

# Microeconomics I

## Problem Set 3

1. Martha has the utility function  $U(x, y) = \min\{4x, 2y\}$ . Write down her demand function for  $x$  as a function of the variables  $m$ ,  $p_x$ , and  $p_y$ , where  $m$  is income,  $p_x$  is the price of  $x$ , and  $p_y$  is the price of  $y$ .

2. Mark has the following utility function on goods  $x$  and  $y$ :

$$U(x, y) = \sqrt{x} + \sqrt{y}$$

Prices are  $p_y = 1$ ,  $p_x = 5$ .

a) Assume that Mark's income is  $I = 60$ . What is his optimal consumption of the two goods? Can you rule out the existence of corner solutions?

b) Derive Mark's demand for  $x$ , given that  $I = 60$  and  $p_y = 1$ .

c) If  $p_x = p_y = 1$ , what is the expression for Mark's Engel curve for good  $x$ . Is it a normal good?

3. Miss Muffet always likes to have things "just so." In fact the only way she will consume her curds and whey is in the ratio of 2 units of whey per unit of curds. She has an income of 22 euros. Whey costs 0.75 euro per unit. Curds cost 1 euro per unit. Draw Miss Muffet's budget line, and plot some of her indifference curves. (Hint: Have you noticed something kinky about Miss Muffet?).

a) How many units of curds will Miss Muffet demand in this situation? How many units of whey?

b) Write down Miss Muffet's demand function for whey as a function of the prices of curds and whey and of her income, where  $p_c$  is the price of curds,  $p_w$  is the price of whey, and  $m$  is her income.

c) What would be your answer to (a) if you cannot consume fractional units of whey?

4. John considers peach juice and orange juice to be perfect substitutes. He spends \$5 a month on these types of juice. Initially, peach juice is \$1 a liter and orange juice is \$1.25 a liter. Then, the price of peach juice increases to \$1.5 a liter. His income allocated to juice does not change, however.

a) How does consumption change when the price of peach juice changes?

b) Show with the aid of a graph how utility changes when the price changes.

c) How much must his income increase in order to return to the original utility level?

d) Derive and graph the demand curve for orange juice, both for the case when the price of peach juice is \$1 and for the case when the price of peach juice is \$1.5.

e) Derive and graph the Engel curve for orange juice (under the assumption that the price of peach juice is \$1.5 a liter).

5. Anna, whose preferences exhibit decreasing MRS, maximized her utility subject to her budget constraint. Then the price of the first good increased and the price of the second good decreased. Since the bundle that she optimally consumed before the price change is no longer affordable, we can conclude that she is worse off after the price change. True or false? Explain.

6. Cindy consumes goods  $x$  and  $y$ . Her demand for  $x$  is given by  $x(p_x, m) = 0.05m - 5.15p_x$ . Now her income is \$419, the price of  $x$  is \$3, and the price of  $y$  is \$1. If the price of  $x$  rises to \$4 and if we denote the income effect on her demand for  $x$  by  $DI$  and the substitution effect on her demand for  $x$  by  $DS$ , then

- a.  $DI = -0.28$  and  $DS = -0.52$ .
- b.  $DI = -0.28$  and  $DS = -4.88$ .
- c.  $DI = -0.52$  and  $DS = -0.52$ .
- d.  $DI = 0$  and  $DS = -2.00$ .
- e. None of the above.

7. Katie's utility function is  $U(x_1, x_2) = 2\ln(x_1) + x_2$ . Given her current income and the current relative prices, she consumes 10 units of  $x_1$  and 15 units of  $x_2$ . If her income doubles, while prices stay constant, how many units of  $x_1$  will she consume after the change in income?

- a. 20
- b. 18
- c. 10
- d. 5
- e. There is not enough information to determine how many.

8. Clarissa's utility function is  $U(r, z) = z + 120r - r^2$ , where  $r$  is the number of rose plants she has in her garden and  $z$  is the number of zinnias. She has 250 square feet to allocate to roses and zinnias. Roses each take up 4 square feet and zinnias each take up 1 square foot. She gets the plants for free from a generous friend. If she acquires another 100 square feet of land for her garden and her utility function remains unchanged, she will plant

- a. 99 more zinnias and some more roses.
- b. 20 more roses and 20 more zinnias.
- c. 25 more roses and no more zinnias.
- d. 100 more zinnias and no more roses.
- e. None of the above.

9. Will unexpectedly inherits \$10,000 from a rich uncle. He is observed to consume fewer hamburgers than he used to.

- a. Hamburgers are a Giffen good for Will.
- b. Hamburgers are a normal good for Will.
- c. Will's Engel curve for hamburgers is vertical.
- d. Will's Engel curve for hamburgers is horizontal.
- e. Will's preferences are not homothetic.

10. Goods 1 and 2 are perfect complements and a consumer always consumes them in the ratio of 2 units of good 2 to 1 unit of good 1. If a consumer has an income of \$300 and if the price of good 2 changes from \$5 to \$6, while the price of good 1 stays at \$1, then the income effect of the price change
- is 6 times as strong as the substitution effect.
  - does not change the demand for good 1.
  - accounts for the entire change in demand.
  - is exactly twice as strong as the substitution effect.
  - is 5 times as strong as the substitution effect.