

Intermediate Microeconomics
Econ 3101, Section 002
Homework 4

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Question 1. Monopoly.

Consider a monopolist with the total cost function

$$TC(Q) = \frac{Q^2}{2} + 10Q + 20 \tag{1}$$

facing the market demand equation $Q = 70 - P$.

- (a) [5] What is the profit-maximizing output and price for the monopolist? Calculate its profit.
- (b) [5] What is the socially optimal output and price for this firm?
- (c) [5] What is the deadweight loss generated by the monopolist?
- (d) [5] Suppose now that the monopolist is charged a profit tax of 25%. What is the profit-maximizing output in this case? Compare this to what you obtained in part (a). Explain any similarities/differences.
- (e) [5] Suppose the monopolist is charged a quantity tax instead. For what (nonzero) value(s) of the quantity tax will this tax system be equivalent to the profit tax system given in (d)? Here we define two tax systems to be equivalent if they result in the monopolist producing the same output. Justify your answer.
- (f) [5] Now suppose there are no taxes and the firm is a perfect price-discriminating monopolist. Calculate equilibrium output and quantity.
- (g) [5] Is there any deadweight loss in the case presented in part (f)? How is it different from the perfectly competitive outcome? (Hint: Think about who gains and loses as a result of these different market structures.)

Question 2. Oligopoly.

Let market demand be given by $P = 100 - Q$, and suppose the only two firms in the market have the following cost functions: $TC(y_1) = 20y_1$ and $TC(y_2) = 20y_2$.

- (a) [5] Find the Cournot-Nash equilibrium.
- (b) [5] What is the market price and profits of the firms under Cournot-Nash equilibrium?

- (c) [5] Suppose now the two firms collude and form a cartel. Find the market price, total output, and joint profit of the cartel.
- (d) [5] Now suppose the first firm cheats while the second firm doesn't. What is the first firm's profit-maximizing output and how much profit does it make?
- (e) [5] What if the second firm cheats instead (while the first firm doesn't)? How much output will it produce? Calculate the resulting profit.
- (f) [5] Consider the scenario given in part (e). Firm 1 discovers firm 2 cheating and decides to punish it by following suit (so that both firms go down together). What will be the market price and profit made by each firm?
- (g) [5] Now suppose instead that the first firm sets its quantity first and the other firm follows. Find the quantities produced by each firm, the market price, and the firm's profits.

Question 3. *Game Theory.*

Consider the Colluder's Dilemma (an example of which is given in the previous question). Two firms that collude successfully to suppress output can charge a higher price and hence make a larger profit (than they would by competing against each other). There is, however, an incentive to cheat: by cheating, they make even more profit but only if the other firm doesn't retaliate. If it does, they both lose out. Suppose colluding brings both parties a profit of 1000. If only one firm cheats, it makes 1200 while its partner gets 600. If retaliation occurs (i.e. they both cheat), they each get 800.

- (a) [10] Construct the payoff matrix for this game.
- (b) [10] Find all pure-strategy Nash equilibrium (equilibria).
- (c) [10] Find all purely-mixed Nash equilibrium (equilibria).