ECON 360: Intermediate Microeconomics

Homework 4

- Define any variables you need to answer the problems.

- Use any materials to help you with these questions. That includes others in this course!

- Please write your answers in the space provided.

- Keep your answers short but clear. Your goal is to convince a skeptical grader that you understand the relevant concepts well enough to answer the question you are given.

- The questions on this homework sum to 73 points. But you get a 100 for completing/attempting the majority of the questions.

- Remember to write down the names of anyone you worked with on this homework!

- Bring any and all questions to office hours!

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1. (4 points) What is your name?

2. (4 points) Who did you work with on this homework?

1 True/False Questions

Indicate "T"rue or "F"alse for each of the following statements or claims. For each false statement, if you explain why it is false I will give you a bonus point.

3. (2 points) In order to teach a class in person, you need both a professor and classroom. **Claim**: Professors and classrooms are probably perfect substitutes in the production function of in-person lectures.

4. (2 points) Suppose Erin offers tutoring services to econ classes over zoom. At her current amount of tutoring, it would cost Erin $40 to fit another hour of tutoring into her schedule. Suppose the rate she charges is $60 per hour. **Claim**: Erin is profit maximizing at her current amount of tutoring.

5. (2 points) Consider a firm that employs capital and labor. The marginal products of capital and labor are MP_K and MP_L and the prices of capital and labor are r and w. The production function is Cobb-Douglas with decreasing returns to scale. **Claim**: If $\frac{MP_L}{w} < \frac{MP_K}{r}$ then the firm could increase their profit by reducing the amount of labor and increasing the amount of capital.

6. (2 points) **Claim**: If $\frac{MP_L}{w} < \frac{MP_K}{r}$ a firm can **always** increase profits by increasing the amount of labor the firm uses and decreasing the amount of the capital regardless of the production function.

7. (2 points) Cathy makes string bracelets to sell on Etsy for $2 each and currently sells 10 each month. She does not have any employers and she only has 1 sowing machine that requires exactly one person in order to operate. If she chose to purchase an additional fully automatic sowing machine it would increase her quantity of bracelets produced by a factor of 10. She would buy this machine with cash and therefore it would not increase her marginal cost. **Claim**: From a profit maximization perspective Cathy should buy the automatic machine.

2 Multiple Choice Questions

Circle the best answer to each question. There is only one answer for each question. No explanation necessary.

8. (2 points) Suppose the production function is given by $y = K^2 L^3$. When the amount of capital is 2 and the amount of labor is 3, the marginal product of capital is equal to _____ and the marginal product of labor is equal to _____.

   A. MPK=36, MPL=108
   B. MPK=108, MPL=36
   C. MPK=108,MPL=108
   D. MPKE=36, MPL=36

9. (2 points) Suppose Kevin's demand for apples is given by $Q^D = 10 - 2p$. Kevin has 3 friends who each have demand for apples given by $Q_i^D = 30 - 6p$. Now suppose the price of apples is $4. By what percentage will the demand for apples change if the price of apples increases by 1%?

   A. 4
   B. -4
   C. -20
   D. 20

10. (2 points) Tamara's production function for lemonade is given by $y = 2\ln(K) + 3\ln(L)$. Which best describes Tamara's production function?

   A. Perfect Substitutes
   B. Perfect Complements
   C. We need more information.
   D. Cobb-Douglas

11. (2 points) Suppose the production function is given by $y = (L + K)^3$. Which option correctly describes the type of returns to scale this function exhibits?

   A. Decreasing returns to scale.
   B. Constant returns to scale.
   C. Increasing returns to scale.
   D. We need more information.

12. (2 points) What is the technical rate of substitution for the production function given above in question 9?

   A. -1

B. 1

C. -3

D. 3

3   Short Answer Questions

These questions all require an explanation. Remember you are trying to convince me you understand the why and the how of what you are doing, not simply getting the answer correct. Cite specific concepts from class in your answers for full credit.

13. **Agricultural Economics**. Suppose Bill is a corn farmer and is trying to think about how to maximize his profits. In reality, there are a lot of inputs that go into growing corn (equipment, seeds, fertilizer, labor, water, etc) but for this problem we will simplify the process by focusing on two main inputs, water and fertilizer. Bill has figured out over the years that his corn plants do best if he uses twice as much pounds of fertilizer as gallons of water, and any other combination of water and fertilizer leads to wasted fertilizer or water. Assume that the prices of water and fertilizer are both positive.

    (a) (5 points) Define your variables for the amount of water and fertilizer, as well as the price of water and the price of fertilizer.

    (b) (6 points) Write down what you think Bill's corn production function might look like and explain why your production function represents the production process described above. Note that there are many possible correct answers, you only need to write down a single production function.

(c) (6 points) Let's check your production function. Intuitively, if Bill wanted to grow 100 corn plants, what are the minimum amounts of fertilizer and water Bill would need? Show that your production function reflects this intuitive answer.

(d) (6 points) Draw a graph with at least 2 isoquant curves and at least 2 isocost curves.

(e) (4 points) Suppose Bill wanted to produce y corn plants. How much fertilizer and water would Bill need? What would Bill's total cost to produce y corn plants be?

14. **Industrial Organization**. Suppose Jerry wants to open a pizza place in the exact middle of a neighborhood that consists of a single main street that is 1 mile long. There are 100 houses along this street each consisting of one household. The houses are all equally spaced along the street (uniformly distributed). Suppose each household's willingness to pay for pizza is $30 and would purchase 1 pizza per week. Also suppose it costs each household $10 per mile in travel costs. Jerry's marginal cost of producing a pizza is $5.

   (a) (2 points) What is the average distance a household would have to travel to Jerry's pizza shop? What is their average transportation cost?

(b) (6 points) Suppose Jerry set the price of his pizza at $20. How many households would purchase 1 pizza a week? Which, if any, households would not purchase a pizza?

(c) (2 points) Suppose Jerry set the price of his pizza at $30. How many households would purchase 1 pizza a week? Which, if any, households would not purchase a pizza?

(d) (4 points) Based on your answer to parts b and c, what is the maximum price Jerry could charge a given household for his pizza using t as the household's transportation cost?

(e) (4 points) Based on the profit maximization concepts we have learned in class, should Jerry open his pizza shop in this neighborhood? Why or why not?