

Group Homework 3 & 4

Semester 2/2022 EE320 Introductory mathematical economics

Due date: Feb 25th 2022 (before midnight /B.E. moodle).

Note: Late homework will not be accepted. Use the format of filename as required; this will cost you two points if you don't follow the instruction.

1. Suppose that $Y = x^3 - 5x^2 + 7x - 5$

- Show the domain of X where the function exhibits the property of an increasing function.
- Define the domain set of X . Is the function concave for all over the domain?

2. Suppose that a firm's short-run production function is given by

$$Q(L) = 6L^2 - L^3$$

where $Q(L)$ is the output level, and L is the number of workers

- Derive the average product of labor (AP_L) and the marginal product of labor (MP_L).
- What size of the work force (L^{**}) maximizes the average output per labor, $Q(L)/L$?
- Use calculus to show that the MP_L curve must cross the AP_L curve at its maximum point.
- Given that the firm faces the demand function

$$Q = 100 - 2P$$

derive the marginal revenue product (MRP) function.

3. Suppose a monopolist faces with the market demand equation given by,

$$P = 40 + \frac{105}{Q} - \frac{3}{2}Q^2$$

where P is the unit price and Q is the amount of quantity purchased. The monopolist is running the firm using the cost function given as follow,

$$C(Q) = 6Q^3 - 81Q^2 - 175Q + 10.$$

Consider the following questions.

- a. Determine the level of revenue-maximizing output, and calculate the value of the elasticity of demand at that level of output?
- b. Construct the profit function.
- c. Determine the profit-maximizing level of output. Confirm your result that the proposed solution is correct.
- d. Discuss the effect that would likely be happening if the government imposes a lump-sum tax on the monopolist.

4. The swimming pool maintenance sector consists of 100 identical firms, each having short-run total costs given by $STC = 0.5q^2 + 10q + 5$, where q is the number of swimming pools serviced per day.

- a. What is the short-run supply curve for each pool maintenance firm? What is the short-run supply curve for the market as a whole?
- b. Suppose the demand for the maintenance of swimming pools is given by $Q = 1100 - 50P$. What will be the equilibrium in this marketplace? What will *each* firm's total short-run profits be?

- c. Suppose the government imposed a €3 tax on chemicals per pool maintained. How would this tax change the market equilibrium?
- d. How would the burden of this tax be shared between owners of swimming pools and the firms that offer pool maintenance services?
- e. Calculate the total loss of producer surplus as a result of the new tax. Show that this loss equals the change in total short-run profits in this industry.

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