

Economics 101

Spring 2017

Homework #4

Due Thursday, April 6, 2017

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!

<https://www.bls.gov/cpi/cpid1612.pdf>

Part I (Consumer Theory).

1. Joseph works 30 hours a week at a wage rate of \$8 per hour. He purchases only two goods with the income he earns: food and books. If he only buys books he finds that he can purchase 24 books per week and if he purchases two books he finds that he has enough money to purchase 11 units of food. You are also told that Joseph's utility function for these two goods is given by the equation $U = B \cdot F$ where U is his level of utility, B is the number of books, and F is the number of units of food. His marginal utility from books is given by the equation $MU_B = F$ and his marginal utility from food is given by the equation $MU_F = B$. Given this information:

- a. What is Joseph's weekly income? Show how you found this answer: do not just provide a number.
- b. What is the price of a book? Explain your reasoning.
- c. What is the price of a unit of food? Explain your reasoning.
- d. Draw a graph of Joseph's budget line (BL1) measuring books (B) on the vertical axis and food (F) on the horizontal axis.
- e. Write an equation in slope-intercept form for Joseph's budget line (BL1) measuring books (B) as the y variable.
- f. Given the above information how many books and how many units of food should Joseph purchase in order to maximize his utility? Show how you calculated this combination and verify

that Joseph can afford this combination and that this combination exhausts all of his income. How much utility does Joseph get when he purchases this combination of books and food?

g. Suppose that Joseph continues to work for 30 hours a week but that his wage rate rises to \$12 an hour. The price of food and books does not change from their original levels. Draw a graph that represents both BL1 and BL2 for Joseph given this information. Provide an equation in slope-intercept form for BL2 given this information. Measure books as the y variable.

h. Given the above information about BL2 how many books and how many units of food should Joseph purchase in order to maximize his utility? Show how you calculated this combination and verify that Joseph can afford this combination and that this combination exhausts all of his income. How much utility does Joseph get when he purchases this combination of books and food?

i. When you compare the optimal consumption of food for Joseph with BL1 and the optimal consumption of food for Joseph with BL2, how much of the change in food consumption is due to the substitution effect and how much is due to the income effect? Be specific in your answers and explain your answer fully and completely.

2. Consider Suzie who has income of \$200 per week that she spends on two goods: tacos and pizza. If she spends all of her income on pizza she can purchase 25 pizzas per week and if she buys only tacos she can purchase 50 tacos. You are also told that from Suzie's perspective she gets the equivalent amount of utility from 3 tacos as she does from 1 pizza. That is, she considers three tacos to be a perfect substitute for 1 pizza.

a. Given the above information, what is the price of a pizza? Explain how you found your answer.

b. Given the above information, what is the price of a taco? Explain how you found your answer.

c. Write the equation for Suzie's budget line in slope-intercept form where tacos (T) is measured as the y-variable and pizza (P) is measured as the x-variable.

d. Given the above information what is the optimal consumption bundle (P, T) for Suzie to consume given her tastes and preferences, her income and the prices of the two goods. Explain your answer and then provide a graph to illustrate the budget line, the indifference curve map, and the consumer optimization point for Suzie.

e. Suppose that Suzie still has the same tastes and preferences and her income is still \$200 per week but that the price of pizza changes to \$10 per pizza while the price of tacos changes to \$2 per taco. Determine Suzie's optimal consumption bundle (P, T) given this information. Provide an explanation for how you got your answer and a graph depicting your answer as well (should include Suzie's budget line, her indifference curves, and the consumer optimization point for Suzie).

3. Consider Pablo who has \$100 in income that he spends on good X and good Y. If he spends all of his income on good X he finds that he can purchase 20 units of good X and if he spends all of his income on good Y he finds that he can purchase 10 units of good Y. Pablo's utility is given by the following equation where U is his total utility, X is the number of units of good X and Y is the number of units of good Y:

$$U = XY$$

You are also told that Pablo's marginal utility for good X and for good Y can be expressed as follows:

$$MU_X = Y$$

$$MU_Y = X$$

- a. Given the above information find the price of good X and good Y.
- b. Given this information find the combination of good X and good Y, (X, Y) , that maximizes Pablo's utility given his income, the prices of the two goods, and his tastes and preferences. Show your work and explain your answer. Let's call this optimal bundle, bundle A. Bundle A sits on indifference curve 1 and on budget line 1.
- c. Suppose that the price of good X increases by 100% from its original level. Everything else stays the same. Given this new information, find the combination of good X and good Y (X', Y') , that maximizes Pablo's utility given his income, the prices of the two good (using the new price for good X), and his tastes and preferences. Show your work and explain your answer. Let's call this optimal bundle, bundle B. Bundle B sits on indifference curve 2 and on budget line 2.
- d. Suppose that Pablo's demand curve is linear. Use the information from (b) and (c) to write the equation for Pablo's demand curve. Show your work and explain in words what you are doing.
- e. When the price of good X increases, Pablo responds by decreasing his consumption of good X due to the substitution and the income effects. Pablo wants you to figure out how much of this change in consumption is due to the substitution effect and how much is due to the income effect. To do this, you will need to find bundle C where Pablo faces the new price for good X (the price in (c)) while having the same utility as he had at point A. Here are some questions to guide you on this work.
 - i. What was Pablo's utility at point A? Show your work.
 - ii. What will be Pablo's utility at point C where point C corresponds to the consumption bundle (X'', Y'') ?
 - iii. What is the consumer optimization relationship at point C where point C corresponds to the consumption bundle (X'', Y'') ?
 - iv. Use the information in (ii) and (iii) to find the values of X'' and Y'' . These values are the coordinates for bundle C. Provide a check that the utility level at bundle A equals the utility level at bundle C.

- v. Approximately (to the nearest dollar amount) how much income does Pablo need to purchase bundle C?
- vi. How much of the change in consumption of good X that occurs when Pablo moves from point A to point B is due to the substitution effect?
- vii. How much of the change in consumption of good X that occurs when Pablo moves from point A to point B is due to the income effect?

Part II: CPI, Real vs. Nominal, and Inflation

4. In this problem you will go through the process of calculating the CPI for a simple example. For purposes of calculating the CPI you are told that the market basket consists of 10 apples, 20 oranges, and 5 books. You are provided the following information:

Year	Price per Apple	Price per Orange	Price per Book	Cost of Market Basket
1	\$1	\$2	\$5	V
2	\$1	X	\$6	100
3	Y	\$4	\$5	U = Cost of Market Basket in Year 3 is 25% greater than in Year 2
4	S = Price in Year 4 is 50% less than in Year 3	\$3	Z	T = Cost of Market Basket in Year 4 is 100% greater than in Year 3

- a. Fill in the missing cells in the above table and show the work you did to get each answer.
- b. Using the table you completed in (a), calculate the CPI based on the given market basket for these four years. Use Year 1 as the base year and a 100 point scale. Put your results in the following table. Round your answers to the nearest tenth.

Year	CPI with base year Year 1 and a 100 point scale
1	
2	
3	
4	

- c. Calculate the annual rate of inflation based upon the CPI figures you calculated in (b) and enter your results in the following table. Round your answer to the nearest whole percentage.

Year	Annual Rate of Inflation based on CPI with Year 1 as base year
2	
3	
4	

d. Using the table you completed in (a), calculate the CPI based on the given market basket for these four years. Use Year 2 as the base year and a 100 point scale. Put your results in the following table:

Year	CPI with base year Year 2 and a 100 point scale
1	
2	
3	
4	

e. Calculate the annual rate of inflation based upon the CPI figures you calculated in (d) and enter your results in the following table. Round your answer to the nearest whole percentage. Did you get the same annual rate of inflation (with possibly a bit or rounding error) as you did in (c)?

Year	Annual Rate of Inflation based on CPI with Year 2 as base year
2	
3	
4	

5. After four years of studying, Marci is scheduled to graduate from the UW-Madison in May! She is excited and she is also pleased that she has four job offers all starting July 1. For the sake of this problem let's assume that the work is the same at all four jobs and that she has no locational preference. Her only criteria for selecting a job is that it pays the highest real wage. Marci paid attention during her Economics 101 class and knows that she should be able to figure out the real wage for each of these locations if she has the CPI for the location. She plans to use the December 2016 CPI index number for each location (since the 2017 figures will not yet be available). She plans to utilize the government as the source of this data. She knows that the Bureau of Labor Statistics (BLS) provides this information and she challenges herself to find it on her own! [Don't cheat here: you try to find it as well!....But, if you can't find it, the web address is buried in this document!....I can at least get you to hunt through this document!...But, you will learn more if you go to the web and check out the BLS!] You will want to look for the "CPI Detailed Report" and once you find it, you will want to go to table 16 and then use the data for the Dec. 2016 "All Item" index number for the particular city. Plan to use the CPI figure that includes three places past the decimal for your calculations (fine to use a calculator on this set of questions!).

Here are Marci's offers:

Location of Job Offer	Nominal Salary	CPI for Dec. 2016 from BLS website	Real Salary in 1982- 84 (base year for CPI index) dollars
Atlanta, Georgia	\$45,000		
Los Angeles- Riverside-Orange County, CA	\$61,000		

Miami-Fort Lauderdale, FL	\$63,000		
Seattle-Tacoma-Bremerton, WA	\$58,000		

- a. Complete the above table. You will get the CPI numbers from the website and then you will use the formula provided in class to calculate the real salary for each of these locations.
- b. Based solely on real income, which offer should Marci take?
- c. Given the data you collected in (a), what would each offer need to be in order for all the offers to have the equivalent purchasing power as the Seattle-Tacoma-Bremerton, WA offer as measured in 2016 dollars? Show how you computed these new nominal income salaries. Report the nearest whole number for your salary figures.
- d. You just did a lot of work for answer (c), can you now provide a rationale for why Marci might want to know how to do this?

Part III: Production and Cost

6. For this problem I want you to use EXCEL or a similar spreadsheet program. If you have never used a spreadsheet program, it is not that hard and it is a very valuable skill to have for personal use as well as professional use.

Imagine that you produce widgets and you know that you need to use labor (L) and capital (K) to produce your widgets. Your capital is a fixed input while your labor is a variable input. You also know that your production of widget is described by the following production function:

$$q = \sqrt{K} \sqrt{L}$$

q is the number of widgets, K is the number of units of capital, and L is the number of units of labor.

a. Given the above information, fill in the missing values in the table below. Actually make your own spreadsheet, insert the necessary formulas and compute the values for each missing cell. For all computations except fixed cost (FC) and variable cost (VC) carry your answer to two places past the decimal. For FC and VC calculate the round to the closest whole number. Here are a couple of hints in doing this work:

- i. You should be able to fill in the first three columns from the provided information.
- ii. You will need to have a strong command of the various definitions we discuss in class:

$$ATC = TC/q$$

$$AFC = FC/q$$

$$AVC = VC/q$$

$$VC = (\text{Price of the variable input})(\text{Number of units of the variable input})$$

$$FC = (\text{Price of the fixed input})(\text{Number of units of the fixed input})$$

$$TC = FC + VC$$

$MC = (\text{Change in total cost}) / (\text{Change in output})$

$MPI = (\text{Change in output}) / (\text{Change in labor})$

iii. You will need to think and consider this a logic puzzle: easy to do if you just stop and apply the various pieces of information you have.

K	L	q	FC	VC	TC	AFC	AVC	ATC	MC	MPI
100	0					---	---	---	---	---
	10									
	20									
	30						1.10			
	40									
	50									
	60									
	70									
	80									
	90					1.05				
	100									
	110									
	120									
	130									
	140									

b. What is the price of a unit of capital? What is the price of a unit of labor? Explain how you found these prices.

c. Describe what happens to the Marginal Product of Labor (MPI) as output increases. Use the information that you calculated in the table.

d. Examine the results in your table. Describe what happens to AFC as output increases. Explain why this is happening.

e. Examine the results in your table. Describe what happens to ATC as output increases. In your answer include a reference and description of the spreading effect as well as the diminishing returns effect (you may need to consult your textbook on this: make sure that you do not write a copy of your textbook's material here: that would be academic misconduct-plagiarism!).

f. Suppose this firm is a perfectly competitive firm. Furthermore, suppose that the market price for this good is equal to \$4. What is the profit maximizing level of output for this firm to produce given this information? What will be the firm's level of profits? Show how you found this answer.

Part IV: Perfect Competition in Short-run and Long-run

7. Consider the market for widgets. This is a perfectly competitive market where all the firms are identical. Each firm has identical cost curves where q is the quantity of widgets:

$$\text{TC for each firm: } \text{TC} = q^2 + 9q + 9$$

$$\text{MC for each firm: } \text{MC} = 2q + 9$$

The market demand curve is given by the following equation where P is the price per widget and Q is the total number of widgets produced in the market.

$$\text{Market Demand: } P = 559 - Q$$

Initially there are twenty firms in the market.

- a. Find the short run market supply curve given the above information.
 - b. Given the short run market supply curve you found in (a) and the market demand curve, find the short run market equilibrium quantity and the market equilibrium price. Then calculate the quantity produced by the representative firm. Then, compute the representative firm's profit in the short run. Finally make a prediction about what will happen in the long run. Explain the logic behind your prediction. Show how you found all of these answers.
 - c. Given the market demand curve and cost curves, find the long run market equilibrium price, the level of production by the representative firm, and the market equilibrium quantity. Then calculate the total number of firms in the industry in the long run. Show your work for each of these steps. (It is okay to have a "partial firm" in your answer!)
8. Consider the market for coffee shops in Madison. The city has so many coffee shops that that market can be seen as perfectly competitive. Each coffee shop can serve at most 90 cups of coffee per day. Assume for mathematical simplicity that the marginal cost of serving a cup of coffee is constant and equal to \$2. The market demand for coffee in a day is given by the equation:

$$Q = 1000 - 5P$$

- a. How much is a cup of coffee in this perfectly competitive market?
- b. How many cups of coffee will be sold in Madison every day?
- c. How many coffee shops will be in Madison?

Part V: Monopoly

9. Polly owns a monopoly in her small town. She knows that the market demand curve for her product is given by the following equation where P is the price per unit of the good and Q is the number of units of the good:

$$\text{Market Demand: } P = 330 - 2Q$$

Polly also knows her total cost equation and her marginal cost equation:

$$\text{Total Cost: } TC = (1/16)Q^2 + 5$$

$$\text{Marginal Cost: } MC = (1/8)Q$$

- a. What is the profit maximizing quantity and price for Polly given the above information? Show how you found your answer.
- b. What is the value of Polly's profits? Show how you found your answer.
- c. What is the value of consumer surplus when Polly acts as a monopolist in this market? Show how you found your answer.
- d. What is the value of producer surplus when Polly acts as a monopolist in this market? Show how you found your answer.
- e. What is the deadweight loss due to this firm acting as a monopolist? Show how you found your answer.
- f. Draw a graph that illustrates this monopolist's situation. In your graph include the monopolist's demand curve, marginal revenue curve, marginal cost curve. Label the monopolist's price and the monopolist's quantity in your graph. Shade and label the areas that correspond to consumer surplus, producer surplus, and deadweight loss for the monopolist.