

Economics 101  
Fall 2016  
Homework #4  
Due November 17, 2016

**Directions:**

- The homework will be collected in a box **before** the lecture.
- Please place **your name, TA name** and **section number** on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade.
- Late homework will not be accepted so make plans ahead of time.
- **Show your work.** Good luck!

**Please realize that you are essentially creating “your brand” when you submit this homework. Do you want your homework to convey that you are competent, careful and professional? Or, do you want to convey the image that you are careless, sloppy, and less than professional. For the rest of your life you will be creating your brand: please think about what you are saying about yourself when you do any work for someone else!**

**Part I (Consumer Theory).**

**Question 1 (Budget Lines, Income Compensation Lines).**

1. Meredith is a freshman student at UW Madison and She works 10 hours a week at the Badger market and her hourly wage is \$8. She spends all of her income to buy coffee or books. Assume that the price of a book is  $p_B = \$10$  and the price of a cup of coffee is  $p_C = \$2$ .
  - a. Find the equation for Meredith’s budget line (BL1) and then draw a well labeled graph representing this budget line. Measure books (B) on the vertical axis and coffee (C) on the horizontal axis. Assume that her BL in this problem are based on a week's amount of time.

In Meredith's second year at the university, Meredith's hourly rate rises to \$10 per hour due to negotiations between the student association and the university.

- b. Find the equation for Meredith’s new budget line (BL2) in the second year and draw and label BL2 on the same graph that you have from (a).

In Meredith's third year as a student, the price of a cup of coffee increases to \$4.

- c. Find the equation for Meredith’s budget line in the third year (BL3) and then draw and label this BL3 in the same graph as you had in (a) and (b).

Assume that Meredith’s utility function over books and cups of coffee is given by  $u(B, C) = \min\{5B, 3C\}$  (this is an example of the perfect complement utility function). Let's examine this information before proceeding. As an example suppose that the bundle of coffee and books we are

considering is 4 coffees and 3 books. The utility function (or equation) tells us that the level of utility will be equal to the minimum of  $5B$  or  $3C$ . So,  $5B = 5(3) = 15$  and  $3C = 3(4) = 12$ . So the utility for this individual will equal 12 since 12 is less than 15. How many books could Meredith consume to have an utility of 12? If  $B = 12/5$ , then utility is the minimum of  $\{5b, 3C\}$ :  $5(12/5) = 12$  and  $3(4) = 12$ . So,  $12/5$  books and 4 coffees both yield a utility of 12 for Meredith. This suggests that there is a very particular relationship between the amount of coffee and the amount of books. Ponder this a bit before heading into the rest of this problem.

- d. Given this information, determine how many books and how much coffee Meredith will choose to consume each year in order to maximize her utility.
- e. Draw a graph illustrating the Meredith's utility maximization points for year 2 (label this point A) and year 3 (label this point B). Then in your graph determine the substitution and income effects for coffee between these two years. Based on your result with regard to the substitution effect, can you explain why this utility function is called the perfect complement utility function?)

**Part II (CPI, Real vs. Nominal, and Inflation).**

**Question 2.**

2. As a fieldwork assignment for Econ 101, you investigate life in Madison in the early 2010s: the time period from 2010—2014. You have obtained the following list of **nominal prices** for milk, snow boots and apartments.

year	milk (\$/gallon)	snow boots (\$/pair)	apartments
2010	\$2.5	\$30	\$530
2011	\$3	\$24	\$500
2012	\$3.5	\$28	\$520
2013	\$3	\$35	\$550
2014	\$3.5	\$33	\$570

Assume that purposes of calculating the CPI that the consumer basket consists of 60 gallons of milk, 4 pairs of snow boots and 1 apartment.

- a) Find the cost of market basket for each year.

Year	Cost of Market Basket
2010	
2011	
2012	
2013	
2014	

b) Suppose 2010 is the base year. Find the CPI for each year using a 100 point scale.

Year	CPI (with base year 2010)
2010	
2011	
2012	
2013	
2014	

c) The CPI is used to assess the trend of prices. Using the CPI's obtained in (b), find the annual inflation rate for each year. Please round off to two places past the decimal. (Note that you don't have to calculate the annual inflation rate from 2009 to 2010 because there is no data for 2009.)

	Annual Inflation Rate
2010—2011	
2011—2012	
2012—2013	
2013—2014	

d) Using the CPI's obtained in (b), find the **real prices** of apartments based on dollars in 2010. Please round off to the nearest whole number.

Year	Real Price of Apartments (with base year 2010)
2010	
2011	
2012	
2013	
2014	

- e) A friend of yours also investigates the cost of living in Madison with the same market basket, but she is interested in the late 2000s: from 2005 to 2009. However, she fails to collect the **nominal price** of milk in 2009. She knows that the **nominal prices** of snow boots and apartments in 2009 are \$26 per pair of snowboots and \$476 per apartment; furthermore, the **real price** of apartments in 2009 is \$544 with the base year 2010. What is the **nominal price** of milk in 2009?
- f) If you want to compare the costs of living in Madison and Pennsylvania in 2015 based on dollars in 2010, then how can you do that? Please explain the procedure.

### Part III (Production and Cost).

#### Question 3.

3. Luffy and Sanji are mechanical engineering students at UW Madison. They have discovered a new method for producing turbines. They decide to build a factory together that uses their new method. They ask their friend Nico, who studies economics, to help them make plans for their factory. They build their turbines using capital and labor, and they only have 10 units of capital. The table below summarizes the production and cost functions of their method, where  $q$ ,  $K$  and  $L$  respectively represent the quantity of turbines, capital and labor. Costs are measured in dollars, average costs are measured in dollars per turbine, marginal cost is measured in dollars per turbine, and the marginal product of labor is measured in turbines per unit of labor. (Before starting this question it would be a good idea to compile all the relevant formulae on a single piece of paper! Also, for some of the calculation on this question you may want to use a calculator! Or a spreadsheet program like EXCEL!)

K	L	q	FC	VC	TC	AFC	AVC	ATC	MC	MPL
10	0	0			20					
10		1							2	0.5
10	3	2								
10		3			26					
10		4					2.5			
10		5								0.2

- Given the above information, what is the cost of one unit of capital?
- How much labor is required to produce the first unit of output? What is the cost of a unit of labor? (Hint: you can figure this out using marginal cost and the marginal product of labor.)
- Fill in the blank cells in the table. Check to make sure that your numbers are consistent with each other!
- At what quantity does the factory start to exhibit diminishing marginal productivity of labor?
- Is their factory operating in the short run or the long run? How do you know?
- If the market price of a turbine is \$3, what quantity of turbines would the factory produce (assume that their decisions do not affect the market price)? How large would their profit or loss be given the market price and their production decision? Would they produce at this price?
- Assume that they see that the price of turbines decreases to \$1. Would they continue to produce at this market price?

#### Part IV (Perfect Competition in Short-run and Long-run)

##### Question 4.

Consider the milk market in the U.S. There are a number of companies selling milk, so that the market is perfectly competitive. Let's look at Kemps, a firm that produces milk. Assume that Kemp's total and marginal costs are given by the following equations:

$$TC = q^2 + 8q + 5$$

$$MC = 2q + 8$$

where q denotes units of milk. The market price is \$50 per unit of milk.

- Given the above information, how many gallons of milk will Kemps produce in the short run?

- b) Given your answer in (a), find the short run profit for Kemps. Show your work.
- c) What will happen in this market in the long-run? Do new companies enter the market or existing companies exit the market? If there is entry or exit, when will the entry/exit stop?

**Question 5.**

Consider the Chinese restaurant industry in Madison. The city has so many Chinese restaurants that that market can be seen as perfectly competitive. Each restaurant can serve at most 30 bowls of fried rice. Assume for mathematical simplicity that the marginal cost of serving a bowl of fried rice is constant and it is \$8. The market demand for fried rice in a day is given by

$$Q = 700 - 5P$$

- a) How much is a bowl of fried rice in the perfectly competitive market?
- b) How many bowls of fried rice will be sold in Madison every day?
- c) How many Chinese restaurants will be in Madison?

**Part V (Monopoly)**

**Question 6.**

MG&E (Madison Gas and Electronic) is a monopolist in selling electricity in Madison. The market demand curve for electricity faced by this monopolist is given as  $p = 6 - \frac{1}{8}Q^D$ . MG&E's total cost is given by  $p = \frac{1}{16}Q^2 + 5$ , and the marginal cost is given by  $MC = \frac{1}{8}Q$ . Use this information to answer the following questions.

- a) What is the equation for the marginal revenue (MR) curve for MG&E?
- b) What are the equations for the average total cost (ATC), average variable cost (AVC), and average fixed cost (AFC) for MG&E?
- c) What is the profit maximizing production quantity, QM, for MG&E if the monopolist only charges one price and the monopolist is free to set whatever price it chooses (that is, the monopoly is not regulated)? What price, PM, will it charge? Calculate the value of this monopolist's profits.
- d) Compute the consumer surplus and producer surplus for the monopolist. What is the deadweight loss in this market because of the presence of a monopoly?
- e) Now suppose that because of the deadweight loss in the economy, the government decides to set a price ceiling of \$3.50 per unit of the good. Is this price ceiling good or bad for consumers and producers?