

PROBLEM SET 7 – Tutorial Week 10 (October 17–20)

Deadline: 11:59 p.m. two days before your tutorial. Please submit a PDF in groups of 2–3 within your tutorial group. On the first page, write your full names (as on the roster) in alphabetical order. Start each question on a new page. Name your PDF “PSet # – LastName LastName LastName,” e.g., “PSet 7 – Banerjee Duflo Kremer.” Points will be deducted for not adhering to the instructions.

QUESTION 1

For each of the following examples, draw a representative isoquant. What can you say about the marginal rate of technical substitution in each case?

- (a) A firm can either: (i) hire only full-time employees to produce its output; or (ii) hire some combination of full-time and part-time employees. For each full-time employee that the firm dismisses, the firm must hire an increasing number of part-time employees to maintain the same level of output. Place full-time employees on the horizontal axis and part-time employees on the vertical axis.
- (b) A firm finds that it can always trade three units of labor for one unit of capital and maintain the same level of output. Place labor on the horizontal axis and capital on the vertical axis.

QUESTION 2

Monsters University’s production function is $Q = KL - L^2$. Use Excel to draw the graphs.

- (a) Consider the isoquant of $Q = 4$. Is there an uneconomic region of production? If so, is MP_L negative in the uneconomic region of production? Is MP_K negative in the uneconomic region of production?
- (b) Suppose $K = 10$. Write down the equations of AP_L and MP_L . Plot AP_L and MP_L in one graph.
- (c) Suppose $L = 10$. Write down the equations of AP_K and MP_K . Plot AP_K and MP_K in one graph.

QUESTION 3

Monsters, Inc.’s production function is initially $Q = \sqrt{KL}$. Over time, the production function changes to $Q = KL$. (For simplicity, assume that $L > 1$ and $K > 1$.)

- (a) Show that the change in the production function represents technological progress.
- (b) Is the change in the production function labor saving, capital saving, or neutral?
- (c) Consider the general form of the Cobb-Douglas production function, $Q = AK^\alpha L^\beta$. How do the returns to scale of the Cobb-Douglas production function depend on the value of $\alpha + \beta$?
- (d) Based on your answer to (c), what can you say about the returns to scale for the two production functions in this question: $Q = \sqrt{KL}$ and $Q = KL$?

QUESTION 4

You obtained the following information about Tony's Grossery's short-run cost. When Tony's Grossery produces 2 units of output, its total cost is \$35,000. When Tony's Grossery produces 10 units of output, its average fixed cost is \$3,000.

- (a) What is the average variable cost when the firm produces 2 units of output?
- (b) What is the average fixed cost when the firm produces 5 units of output?

QUESTION 5

Harryhausen's produces sushi with labor and capital. The price of labor is $w = 1$, and the price of capital is $r = 2$. Suppose capital is fixed at $K = 2$ in the short run. For simplicity, suppose the fixed cost is sunk.

- (a) Suppose Harryhausen's production function is $Q = L + K$. If Harryhausen's wants to produce 3 units of output, what is the cost-minimizing choice of labor in the short run? What is the equation of the short-run total cost curve?
- (b) Suppose Harryhausen's production function is $Q = \min\{L, K\}$. If Harryhausen's wants to produce 1 unit of output, what is the cost-minimizing choice of labor in the short run? What is the equation of the short-run total cost curve?

QUESTION 6

When Hidden City Cafe uses K units of capital and L units of labor, it can produce Q units of output with the production function $Q = K\sqrt{L}$. Each unit of capital costs $r = 20$, and each unit of labor costs $w = 25$. The level of K is fixed at 5 units in the short run. For simplicity, suppose the fixed cost is sunk.

- (a) Find the equation of the firm's short-run total cost curve.
- (b) Find the equations of the firm's short-run average total cost curve, short-run marginal cost curve, average variable cost curve, and average fixed cost curve.
- (c) Use Excel to draw a graph of the firm's short-run average total cost curve, short-run marginal cost curve, and average variable cost curve. Calculate and label the critical points.