

HOMEWORK 4: Theory of the Firm

Due: Wednesday, April 9th, 2014

40 Points

LEARNING OBJECTIVES

- Firms seek to maximize economic profit = total revenue minus total cost.
- A total product curve shows the limits to the output that the firm can produce with a given quantity of capital and different quantities of labor.
- As total product increases, total fixed cost is constant, and total variable cost and total cost increase.
- Long-run cost is the cost of production when all inputs have been adjusted to produce at the lowest attainable cost.
- **Cost functions are directly related to the firms production function.**

INSTRUCTIONS

Carefully read the question before answering. Make sure your pages are in order and stapled together. Your work should be **clear** and **easy to follow**. When prompted, make sure that you explain your answer completely.

QUESTIONS

1. (12 points) Suppose the annual production of U.S. oil is given by the production function $q = 10K^{0.5}L^{0.4}$, where q is millions of barrels of oil per day, K = millions of capital units used in the production of oil per day and L = millions of workers used in the production of oil per day.
 - a. (3 points) Assume that K is fixed at 4 million units. Using integer values of $L = 2, 4, 6, 8, 10$ million, find and graph the total product, marginal product of labor (use derivative), and average product of labor curves.
 - b. (2 point) Is this a short-run or long-run problem? Briefly explain your answer.
 - c. (2 point) Using the **general rules** of production that we discussed in class, when are AP_L and MP_L equal and when does total product begin to fall? Explain this answer with at least 2 sentences.
 - d. (3 points) The U.S. consumes 14 million barrels of oil daily, which includes its own production of 7 million barrels and Russia's production of 0.47 million barrels. If the U.S. does not receive the 0.47 million barrels of oil produced by Russia, by how much would the U.S. have to increase labor to keep consumption constant (i.e. the U.S. produces 7 million barrels before the shortage and now needs to product 7.47 million barrels to make up for Russia's oil production).
 - e. (2 points) Assume now that K is allowed to vary. What is the marginal rate of technical substitution, MRTS, for this production function? Assume that labor is on the x-axis and capital is on the y-axis. Interpret the MRTS with at least 2 sentences.
2. (5 points) True or false. Technical progress will shift an isoquant inward. Provide at least a 3 sentence explanation along with one graph.

HOMEWORK 4: Theory of the Firm Continued

3. (12 points) Every off-season baseball teams must determine the optimal number of in-fielders and out-fielders to maximize the chance that the team wins games. Assume that in-fielders are paid \$750 per game and out-fielders are paid \$500 per game. The production function for winning a game is a function of the number of in-fielders and out-fielders given by $q = 0.46I^{1.1}O^{0.9}$, where q = the number of games won in the regular season, I = the number of in-fielders on the roster (x-axis), O = the number of out-fielders on the roster (y-axis).
- (1 point) Derive the MP_I , MP_O functions and the MRTS.
 - (1 point) What returns to scale does this production function possess? Briefly explain your answer.
 - (3 points) Graph the baseball team's two isoquants for winning 90 games and 97 games or $q = 90$ and $q = 97$. Let $I = 6, 15, 20$ and calculate O for each isoquant and then graph.
 - (3 points) Calculate the minimum cost of producing 90 games won. Round to two decimal places. Draw the isocost line tangent to the $q = 90$ isoquant to illustrate the optimal bundle of I and O .
 - (3 point) Calculate the minimum cost of producing 97 games won. Round to two decimal places. Draw the isocost line tangent to the $q = 97$ isoquant to illustrate the optimal bundle of I and O .
 - (1 point) Show the firm's expansion path on the graph used for parts c, d and e.
4. (5 points) "Dear Economist, I need a date." In a recent Planet Money podcast on NPR, an economist was presented with the following question: "I have spent the last x-number of years with my current partner but I don't want to end the relationship because of the time and money we have put our relationship over the years." If you were the economist being questioned, would you agree or disagree with the caller and why? Make sure to reference cost theory and provide at least a 4 sentence explanation.
<http://www.npr.org/blogs/money/2014/01/29/268422490/episode-513-dear-economist-i-need-a-date>
5. (6 points) Assume the cost function for Spirit Airlines, the least favorite airline and also the fastest growing, is $C = 50 + 2q + 3q^3$, where C = thousands of dollars of operational costs per day and q = thousands of passengers serviced each day.
- (2 points) Create a table giving output, fixed cost, variable cost, total cost, marginal cost (derivative), average cost, average fixed cost, and average variable cost. Use integer values of output from $q = 0$ to $q = 10$.
 - (1 point) Graph these curves.
 - (2 points) Find the output where average cost is minimized. (Note: a similar process is used to find the output where average variable cost is minimized.)
 - (1 point) Is this a short-run or a long-run cost function? Briefly explain your answer with at least 2 sentences.
<http://www.npr.org/blogs/money/2014/02/14/276973956/episode-517-the-fastest-growing-least-popular-airline-in-america>