

Fall 2023  
ECO2011 L07-10  
BASIC MICROECONOMICS  
November 23, 2023  
Barick Chung  
Written assignment #04

Instructions:

- 1) Submit by 15:59 p.m. on December 04 (Monday), 2023 to the assignment drop box located on the 3rd floor of Zhiren building.
- 2) Late submission is not allowed. If there is reason that a late homework is accepted, at least 21 (out of 100) marks will be deducted.
- 3) Your answers must be in English.
- 4) Your answers must be in hand writing. Photocopy, computer printout or electronic submission will not be accepted.
- 5) Write down your name and student ID on the top of the front page of the answer sheets. Submission without a name or student ID will receive zero mark.
- 6) Once you have submitted your assignment work to the drop box, you cannot take it back or change any part of the answers.
- 7) If you submit more than one copy of the assignment work, the teaching assistants /or graders will randomly choose a copy to grade, and /or give you the lowest score among all your assignment work submissions.
- 8) Write on both sides of papers.
- 9) There is no need to copy the questions.
- 10) Use a pen /or a ball pen.
- 11) Staple your answer sheets if there is more than one sheet. If you do not staple your answer sheets, only the sheet that shows your name and student ID will be graded.
- 12) If you think there is chance of getting stuck, blocked, or locked down in your home town and cannot come back campus to submit your homework, work out your assignment work early and mail it to the teaching assistants' office (3rd floor, Zhiren building) by express delivery and make sure it arrives before the deadline.
- 13) If you have any question related to the submission of this written assignment, ask in Forum#2 on BB.
- 14) Read the University policy regarding academic honesty before doing this assignment.

# Question #01

Fill in the gaps in the tables below in which time period is the short run:

(a)

Quantity of variable input	Total output	Marginal product of variable input	Average product of variable input
0	0	-	-
1	225	225	225
2	600	375	300
3	900	300	300
4	1140	240	285
5	1365	225	273
6	1350	-15	225

(b)

Labor L	Capital K	Output q	$AP_L = q/L$	$MP_L = \Delta q / \Delta L$	$AP_K = q/K$	$MP_K = \Delta q / \Delta K$
0	10	0	-	-	0	
1	10	10	10	10	1	
2	10	30	15	20	3	
3	10	60	20	30	6	
4	10	80	20	20	8	
5	10	95	19	15	9.5	
6	10	108	18	13	10.8	
7	10	112	16	4	11.2	
8	10	112	14	0	11.2	
9	10	108	12	-4	10.8	
10	10	100	10	-8	10	

(c)

Output	TC	TFC	TVC	AFC	AVC	ATC	MC
0	\$3		\$0	-	-	-	-
1	3.3		0.3	3	0.3	3.3	\$0.3
2	3.8		0.8	1.5	0.4	1.9	0.5
3	4.5		1.5	1	0.5	1.5	0.7
4	5.4		2.4	0.75	0.6	1.35	0.9
5	6.5		3.5	0.6	0.7	1.3	1.1
6	7.8		4.8	0.5	0.8	1.3	1.3
7	9.3		6.3	0.429	0.9	1.329	1.5
8	11		8	0.375	1	1.375	1.7
9	12		9	0.333	1	1.333	1

## Question #02

Suppose a chair manufacturer is producing **in the short run** (with its existing plant and equipment). The manufacturer has observed the following levels of **production** corresponding to different numbers of workers:

(a)

Number of workers	Number of chairs	marginal product	average product
1	10	—	10
2	18	8	9
3	24	6	8
4	28	4	7
5	30	2	6
6	28	-2	4.67
7	25	-3	3.57

a) Calculate the marginal and average product of labor for this production function.

b) Does this production function exhibit diminishing marginal returns to labor?

Explain. **Yes.** as the use of an input increases with other inputs fixed, the resulting additions to output eventually decrease.

c) Explain intuitively what might cause the marginal product of labor to become negative.

1. **Overcrowding:** If a work environment becomes too crowded with additional workers, it can lead to inefficiencies.

2. **Diminishing Returns:** In many production processes, there's a point where each additional worker contributes less and less to total output. When the marginal product of labor becomes negative, it indicates that the point of diminishing returns has been passed to such an extent that each additional worker is detracting from total output rather than adding to it.

3. **Resource Limitations:** If there are fixed resources (like machinery, space, or materials), and you keep adding more labor, these resources become increasingly scarce per worker. There might not be enough tools or space for every worker to be productive, leading to a situation where the addition of more workers actually decreases total output.

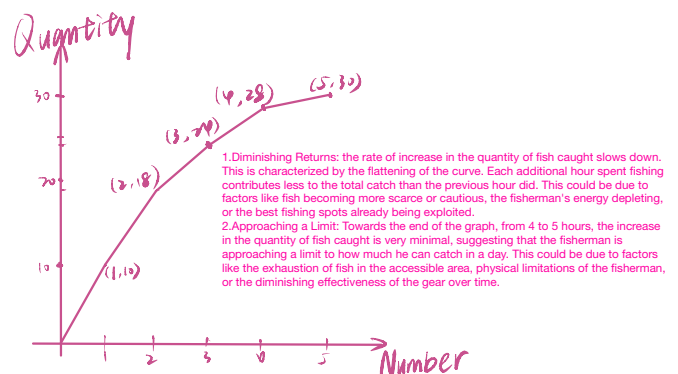
4. **Coordination and Management Challenges:** As more workers are added, coordinating their efforts becomes more complex. This can lead to inefficiencies and mistakes, where the effort to manage and align the increasing number of workers becomes a burden that outweighs the additional output they might provide.

5. **Morale and Work Culture Impacts:** In some cases, adding more workers may negatively impact the morale and culture of the workplace. If workers feel overcrowded, underutilized, or if there's increased competition for the same tasks, their productivity might decrease, leading to a negative marginal product of labor.

## Question #03

A commercial fisherman notices the following relationship between hours spent fishing and the quantity of fish caught: (a)

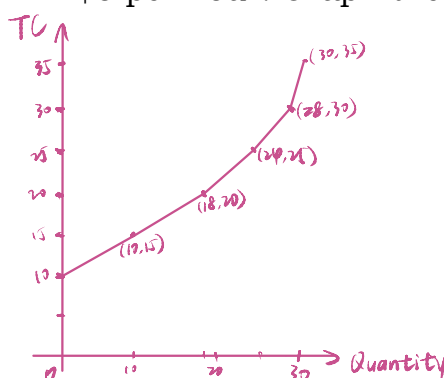
Hours	Quantity of fish (in pounds)	marginal product
0	0 Lb	—
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2



a) What is the marginal product of each hour spent fishing?

b) Use these data to graph the fisherman's **production function**. Explain its shape.

c) The fisherman has a fixed cost of \$10 (his pole). The opportunity cost of his time is \$5 per hour. Graph the fisherman's total-cost curve. Explain its shape.



In the short term, with other conditions held constant, the phenomenon of an increasing rate of total cost as quantity rises can be attributed to the concept of marginal cost. Marginal cost represents the additional cost required to produce one extra unit of output. In the context of fishing, as the fisherman catches more fish (increasing quantity), the rate of increase in total cost accelerates for several reasons:

1. **Diminishing Marginal Returns:** Typically, in the short term, an initial increase in production may occur relatively rapidly. However, due to limitations on production factors, such as fewer available resources or constraints in fishing areas, achieving further increases in output becomes more challenging. This results in diminishing marginal returns, meaning the additional output gained from each extra unit of effort gradually decreases. Therefore, capturing more fish requires investing more time and resources, leading to an accelerated increase in costs.

2. **Rising Marginal Costs:** With an increase in quantity, the marginal cost per unit of output may rise. Marginal cost refers to the additional cost of producing one extra unit. In the fishing scenario, capturing more fish may demand additional labor, fuel, or other resources. Acquiring these extra resources and labor may be more challenging or come at higher costs, causing an increase in marginal costs. This, in turn, contributes to a faster rate of increase in total costs.

3. In summary, in the short term, due to diminishing marginal returns and rising marginal costs, the total cost increases at an accelerating rate as quantity rises. This phenomenon is common in short-term production processes and reflects the impact of limitations on production factors and resources.

### Question #04

Do the following functions exhibit increasing, constant, or decreasing returns to scale? What happens to the marginal product of each individual factor as that factor is increased and the other factor held constant?

- a)  $Q = 3L + 2K$       Function (a) exhibits constant returns to scale.
- b)  $Q = (2L + 2K)^{\frac{1}{2}}$       Function (b) exhibits decreasing returns to scale.
- c)  $Q = 3L \cdot K^2$       Function (c) exhibits increasing returns to scale.
- d)  $Q = L^{\frac{1}{2}} \cdot K^{\frac{1}{2}}$       Function (d) exhibits constant returns to scale.

### Question #05

The short-run cost function of a company is given by the equation  $TC = 200 + 55q$ , where TC is the total cost and q is the total quantity of output, both measured in thousands.

- a) What is the company's fixed cost?  $\$200,000$
- b) If the company produced 100,000 units of goods, what would be its average variable cost?  $AVC = \frac{TC - TFC}{q} = \frac{200 + 55 \times 100 - 200}{100} = 55 (\$)$
- c) What would be its marginal cost of production?  $MC = TC'(q) = 55 (\$)$
- d) What would be its average fixed cost?  $AFC = \frac{200}{100} = 2 (\$)$
- e) Suppose the company borrows money and expands its factory. Its fixed cost rises by \$50,000, but its variable cost falls to \$45,000 per 1000 units. The cost of interest (i) also enters into the equation. Each 1-point increase in the interest rate raises costs by \$3000. Write the new cost equation.

The new cost equation after the expansion, considering the increased fixed cost, reduced variable cost, and the cost of interest, can be written as follows:

$$TC = (200 + 50) + (45q) + (3000 \times i)$$

Simplifying this expression:

$$TC = 250 + 45q + 3000i$$

Therefore, the new cost equation is ( $TC = 250 + 45q + 3000i$ ).

(i) represents the interest rate.

### Question #06

There are two firms, A and B, whose production functions are:

$$Q_A = 10 \times L^{0.5} \times K^{0.5}$$

$$Q_B = 10 \times L^{0.4} \times K^{0.6}$$

where L is labor input and K is capital input.

a) Find marginal products,  $MP_L$  and  $MP_K$ , of firms A and B.

b) (i) If firm A uses 8 units of labor input and 8 units of capital input, what will be firm A's output? (ii) If firm B uses also 8 units of labor input and 8 units of capital input, what will be firm B's output?

c) (i) If firm A uses 8 units of labor input and 8 units of capital input, what will be firm A's marginal products,  $MP_L$  and  $MP_K$ ? (ii) If firm B uses also 8 units of labor input and 8 units of capital input, what will be firm B's marginal products,  $MP_L$  and  $MP_K$ ?

d) (i) If firm A reduces 1 unit use of labor input and increases 1 unit use of capital input (i.e.  $L = 7$ ,  $K = 9$ ), what will be firm A's output? (ii) To the contrary, if firm A increases 1 unit use of labor input and reduces 1 unit use of capital input (i.e.  $L = 9$ ,  $K = 7$ ), what will be firm A's output?

e) (i) If firm B reduces 1 unit use of labor input and increases 1 unit use of capital input (i.e.  $L = 7$ ,  $K = 9$ ), what will be firm B's output? (ii) To the contrary, if firm B increases 1 unit use of labor input and reduces 1 unit use of capital input (i.e.  $L = 9$ ,  $K = 7$ ), what will be firm B's output?

If L and K start out equal, and then change the same amount, then the final value is equal. In this case, both are 79.5.

### Question #07

Suppose the production function is described by  $q(L, K) = 10 \times L \times K$ .

a) What is the total output when L is increased by 1 unit, keeping K unchanged?

b) What is marginal product of L?

c) What is the total output when K is increased by 1 unit, keeping L unchanged?

d) What is marginal product of K?

e) If output quantity is fixed at 100 units, and wage rate is \$10 per unit of labor and rental rate is \$5 per unit of capital, show that  $\{L, K\} = \{1, 10\}$  is not optimal. Explain.

f) To lower the total cost of production (100 units of output), should the firm use more labor? Should the firm use more capital? Explain?

$$\text{If } \frac{MP_L}{w} > \frac{MP_K}{r} : \text{more labor}$$

$$\text{If } \frac{MP_L}{w} < \frac{MP_K}{r} : \text{more capital}$$

\*\*\*\*\* End of written assignment \*\*\*\*\*