ECON 300: Intermediate Price Theory

Problem Set #5 - Part #1

Fall 2024

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Problem 1. Production Technologies

Suppose that your firm is producing output Q with using two inputs, labor L and capital K, using the following technology:

$$F(L, K) = LK^2$$

1.A. In your own words, describe what the Marginal Product of Labor measures.

1.B. Find the Marginal Product of Labor (MP_L).

- $MP_L =$

1.C. Find the Marginal Product of Capital (MP_K).

- $MP_K =$

1.D. In your own words, describe what the Marginal Rate of Technical Substitution measures.

1.E. Find the Marginal Rate of Technical Substitution $(MRTS_{LK})$

- $MRTS_{LK} =$

Problem 1. Production Technologies (continued)

Suppose that your firm is producing output Q with using two inputs, labor L and capital K, using the following technology:
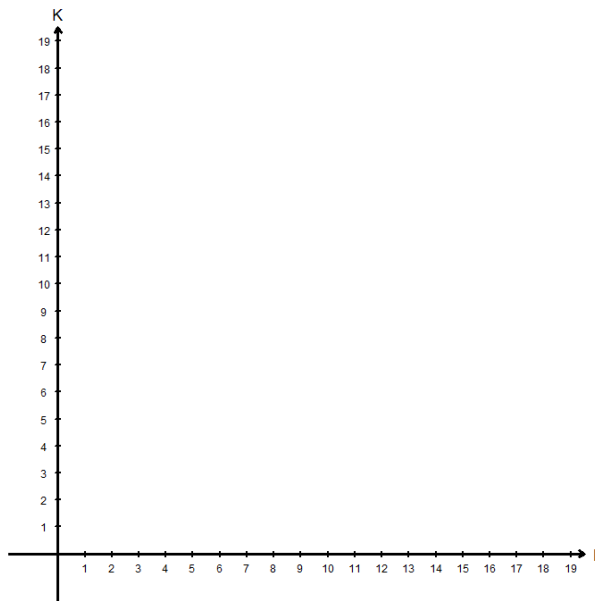
$$F(L, K) = LK^2$$

1.F. How many units of output can you produce if you employ $L = 16$ and $K = 1$?

1.G. How many units of output can you produce if you employ $L = 4$ and $K = 2$?

1.H. How many units of output can you produce if you employ $L = 1$ and $K = 4$?

1.I. Based on your answers from 1.F through 1.H, approximate the isoquant of your firm when your total product is 16.

Problem 2. Returns to Scale

2.A In your own words, define the following terms.

- Constant Returns to Scale (CRS)

- Increasing Returns to Scale (IRS)

- Decreasing Returns to Scale (DRS)

2.B Determine if the following production functions display CRS, IRS, DRS, or is inconclusive.

- $F(L, K) = LK^2$

- $F(L, K) = L + K$

- $F(L, K) = L^{\frac{1}{3}} K^{\frac{1}{3}}$

Problem 3. The Short Run, Long Run, and Cost Minimization

Suppose that you are given a production quota of 10000 units of output, where the inputs are labor L and capital K. Due to the short turnaround timeframe, you have no choice b ut to work with the capital stock you are given, which is $\bar{K} = 10$. The wage is given as $w = 10$ and rent for each unit of capital is given as $r = 20$. Your production technology is given as follows:

$$F(L, K) = 4L^2 K^2$$

3.A. Find the short run conditional factor demand.

3.B. What is the value of the short run total cost?

Now suppose that you are given a longer turnaround timeframe so that you have some control over the capital stock you would be using in production. All other conditions remain identical to the situation described above.

3.C. Find the Marginal Product of Labor (MP_L).

 - $MP_L =$

3.D. Find the Marginal Product of Capital (MP_K).

 - $MP_K =$

3.E. Find the Marginal Rate of Technical Substitution $(MRTS_{LK})$

 - $MRTS_{LK} =$

Problem 3. The Short Run, Long Run, and Cost Minimization (continued)

Suppose that you are given a production quota of 10000 units of output, where the inputs are labor L and capital K. The wage is given as $w = 10$ and rent for each unit of capital is given as $r = 20$. Your production technology is given as follows:

$$F(L, K) = 4L^2K^2$$

3.F. Find the optimal ratio of Labor and Capital you should use in production.

3.G. Formally express the firm's Isocost.

3.H. Find the optimal inputs of Labor and Capital you should use in production.

- Score: _____   • Extra Credit: _____