

Fall 2018 14.01 Problem Set 2

Problem 1: True or False (24 points)

For each of the following statements, indicate if they are True or False. Justify your answer.

1. (4 points) Suppose potatoes are a Giffen good. When the price of potatoes increases, both the substitution and the income effects cause the demand for potatoes to increase.
2. (4 points) John consumes only sodas (x) and pizza (y). Suppose that his preferences can be represented by $U = \min\{x, y\}$, so sodas and pizza are perfect complements: John wants to drink one soda for every pizza he eats. If the price of sodas increases, John's demand for both sodas and pizzas will decrease, and all the change in demand will be due to the substitution effect.
3. (4 points) Consider a situation with only two goods, x and y . It is possible for one of the goods to be inferior, but they can't both be inferior at the same time.
4. (4 points) A production function uses capital and labor as inputs. If both capital and labor have diminishing marginal returns, then the production function can't display increasing returns to scale.
5. (4 points) Returns to scale for a firm are the same at all production levels.
6. (4 points) Thomas Malthus' prediction about mass starvation was wrong because the diminishing marginal product of labor has been offset by the increase in agricultural productivity.

Problem 2 (35 points)

Anne consumes only books (x) and video games (y). Her preferences can be represented by the following utility function: $U = x^2y$. The price of books is p_x , the price of video games is p_y , and Anne has an income of m dollars.

1. (5 points) Write down Anne's budget constraint, calculate the Marginal Rate of Substitution (at an arbitrary bundle (x, y)) and compute her demand for books and video games (as a function of p_x, p_y and m).
2. (5 points) Compute the price elasticity of the demand for books. Compute the cross-price elasticity of the demand for books with respect to the price of video games. (The cross-price elasticity measures the change of the quantity demanded for a good in response to a change in the price of another good, holding everything else constant. It is measured as the percentage change in quantity demanded for the first good divided by the percentage change in price of the second good.)
3. (5 points) Draw the Engel curve for video games. Are video games an inferior or a normal good? Explain.
4. (5 points) Suppose that initially the prices are $p_x = p_y = 1$ and income is $m = 90$. How many books does Anne buy? Now suppose that the price of books increases to $p_x = 2$, how many books will she buy now? How much of the drop in demand for books is due to the substitution effect and how much is due to the income effect? Calculate this numerically and show it in a graph.
5. (15 points) Suppose that her utility function were $u(x, y) = x^{1/2} + y$ instead. Also suppose that the prices are now $p_x = 1, p_y = 10$ and her income is $m = 50$. (i) Calculate her demand for books and video games in this case. (ii) Now suppose that the price of video games increases to $p_y = 15$ how many books and video games will she buy now? What is different in this case compared to question 2.4. Explain. (iii) How much of the drop in demand for video games is due to the substitution effect and how much is due to the income effect? Calculate this numerically and show it in a graph.

Problem 3 (18 points)

For each of the following production functions:

$$(a) F(L, K) = L^2 K^{\frac{1}{2}}$$

$$(b) F(L, K) = L + L^{\frac{1}{2}}K^{\frac{1}{2}}$$

$$(c) F(L, K) = 2L + K$$

1. (2 points, per production function) Find the marginal product of labor and capital, and state if the returns to capital and labor are increasing, decreasing or constant.
2. (2 points, per production function) Find the marginal rate of technical substitution.
3. (2 points, per production function) State whether the production function exhibits constant, increasing or decreasing returns to scale.

Problem 4 (23 points)

Firm X has the following production function $f(K, L) = (L + K^{2/3})$.

1. (6 points) Find the marginal product of labor and capital and the marginal rate of technical substitution, and state if the returns to capital and labor are increasing, decreasing or constant. Explain what is "weird" about this MRTS.
2. (8 points) Graph the isoquants of the production function and state whether the production function exhibits constant, increasing or decreasing returns to scale.
3. (9 points) Now suppose that the production function is $f(K, L) = \exp(2t)(L + K^{2/3})$ where t measures years. How does this affect the marginal products of labor and capital, the returns to scale and the MRTS? What is the rate of productivity increase over time? Graph the isoquants for $q = 100$ for $t = 1, 2$. Explain.

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