Practice Set 4

Monopoly & Market Efficiency

This set contains problems for your own practice. Do not just read the provided solutions — try to solve the problems first, and use the solutions only when you are stuck. Reading solutions without attempting the problems first has the same value for your preparation as watching someone else run a marathon and then expecting to be able to run it yourself. If you are unable to comprehend the solution of a problem even after reading the instructional answer key, you have most likely missed the relevant part of the material underlying this problem. Direct any questions about this problem set to your section's teaching assistant.

1. Show how market power increases with the gradient of the demand curve the firm is facing.

2. A market faces demand $p = 10 - 2Q$, while the marginal cost of production is $MC = 2$.
   (a) What will the price and the total quantity be if this market is served by many identical firms?
   (b) What will the price and the total quantity be if this market is served by one firm?
   (c) Calculate the DWL when the market is served by one firm.

3. A monopolist faces market demand $p = 14 - q$. Verify that the marginal revenue of the 4th unit is smaller than the price.

4. Katerina operates the only ice-cream store in a town. Demand for ice-cream is $p = 30 - 2q$, where q are ice-cream cones and p is the price per cone. Her marginal cost is $MC = q$ and her fixed cost is 2.
   (a) Make a table with Katerina's FC, MC, AC, TC, p and profit for quantities from 1 to 15.
   (b) How many cones should Katerina sell to maximize her profit?
   (c) How much should Katerina charge per cone in order to maximize her profit?
   (d) How much is the maximum profit that Katerina will make?
   (e) How many cones would Katerina sell if she acted as a PC firm?
   (f) How much would she charge per cone if she acted as a PC firm?
   (g) How much S-R profit would she make if she acted as a PC firm?

5. Calculate VC for $q = 500$ if $MC = 2q$.

6. Consider the market of a PC good with a vertical market demand.
   (a) Explain the economic meaning of a vertical demand curve.
   (b) A tax per unit is imposed on the good. Explain who will end up paying the burden of the tax.

7. Explain how *lobbying* can increase the social cost of monopolies if it is used for rent-seeking.

8. Explain how *advertisement* can increase the social cost of monopolies if it is used for rent-seeking.

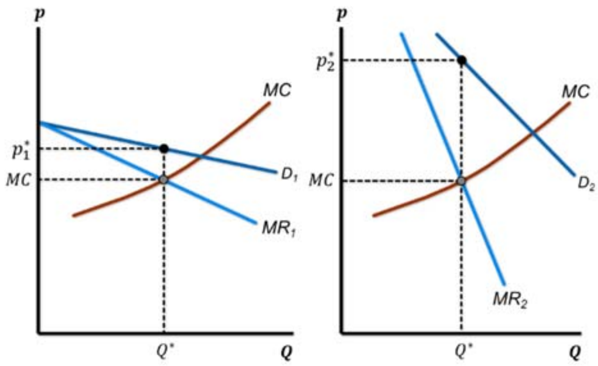
9. Explain how *building excess capacity* can increase the social cost of monopolies if it is used for rent-seeking.

10. [*Optional – requires math beyond the scope of this course*] A seller faces demand $p = 10 - q$.
    (a) Subtract the revenue for $q = 2$ from the revenue for $q = 3$ to calculate the marginal revenue of the 3rd unit.
    (b) Calculate the marginal revenue for the 3rd unit using the "double gradient" rule.
    (c) Why do (a) and (b) yield different marginal revenue for the same number of units?

Answer Key

1. Show how market power increases with the gradient of the demand curve the firm is facing.

When the firm faces a horizontal demand curve, as in perfect competition, price equals MC and market power is zero — there is no wedge between what consumers pay and what it costs to produce. When demand slopes downward, a monopolist's MR lies below the demand curve, because selling an extra unit requires lowering the price on all previous units.



In the left figure, D_1 is relatively elastic — its gradient is small. MR_1 lies only moderately below D_1, so the $MR = MC$ intersection occurs close to the demand curve. The resulting gap between p_1^* and MC is small, reflecting limited market power.

In the right figure, D_2 is steeper — its gradient is larger. MR_2 lies much further below D_2, so the $MR = MC$ intersection occurs well below the demand curve. The gap between p_2^* and MC is now substantially larger, reflecting greater market power.

In general, a steeper demand curve pushes MR further below demand, which drives a larger wedge between p and MC — and it is this wedge that measures market power.

2. A market faces demand $p = 10 - 2Q$, while the marginal cost of production is $MC = 2$.

   (a) What will the price and the total quantity be if this market is served by many identical firms?

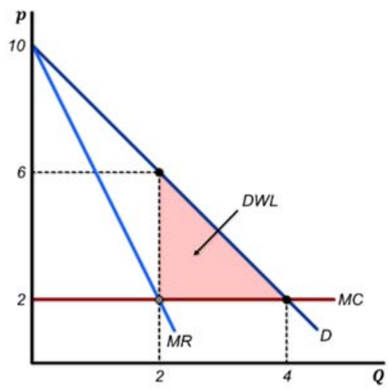
   In a PC market, price equals MC, so $p = 2$. Substituting into the demand: $2 = 10 - 2Q$, so $Q = 4$.

   (b) What will the price and the total quantity be if this market is served by one firm?

   The marginal revenue is $MR = 10 - 4Q$. Setting $MR = MC$: $10 - 4Q = 2$, so $Q = 2$. At $Q = 2$, demand gives $p = 10 - 2 \cdot 2 = 6$.

   (c) Calculate the DWL when the market is served by one firm.

   The DWL is the triangle between the monopoly outcome and the PC outcome — the units that would have been traded efficiently but are not. Its height is the gap between the monopoly price and MC: $6 - 2 = 4$. Its base is the gap between the PC quantity and the monopoly quantity: $4 - 2 = 2$. Thus, $DWL = 0.5 \cdot 4 \cdot 2 = 4$.



3. A monopolist faces market demand $p = 14 - q$. Verify that the marginal revenue of the 4th unit is smaller than the price.

The marginal revenue of the 4th unit is: Revenue from selling 4 units – revenue from selling 3 units:
For $q = 4, p = 14 - 4 = \$10$; so, revenue is $4 \cdot \$10 = \$40$.
For $q = 3, p = 14 - 3 = \$11$; so, revenue is $3 \cdot \$11 = \$33$.
So, the marginal revenue for the 4th unit is $\$40 - \$33 = \$7$, which is lower than the price of $\$10$.

4. Katerina operates the only ice-cream store in a town. Demand for ice-cream is $p = 30 - 2q$, where q are ice-cream cones and p is the price per cone. Her marginal cost is $MC = q$ and her fixed cost is 2.

   (h) Make a table with Katerina's FC, MC, AC, TC, p and profit for quantities from 1 to 15.

q	FC	MC	AC	TC	p	Profit
1	2	1	3	3	28	25
2	2	2	2.5	5	26	47
3	2	3	2.67	8	24	64
4	2	4	3	12	22	76
5	2	5	3.4	17	20	83
6	2	6	3.83	23	18	**85**
7	2	7	4.29	30	16	82
8	2	8	4.75	38	14	74
9	2	9	5.22	47	12	61
10	2	10	5.7	57	10	43
11	2	11	6.18	68	8	20
12	2	12	6.67	80	6	-8
13	2	13	7.15	93	4	-41
14	2	14	7.64	107	2	-79
15	2	15	8.13	122	0	-122

   (a) How many cones should Katerina sell to maximize her profit?

   Katerina's marginal revenue is $MR = 30 - 4q$. Setting $MR = MC$: $30 - 4q = q$, so $q = 6$ cones.

   (b) How much should Katerina charge per cone in order to maximize her profit?

   Substituting q=6 into the demand function gives the price consumers are willing to pay for 6 cones: $p = 30 - 2 \cdot 6 = \$18$.

   (c) How much is the maximum profit that Katerina will make?

   Katerina's profit for $q = 6$ will be $\Pi = p \cdot q - TC = 18 \cdot 6 - 23 = \$85$.

   (d) How many cones would Katerina sell if she acted as a PC firm?

   A PC firm sets $p = MC$: $30 - 2q = q$, so $q = 30/3 = 10$ cones.

   (e) How much would she charge per cone if she acted as a PC firm?

   Substituting $q = 10$ into the demand function: $p = 30 - 2 \cdot 10 = \$10$.

   (f) How much S-R profit would she make if she acted as a PC firm?

   Katerina's profit for $q = 10$ will be $\Pi = p \cdot q - TC = 10 \cdot 10 - 57 = \$43$.

5. Calculate VC for $q = 500$ if $MC = 2q$.

   If $MC = 2q$, MC for the first unit is 2, for the second is 4, for the third is 6, and so on until the 500th unit for which $MC = 1{,}000$. VC for 500 units is therefore the sum of all MCs:

$$2 + 4 + 6 + \cdots + 996 + 998 + 1{,}000.$$

   This summation has 500 terms and would take too long to enter into a calculator. Fortunately, there is a shortcut. The first term (2) and the last term ($1{,}000$) sum to $1{,}002$. The second term (4) and the second-to-last term (998) also sum to $1{,}002$. This pattern continues as we pair terms moving inward. With 500 terms in total, we have 250 such pairs, each summing to $1{,}002$. Thus, the total is $250 \cdot 1{,}002 = 250{,}500$.

6. Consider the market of a PC good with a vertical market demand.

   (a) Explain the economic meaning of a vertical demand curve.

   A vertical demand curve means that consumers buy the same quantity regardless of price. This occurs when the good is a strict necessity with no substitutes — such as surgery, insulin, or chemotherapy — or when it represents such a small share of the household budget that price changes are barely noticed (e.g. water, salt, toothpicks).

   (b) A tax per unit is imposed on the good. Explain who will end up paying the burden of the tax.

   The tax shifts the supply curve upward by the amount of the tax. Since demand is vertical, the equilibrium quantity remains unchanged and the price rises by exactly the amount of the tax. The consumer therefore bears the entire burden of the tax.

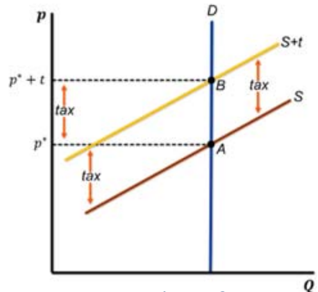


Figure 3

7. Explain how *lobbying* can increase the social cost of monopolies if it is used for rent-seeking.

   Lobbying involves spending money to influence politicians into granting or protecting monopoly rights. These resources are not used to produce anything — they are pure waste from society's perspective. Moreover, a monopolist may be willing to spend up to the value of its monopoly profit on lobbying, which can far exceed the DWL. The social cost of the monopoly therefore includes not just the DWL but also the resources consumed by rent-seeking.

8. Explain how *advertisement* can increase the social cost of monopolies if it is used for rent-seeking.

   When used for rent-seeking, advertising is not aimed at informing consumers — it is aimed at raising the cost of entry for potential competitors. By spending heavily on advertising, an incumbent monopolist signals that any entrant would need to match that spending to compete, which deters firms with limited funds. These advertising resources produce no social value; like lobbying, they are pure waste. The social cost of the monopoly therefore grows by the amount spent on rent-seeking advertising, on top of the DWL.

9. Explain how *building excess capacity* can increase the social cost of monopolies if it is used for rent-seeking.

   A monopolist may invest in production capacity it never intends to use. This excess capacity serves as a credible threat to potential entrants: if a competitor enters the market, the monopolist can rapidly scale up output, flood the market, and drive the price below the entrant's AC — making entry unprofitable. The social cost increases because resources spent building this excess capacity are wasted; the equipment sits idle and produces nothing of value, yet it successfully deters competition.

10. [*Optional – requires math beyond the scope of this course*] A seller faces demand $p = 10 - q$.

(a) Subtract the revenue for $q = 2$ from the revenue for $q = 3$ to calculate the marginal revenue of the 3rd unit.

For $q = 3, p = 10 - 3 = \$7;$ *so revenue is* $3 \cdot \$7 = \$21.$
For $q = 2, p = 10 - 2 = \$8;$ *so, revenue is* $2 \cdot \$8 = \$16.$
Marginal revenue for the 3rd unit is $\$21 - \$16 = \$5.$

(b) Calculate the marginal revenue for the 3rd unit using the "double gradient" rule.

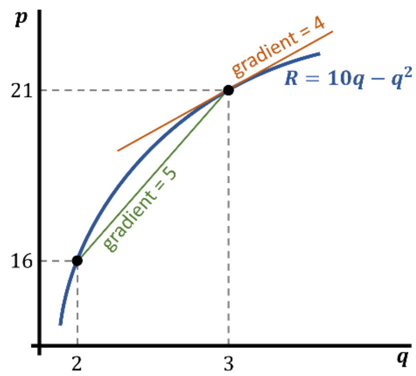
$MR = 10 - 2q$, *for* $q = 3$, $MR = 10 - 2 \cdot 3 = \$4.$

(c) Why do (a) and (b) yield different marginal revenue for the same number of units?

They do not yield different marginal revenues — they calculate slightly different things. The revenue function is:

$$R = p \cdot q = (10 - q)q = 10q - q^2,$$

which is quadratic, not linear. Its gradient therefore varies with q — moving from $q = 2$ *to* $q = 3$*, the gradient goes from 6 to 4. In (a) we calculate an average gradient between* $q = 2$ *and* $q = 3$*, which is preferable when dealing with discrete units (cars, devices, chairs, etc.), where output jumps from one whole unit to the next. In (b) we calculate the gradient exactly at* $q = 3$*, which is preferable when quantities are continuous (kg, liters, GB, watt-hours, etc.), where it is possible to go from 2.999 to 3 units. In this course, you can use either method interchangeably.*



Please report any typos, mistakes, or suggestions for improvement to kmarinakis@smu.edu.sg.