Intermediate Microeconomics – Spring 2025

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Problems Set 3

Due Monday April 7th

Instructions:

1. You can either write down your answers by hand or type out your solutions. Please hand in a hard copy of your answers and make sure your work is stapled. Alternatively, you can submit a digital copy to the TA via email. Most importantly, please remember to indicate your name and student number on your homework.

2. The problem sets should be submitted to the TA before the beginning of the lecture on the due day. Late submissions will NOT be accepted. If you have any emergency that prevents you from coming to the lecture, please email an electronic version of your problem set to the TA before the class.

3. You are encouraged to discuss with your classmates, but please write down your answers individually. Directly copying others' answers may result in zero points.

Question 1 (Cost Curves)

Tesla company is considering building a new electric car in China. The total (fixed) cost of the investment is $F = 4$. When built, the factory will allow to produce y cars at the (variable) cost given by $c(y) = 4y^2$

a. Does the technology used in the new factory exhibit increasing, decreasing or constant returns to scale (ignore the fixed costs at this point)?

b. Find a total costs (*TC*) of producing 1, 2 and 4 cars. In the graph (*y*, *COST*) plot a *TC* curve, and decompose it into a fixed cost curve and a variable cost curve by adding the two curves to your graph.

c. Find the values of the average fixed cost (*AFC*) for three levels of production $y = 1,2$ and 4. Plot an *AFC* curve in a separate graph. What happens to the *AFC* when production becomes very large (close to infinity) and when it is very small (close to zero). Explain.

d. Find the values of the average variable cost *AVC* for $y = 1$, 2 and 4, and mark them in the graph from question (c). Connect the three points to obtain the *AVC* curve.

e. Find the values of the average total cost *ATC* for $y = 1$, 2 and 4, and mark them in the graph from question (c). Connect the three points to obtain the *ATC* curve. What are the values of *ATC* when the production is very small and very large? Explain which of the two components of *ATC, AFC* or *AVC,* dominates in each of the two extremes. Why?

f. Find the output level *y* that minimizes the *ATC*.

g. Find analytically marginal cost *MC* curve. In a new graph, plot the *MC* curve, together with the *ATC*, marking the point where the two curves intersect. How is the intersection point related to the output level *y* you found in (f).

Question 2 (Supply Curve)

Suppose Tesla from Question 1 maximizing its profit given by:

$$\pi = py - TC(y)$$

a. Find analytically the long-run optimal level of production for each of the three price levels $p = 4$, $p = 8$, $p = 16$?

Hint: you may use the first-order condition for profit maximization. Make sure you check if the maximal profit is non-negative. If it's non-negative, then what you find is optimal. Otherwise, the optimal production level should be zero.

b. Find analytically the supply function, $y(p)$.

c. Plot your supply function on the graph, adding the ATC function.

d. Find supply as in (b), (c) for $F = 1$ (instead of $F = 4$). How is your supply function affected by the change of F? Is it steeper?

Question 3 (Partial Competitive Equilibrium)

A perfectly competitive industry has a large number of potential entrants. Each firm has an identical cost structure such that long-run average cost is minimized at an output of 20 units ($q_i = 20$). The minimum average cost is \$10 per unit. Total market demand is given by

$$Q = 1500 - 50P$$

a. What is the industry's long-run supply schedule?
b. What is the long-run equilibrium price (P^*)? The total industry output (Q^*)? The output of each firm (q^*)? The number of firms? The profits of each firm?
c. The short-run total cost function associated with each firm's long-run equilibrium output is given by

$$C(q) = 0.5q^2 - 10q + 200.$$

Calculate the short-run average and marginal cost function. At what output level does short-run average cost reach a minimum?

d. Calculate the short-run supply function for each firm and the industry short-run supply function.
e. Suppose now that the market demand function shifts upward to $Q = 2000 - 50P$. Using this new demand curve, answer part (b) for the very short run when firms cannot change their outputs.
f. In the short run, use the industry short-run supply function to recalculate the answers to part (b).
g. What is the new long-run equilibrium for the industry?

Question 4 (Edgeworth box and general equilibrium)

Consider an economy with James and Nick whose initial endowments are $\omega^J = (13,1)$ and $\omega^N = (1, 13)$ and who have identical utility functions

$$U^i(x_1, x_2) = 2\ln(x_1) + 2\ln(x_2).$$

a. Plot an Edgeworth box for the considered economy. Mark a point that corresponds to the initial allocation.

b. Give the definition of Pareto efficiency. Argue that this definition is equivalent to the equality of marginal rates of substitution. Verify whether initial allocation is Pareto efficient.

c. Find a competitive equilibrium and depict it in the Edgeworth box.

d. Verify whether the equilibrium allocation is Pareto efficient.

e. Suppose now James and Nick have quasi-linear utility functions $U^i(x_1, x_2) = 2\ln(x_1) + x_2$. Find analytically a contract curve and depict it in an Edgeworth box.