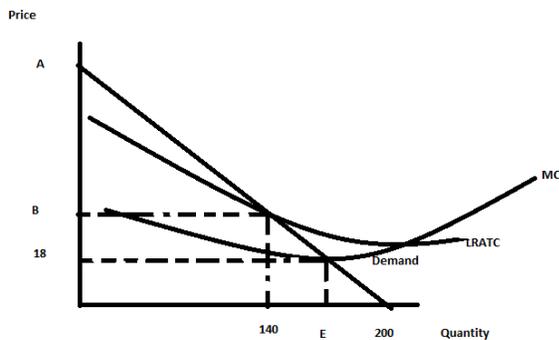


Directions: The homework will be collected in a box **before** the lecture. Please place your name, TA name and section number on top of the homework (legibly). Make sure you write your name as it appears on your ID so that you can receive the correct grade. Late homework will not be accepted so make plans ahead of time. **Please 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, 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!

4. Use the following graph of a natural monopolist to answer this next question. The graph depicts the market for a monopolist where LRATC is the long-run average total cost curve, MC is the marginal cost curve, and Demand is the market demand for the product. You are also told that the reciprocal of the slope of the market demand curve is -2.



a) Given the above information and the graph, write the equation for the market demand curve in slope intercept form. Explain how you found your answer. You will need to provide a numeric value for “A” in the above graph.

b) Suppose that this monopolist is not regulated. Explain how this monopolist will determine its profit maximizing output and price. Assume that the monopolist is a single price monopolist. After explaining the process, identify the unregulated monopolist’s quantity and price on the graph labeling the quantity (F) and the price (G). Note: you will not be able to actually compute F and G – just label them on a well-drawn diagram.

c) Will the monopolist described in (b) earn positive, negative, or zero economic profits? Explain your answer.

d) Suppose that this monopolist is regulated with a MC pricing regulation. This insures that the monopolist produces the socially optimal amount of the good, but will require a subsidy for the producer since economic profits will be negative. From the graph and your prior work, identify

(that is, provide a numeric value) the socially optimal amount of the good. Then amend the graph to show the amount of total subsidy this monopolist will need to receive if they are to produce the socially optimal amount of the good.

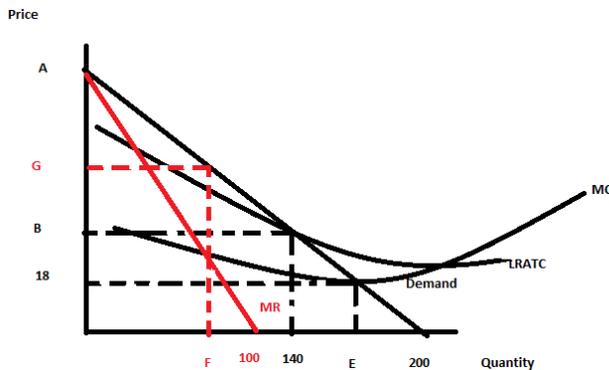
e) Suppose that this monopolist is regulated with AC pricing regulation. This insures that the monopolist produces the level of output where its economic profit is equal to zero. From the graph and your prior work, identify (that is, provide a numeric value) of the price the monopolist will charge if it is regulated to produce that level of output where the monopolist breaks even. Amend the graph to provide this numeric value.

Answer:

a) You are told that the reciprocal of the slope of the demand curve is -2 : this implies that the slope of the demand curve is $-1/2$. You know from the provided figure that the x-intercept is 200 for the market demand curve so you need to figure out the y-intercept that will result in the slope of the line being $-1/2$. Thus, $(\text{change in price})/(\text{change in quantity}) = -1/2$. Since change in quantity is equal to 200, this implies that change in price must be a negative 100: so the value of "A" is 100.

Once we have the value for "A" and the slope of the line it is easy to write the equation for the market demand curve in slope intercept form: $P = 100 - (1/2)Q$.

b) The unregulated single price monopolist will equate its MR curve to its MC curve and produce that quantity. It will go vertically up from this quantity to the demand curve to determine the price it will charge for the good. Here's the altered graph:



c) The single price unregulated monopolist will earn positive economic profits since when it produces "F" amount of the good, the price it sells the good for ("G") is greater than the average cost per unit of producing this level of output. Since the price exceeds the ATC at this level of output then the firm must be earning positive economic profit.

d) The socially optimal amount of the good is that quantity where the demand curve intersects the MC curve. From the graph we can locate this point and see that we have the following: $(Q, P) = (E, 18)$. Let's use the demand curve equation to solve for the value of "E":

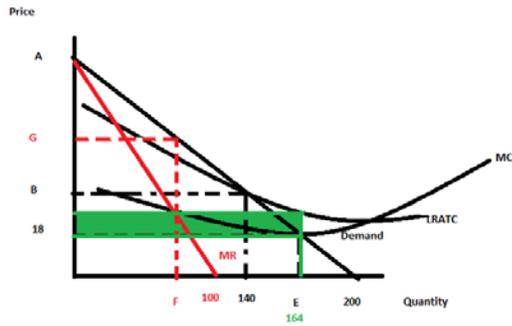
$$P = 100 - (1/2)Q \text{ but } Q = E \text{ in this case, so}$$

$$P = 100 - (1/2)E$$

$$18 = 100 - (1/2)E$$

$$E = 164 \text{ units of output}$$

Here's the amended graph where the shaded area shows the total subsidy that the monopolist must receive if they are to produce the socially optimal amount of the good, "E".



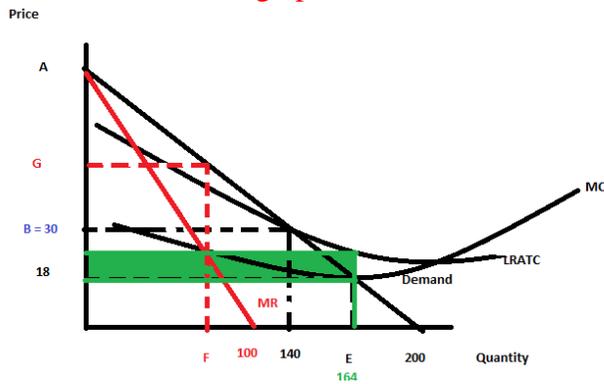
e) If the monopolist is regulated by AC pricing regulation the monopolist will produce where $P = ATC$ and this will occur at that quantity where the LRATC curve intersects the demand curve. In the provided graph we can see that this is at a quantity of 140 units. We can find the regulated price by using this quantity in the market demand curve: thus,

$P = 100 - (1/2)(Q)$ where Q is set to 140 units, the quantity where the firm will break even.

$$P = 100 - (1/2)(140)$$

$$P = 30$$

Here's the amended graph:



5. Consider a market that is served by a single producer. This market has significant barriers to entry so the single producer has market power and is not likely to face any competition due to these barriers of entry. You are given the following information about this market:

Market Demand: $Q = 45 - 3P$

$MC = 3$

Fixed Cost for the Producer: $FC = 5$

a) Given the above information, if this producer acts as a single price monopolist, calculate the following:

Profit maximizing quantity = _____

Profit maximizing price = _____

Level of profits = _____

Consumer Surplus = CS = _____

Producer Surplus (remember you will need to adjust this to take into account FC) = PS = _____

Deadweight Loss = _____

Show your work and provide a graph to illustrate your answer.

b) Suppose that this monopolist decides to practice second degree price discrimination. The monopolist decides that it will sell its first 18 units of the good produced for a price of \$9 per unit and then it will sell an additional 9 units for a price of \$6 per unit. Given this information and the initial information, calculate the following for the monopolist who practices this second degree price discrimination:

Total quantity produced by the second degree price discriminator = _____

Prices charged by the second degree price discriminator = _____

Level of profits for the second degree price discriminator = _____

Consumer Surplus in this case of second degree price discrimination = CS' = _____

Producer Surplus (remember you will need to adjust this to take into account FC) in this case of second degree price discrimination = PS' = _____

Deadweight Loss in this case of second degree price discrimination = _____

Show your work and provide a graph to illustrate your answer.

c) Compare your answers in (a) and (b). Does second degree price discrimination benefit consumers in this case? Explain your answer here and provide evidence to support your answer. Does second degree price discrimination benefit the producer? Explain your answer here and provide evidence to support your answer.

d) Suppose this monopolist is able to practice first degree price discrimination in this market. Compute the following if this monopolist successfully implements first degree price discrimination.

Total amount of the good produced in the market = _____

PS'' with perfect price discrimination (remember to account for those fixed costs) = _____

CS'' with perfect price discrimination = _____

Profit for firm with perfect price discrimination = _____

DWL with perfect price discrimination = _____

Show your work and provide a graph to illustrate your answer.

Answer:

a) The firm if it acts as a single price monopolist will produce that quantity where $MR = MC$ and then charge the price associated with this quantity from the demand curve. So, we need to find MR first. Rewrite the demand curve in slope-intercept form: $P = 15 - (1/3)Q$. Recall that MR for the monopolist facing a linear demand curve shares the same y-intercept as the demand curve and has twice the slope of the demand curve. Thus, $MR = 15 - (2/3)Q$. Now, equate MR to MC:

$$15 - (2/3)Q = 3$$

$$45 - 2Q = 9$$

$Q = 18$ units

Go to the demand curve with this quantity to find the price the single price monopolist will charge:

$$P = 15 - (1/3)Q = 15 - (1/3)(18) = \$9$$

Now, to calculate profit, we need TR and TC:

$$\text{Thus, TR} = P \cdot Q = 9(18) = \$162$$

$$\text{TC} = \text{FC} + \text{VC} = 5 + 3(18) = \$59$$

$$\text{Profit for the single price monopolist} = \$162 - \$59 = \$103$$

$$\text{CS} = (1/2)(\$15 \text{ per unit} - \$9 \text{ per unit})(18 \text{ units}) = \$54$$

$$\text{PS} = (\$9 \text{ per unit} - \$3 \text{ per unit})(18 \text{ units}) = \$108 = \$108$$

To calculate DWL we need to know the quantity which is socially optimal: to find this quantity locate where the MC intersects the demand curve and determine this quantity. Thus, $15 - (1/3)Q = 3$ and $Q_{\text{socially optimal}} = 36$ units.

$$\text{DWL} = (1/2)(\$9 \text{ per unit} - \$3 \text{ per unit})(36 \text{ units} - 18 \text{ units}) = \$54$$

To summarize for the single price monopolist:

Profit maximizing quantity = 18 units

Profit maximizing price = \$9

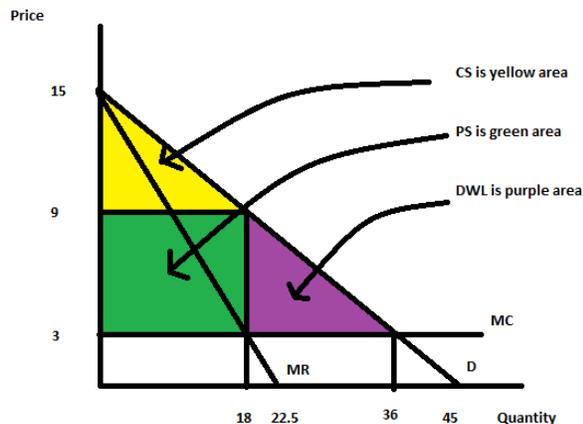
Level of profits = \$103

Consumer Surplus = CS = \$54

Producer Surplus = PS = \$108

Deadweight Loss = \$54

Here's the graph to illustrate this outcome:



b) When this firm is a second degree price discriminator it chooses to produce 27 units in all. It will charge \$9 per unit for the first 18 units sold and then \$6 per unit for the next 9 units it sells. To calculate the level of profits the firm earns when it practices second degree price discrimination we need to calculate its TR and its TC:

$$\text{TR} = P \cdot Q = (\$9 \text{ per unit})(18 \text{ units}) + (\$6 \text{ per unit})(9 \text{ units}) = \$216$$

$$\text{TC} = \text{FC} + \text{VC} = \$5 + (\$3 \text{ per unit})(27 \text{ units}) = \$86$$

$$\text{Profits for this second degree price discriminator} = \$216 - \$86 = \$130$$

$$\text{CS}' = (1/2)(\$15 \text{ per unit} - \$9 \text{ per unit})(18 \text{ units}) + (1/2)(\$9 \text{ per unit} - \$6 \text{ per unit})(27 \text{ units} - 18 \text{ units}) = \$67.50$$

$$\text{PS}' = (\$9 \text{ per unit} - \$3 \text{ per unit})(18 \text{ units}) + (\$6 \text{ per unit} - \$3 \text{ per unit})(27 \text{ units} - 18 \text{ units}) = \$135$$

$$DWL' = (1/2)(\$6 \text{ per unit} - \$3 \text{ per unit})(36 \text{ units} - 27 \text{ units}) = \$13.50$$

To summarize our findings:

Total quantity produced by the second degree price discriminator = 27 units

Prices charged by the second degree price discriminator = \$9 per unit for the first 18 units and \$6 per unit for the next 9 units

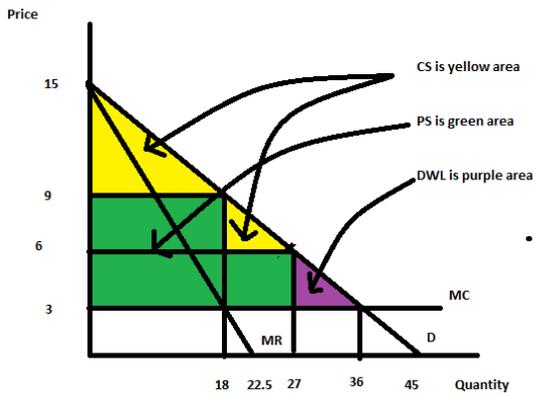
Level of profits for the second degree price discriminator = \$130

Consumer Surplus in this case of second degree price discrimination = $CS' = \$67.50$

Producer Surplus = $PS' = \$135$

Deadweight Loss in this case of second degree price discrimination = \$13.50

Here's the graph to illustrate the second degree price discrimination case:



c) Second degree price discrimination does benefit consumers: they get more of the good-in this case, 27 units instead of 18; and some of these units are cheaper-9 units are now selling for \$6 per unit. We can also see that CS increases from \$54 to \$67.50. We can also see that the area of DWL is shrinking from \$54 to \$13.50.

Second degree price discrimination also benefits the producer: they sell more of the good and their total profit goes up from \$103 to \$130.

d) When the firm practices perfect price discrimination it charges a different price for every unit it sells. This results in the market demand curve also being the firm's marginal revenue curve. To find the quantity the firm will produce we still set $MR = MC$ but this time the MR is the firm's demand curve. Thus,

$$MR = MC$$

$$15 - (1/3)Q = 3$$

$Q_{\text{socially optimal}} = 36 =$ the amount that the perfect price discriminator will produce. This is the socially optimal amount of the good because the MC of producing the last unit is equal to the price the consumer pays for this last unit: that is, the cost to society of producing this last unit equals the value to the consumer of consuming this last unit.

$CS'' = 0$ since the producer captures all of the consumer surplus when they practice perfect price discrimination

$$PS'' = (1/2)(\$15 \text{ per unit} - \$3 \text{ per unit})(36 \text{ units}) = \$216$$

$$TR = (1/2)(\$15 \text{ per unit} - \$3 \text{ per unit})(36 \text{ units}) + (\$3 \text{ per unit})(36 \text{ units}) = \$324$$

$$TC = FC + VC = 5 + (\$3 \text{ per unit})(36 \text{ units}) = \$113$$

Profit for the perfect price discriminator = $\$324 - \$113 = \$211$
 DWL'' = 0 since the firm is now producing the socially optimal amount of the good

To summarize our findings:

Total amount of the good produced in the market = 36 units

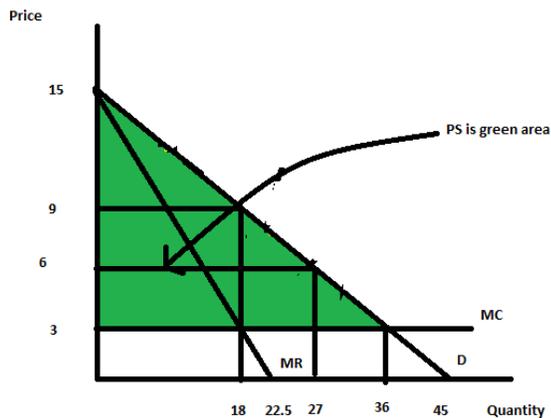
PS'' with perfect price discrimination = $\$216$

CS'' with perfect price discrimination = $\$0$

Profit for firm with perfect price discrimination = $\$211$

DWL with perfect price discrimination = $\$0$

Here's the graph:



6. Kem is a supplier of dry cleaning services in her small town. She operates the only dry cleaning service and therefore has significant market power. She knows that she has two types of clients: business clients who come in regularly to have their clothing cleaned and non-business clients who have occasional garments to clean. She knows the following information:

Demand for dry cleaning services from business clients: $P = 20 - 2Q$

Demand for dry cleaning services from non-business clients: $P = 10 - Q$

MC of providing dry cleaning services: $MC = 2$

Fixed Costs of providing dry cleaning services: $FC = 10$

Suppose that Kem decides to treat her dry cleaning business as two separate monopolies: one providing dry cleaning services to business clients and one providing dry cleaning services to non-business clients. She can readily identify the status of each of her clients since she has been in business in this small town for a long, long time and she knows her customers well.

a) Given that Kem is going to treat these two types of customers as separate entities, what will be the profit maximizing price and quantity of the good for each type of customer? And, what will total profits be equal to? Show how you found your answers to this set of questions clearly and logically! Provide a set of graphs to illustrate your answer.

b) Now, suppose Kem would like to verify that this two pricing scheme idea in (a) actually results in her earning greater profits than if she were to simply follow a single pricing monopoly

model. So, find the market demand curve. Then determine the profit maximizing quantity and price if Kem treats this market as a single market with one price for dry cleaning. What happens to the level of profits Kem earns under this pricing decision? Provide numeric values for all your work and clearly and logically explain how you found your answers. Also, provide a graph to illustrate your answer.

Answers:

a) Kem has decided to treat this pricing and production decision as two separate monopolies: so she needs to find the MR curves for each sub-market and then equate MR to MC to identify the profit maximizing quantity for each market. She will then take these quantities and use the respective demand curve to find the profit maximizing price for each market. Once she has the price and quantity for each sub-market she can calculate the total profit she will earn by treating this market as two separate monopolies. So, let's go through this process:

Business Client Market Analysis:

Demand for this market: $P = 20 - 2Q$

MR for this market: $MR = 20 - 4Q$

MC for this market: $MC = 2$

Set $MR = MC$: $20 - 4Q = 2$

Q for business client market = 4.5 units

Use this quantity in the demand curve to find the profit maximizing price for this sub-market:

$P = 20 - 2(4.5) = 11 =$ price for a unit of dry cleaning for the business clients

Non-business Client Market Analysis:

Demand for this market: $P = 10 - Q$

MR for this market: $MR = 10 - 2Q$

MC for this market: $MC = 2$

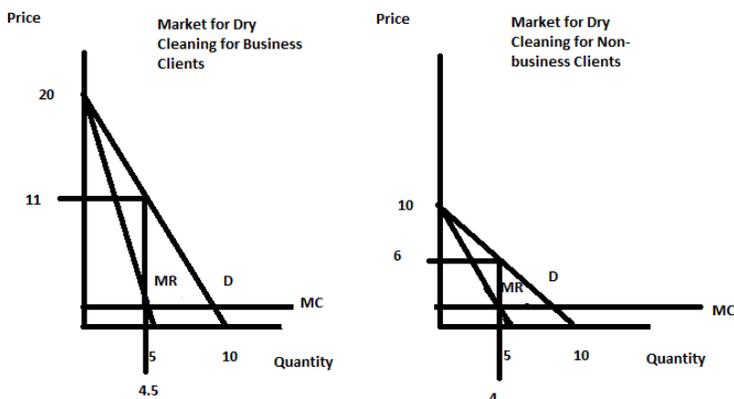
Set $MR = MC$: $10 - 2Q = 2$

Q for non-business client market = 4 units

Use this quantity in the demand curve to find the profit maximizing price for this sub-market:

$P = 10 - 4 = 6 =$ price for a unit of dry cleaning for the non-business clients

Here's the set of graphs:



b) To find the market demand curve we need to horizontally sum together the individual demand curves: so, for prices greater than or equal to 10 and less than or equal to 20, we know that the market demand

curve is $P = 20 - 2Q$ (or just the business client demand curve). For prices less than or equal to 10 we need to sum together the two sub-markets. The lower segment of the market demand curve contains the two points $(Q, P) = (5, 10)$ and $(20, 0)$. We can use these two points to write the equation for the lower segment of the market demand curve: $P = 40/3 - (2/3)Q$. Thus, the market demand curve is two different equations:

For prices greater than or equal to 10: $P = 20 - 2Q$

For prices less than or equal to 10: $P = (40/3) - (2/3)Q$

Kem will also need to compute the MR curves that go along with these two market demand curves:

MR for upper segment of the demand curve: $MR = 20 - 4Q$

MR for lower segment of the demand curve: $MR = (40/3) - (4/3)Q$

I hope that you can see that the upper segment of the demand curve is just the sub-market for business clients while the lower segment of the demand curve is the combination of the two markets.

Now, Kem needs to equate the MR to the MC. If we use the upper segment MR we effectively have Kem selling only to the business clients: can it be more profitable to only sell to this group? Not likely, but let's prove it:

MR = MC for upper segment of the market demand curve

$$20 - 4Q = 2$$

$$Q = 4.5 \text{ units}$$

$$P = 20 - 2Q = 20 - 2(4.5) = \$11$$

$$TR = (\$11 \text{ per unit})(4.5 \text{ units}) = \$49.50$$

$$TC = FC + VC = 10 + (2)(4.5) = \$19.00$$

$$\text{Profit if a single price monopolist that only sells to the business client} = 49.50 - 19.00 = \$30.50$$

Clearly Kem is making less profit if she only sells to the business client than if she price discriminates as in (a) and sells to both groups.

What happens to Kem's profit if she continues to be a single price monopolist and sells to the combined market? Now we need to use the lower segment of the market demand curve and its respective MR curve.

MR = MC for lower segment of the market demand curve

$$40/3 - (4/3)Q = 2$$

$$Q = 8.5 \text{ units}$$

$$P = (40/3) - (2/3)Q = (40/3) - (2/3)(8.5) = 7.67$$

$$TR = P*Q = (7.67)(8.5) = \$65.17$$

$$TC = FC + VC = 10 + (2)(8.5) = \$27.00$$

$$\text{Profit if selling to the combined market but with a single price pricing rule} = \$65.17 - \$27.00 = \$38.17$$

Kem can choose to price discriminate and charge the two groups different prices and her profit will be \$46.50; sell to both groups and have a single price which results in profits of \$38.17; or she can sell only to the business client group and have a profit of \$30.50. Clearly Kem benefits from price discrimination.