. The demand functions are:

$$q_1 = 25 - 5p_1 + 2p_2 \quad \text{and} \quad q_2 = 25 - 5p_2 + 2p_1$$

The total cost functions are $C(q_1) = 2 + q_1$ and $C(q_2) = 2 + q_2$.

- (i) Find the best response function of each firm. How does the price firm i sets change with increases in the price of its competitor's good? What is the Nash equilibrium?
- (ii) What is the Lerner Index for good 1 and for good 2? What is the interpretation? Do the firms have market power?
- (iii) Explain why the Bertrand Paradox of zero market power does not apply in this case.