Economics 101
Fall 2018
Homework #5
Due Tuesday, December 11, 2018

Directions:

- The homework will be collected in a box labeled with your TA's name **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.
- Please **staple** your homework: we expect you to take care of this prior to coming to the large lecture. You do not need to turn in the homework questions, but your homework should be neat, orderly, and easy for the TAs to see the answers to each question.
- Late homework will not be accepted so make plans ahead of time.
- Show your work. Good luck!

Part 1. Monopoly and Price Discrimination

1. Suppose you are given the following information about a monopolist:
   Market Demand Curve: $P = 200 - 2Q$
   MC for the monopolist: $MC = 20 + 2Q$
   Total Cost for the monopolist: $TC = 20Q + Q^2 + 100$
   Use this information to answer this set of questions.
   1) What is the profit maximizing price and quantity for this monopolist given the above information? Show how you found your answer and what your reasoning was. Calculate the monopolist's profit.
   2) Calculate the monopolist's consumer surplus (CS), producer surplus (PS), and deadweight loss (DWL). In a well-labeled graph illustrate this monopolist: be sure to include the areas that represent CS, PS, and DWL in your graph.
   3) Suppose demand increases by 90 units at every price. Find the equation for the monopolist's new demand curve. Then, calculate the new profit maximizing price and quantity for this monopolist given the new demand curve. Calculate the new level of monopoly profits.
   4) Calculate the value of consumer surplus (CS'), producer surplus (PS'), and deadweight loss (DWL') for this monopolist given the information in (3). In a well-labeled graph illustrate this monopolist: be sure to include the areas that represent CS', PS', and DWL' in your graph.

2. Consider a monopoly where the market demand curve is given by the equation:

Market Demand Curve: $Q = 40 - 2P$

To simplify the math of this problem let's assume this firm has fixed cost of $10 and that the firm's MC can be written as:

MC for the Firm: MC = $2 per unit of output

1) Suppose this profit-maximizing monopolist acts as a perfect price discriminating (1st degree) monopolist. Determine the following values.
   a. What is the level of output the firm will produce of the firm acts as a perfect price discriminating monopolist? Show your work.
   b. What is the level of consumer surplus (CS), the level of producer surplus (PS), and the deadweight loss (DWL) if this firm acts as a perfect price discriminating monopolist?
   c. What is the level of profits the firm will earn when it acts as a perfect price discriminating monopolist? Provide a graph that illustrates your answers from (a), (b), and (c).

2) Now, suppose this monopolist decides to practice second degree price discrimination. The monopolist plans to sell 18 units of output at a price of $11per unit. The monopolist then plans to offer an additional 10 more units at a second pricing level; and an additional 4 more units at a third, and lower, pricing level. Given this information and holding everything else constant, determine your answers to the following questions.
   a. What is the second pricing level? Show how you found your answer to this question.
   b. What is the third pricing level? Show how you found your answer to this question.
   c. Is it better for the monopolist to practice first degree price discrimination as described in the first part of this question or is it better for the monopolist to practice second degree price discrimination as described by this part of the question? Explain your answer. Illustrate your answers to (a), (b) and (c) with a well-labeled graph. In your graph indicate the areas that correspond to total revenue (TR) and variable costs (VC)

3) Suppose now suppose this monopolist decides to practice third degree price discrimination. That is, it can discriminate between two groups of consumers and charge each group a different price. (The original market demand curve is unrelated to this question)

The demand functions of the two groups are given by:

Demand Curve for Group 1: $P1 = 24 - Q1$

Demand Curve for Group 2: $P2 = 10 - 0.5\ Q2$

   a. What is the level of output each group will choose to consume and the price each group will pay for the good? Show how you found your answer.

b. What is the value of consumer surplus (CS) and producer surplus (PS) when this monopolist practices third degree price discrimination? Show how you found your answer.
c. What is the level of profits the monopolist will earn when it practices third degree price discrimination? Show how you found your answer. Then illustrate your answer by drawing two graphs: one representing Group 1 and the other representing Group 2. Make sure you label both graphs clearly and completely.

Part 2. Game Theory

3. Consider the following games:

1) Two people are trying to figure out how to split $8 that they found lying around. In order to make it fair (but interesting!), they use a random number generator to create some simple payouts for a 2x2 game. The game can be represented by the following payoff matrix, with the left number in each cell referring to Player One, and the right number referring to Player Two. Each person can choose one of two options that the machine spits out, which gives the following results:

		Player Two	
		Option A	Option B
Player One	Option A	3,5	2,6
	Option B	7,1	1,7

Are there any dominant strategies for Player One? Are there any dominant strategies for Player Two? Based on this and assuming players are rational, what do you think the outcome of the game will be?

2) In the classic game theory problem "the Stag Hunt", two hunters must decide on their approach. By working together, they can bring down a stag, which means they'll have a feast. However, either hunter can decide instead to abandon the plan and try to trap rabbits. Catching a rabbit is good, but not as good as a stag. Worse still, if a hunter tries to catch a stag alone, he fails and receives nothing.

The game can be represented by the following payoff matrix, with the left number in each cell referring to hunter one, and the right number referring to hunter two.

	Hunter Two	
	Hunt Stag	Hunt Rabbit

Hunter One	Hunt Stag	4,4	0,2
	Hunt Rabbit	2,0	2,2

Are there any strictly dominant strategies for either hunter? Based on this, what do you think the outcome of the game will be?

Part 3. Externality and Public Good

4. A vast reserve of tight oil is discovered in previously-unnoticed shale underneath the University of Madison! An oil company rapidly sets up to extract as much as they can, with a local market supply curve (the marginal private cost curve) given by the following equation:

Market supply: $P = 2Q$

Where Q is the quantity of barrels of crude oil and P is the price per barrel. A small refining industry develops around the University, with a demand (marginal private benefit) curve given by:

Market demand: $P = 150 - Q$

A group of environmental economists have concerns, however, that the horizontal drilling and hydraulic fracturing methods used to extract oil could have adverse effects on Lake Mendota. They estimate an approximate negative externality of $15 per barrel per barrel of oil that is sold.

1) Find the competitive equilibrium (i.e., the equilibrium quantity and the equilibrium price) in the market, assuming externalities are not accounted for by any of the market participants.

2) Given the above information, what are the equations for the marginal social cost and marginal social benefit curves?

3) Graph the marginal private cost/benefit and marginal social cost/benefit curves. Find the socially optimal equilibrium. Compare it to the competitive equilibrium.

4) The State of Wisconsin steps in to intervene by ordering an excise tax placed on local oil <u>producers</u>. What level of tax is needed to result in the new competitive equilibrium producing the same result as the socially optimum equilibrium?

5) Under this tax level and the new competitive equilibrium, find the price producers will receive, the price consumers will pay, and the tax revenue.

6) What is the deadweight loss when the government decides <u>not</u> to intervene?

5. As winter rolls around in the village of Economica, three residents begin considering that they will need to organize snow-plowing services if they ever want to get to work to write exams. Each resident has different levels of acclimation to the cold and tolerance for inconvenience, so they value the use of snow-plowing differently. We can write their willingness to pay represented by the following demand curves, where P is the price of the service and Q is the quantity of hours spent plowing per month.

   Resident A: $P = 120 - 2Q$

   Resident B: $P = 180 - 2Q$

   Resident C: $P = 300 - 6Q$

   It costs the village $80 per hour of snow-plowing per month, and hence the MC of each additional unit is constant at $80.

   1) Suppose this market is competitive. Find the quantity demanded by each resident and the price per unit paid. Are there any free-riders in this market?

   2) Now, recognizing that this good is a public good in that it is nonexcludable and nonrival in consumption, find the aggregate demand for snow-plowing services. Draw the graph of this aggregate demand curve and label any kink points.

   3) What is the socially optimum quantity of snow-plowing? How much should each resident contribute towards this on a per-unit basis?