

Monopoly and Price Discrimination

- 1) If the government sets a price ceiling below the monopoly price, will this reduce deadweight loss in a monopolized market?
- 2) True/False. A profit maximizing monopolist will always produce an output that is less than the output that maximizes sales revenue.
- 3) What is the effect of a lump sum tax on a monopolist?
- 4) Can the government find a price at which to regulate a natural monopoly that is lower than the monopolist's price but generates the same profit?
- 5) True/False. If an unregulated monopolistic firm is making zero profit, then it must be true that price equals minimum average total cost.
- 6) How does imposing a tax on profits affect the monopoly optimum and the welfare of consumers, the monopoly and society?
- 7) An electric utility is going to use a block-pricing schedule. They plan to charge P_1 for the first Q_1 units and P_2 for the subsequent units. The units sold at P_2 are the total units sold, Q_2 , minus the total units sold at P_1 . The inverse demand curve is $P = \$100 - Q$, and the marginal and average cost is $\$40$. Use calculus to solve for P_1 , P_2 , Q_1 , Q_2 .
- 8) A monopolist with $TC = 3q^2 + q + 12$ faces a demand curve of $P = 81 - 2q$.
 - i) Find the monopoly price and quantity.
 - ii) Find CS and DWL.
 - iii) Find the elasticity of the demand at the monopoly equilibrium.
- 9) The market demand for peanuts is given by $p = 50 - 0.5y$. Squirell Inc. is the only supplier of peanuts. Its total cost function is given by $TC(y) = 10y$. Calculate:
 - i) the profit maximizing level of output, the profit maximizing price, the consumers surplus, the monopoly profits, the burden of monopoly (deadweight loss)
 - ii) Squirell Inc. loses a legal battle and as a result has to pay licensing fee of $\$700$ per year to Jiffy Ltd. Its total costs therefore increase to $TC = 10y + 700$. With this new cost function, once again calculate: the profit maximizing level of output, the profit maximizing price, the consumers surplus, the monopoly profits, the deadweight loss.
 - iii) Are your answers the same as in part (a) or different? Explain why.

- 10) Consider a monopoly with inverse demand function $p = 24 - y$ and cost function $c(y) = 5y^2 + 4$:
- Find the profit maximizing output and price, and calculate the monopolist's profits.
 - Now consider the case in which the monopolist has now another plant with the cost structure $c_2(y_2) = 10y_2$. How much will the monopolist produce in each plant, what is the price, and the total profits of the monopoly?
 - Now suppose there is a technological change in the first plant and it has the following cost function: $c_1(y_1) = 2y_1$. How much will the monopolist produce in each plant and what is the price?
- 11) A monopoly publisher either pays an author
- a royalty of x percentage of the revenues from the book, or
 - a lump-sum amount of L dollars.
- Show how the compensation scheme affects the price the publisher sets and the number of books that the publisher sells.
- 12) Consider a monopoly with inverse demand function $p = 90 - 10y$ and cost function $c(y) = 10y$.
- Find the profit maximizing output and price, and calculate the monopolist's profits.
 - Now, suppose the government imposes a per unit tax $t = 20$. Find the new price, output and profits.
- 13) A monopolist firm faces the following cost curve: $C(Q) = Q^2 + 12$, where Q is the output produced. The demand for its product is given by $P = 24 - Q$.
- Find the equilibrium price and quantity.
 - Find the profit level.
 - Calculate the Consumer Surplus, the Producer Surplus and the Deadweight Loss associated to the monopoly.
- 14) A monopolist firm faces the following cost curve: $C(y) = Q^2 + 12$, where Q is the output produced. The demand for its product is given by $P = 24 - Q$.
- Derive the MR for this firm.
 - Find the equilibrium price and quantity.
 - Find the profit level.
 - Calculate the Consumer Surplus, the Producer Surplus and the Deadweight Loss associated with monopoly pricing.
 - How does charging the monopolist a specific tax of \$8 per unit affect the monopoly optimum and the welfare of consumers, the monopoly and society (where society's welfare, or surplus, includes the tax revenue)? What is the incidence of the tax on consumers?
- 15) What quantity will a perfect price discriminating monopolist facing demand given by $P = 35 - 2Q$ choose if its marginal cost is equal to 5?
- 16) Comment on the following statement: "Price discrimination cannot take place unless consumers can be isolated into groups and the goods cannot be sold by one group to other groups."
- 17) Comment on the following statement: "If a monopoly faces the possibility of selling to two markets with different linear demand curves of equal slopes, it will charge the same price in the two markets."
- 18) Does a monopolist engaging in price discrimination still use the $MR=MC$ relationship to determine its output?
- 19) Provide two examples of the use of ordinary price discrimination pricing in the daily life.

- 20) Define price discrimination. What conditions must hold for a firm to be able to practice price discrimination?
How are consumers affected by price discrimination?
- 21) A monopolist has total production costs given by $0.5 Q^2$. The demand function in the "home" market is $P = 20 - 0.5 Q$
- If the monopolist sells all its output to the home market, what is the equilibrium price and quantity?
 - Now suppose the monopolist has a choice between the home market and a foreign market in which the monopolist can sell any amount Q at a price of \$12. Will the monopolist sell in the foreign market? If yes, what would happen to the price the monopolist charges in the home market?
- 22) A monopolist operates in two markets whose demand functions are $p_1 = 120 - q_1$ and $p_2 = 100 - 0.5q_2$. The monopolist has a constant marginal cost of \$20.
- Find the prices and market quantities when the monopolist can price discriminate between the two markets.
 - Find the output in each market if price discrimination is impossible.
 - Show that the total output $q_1 + q_2$ is the same in part a. and b.
- 23) A specialized rice grower sells rice in two markets, the United States and Japan, and the marginal cost the same in both markets. The price elasticity of demand in the United States is -2.0 , and the price elasticity of demand in Japan is -1.5 . If the grower practices multimarket price discrimination, which country's consumers will pay a higher price and by how much?
- 24) A weapons producer sells guns to two countries that are at war with each other. The guns can be produced at a constant marginal cost of \$10. The demand for guns from the two countries can be represented as:
- $$Q_A = 100 - 2p$$
- $$Q_B = 80 - 4p$$
- Why is the weapons producer able to price discriminate?
What price will it charge to each country?
- 25) A monopolist operates in two markets whose demand functions are $p_1 = 100 - q_1$ and $p_2 = 120 - 0.5q_2$. The monopolist has a constant marginal cost of \$40.
- Find the prices and market quantities when the monopolist cannot price discriminate between the two markets.
 - Calculate the price elasticity for each market demand and evaluate it at the price and quantities derived in a. If the monopolist is allowed to use price discrimination, which one of the two markets will have a higher price? Why?
 - Find the price and market quantities when the monopolist can price discriminate between the two markets.
 - Will the consumers in the first market be better off with discrimination or not? What about the consumers in the second market?
- 26) A monopolist can sell in two separate markets with demand curves $p_1 = 160 - 8q_1$ and $p_2 = 80 - 2q_2$. The monopolist's marginal cost is $5 + Q$. What will be the prices charged by the monopolist in the two markets? What are the quantities sold in the two markets?

- 27) Between Ottawa and Toronto Island, Porter Air has a monopoly in two markets, one for students who are willing to fly on a standby basis, and one for business people who are not. The marginal cost of a seat on a plane that is not filled to capacity is zero. The demand function of all students combined is $Q_S = 500 - 25P_S$ and the demand function of all non-students combined is $Q_N = 4000 - 10P_N$. If the airline can engage in ordinary price discrimination and its planes are not filled to capacity, find:
- The price to students.
 - The price to non-students.
 - The deadweight loss in the market.
 - Suppose price discrimination between students and non-students is illegal. What is the deadweight loss in the market?
- 28) A firm's demand curve is given by $P = 500 - 2Q$. The firm's current price is \$300 and the firm sells 100 units of output per week.
- Calculate the firm's marginal revenue at the current price and quantity using the expression for marginal revenue that utilizes the price elasticity of demand.
 - Assuming that the firm's marginal cost is zero, is the firm maximizing profit?
- 29) Determine the "rule-of-thumb" price when the monopolist has a marginal cost of \$25 and the price elasticity of demand of -3.0 .
- 30) The Metro Electric Company produces and distributes electricity to residential customers in the metropolitan area. This monopoly firm is regulated, as are other investor owned electric companies. The company faces the following demand and marginal revenue functions:
- $$P = 0.04 - 0.01Q$$
- $$MR = 0.04 - 0.02Q$$
- Its marginal cost function is:
- $$MC = 0.005 + 0.0075Q,$$
- where Q is in millions of kilowatt hours and P is in dollars per kilowatt hour. Find the deadweight loss that would result if this company were allowed to operate as a profit maximizing firm, assuming that $P = MC$ under regulation.
- 31) Hawkins Micro Brewery has a monopoly on Oatmeal Stout in the local market. The demand is:
- $$Q_D = 100 - 2P \Leftrightarrow P = 50 - \frac{1}{2}Q.$$
- The resulting marginal revenue function is $MR(Q) = 50 - Q$. Hawkins marginal cost of producing Oatmeal Stout is $MC(Q) = 5 + \frac{1}{2}Q$. Calculate Hawkins profit maximizing output. Calculate the social cost of Hawkins monopoly power.

32) John Gardner is the city planner in a medium-sized southeastern city. The city is considering a proposal to award an exclusive contract to Clear Vision, Inc., a cable television carrier. Mr. Gardner has discovered that an economic planner hired a year before has generated the demand, marginal revenue, total cost and marginal cost functions given below:

$$P = 28 - 0.0008Q$$

$$MR = 28 - 0.0016Q$$

$$TC = 120,000 + 0.00062Q$$

$$MC = 0.0012Q,$$

where Q = the number of cable subscribers and P = the price of basic monthly cable service. Conditions change very slowly in the community so that Mr. Gardner considers the cost and demand functions to be reasonably valid for present conditions. Mr. Gardner knows relatively little economics and has hired you to answer the questions listed below.

- a. What price and quantity would be expected if the firm is allowed to operate completely unregulated?
- b. Mr. Gardner has asked you to recommend a price and quantity that would be socially efficient. Recommend a price and quantity to Mr. Gardner using economic theory to justify your answer.
- c. Compare the economic efficiency implications of (a) and (b) above. Your answer need not include numerical calculations, but should include relevant diagrams to demonstrate deadweight loss.

33) Calloway Shirt Manufacturers sells knit shirts in two sub-markets. In one market, the shirts carry Calloway's popular label and breast logo and receive a substantial price premium. The other sub-market is targeted toward more price conscious consumers who buy the shirts without a breast logo, carrying the name Archwood. The retail price of the shirts carrying the Calloway label is \$42.00 while the Archwood shirts sell for \$25. Calloway's market research indicates a price elasticity of demand for the higher priced shirt of -2.0 , and an elasticity for the Archwood shirts of -4.0 . Moreover, the research suggests that both elasticities are constant over broad ranges of output.

- a. Are Calloway's current prices optimal?
- b. Management considers the \$25 price to be optimal and necessary to meet the competition. What price should the firm set for the Calloway label to achieve an optimal price ratio?

34) American Tire and Rubber Company sells identical radial tires under the firm's own brand name and to discount stores for private labeling. Marginal cost is a constant \$10 per tire, regardless of the sub-market in which the tire is sold. The firm has estimated the following demand curves for each of the markets.

$$PB = 70 - 0.0005QB \text{ (brand name)}$$

$$PP = 20 - 0.0002QP \text{ (private label).}$$

Quantities are measured in thousands per month and price refers to the wholesale price. American currently sells brand name tires at a wholesale price of \$28.50 and private label tires for a price of \$17. Are these prices optimal for the firm?

35) The local zoo has hired you to assist them in setting admission prices. The zoo's managers recognize that there are two distinct demand curves for zoo admission. One demand curve applies to those ages 12 to 64, while the other is for children and senior citizens. The two demand and marginal revenue curves are:

$$PA = 9.6 - 0.08QA$$

$$MRA = 9.6 - 0.16QA$$

$$PCS = 4 - 0.05QCS$$

$$MRCS = 4 - 0.10QCS$$

where PA = adult price, PCS = children's/senior citizen's price, QA = daily quantity of adults, and QCS = daily quantity of children and senior citizens. Crowding is not a problem at the zoo, so that the managers consider marginal cost to be zero.

- a. If the zoo decides to price discriminate, what should the price and quantity be in each market? Calculate total revenue in each sub-market.
- b. What is the elasticity of demand at the quantities calculated in (a) for each market. Are these elasticities consistent with your understanding of profit maximization and the relationship between marginal revenue and elasticity?

36) Merriwell Corporation has a virtual monopoly in the ultra high speed computer market. Merriwell has recently introduced a new computer that will be used by satellite installations around the world. The installations have identical demands for the computers. Merriwell's managers have decided to lease rather than sell the computer, but they have been unable to decide whether to use a single hourly rental charge or a two-part tariff. Under the two-part tariff, users would be levied an "access charge" plus an hourly rental rate. Merriwell's marketing staff estimates the demand and marginal revenue curves below for each potential user:

$$P = 45 - 0.025Q$$

$$MR = 45 - 0.05Q,$$

where P = price per hour of computer time, and Q = the number of hours of computer time leased per month. Merriwell offers their users extensive maintenance assistance and technical support. The firm's engineers estimate that marginal cost is \$30 per computer hour.

- a. Assuming that Merriwell chooses to set a single price, what will the firm's price and output be?
- b. Assuming that Merriwell uses a two-part tariff, what "access charge" and hourly rental fee should the firm set? Compare the firm's revenues under the options in (a) and (b).
- c. Briefly describe how differing demand curves among the various buyers would alter the two-part tariff.

37) The industry demand curve for a particular market is:

$$Q = 1800 - 200P.$$

The industry exhibits constant long run average cost at all levels of output, regardless of the market structure. Long run average cost is a constant \$1.50 per unit of output. Calculate market output, price (if applicable), consumer surplus, and producer surplus (profit) for each of the scenarios below. Compare the economic efficiency of each possibility.

- a. Perfect Competition
- b. Pure Monopoly (hint: $MR = 9 - 0.01Q$)
- c. First Degree Price Discrimination

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

- 1) Yes, as long as the price ceiling is not set too low. The price ceiling becomes the monopolist's marginal revenue (up to the quantity demanded at that price, at least). Since the monopolist's new marginal revenue curve is below the old one, the firm's MC will intersect MR at a higher level of output and the monopolist will produce a level of output closer to the socially optimal level of output, thereby reducing the deadweight loss.
- 2) True unless $MC = 0$. Sales are maximized when $MR(y_1) = 0$ (Note that this is not the point where $p = MC$) and profits are maximized when $MR(y_2) = MC(y_2)$. y_2 and y_1 are the same only when MC is equal to zero.
- 3) If the firm's profits are larger than the amount of the lump sum tax, there will be no effect as a lump sum tax is like a fixed cost and does not affect the firm's marginal costs or marginal revenues. If the firm is earning less than the amount of the tax in profits, the tax will result in the firm making a loss. The firm will not change output or price in the short run; but it will exit the industry in the long run.
- 4) No. At any price below the monopolist's price, $MR < MC$ implying that the increase in revenues from the last unit produced was less than the increase in costs. At any price above the monopoly price, $MR > MC$ implying that if the firm could increase its output (i.e., lower its price), it would increase its revenues more than it would increase its costs, thereby resulting in an increase in profits.
- 5) False. When the monopoly price is equal to the average cost, the profit is indeed zero but this doesn't have to be minimum AC.
- 6) A tax on profits does not change the quantity nor the price chosen by the monopolist since profit after tax = $(1 - t) * \text{profit before tax} = (1 - t) * (\text{revenue} - \text{costs})$, where t is the tax rate on the profits. Well, this tax will not change the quantity chosen by the monopolist (Why?) and as a consequence will not change the price. We have the same surplus and the same deadweight loss as without a tax on profits. The difference is that part of the producer surplus now goes to the government in the form of taxes.
- 7) The profit equation for this utility is $\pi = P_1(Q_1) * Q_1 + P_2(Q_2) * (Q_2 - Q_1) - 40Q_2$. The derivative of profit with respect to Q_1 is $100 - 2 * Q_1 - 100 + Q_2$. The derivative of profit with respect to Q_2 is $100 - 2 * Q_2 + Q_1 - 40$. By setting these two derivatives equal to zero and substituting, Q_1 equals 20 and Q_2 equals 40. Substituting the quantities into the inverse demand curve, P_1 equals \$80 and P_2 equals \$60.
- 8) i) $MC = 6q + 1$ and $MR = 81 - 4q$. Set $MC = MR$ and you get $10q = 80$ or $q = 8$. P is found by plugging q into the demand curve: $p = 81 - 2(8) = 65$.
ii) $CS = 64$; $DWL = 16$.
iii) $E = -65/16$.
- 9) i) $y = 40$, $p = 30$, $CS = 400$, $\text{Profit} = 800$, $DWL = 400$;
ii) $y = 40$, $p = 30$, $CS = 400$, $\text{Profit} = 100$, $DWL = 400$;
iii) they are the same. A lump sum tax reduces profit but does not influence the profit maximizing price and quantity.
- 10) i) $p = 22$; $y = 2$; $\text{profit} = 20$;
ii) $y_1 = 1$; $y_2 = 6$; $p = 17$; $\text{profit} = 50$;
iii) $(y_1; y_2) = (11; 0)$ and $p = 13$.
- 11) i) The publisher's objective is to maximize profits. Let $\text{Profit}(Q)$ denote profits when the monopolist produces Q . The monopolist maximizes $\text{Profit}(Q) = P(Q) * Q - C(Q)$, where $C(Q)$ is the cost function.
Under scheme (i), the monopolist maximizes $\text{Profit}(Q) = (1 - x)P(Q) * Q - C(Q)$.
If demand is linear, $P(Q) = a - bQ$, then $(1 - x)P(Q) * Q = (1 - x)aQ - (1 - x)bQ^2$. So it is 'as if' the monopolist faces a new (inverse) demand curve which has a lower P -intercept and the same Q -intercept. The marginal revenue $MR(Q) = a - 2bQ$ will change in the same manner. That is, $MR'(Q) = (1 - x)a - (1 - x)2bQ$. Since marginal cost has not changed, quantity and price will change under this scheme.
Note that the publisher receives $(1 - x)p_t$ for each unit sold and consumers pay $p_t > p^*$ in the new equilibrium. The number of books sold in the new equilibrium is $Q_t < Q^*$.
Under scheme (ii), the monopolist maximizes $\text{Profit}(Q) = P(Q)Q - C(Q) - L$. The marginal revenue and marginal cost are NOT affected by a lump-sum tax. Hence there is no change in the (p^*, Q^*) with a lump-sum tax. The only thing that will be affected under the lump-sum scheme is the publisher's profit.

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

- 12) i) $y = 4$, $p = 50$, profit = 160.
ii) $y = 3$, $p = 60$, profit = 90.
- 13) i) $MR = MC$, so $Q = 6$. Now plug this Q in the demand curve to get $P = \$18$.
ii) profit = \$60.
iii) $CS = \$18$, $PS = \$72$, $DWL = \$6$. (The best way to figure out these values is to draw a graph.)
- 14) a) $MR = 24 - 2Q$.
b) $Q = 6$, $P = \$18$.
c) profit = \$60.
d) $CS = \$18$; $PS = \$72$; $DWL = 2 \cdot 6 / 2 = \$6$
e) The tax here will affect the MC and then the quantity produced and the price charged.
 $Q = 4$ and $P = \$20$. The tax will reduce the CS and PS and will produce tax revenue to the government of \$32. Finally, the DWL will increase as we move further from the "competitive" equilibrium. Also, the consumer will pay only part of the tax. Notice that the new price is \$20. And the price before tax was \$18. So, consumers only pay 2/8 of the tax. The monopolist pays the rest.³
- 15) For a perfect price discriminating firm, $P = MR$ since it does not have to lower its price to other customers to increase its sales. Therefore, we have $MR = 35 - 2Q$. As always, the firm sets $MR = MC$ to find its quantity. This yields $35 - 2Q = 5$ or $30 = 2Q$ or $Q = 15$.
- 16) The two conditions are essential for successful price discrimination. The monopolist has to be able to distinguish between two or more groups of consumers with different willingness (and ability) to pay for the goods sold. Also, in order to prevent arbitrage initiated by the low-price customers, the markets have to be segmented. Otherwise, the monopolist may find it less profitable to engage in price discrimination.
- 17) Provided the market segmentation is feasible, the monopolist will engage in ordinary price discrimination. In the case of distributing a given amount of output to the two markets, the allocation will require the equalization of the marginal revenue in the two markets, and this condition cannot result in charging the same price in the two markets. Alternatively, the two demand curves have different price elasticity of demand, and therefore there is scope for price discrimination.
- 18) Yes. The profit-maximizing monopolist able to engage in ordinary price discrimination will choose an aggregate output where aggregate marginal revenue is equal to marginal cost, and will allocate that output so that marginal revenue is identical in all markets.
- 19) The use of coupon books in the grocery stores allows price discrimination between busy people that do not have time to clip coupons and those that do. The use of picture IDs allows public transit companies to segment the markets formed by adults traveling to work (high ability and willingness to pay), and by senior citizens and students (low ability to pay).
- 20) Price discrimination is charging different prices to different consumers for the same product; in other words, price differentials that do not reflect cost differentials. The three conditions are: firms must possess market power, must segment the market, and must prevent resale. While some consumers may end up paying higher prices compared to other consumers, as a whole, consumers may actually be better off since the monopolist has incentives to sell to more people (thereby eliminating deadweight loss).
- 21) a) $p = 15$;
b) Yes, the monopoly will sell 4 units in the foreign market and 8 units in the domestic market; The price in the domestic market will increase to 16.
- 22) a. $q_1 = 50$, $q_2 = 80$, $p_1 = 70$, $p_2 = 60$;
b. $q_1 = 170/3$, $q_2 = 220/3$, $p = 190/3$;
c. $q_1 + q_2 = 130$ in both a. and b.
- 23) $p_{US}(1 + 1/-2) = p_j(1 + 1/-1.5)$. Rearranging yields $p_{US} = (2/3)p_j$. The price in the United States will be 2/3 the price in Japan.

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

24) The firm can price discriminate because there are two identifiable segments with different elasticities. Since the two countries are at war, resale is doubtful. To solve, find marginal revenue for each and set equal to marginal cost of \$10.

$$MR_B = 20 - (1/2)Q_B = 10 \text{ or } Q_B = 20 \text{ and } p_B = 15.$$

$$MR_A = 50 - Q_A = 10 \text{ or } Q_A = 40 \text{ and } p_A = 30.$$

25) a) Calculate the aggregate demand and then aggregate MR. Set it equal to MC and get $Q = 110$, $p = 230/3$, $q_1 = 70/3$, and $q_2 = 260/3$ without discrimination.

b) $E_1 = -3.2$. $E_2 = -1.7$. Type two consumers pay more with discrimination.

c) $P_1 = 210/3$, $p_2 = 240/3$, $q_1 = 90/3$, $q_2 = 240/3$ with discrimination

d) Type one consumers will be worse off since they lose $3805/9$ in consumer surplus. Type two consumers are better off with discrimination since they gain $2500/9$ in consumer surplus.

26) $p_1 = 53.33$, $p_2 = 63.33$, $q_1 = 13.33$, $q_2 = 8.33$.

27) a) 10; b) 200; c) 201,250; d) 205,000.

28) a.

Begin by calculating the price elasticity of demand, E_D :

$$E_D = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

To find $\frac{\Delta Q}{\Delta P}$ solve for Q in terms of P.

$$P = 500 - 2Q$$

$$P - 500 = -2Q$$

$$Q = 250 - 0.5P$$

$$\frac{\Delta Q}{\Delta P} = -0.5; E_D = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$E_D = -0.5 \cdot \frac{300}{100} = -1.5$$

$$MR = P + P \left(\frac{1}{E_D} \right)$$

$$MR = 300 + 300 \left(\frac{1}{-1.5} \right)$$

$$MR = 300 - 200 = 100$$

b.

If $MC = 0$, the firm is not maximizing profit since MR should be equal to MC. The firm should expand output.

$$MR = 500 - 4Q = 0$$

$$4Q = 500$$

$$Q = 125$$

29) Use equation (10.2) from the text, and solve for price.

$$P = \frac{MC}{1 + \frac{1}{E_D}} = \frac{\$25.00}{1 + \frac{1}{-3}} = \$37.50$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

- 30) Find the area between the average revenue curve and the marginal cost curve that is bounded by the rates of production chosen first by the profit maximizing monopoly and second by the regulated industry having the same cost structure.

Monopoly output is denoted Q_M and is found where $MC = MR$.

$$0.04 - 0.02Q = 0.005 + 0.0075Q$$

$$Q_M = 1.2727 \text{ (in millions of KWH)}$$

The regulated industry output takes place where average revenue equals marginal cost.

$$AR = \frac{R}{Q} = 0.04 - 0.01Q$$

$$0.04 - 0.01Q = 0.005 + 0.0075Q$$

$$Q = 2 \text{ (in millions of KWH)}$$

The area representing deadweight loss is the area under the AR curve minus the area under the MC curve between $Q = 2$ and $Q = 1.2727$.

Area under AR is computed by first finding the heights of AR at the two quantities.

$$\text{At } Q = 2, AR = 0.04 - 0.01(2) = 0.04 - 0.02 = 0.02$$

$$\text{At } Q = 1.2727, AR = 0.04 - 0.01(1.2727) = 0.04 - 0.012727 = 0.02727.$$

$$\text{The average AR} = \frac{0.02 + 0.02727}{2} = 0.023636$$

$$\text{Area} = (2 - 1.2727)(0.023636) = 0.01719$$

The area under MC is

$$\text{At } Q = 2, MC = 0.005 + 0.0075(2) = 0.02$$

$$\text{At } Q = 1.2727, MC = 0.005 + 0.0075(1.2727) = 0.014545$$

$$\text{Average height} = \frac{0.02 + 0.014545}{2}$$

The area under MC is

$$\text{Area} = (2 - 1.2727)(0.01727) = 0.01256$$

$$\text{Deadweight loss} = 0.01719 - 0.01256$$

$$= 0.00463 \text{ in millions of dollars}$$

$$= \$4,630 / \text{time period.}$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

31) Hawkins will set marginal revenue equal to marginal cost to find optimal output.

$MR(Q) = 50 - Q = MC(Q) = 5 + \frac{1}{2}Q \Rightarrow Q = 30$. At this output level, Hawkins charges \$35 per unit. The choke price is

\$50 while Hawkins reservation price is \$5. Consumer surplus is

$CS = \frac{1}{2}(50 - 35)30 = 225$. Producer surplus is $PS = 0.5(20 - 15)(30) + (35 - 20)(30) = 675$. Total surplus in the local

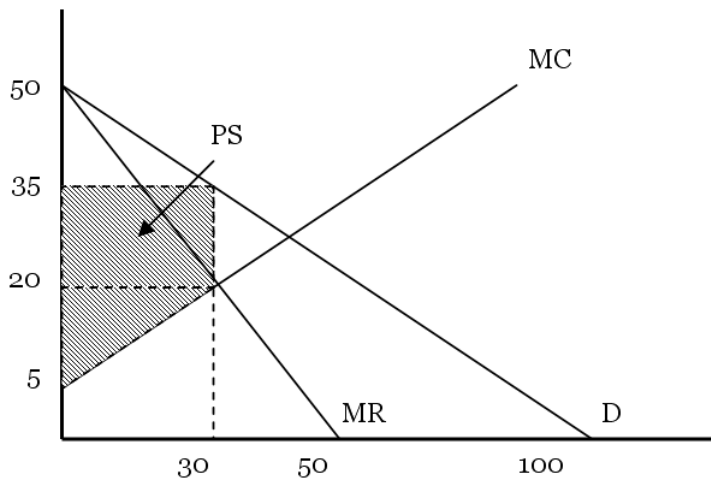
Oatmeal Stout market is \$900 when Hawkins has monopoly power. If Hawkins did not have monopoly power, the price of Oatmeal Stout would equal Hawkins marginal cost. We can find this output level by setting consumer's price

as a function of output equal to Hawkins marginal cost. $P = 50 - \frac{1}{2}Q = MC = 5 + \frac{1}{2}Q \Rightarrow Q = 45$. At this output level,

the price of Oatmeal Stout is \$27.50. Consumer surplus is $CS' = \frac{1}{2}(50 - 27.50)45 = 506.25$. Producer surplus is

$PS' = \frac{1}{2}(27.50 - 5)45 = 506.25$. Total surplus when Hawkins does not have monopoly power would be \$1,012.50.

Thus, society loses 112.50 of surplus due to Hawkins' monopoly power in the local Oatmeal Stout market.



Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

32) a.

Without regulation we would expect the firm to behave as a monopolist, equating MR and MC.

$$28 - 0.0016Q = 0.0012Q$$

$$Q = 10,000$$

$$P = 28 - 0.0008(10,000)$$

$$P = \$20$$

b.

Economic theory suggests that price should be equal to MC to achieve allocative efficiency.

$$P = 28 - 0.0008Q$$

$$MC = 0.0012Q$$

$$28 - 0.0008Q = 0.0012Q$$

$$28 = 0.002Q$$

$$Q = 14,000$$

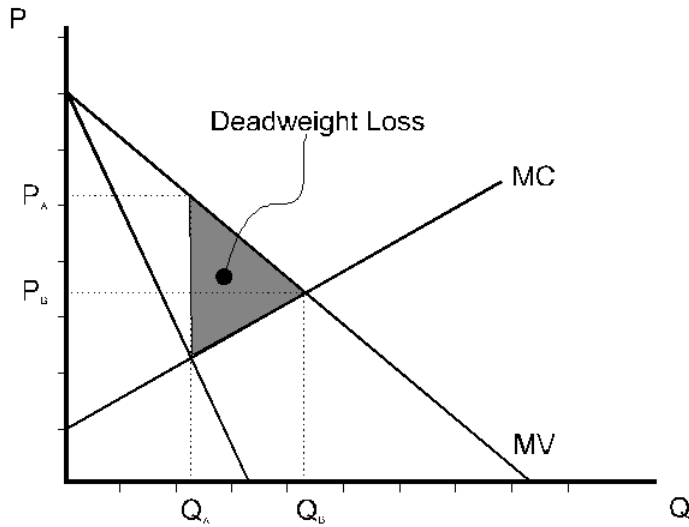
$$P = 28 - 0.0008(14,000)$$

$$P = 28 - 11.20$$

$$P = 16.80$$

c.

In (a), the price is higher (\$20 as opposed to \$16.80), and quantity lower (10,000 as opposed to 14,000). The monopolist's higher price and smaller quantity result in a deadweight loss as shown below.



Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

33) Let P_C = Calloway price

P_A = Archwood price

E_C = Calloway elasticity

E_A = Archwood elasticity

a.

For an optimal price ration the following conditions must hold.

$$\frac{P_C}{P_A} \text{ must} = \frac{\left(1 + \frac{1}{E_A}\right)}{\left(1 + \frac{1}{E_C}\right)}$$

$$\frac{P_C}{P_A} \text{ must} = \frac{42}{25} = 1.68$$

$$\frac{\left(1 + \frac{1}{E_A}\right)}{\left(1 + \frac{1}{E_C}\right)} = \frac{\left(1 + \frac{1}{-4}\right)}{\left(1 + \frac{1}{-2}\right)} = \frac{\frac{3}{4}}{\frac{1}{2}} = \frac{3}{2} = 1.5$$

The current price is not optimal.

b.

If the elasticities are constant $\frac{P_C}{P_A}$ should equal 1.5.

$P_A = \$25$, P_C should be $\$37.50$

34) To determine optimal prices $MRA = MRB = MC$. (This is acceptable because MC is constant.)

Setting $MRB = MC$

$$70 - 0.001Q_B = 10$$

$$-0.001Q_B = -60$$

$$Q_B = 60,000$$

$$P_B = 70 - 0.0005(60,000) = \$40$$

setting $MRP = MC$

$$20 - 0.0004Q_P = 10$$

$$-0.0004Q_P = -10$$

$$Q_P = 25,000$$

$$P_P = 20 - 0.0002(25,000) = \$15$$

$P_B = \$40$; $P_P = \$15$. Therefore the prices are not optimal.

35) *a.*

Optimal price discrimination requires the zoo to set $MRA = MRCS = MC$.

Setting $MRA = 0$

$$9.6 - 0.16Q_A = 0$$

$$9.6 = 0.16Q_A$$

$$Q_A = 60$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

$$P_A = 9.6 - 0.08(60)$$

$$P_A = \$4.8$$

$$MR_{CS} = 4 - 0.10Q_{CS} = 0$$

$$4 = 0.10Q_{CS}$$

$$Q_{CS} = 40$$

$$P_{CS} = 4 - 0.05(40) = \$2$$

$$P_{CS} = \$2$$

$$TR_A = P_A \cdot Q_A$$

$$TR_A = 4.8 \cdot 60 = \$288$$

$$TR_{CS} = P_{CS} \cdot Q_{CS}$$

$$TR_{CS} = 2 \cdot 40 = \$80$$

$$TR = 288 + 80 = \$368$$

b.

To calculate elasticities, solve for Q .

$$P_A = 9.6 - 0.08Q_A$$

$$P_A - 9.6 = -0.08Q_A$$

$$Q_A = 120 - 12.5P_A$$

$$Q_A = 120 - 12.5P_A$$

$$E_A = \frac{\Delta Q_A}{\Delta P_A} \cdot \frac{P_A}{Q_A}$$

$$E_A = -12.50 \cdot \frac{4.8}{60}$$

$$E_A = \frac{-60}{60} = -1.0$$

$$P_{CS} = 4 - 0.05Q_{CS}$$

$$P_{CS} = 4 - 0.05Q_{CS}$$

$$P_{CS} - 4 = -0.05Q_{CS}$$

$$Q_{CS} = 80 - 20P_{CS}$$

$$E_{CS} = -20 \cdot \frac{2}{40}$$

$$E_{CS} = -1$$

Yes it is consistent. When $MC = 0$, profit maximization requires that $MR = 0$.

36) *a.*

As a simple monopolist, the firm would set $MR = MC$

$$45 - 0.05Q = 30$$

$$-0.05Q = -15$$

$$Q = 300$$

$$P = 45 - 0.025(300)$$

$$P = 45 - 7.5$$

$$P = 37.50$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

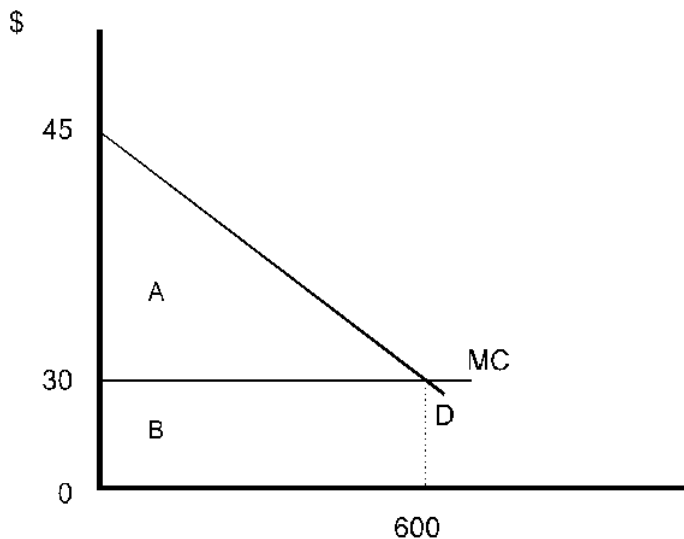
$$TR = 37.50 \times 300 = \$11,250$$

b.

Under a two-part tariff with identical consumers, price and output are determined where $P = MC$.

$$\begin{aligned} 45 - 0.025Q &= 30 \\ -0.025Q &= -15 \\ Q &= 600 \end{aligned}$$

$$\begin{aligned} P &= 45 - 0.025(600) \\ P &= 30 \end{aligned}$$



To find access charge, must find the consumer surplus which is area A.

$$\text{Area A} = CS = (0.5)(15)(600) = 4,500$$

Set access charge of \$4,500 and a \$30 hourly fee.

Total revenue under this option is the area under demand curve or \$22,500. Total revenue doubles with a two-part tariff as compared with the single hourly rental charge option.

c.

With differing demands, the firm should set prices slightly above MC. The access charge should then be set to capture all consumer surplus from the buyer with the smallest demand.

37) Since LAC is constant, LMC is also constant and equal to LAC. $LMC = \$1.50$

a.

Under perfect competition $P = LMC$. We begin by solving P as a function of Q:

$$\begin{aligned} Q &= 1800 - 200P \\ Q - 1800 &= -200P \\ P &= 9 - 0.005Q \end{aligned}$$

Under competition $P = LMC$

$$\begin{aligned} 9 - 0.005Q &= 1.5 \\ -0.005Q &= -7.5 \\ Q &= 1500 \end{aligned}$$

Answer Key

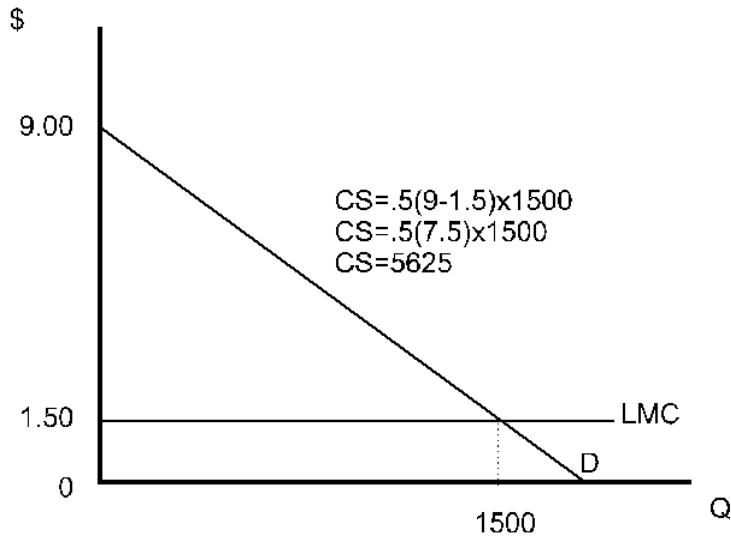
Testname: 6500_MONOPOLY_LONG_PROBLEMS

$$P = 9 - 0.005(1500)$$

$$P = 9 - 7.5 = \$1.50$$

$$P = LMC = LAC \text{ so that } p \text{ (producer surplus)} = 0$$

Consumer surplus is the area under the demand curve above market price, as indicated in the figure.



b.

Under monopoly $MR = MC$

$$P = 9 - 0.005Q$$

$$MR = 9 - 0.01Q$$

Setting $MR = MC$

$$9 - 0.01Q = 1.5$$

$$-0.01Q = -7.5$$

$$Q = 750$$

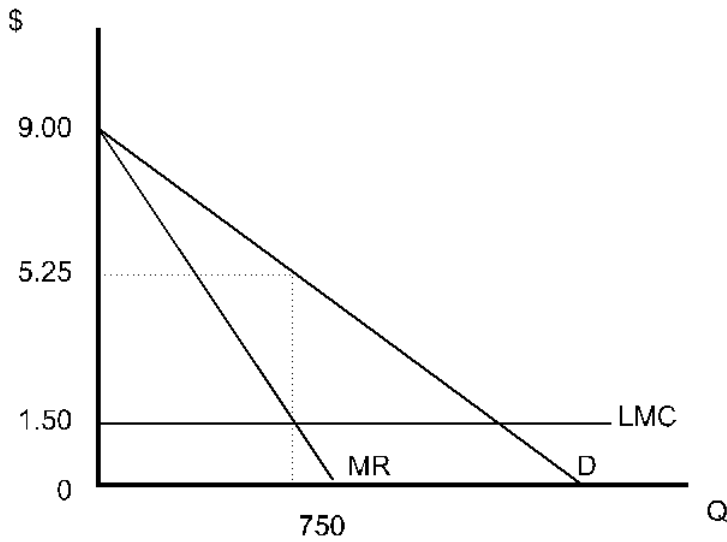
$$P = 9 - 0.005(750)$$

$$P = 9 - 3.75$$

$$P = 5.25$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS



$$\begin{aligned} \pi &= (P - LAC) \times Q \\ \pi &= (5.25 - 1.50) \times 750 \\ \pi &= 2812.50 \end{aligned}$$

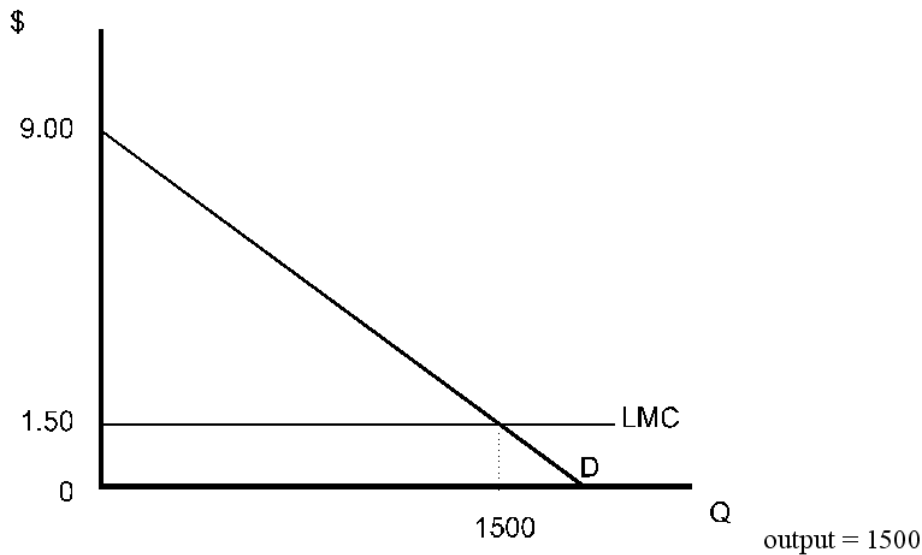
To find consumer surplus, find area of the triangle under the demand curve and above price.

$$CS = 9 - 5.25)(750)(0.5) = 1,406.25.$$

The sum of consumer surplus and producer surplus is $1,406.25 + 2,812.50 = 4,218.75$.

c.

Under first-degree price discrimination-output is at the point where the demand curve cuts the LMC curve.



The firm charges the entire area under the demand curve.

$$PS = (9 - 1.5)(1,500)(0.5) = 5,625.$$

Comparison of Efficiency

a. Competition

$$\text{Consumer + Producer Surplus} = 5,625$$

Answer Key

Testname: 6500_MONOPOLY_LONG_PROBLEMS

b. Monopoly

Consumer + Producer Surplus = 4,218.75

c. First Degree

Consumer + Producer Surplus = 5,625

Monopoly results in a deadweight loss. First-degree price discrimination results in a redistribution of income, but does not result in a deadweight loss.