LECTURE NOTES ON MICROECONOMICS

ANALYZING MARKETS WITH BASIC CALCULUS

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Part 4: General equilibrium and market power

Chapter 14: Monopoly

Problems

(14.1) [Barriers to entry] Suppose development of a particular type of software costs $50 million, and distribution of each copy of costs $2.
  a. Find the total cost function TC(Q), where Q denotes the number of copies sold.
  b. Find the average cost function AC(Q).
Suppose 1 million copies of this software are to be produced.
  c. Compute average cost if one firm produces the software.
  d. Compute average cost if output is divided evenly between two firms.
  e. Compute average cost if output is divided evenly between four firms.
  f. Is this industry a natural monopoly? Why or why not?

(14.2) [Marginal revenue] Suppose a sidewalk tee-shirt vendor can sell 5 tee-shirts per hour at a price of $10.
  a. The vendor can sell 6 tee-shirts per hour if the price is dropped to $9. Calculate the marginal revenue (per hour) for that 6th tee-shirt.
  b. The vendor can sell 7 tee-shirts per hour if the price is dropped further to $8. Calculate the marginal revenue (per hour) for that 7th tee-shirt.
  c. The vendor can sell 8 tee-shirts per hour if the price is dropped further to $7. Calculate the marginal revenue (per hour) for that 8th tee-shirt.
  d. Explain in words why the marginal revenue for each tee-shirt is less than the price at which it is sold.

(14.3) [Marginal revenue, monopoly pricing and profit] Suppose a monopolist has total cost function given by $TC(Q) = 3Q + (Q^2/40)$. This monopolist faces a demand curve given by $P = 15 - (Q/20)$.
  a. Find the monopolist's marginal cost function.
  b. Find the monopolist's average cost function.
  c. Find the monopolists total revenue function.
  d. Find the monopolist's marginal revenue function.
  e. Compute the monopolist's profit-maximizing level of output Q_M.
  f. Compute the monopolist's profit-maximizing price P_M.
  g. Compute the monopolist's profit.
  h. Compute the social deadweight loss caused by monopoly. [Hint: answering this question is easier if you first sketch a graph of demand and marginal cost.]

(14.4) [Marginal revenue, monopoly pricing and profit] Suppose a monopolist has total cost function given by $TC(Q) = 4Q + (Q^2/200)$. This monopolist faces a demand curve given by $P = 10 - (Q/100)$.
    a. Find the monopolist's marginal cost function.
    b. Find the monopolist's average cost function.
    c. Find the monopolists total revenue function.
    d. Find the monopolist's marginal revenue function.
    e. Compute the monopolist's profit-maximizing level of output Q_M.
    f. Compute the monopolist's profit-maximizing price P_M.
    g. Compute the monopolist's profit.
    h. Compute the social deadweight loss caused by monopoly. [Hint: answering this question is easier if you first sketch a graph of demand and marginal cost.]

(14.5) [Marginal revenue, monopoly pricing] Suppose a monopolist faces the following demand curve: $P = 10 - (Q/400)$.
    a. Find the total revenue function $TR(Q)$.
    b. Find the marginal revenue function $MR(Q)$.
    c. Compute the monopolist's profit-maximizing quantity and price assuming marginal cost is constant (horizontal) and equal to $2.
    d. Compute the monopolist's new profit-maximizing quantity and price if marginal cost rises to $4.
    e. In a competitive market, if marginal cost is horizontal and increases by any amount (say $2) then the equilibrium market price increases by *exactly the same amount*. Does this monopoly behave the same way? Explain.

(14.6) [Marginal revenue, monopoly pricing] Suppose a monopolist faces the following demand curve: $P = 10\ Q^{-1/5}$.
    a. Find the total evenue function $TR(Q)$.
    b. Find the marginal revenue function $MR(Q)$.
    c. Compute the monopolist's profit-maximizing quantity and price assuming marginal cost is constant (horizontal) and equal to $2.
    d. Compute the monopolist's new profit-maximizing quantity and price if marginal cost rises to $4.
    e. In a competitive market, if marginal cost is horizontal and increases by any amount (say $2) then the equilibrium market price increases by *exactly the same amount*. Does this monopoly behave the same way? Explain.

(14.7) [Monopoly pricing, deadweight loss: 40 pts] A pharmaceutical company is considering whether to develop and patent a particular drug. Annual demand for the drug is predicted to be given by P = 25 - (Q/50). Marginal cost of production is predicted to be constant and equal to $5. There are also up-front costs of developing the drug and acquiring a patent.
    a. If the company were to develop and patent the drug, what quantity would it produce and what price would it charge?
    b. What is the maximum amount of up-front costs the company would pay for developing and patenting the drug? For simplicity, assume the patent would be valid for only one year. [Hint: What level of up-front costs would reduce profits to zero?]
    c. After the patent runs out, other companies could produce the drug with same marginal cost, but without having to incur up-front costs. What quantity would then be produced and what price would prevail in the market, which is now competitive?
    d. Compute the predicted deadweight loss to society from monopoly pricing of this drug. [Hint: answering this question is easier if you first sketch a graph.]

(14.8) [Price discrimination] True or false? Explain your answer in detail.
    a. "Perfect price discrimination (also called 'first-degree price discrimination') causes greater deadweight loss than ordinary single-price monopoly."
    b. "Under market-segmenting price discrimination (also called 'third-degree price discrimination') the market segment with the more elastic demand curve gets the higher price."

(14.9) [Third-degree price discrimination] Suppose you are the president of a software company that sells its product to two market segments: business and academic. Because your software product is somewhat unique, you enjoy market power (downward-sloping demand) in both segments. According to market research, the elasticity of demand in your business segment is -1.5 while the elasticity of demand in your academic segment is -6. Furthermore, your legal department can effectively prevent resale between market segments. Your marginal cost of production is $10 per copy of software.
    a. Compute the profit-maximizing price for your business segment. [Hint: Use the markup formula relating price, marginal cost, and elasticity.]
    b. Compute the profit-maximizing price for your academic segment.

(14.10) [Third-degree price discrimination] Suppose a movie theatre sells tickets to both students and the general public. Suppose the elasticity of demand by children is –11, and the elasticity of demand by adults is –3. Assume the marginal cost of a seat in the theatre is $5.
    a. Compute the profit-maximizing admission price for children. [Hint: Use the markup formula relating price, marginal cost, and elasticity.]
    b. Compute the profit-maximizing admission price for adults.

(14.11) [First-degree price discrimination] Suppose a monopolist faces the following demand curve: $P = 12 - (Q/200)$. Assume this monopolist is somehow able to charge a price for each unit exactly what the buyer is willing to pay. In other words, the monopolist can somehow engage in perfect price discrimination. The monopolist's marginal and average cost are given by $MC(q) = AC(q) = 3$.
   a. How many units will this monopolist produce and sell?
   b. How much revenue will the monopolist enjoy?
   c. How much profit will the monopolist enjoy?

(14.12) [Monopoly pricing] In this problem we prove that, if demand is linear and marginal cost is constant, then the monopolist sets a price that is halfway between the competitive price and the price-intercept of the demand curve. Let the demand curve be given by $P = a - bQ$, and let c denote marginal cost, assumed constant.
   a. Find expressions for the competitive equilibrium price and quantity in terms of a, b, and c.
   b. Find an expression for the monopolist's marginal revenue function in terms of a, b, and c.
   c. Prove that the monopoly quantity is $Q_M = (1/2) (a-c)/b$.
   d. Prove that the monopoly price is $P_M = (1/2)a + (1/2)c$.

(14.13) [Monopoly pricing] In this problem we prove that a monopolist will never operate on the inelastic portion of its demand curve.
   a. If marginal revenue is negative, should the monopolist increase output, decrease output, or keep output as it is?
   b. Prove that if demand is inelastic $(-1 < \varepsilon < 0)$ then marginal revenue is negative.

[end of problem set]