

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!

Public Goods:

1. Provide an example of 1 good that is non-rival but excludable, 1 good that is non-excludable but rival; and one pure public good. For each good explain why this good meets the criterion. Your examples should be different from the ones provided in your textbook or in large lecture (we do want to add to the challenge here and make sure you think a bit about this!).

2. Suppose there are three types of consumers with different demand curves for good public education, good public hospitals and good parks. Let's call this whole bundle of goods the Public Good. (Note that I am "stretching" the definition of public good because education and health are certainly not pure public goods, but for the sake of the interest in policies, let's leave these concepts as part of the public good that we are analyzing.) The following equations provide the demand curves for each group of consumers of this public good where P is the price per unit of the public good and Q is the quantity of units of the public good:

$$\text{Group One: } P = 200 - Q$$

$$\text{Group Two: } P = 40 - 3Q$$

$$\text{Group Three: } P = 50 - Q.$$

The cost of producing public goods in this example is constant and is given by the following equations where TC is total cost and MC is marginal cost:

$$TC = 40Q$$

$$MC = 40$$

a. By vertically summing the three demand curves, derive the aggregate demand curve for the public good. Provide a set of four graphs stacked vertically to illustrate the work you are doing: the top graph should represent Group One, the second graph should represent Group Two, the third graph should represent Group Three, and the fourth graph should represent the aggregate

or market demand for the public good. Make sure all your graphs are clearly and completely labeled.

b. What is the Social Marginal Benefit of the Public Good?

c. Find the socially optimal level of the public good. Also, find the total price of each unit of the public good. Show your work.

d. Suppose that each consumer group has to pay an equal amount P per unit of public good.

Based on P , the consumers must tell the government their optimal quantity of the public good. In the case where each consumer group offers their optimal bid for the socially optimal quantity of the public good, what level of the public good will each consumer group choose when deciding the optimal amount of the public good? Will there be consensus in this society on the optimal quantity of the public good?

e. Suppose that the government recognizes the difficulty of finding a consensus on what the socially optimal amount of the public good is and therefore the government decides to set different prices for each group of consumers. If the government wishes to provide the aggregate socially optimal amount of the good, what prices would it charge each consumer group to get this outcome? Show how you found your prices for each group.

f. Suppose that in this problem the MC was actually equal to: $MC' = \$200$ per unit of the public good. How would this alter the socially optimal amount of the good? What prices would each consumer group pay per unit of the public good with this change? Show your work!

Externalities:

3. Suppose that there are two people who live next door to one another. One person loves loud music and the other person loves flowers. The individual who loves loud music has a marginal private benefit curve for loud music given by the equation:

$$MB_{\text{music}} = 10 - X, \text{ where } X \text{ is the amount of decibels of loud music}$$

The individual who loves flowers has a marginal private benefit curve for flowers given by the equation:

$$MB_{\text{flowers}} = 5 - F/2, \text{ where } F \text{ is the number of flowers}$$

The flower lover receives no marginal benefit from the loud music and the loud music lover receives no marginal benefit from flowers.

The marginal private cost of providing loud music is equal to \$4 per decibel of music and the marginal private cost of growing flowers is equal to \$2 per flower.

When the music lover plays their music they create an externality on the flower lover that is equal to \$2 per decibel of music. When the flower lover grows flowers (growing flowers creates pollen, irritating the allergies of the music lover) this imposes an externality cost of \$1 per flower on the music lover.

a. If the music lover only considers her marginal private benefit and marginal private cost how much loud music will be produced?

b. If the flower lover only considers his marginal private benefit and marginal private cost how many flowers will be produced?

- c. Suppose that the externality from the loud music is internalized in this market. What is the socially optimal level of decibels?
- d. Suppose that the externality from the flowers is internalized in this market. What is the socially optimal level of flowers?
- e. How much would the flower lover need to compensate the music lover in order to get the music lover to produce the socially optimal amount of music?
- f. How much would the music lover need to compensate the flower lover in order to get the flower lover to produce the socially optimal amount of flowers?

Game Theory:

4. Two countries that are the rulers of the Free Island A and Free Island B are disputing control over the country Smaller Island that has a lot of fish and game around. From the perspective of the rulers of both Free Island A and Free Island B, Smaller Island is the promised heaven. For the last couple of months, the two rulers have been threatening each other, saying that war is eminent. The value of the loss of their country's soldiers' lives is a loss of 6 utils to the country. As a result, every time the two countries are in battle each country loses 6 utils, assuming that every time there is a battle all the soldiers from each country die.

We are also told that if Free Island A takes control over Smaller Island and Free Island B does not invade Smaller Island, then Free Island A will receive a payoff of 10 utils while Free Island B will receive a payoff of 0 utils. If both Free Island A and Free Island B invade Smaller Island, then both countries' soldiers will die while the two invading countries share evenly the value of Smaller Island, which is 10 utils in all. If Free Island B invades Smaller Island and Free Island A does not invade Smaller Island, then Free Island B will receive a payoff of 10 utils while Free Island A will receive a payoff of 0 utils.

- a. Describe the set of players in this game, the strategies available to each player, and the payoffs association with each combination of strategies facing the players. Draw a payoff matrix representing this game with Free Island A on the left side of the matrix and Free Island B on the top of the matrix.
- b. Given the payoff matrix you created in (a), what is the best strategy for Free Island A? Explain your answer.
- c. Given the payoff matrix you created in (a), what is the best strategy for Free Island B? Explain your answer.
- d. Given the payoff matrix you created in (a) and your analysis in (b) and (c), what outcome(s) do you predict for this game?
- e. Suppose Free Island A knows that Free Island B is governed by a crazy murderer and that this leader will always choose to "Invade". Given this information, what is the best strategy for Free Island A to pursue?
- f. If Free Island B reasons that Free Island A is going to always choose "Not Invade" due to Free Island B having a ruler only too happy to invade, then what is Free Island B's best strategy given this information? Assume that although Free Island B has a crazy leader, this leader can at times act quite rationally and can certainly do a bit of simple game theory!

Price Discrimination:

5. The demand structure for a specific market has two groups of consumers. The demand for each group is given by the following equations:

$$\text{Demand for Group One: } P = 10 - Q$$

$$\text{Demand for Group Two: } P = 5 - Q/3$$

The marginal cost of producing the good is constant and equal to \$1 per unit of output: that is, marginal cost can be written as:

$$MC = 1$$

For this problem, assume that there are no fixed costs.

- a. Given the above information find the market demand for this product given the group demands.
- b. Given this information and holding everything else constant, what is the socially optimal amount of the good? What price will this socially optimal amount of the good sell for in this market if the monopolist is only allowed to charge one price? Calculate the value of consumer and producer surplus when the socially optimal amount of the good is produced.
- c. Suppose this monopolist acts as a single price monopolist. What is the profit maximizing output for this monopolist and what is the price that they monopolist will charge (take the price out to three places past the decimal)? Calculate the single-price monopolist's profits, the value of CS if this market is served by a single-price monopolist, the value of PS if this market is served by a single-price monopolist, and the value of DWL under this arrangement. Show your work.
- d. Suppose that this monopolist is able to differentiate between these two groups at no cost. The monopolist decides to charge each group a different price: that is, the monopolist decides to practice third degree price discrimination. What price will Group One pay and what quantity of the good will Group One get? What price will Group Two pay and what quantity of the good will Group Two get? Calculate what this third degree monopolist's total profit level will be. Show how you found your answers.
- e. Compare your answer in (c) and (d). Is it an advantage to the monopolist to practice third degree price discrimination rather than be a single-price monopolist? Explain your answer.