Handout 11 Solutions

Topics

- Monopoly
- First and third degree price discrimination*
- Midterm 2 - Discussion of most missed questions

Monopoly Exercises

Exercise 1 A monopoly firm operates under cost structure and faces with market demand as summarized by the information in the below table.

Quantity	Price	Total Revenue	Marginal Revenue	Total Cost	Marginal Cost
0	200	0	-	100	-
1	180	**180**	**180**	130	**30**
2	170	**340**	**160**	170	**40**
3	160	**480**	**140**	**220**	50
4	**150**	600	120	**280**	60
5	140	**700**	100	**350**	70
6	**130**	780	**80**	430	**80**
7	**120**	840	**60**	520	**90**
8	**100**	800	**40**	620	**100**

1. Complete the missing values in this table. What is the profit maximizing level of output? What is the profit-maximizing profit?

   Solution: A profit maximizing firm will choose MC=MR. From the table MC=MR when Q=6. At this production level, $\pi = TR - TC = 780 - 430 = 350$

2. What is the social desirable output and price? How much profit does firm get under this socially desirable outcome?

   Solution: The socially desirable outcome can be implemented through a competitive market. At a competitive market P=MC. Therefore, P=100, Q=8. At Q=8, $\pi = TR - TC = 800 - 620 = 180$.

Exercise 2

Consider a monopoly that produces widgets. Suppose you are told that the monopoly has the following cost curves where TC is total cost measured in dollars, Q is the quantity of widgets, and P is the price per widget in dollars and the following demand curve:

$$TC = 4 + 4Q + Q^2$$
$$MC = 4 + 2Q$$
$$P = 19 - (1/2)Q_D$$

1. Given the above information, what is this monopolist's equation for MR?

   Solution: The monopolist's MR curve has the same y-intercept as the firm's demand curve and for a linear demand curve, has a slope that is twice the slope of the demand curve. The monopolist is the only firm in the market so the market demand curve is the monopolist's demand curve. Thus, the monopolist's MR curve can be written as $MR = 19 - Q$.

2. Determine the profit maximizing level of production for this monopolist as well as the price that will be charged for each unit of the good. Assume that this is a single price monopolist, i.e. the monopolist cannot engage in price discrimination. Explain how you found your answer.

   Solution: The profit maximizing amount of output for the monopolist is that level of output where $MR = MC$.
   Thus, $19–Q = 4 + 2Q \implies 15 = 3Q \implies Q = 5$ *widgets.*
   The price the monopolist will charge can be found by plugging in the profit maximizing quantity into the demand curve.
   Thus, $P = 19 - (1/2)(5) = \$16.50$ *per widget.*

3. Given the above information and your answer in (2) calculate the level of profit in the short- run for this monopolist. Explain how you found your answer.

   Solution: To find the monopolist's profit we need to calculate the monopolist's total revenue and its total cost:
   $TR = P * Q = (\$16.50$ *per widget*$) * (5$ *widgets*$) = \$82.50$
   $TC = 4 + 4Q + Q^2 = 4 + 4 * 5 + 5^2 = 4 + 20 + 25 = \$49$
   Profit for the monopolist $= TR–TC = \$82.50 - \$49.00 = \$33.50$

4. Given your answer in (3), what do you predict will happen to this monopolist in the long-run?

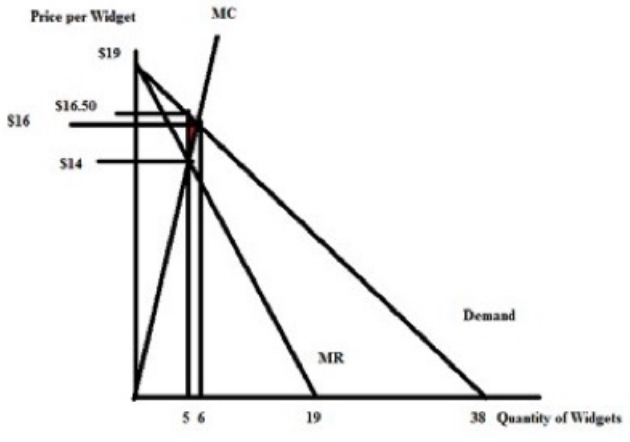
   Solution: This monopolist will continue to earn positive economic profits in the long-run, if there are effective barriers to entry that result in the monopoly continuing to operate as a monopoly and, therefore, be safe from competition.

5. Calculate the deadweight loss that results from this market being served by a monopolist. Show how you found your answer. Provide a graph that is well labeled to illustrate your answer.

   Solution: To find the deadweight loss we need to first figure out the socially optimal amount of the good: this would be the amount of output where MC equals the demand curve since for the last unit of output we have the addition to total cost from producing this last unit is equal to the value the consumer places on consuming the last unit (the price they would be willing to pay).
   So, setting MC equal to the demand curve we have:

   $$4 + 2Q = 19 – (1/2)Q \implies (5/2)Q = 15 \implies Q = 6 widgets$$

   We will also need to find the value of MC when $Q = 6$:
   so, $MC = 4 + 2Q = 4 + 2(6) = \$16$
   Deadweight Loss from the monopoly:
   DWL = (1/2)∗($16.50 per widget - $14 per widget)∗(6 widgets - 5 widgets) = $1.25
   The deadweight loss is shown in the graph below as (the very small) triangle.



First degree price discrimination Exercises*

Exercise 3
Suppose a monopoly is a first-degree price discriminator in the market for cell phones. Cell phone demand is given by $Q = 100 - P$. The monopoly's marginal cost is $MC = 20$.

1. What are the monopoly's profits if it practices first degree price discrimination? Are these higher or lower than when the monopoly cannot price discriminate?

   Solution: Under first degree price discrimination, the monopoly charges every consumer exactly what they are willing to pay. Hence it is as if his marginal revenue curve is the demand curve itself. Thus setting $P = MC$*, we solve* $100 - Q = 20$*, so* $Q = 80$ *is the quantity the monopolist sells. The monopolist's profits are thus the area of a large triangle:* $(0.5)(\$100 - \$20)(80) = \$3200$.
   If the monopoly cannot price discriminate, then its marginal revenue curve is $MR = 100 - 2Q$*. Setting* $MR = MC$*, we have* $100 - 2Q = 20$*, so* $Q = 40$*. Plugging this into the demand curve we have* $P = 60$*. Profits are therefore* $Q(P - AC) = 40(\$60 - \$20) = \$1600$*. Recall that if MC is constant, MC = AC.*
   Note that in general first degree price discrimination will result in higher profits than when the firm can't discriminate

2. What is consumer surplus in this market when the monopoly practices first degree price discrimination? Is this higher or lower compared to the situation where the monopoly cannot price discriminate?

   Solution: Under first degree price discrimination, consumers have to pay exactly what they are willing to pay– therefore, consumer surplus is exactly equal to zero in this case.
   When the monopoly cannot price discriminate but instead charges the uniform price of $P = \$60$ *and sells* $Q = 40$ *units as we found in part 1, consumer surplus is equal to* $0.5(\$100 - 60)(40) = \$800$.

3. What is dead weight loss in this market when the monopoly practices first degree price discrimination? Is this higher or lower than when the monopoly cannot price discriminate?

   Solution: In a perfectly competitive market when the quantity sold is such that $P = MC$*, deadweight loss is zero – it is the efficient level of output. Note that when the monopoly practices first-degree price*

discrimination, it produces exactly this same quantity where $P = MC$. So, there is no deadweight loss when the monopoly practices first degree price discrimination.
When the monopoly cannot practice first degree price discrimination, it produces a smaller quantity.
These lost units generate a deadweight loss of $\frac{1}{2} \cdot (\$60 - \$20) \cdot (40) = \$800$.

Third degree price discrimination Exercises*

Exercise 4

Suppose there is only one airline to serve a certain local airport. The airline serves both students and the general public. The airline's marginal cost is given by $MC = 20$. Suppose the student demand is given by $P = 120 - Q$ and the general public demand is given by $P = 200 - Q/4$. What price should the airline charge each group for tickets? What is this monopolist's total profit?
Solution: We solve the monopoly problem separately for each group.
Students: $P = 120 - Q \longrightarrow MR = 120 - 2Q$. *Setting* $MR = MC$, *we get* $120 - 2Q = 20 \longrightarrow Q = 50$. *Plug 50 into the demand function to get* $P = \$70$.
General Public: $MR = MC$ *so* $200 - Q/2 = 20 \longrightarrow Q = 360$. *Plug* $Q = 360$ *into* $P = 200 - Q/4$ *to get* $P = \$110$.
Profit from sales to students: $50 * (\$70 - \$20) = 50 * 50 = 2500$.
Profit from sales to general public: $360 * (\$110 - \$20) = 360 * \$90 = \$32,400$.
Total profit: $\$2500 + \$32400 = \$34900$.

Multiple Choice Exercises

Use the following information to answer all multiple choice questions

Consider the market for signed Phoebe Bridgers records. Phoebe has a unique signature that cannot be replicated by anybody else, so she has a monopoly on signed records. However, she has to buy pens and records, and the time she spends signing records could be spent making new music, going on tour, or building her burgeoning recording studio empire, so

signing records comes at a cost. Specifically, Phoebe has total cost function $TC = 100 + q^2$ and marginal cost function $MC = 2q$.

1. Suppose that Phoebe has taken an economics course but never learned about monopoly, so she prices signed records as if she were in a perfectly competitve market. If demand for signed Phoebe Bridgers records is $P_D = 100 - 2Q_d$, what price would she charge, and how many signed records would she sell?

   (a) $P = 20$, $Q = 10$
   (b) $P = 80$, $Q = 10$
   (c) $P = 50$, $Q = 25$
   (d) $P = 25$, $Q = 50$

   Solution: Firms in perfectly competitive markets set price equal to marginal cost. Thus, Phoebe would set $P_D = MC$, where $q = Q_D$. $100 - 2Q_D = 2Q_D$ solves to $Q = 25$. Plugging this back into the demand curve yields a price of \$50. Thus, the answer is (c).

2. Now suppose that Phoebe's friend and fellow musician Julien, who has been reading economics textbooks in her spare time, teaches Phoebe about monopolies. What price will Phoebe charge to maximize her profit, and how many signed records will she sell at that price?

   (a) $P = 68$, $Q = 16$
   (b) $P = 50$, $Q = 25$
   (c) $P = 80$, $Q = 10$
   (d) $P = 60$, $Q = 20$

   Solution: Monopolists maximize profit by setting marginal cost equal to marginal revenue, which is the same as the demand curve (with P on the left hand side), but with a slope that's twice as steep. To find the answer, then, you solve $100 - 4Q = 2Q$ for Q, then plug Q into the demand curve to determine price. This gives $Q = \frac{100}{6} \approx 16.67$. Thus, she will sign 16 records at a price of \$68 per record.

3. What is the deadweight loss in the market for signed Phoebe Bridgers records that is caused by Julien sharing her knowledge of monopolies with Phoebe?

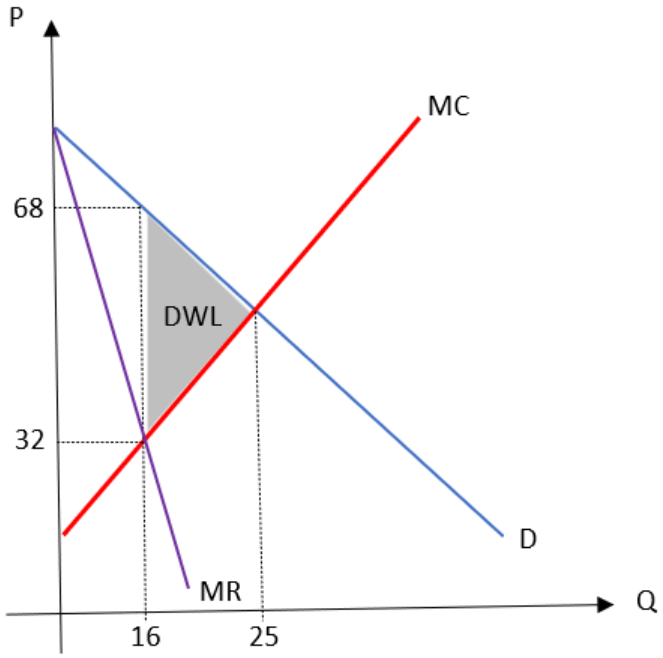
   (a) $450

   (b) $81

   (c) $364

   (d) $162

   Solution: Deadweight loss is represented by the triangle formed between the demand curve and the marginal cost curve, from $Q = 16$ to the intersection of the two curves (see the chart below). This triangle has area $\left(\frac{1}{2}\right)(25-16)(68-32) = 162$. Thus, the deadweight loss is $162, so the answer is (d).



4. Suppose that then-candidate Joe Biden vowed that he would minimize all deadweight loss from musicians' monopolies on signed records. What price ceiling should President-elect Biden enact to minimize deadweight loss from Phoebe's monopoly?

   (a) $50

   (b) $25

   (c) $0

   (d) $68

   Solution: Deadweight loss from a monopoly can be eliminated by enacting a price ceiling equal to the price at which marginal cost is equal to the demand curve. In this case, we solved this value as $50 in question 1. Thus, the answer is (a).