

## Econ 2261 – Problem Set II

Provide a full justification for all your answers.

Due on 03/09

1. Consider a monopolist with the cost function  $C(q) = 6q$ , facing the market demand function  $D(p) = 20 - 2p$ .
  - (a) Find the monopoly quantity and price, the monopolist's profit and the consumer surplus.
  - (b) Now suppose that the government gives to the monopolist a subsidy of \$2 per unit sold. Find the monopoly quantity and price, the monopolist's profit, the consumer surplus, and the cost of the subsidy.
  - (c) How does this subsidy affect total surplus (taking into account its cost)?
2. Consider a monopolist that operates on two. The total demand on the first market is  $D_1(p_1) = 80 - p_1$ . The total demand on the second market is  $D_2(p_2) = 40 - p_2$ . Let the cost function be  $C(q) = 20q$ .
  - (a) Suppose the monopolist cannot price discriminate, i.e., it faces a single demand  $D(p) = D_1(p) + D_2(p)$ . Find the optimal price and quantity on each market, total monopoly profit, consumer surplus, and total surplus.
  - (b) Suppose the monopolist can charge a different price on each of the two markets. Find the optimal price and quantity on each market, total monopoly profit, consumer surplus, and total surplus.
  - (c) Suppose that the monopolist can separate the markets and practice *perfect* price discrimination within each market. Find the quantity traded on each market, total monopoly profit, consumer surplus, and total surplus.
3. Show that underbidding in a second-price sealed-bid auction is weakly dominated.
4. Suppose Henry and George are ice-cream vendors selling the same product at the same price. They choose a location for their vending carts along the beach. Suppose that the beach is divided into 5 uniformly spaced regions. On each region there are 10 people that will buy ice-cream from the closest vendor, splitting evenly if the vendors are at equal distance. Henry and George choose their location simultaneously. They make \$1 in profits for each customer they serve.
  - (a) Write down a  $5 \times 5$  matrix representing this game.
  - (b) Execute the iterated dominance algorithm to find all rationalizable locations.

5. Consider two firms selling differentiated varieties of a product, e.g., Coke and Pepsi. Each firm  $j$  chooses a price  $p_j$  for its own variety. Since these varieties are close substitutes, the demand that each firm faces depends not only on its own price, but also the price of its competitor. Specifically, the demand for  $j$ 's variety is given by

$$D_j(p_j, p_{-j}) = \max\{0, 60 + p_{-j} - 2p_j\}$$

Suppose that both firms can produce any amount of their variety at *no cost*.

- (a) Find firm  $j$ 's best response function.
  - (b) Assume that firms choose prices simultaneously and independently. Show that choosing  $p_j = 18$  is not rationalizable. [*Hint*: perform two rounds of iterated dominance]
  - (c) Assume that firms choose prices simultaneously and independently. Find the *unique* Nash equilibrium of the game. [*Hint*: symmetric games typically have a symmetric equilibrium]
  - (d) Assume that firm 1 chooses its price first, and firm 2 chooses its price second after seeing firm 1's price. Find the Stackelberg equilibrium of the game.
  - (e) Compare the equilibrium profits of each firm under part (c), with their profits on part (d).
6. Two firms engage in Cournot competition. Each firm  $j$  chooses a quantity  $q_j \in [0, \infty)$  to supply to the market. These choices are made simultaneously and independently. Both firms have the same cost function  $C(q_j) = 10q_j$ . The market demand function is given by  $D(p) = \max\{0, 100 - p\}$
- (a) Find the equilibrium quantity and price, the consumer surplus, and the profits of each firm.
  - (b) Now suppose that the government introduces a \$10 tax per unit sold, to be paid by the consumers. Find the equilibrium quantity and price, the consumer surplus, the profits of each firm, and the tax revenue.
  - (c) Does this tax result in dead-weight loss?
7. Consider a market with  $n \geq 2$  firms engaged in Cournot competition. The firms' cost functions, and the market demand function are as in problem 6.
- (a) Find the equilibrium quantity and price, the consumer surplus, and the profits of each firm.

- (b) How much total surplus is lost due to market power?
- (c) What happens to the equilibrium quantity, price, and dead-weight loss when the number of firms grows to infinity?
- 8.** Suppose two long-lived firms are engaged on *repeated* Cournot competition. The firms have a common discount factor  $\delta$ . Each period, firms choose simultaneously how much to produce. Suppose that each firm can only choose between a high output ( $H$ ), or a low output ( $L$ ). The stage game payoffs are as follows.

	H	L
H	4, 4	1, 6
L	6, 1	2, 2

- (a) Which actions are dominated in the stage game?
- (b) Which outcomes are Pareto dominated in the stage game?
- (c) Find a value in  $(0, 1)$  for the discount factor such that the firms can use a grim trigger strategy to implement an efficient outcome.