
Additional Practice Problems

These are additional practice problems related to duopoly, externalities and public goods to help you prepare for the final exam.

1. Two firms compete with one another by choosing quantities. The market price is then determined by what consumers are willing to pay based on the total quantity supplied (the sum of the firms' quantities). Firm A has marginal costs that are constant and equal to \$5 per unit. Firm B also has constant marginal costs but they are equal to \$10 per unit. Market demand is given by:

$$D(p) = 500 - 10p \tag{1}$$

- (a) Write down expressions for firm A 's profits and firm B 's profits as functions of firm A 's quantity (y_A) and firm B 's quantity (y_B).
- (b) Find a function giving firm A 's best response to firm B 's chosen quantity ($y_A(y_B)$).
- (c) Find a function giving firm B 's best response to firm A 's chosen quantity ($y_B(y_A)$).
- (d) Given your best response functions from (b) and (c), find the equilibrium quantity produced by each firm.

2. Two movie theaters compete by advertising against one another. If one theater places an ad and the other doesn't, the advertising theater gets 75% of the demand. If both theaters advertise, they split the demand evenly. If neither theater advertises they also split demand evenly. There are 500 customers each willing to pay \$10 to see a movie. The average costs per customer (not counting spending on advertising) are constant and equal to \$6 for both firms.
- (a) Suppose that advertising costs A dollars. This is a fixed amount and does not depend on the number of customers who see the ad or come to the theater. Write down a payoff matrix showing the different combinations of strategies for the firms and the profits of each firm under each combination.
 - (b) Given your payoff matrix in part (a), over what range of values for A will the equilibrium outcome be neither firm advertising.
 - (c) Over what range of values for A will the equilibrium outcome be both firms advertising.

3. Suppose that the marginal costs of a firm producing TVs are constant and equal to \$100. There is an endless supply of customers willing to pay \$150 for a TV. The production of TVs produces pollution which imposes a cost on local residents. The marginal costs of pollution on the first few TVs are high because the residents are accustomed to a pristine environment. However, these marginal costs fall as the number of TVs increases and people get more accustomed to pollution. Once the number of TVs exceeds 100, marginal costs begin to rise again as the excessive pollution starts to have severe health consequences.
- (a) Graph the marginal benefit, private marginal cost and social marginal cost curves on a graph with number of TVs on the horizontal axis. Assume that the socially efficient number of TVs is positive, finite and not equal to 100.
 - (b) Will setting social marginal benefit equal to social marginal cost yield a unique solution for the efficient quantity of TVs?
 - (c) Assuming there are two values of TVs at which social marginal cost equals social marginal benefit, are they both socially efficient? If not, which one leads to more total surplus?

4. The market for sunscreen is competitive. Firms have constant marginal costs of \$5 per bottle. Demand for sunscreen is given by the following function:

$$D(p) = 400 - 40p \quad (2)$$

For every bottle of sunscreen used by a consumer, health care costs for society decrease by \$5 due to the reduction in skin cancer cases. This is a benefit that individual consumers do not take into account when making sunscreen purchases.

- (a) What will be the equilibrium number of bottles of sunscreen sold in the absence of any government regulation?
- (b) What is total surplus at this quantity? Be certain to account for any externalities.
- (c) What is the efficient number of bottles of sunscreen?
- (d) Assume that the government uses a subsidy per bottle to achieve the efficient number of bottles. How much will the government spend in subsidies in total?

5. Two friends are going on a vacation together and need to decide on a shared hotel room. Friend *A* has a constant marginal benefit from hotel quality of \$10 per additional unit of quality. Friend *B* has a decreasing marginal benefit from quality given by:

$$MB_B(Q) = 20 - \frac{1}{5}Q \quad (3)$$

where Q is the overall quality of the hotel. Hotel prices are increasing in quality. A hotel of quality zero costs \$5 a night. Every additional unit of quality increases the hotel price by an amount that depends on the current level of quality Q . This marginal cost of quality is given by:

$$MC(Q) = \frac{1}{2}Q \quad (4)$$

- (a) If friend *A* were travelling by himself, what hotel quality would he choose?
- (b) If roommate *B* were travelling by himself, what hotel quality would he choose?
- (c) Suppose that friend *A* announces he will pay for the quality you found in part (a). After hearing this, how much extra will roommate *B* chip in for the hotel room? Is this outcome efficient? Be certain to explain your answer.
- (d) Suppose that friend *B* announces he will pay for the quality you found in part (b). After hearing this, how much extra will roommate *A* chip in for the hotel room? Is this outcome efficient? Be certain to explain your answer.