

Intermediate Microeconomic Theory
ECN 100B, Fall 2019
Professor Brendan Price

Homework #2

Due: Friday, October 11th at 5:00pm

1 Monopoly, naturally (12 pts.)

Because producing and distributing electricity involves big fixed costs and therefore big “economies of scale”, it doesn’t make economic sense to have multiple electrical utilities serving the same geographic area. Instead, state governments let electric utilities operate as “natural monopolies”, while placing restrictions on what prices they are allowed to charge.

An electrical utility faces demand given by $p(Q) = 36 - Q$. Its cost function is $C(Q) = Q^2$. (To keep things simple, we’ll ignore the fixed costs throughout this problem.) Assume that the utility is legally obligated to charge all consumers the same price.

- (3 pts.) Suppose that the firm chooses quantity. Express the firm’s profits as a function of Q . Solve for the monopoly quantity Q_m , then solve for the monopoly price p_m .
- (3 pts.) Now suppose that the firm chooses price. Express profits as a function of p . Solve for the monopoly price p_m , then solve for the monopoly quantity Q_m . How do your answers compare with the ones you found in part a?
- (3 pts.) Draw a clearly labeled graph representing this market. Be sure to draw the demand curve, marginal cost curve, and marginal revenue curve. Label the monopoly solution (Q_m, p_m) . Calculate the producer surplus, consumer surplus, and DWL.
- (3 pts.) Explain how the government can use a price regulation to achieve the socially optimal level of output in this market. Should we use a price ceiling or a price floor? At what price should we set the ceiling/floor? Compute consumer surplus, producer surplus, and DWL under this regulatory policy.

2 Pricey pills (6 pts.)

When the patent on a popular medication expires, other companies quickly introduce generic versions that are therapeutically equivalent to the original version. Although doctors regard generic medications as being just as effective, many consumers show “brand loyalty”: they are willing to pay more for brand-name drugs like Tylenol than for generic acetaminophen. This gives drug companies a bit of market power even after their patents expire.

- a. (3 pts.) Demand for Tylenol is given by $p(Q) = 60 - 6Q$. Compute the elasticity of demand as a function of Q , simplifying your answer as much as possible. For what value of Q is demand perfectly inelastic? For what value of Q is demand unit elastic? For what value of Q is demand perfectly elastic?
- b. (3 pts.) Demand for Advil is given by $Q(p) = 100p^{-5}$. Compute the elasticity of demand. (Hint: this is a special function for which the elasticity doesn't vary with Q .) If Advil's manufacturer is profit-maximizing, what price markup will it choose?
- c. (Optional and ungraded) A uniform-pricing monopolist firm faces a downward-sloping (and differentiable) demand curve $p(Q)$. Prove that its total revenue is maximized at a point where demand is unit elastic. Provide economic intuition for this result.

3 Personalized medicine? (12 pts.)

Suppose that the pharmaceutical firm Merck is deciding whether to develop a new diagnostic procedure that can detect early-stage Alzheimer's disease more accurately than existing tests.

Developing this technology would require an up-front fixed cost $FC > 0$. If Merck develops the technology, it can screen Q patients for Alzheimer's at the variable cost $VC(Q) = 20Q$. Merck estimates that market demand for the procedure would be $p(Q) = 80 - \frac{1}{10}Q$.

- a. (3 pts.) Suppose that other companies can quickly copy Merck's procedure as soon as it is developed, so that the market for medical tests will become perfectly competitive. If Merck develops the procedure, what are the equilibrium price p_c and quantity Q_c ? If $FC = 5000$, will Merck develop the procedure? What about if $FC = 10,000$?
- b. (3 pts.) Now suppose that, if Merck develops the procedure, it will receive a patent that allows it to operate as a uniform-pricing monopolist. In this case, if Merck develops the procedure, how many patients will it screen (Q_m), and what will it charge (p_m)? If $FC = 5000$, will Merck develop the procedure? What about if $FC = 10,000$?
- c. (3 pts.) Now suppose that, if Merck develops the procedure, it is legally permitted (and able) to engage in perfect price discrimination. If Merck develops the procedure, what are its optimal quantity Q_{ppd} , revenue $R(Q_{ppd})$, and variable costs $VC(Q_{ppd})$? If $FC = 5000$, will Merck develop the procedure? What about if $FC = 10,000$?
- d. (3 pts.) Suppose that $FC = 5000$. Using your answers above, compute consumer surplus, producer surplus, and total surplus under each of the following policies:
 - i. No patent protecting Merck's innovation (as in part a).
 - ii. A patent letting Merck to operate as a uniform-pricing monopolist (as in b).
 - iii. Legal permission for Merck to engage in perfect price discrimination (as in c).

(If Merck develops the procedure, make sure to subtract FC from the producer surplus.) If we are trying to maximize total surplus, which of these policies is best? If we are instead trying to maximize *consumer* surplus, which policy is best?