

# SECTION NOTES 10

Covering material from Lecture on February 14<sup>th</sup>

## CLASS OUTLINE

1. Production Functions
2. Input Choices
3. Returns to Scale

## 1 Production Functions

Now that we have looked at consumer's optimizing decisions, we now want to focus on producers. The first important point is that technology is captured within a production function, i.e.

$$q = F(K, L).$$

The inputs into the production function are the **factors of production**. The major distinction we have to make for production decisions is short-run versus long-run decisions.

**Short Run:**

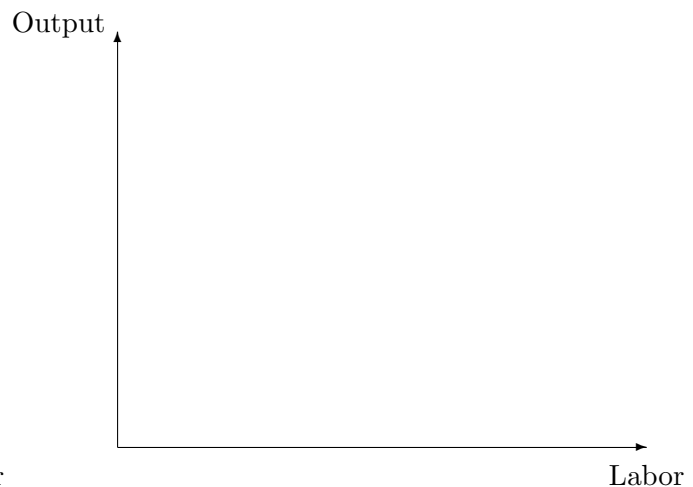
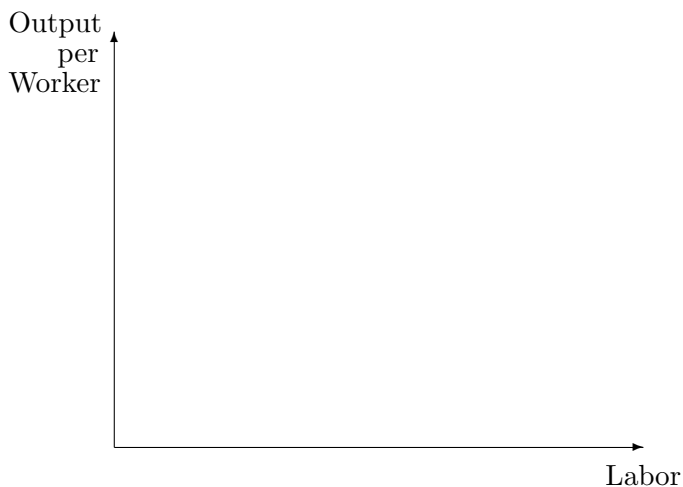
**Long Run:**

Focusing on the short run and making labor variable, we have.

**Average Product:**

**Marginal Product:**

Graphically we have (with **diminishing marginal returns**):



**Problem:** (P&R, Chapter 6, Exercise 3)

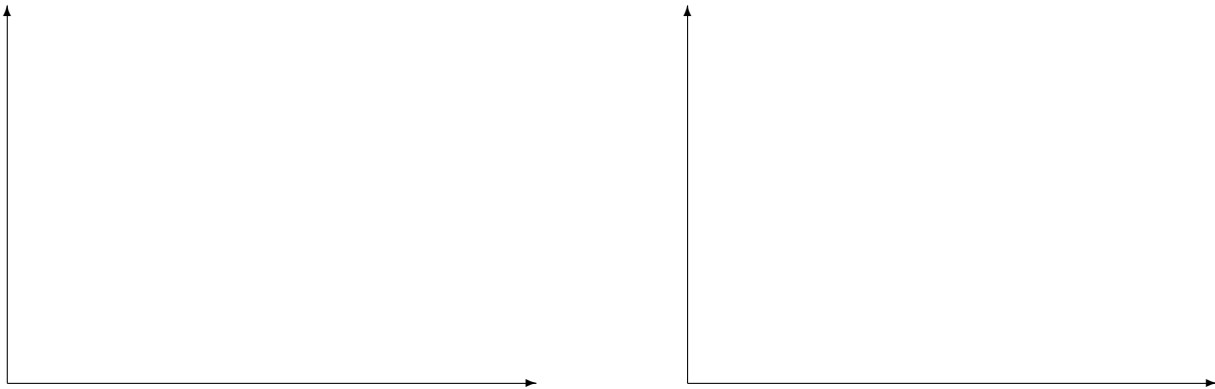
Quantity of Variable Input	Total Output	Marginal Product of Variable Input	Average Product of Variable Input
0	0	–	–
1	225		
2			300
3		300	
4	1140		
5		225	
6			225

## 2 Input Choices

We now want to focus on the long run with two variable inputs.

**Isoquant:** Curve showing all possible combinations of inputs that yield the same output.

**Marginal Rate of Technical Substitution (MRTS):** Amount by which the quantity of one input can be reduced when one extra unit of another input is used, so that output remains constant.



What are some of the different types of isoquants?

### 3 Returns to Scale

There are three types:

1. Increasing Returns to Scale (IRS):
2. Constant Returns to Scale (CRS):
3. Decreasing Returns to Scale (DRS):

So how do different Returns to Scale and Marginal Products relate with each other?

**Problem:** (P&R, Chapter 6, Exercise 8)

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?

1.  $q = 3L + 2K$

2.  $q = (2L + 2K)^{1/2}$

3.  $q = 3LK^2$

4.  $q = L^{1/2}$

5.  $q = L^{1/2}K^{1/2}$

6.  $q = 4L^{1/2} + 4K$

**Problem:** (P&R, Chapter 6, Exercise 10)

Wheat is produced according to the production function

$$q = 100K^{0.8}L^{0.2}$$

- a. Beginning with a capital input of 4 and a labor input of 49, show that the marginal product of labor and the marginal product of capital are both decreasing.
- b. Does this production function exhibit increasing, decreasing, or constant returns to scale?

**Problem:** (P&R, Chapter 6, Exercise 7)

The marginal product of labor in the production of computer chips is 50 chips per hour. The marginal rate of technical substitution of hours of labor for hours of machine capital is  $1/4$ . What is the marginal product of capital?