Problem Set 1: due September 20

Problem 1 (15 points)

Suppose that the demand and supply functions in a competitive industry are $P = 1,000 - 0.025Q$ and $P = 200 + 0.75Q$, respectively.

a (5). Calculate the equilibrium price and quantity.

b (10). Calculate the producer and consumer surplus in the competitive equilibrium.

Problem 2 (25 points)

Suppose that the demand for plastic hangers is $P = 3 - Q/16,000$. Suppose further that the marginal cost of producing hangers is constant at $1.

a (5). What is the equilibrium price and quantity of hangers if the market is competitive?

b (10). What is the equilibrium price and quantity of hangers if the market is monopolized?

c (10). What is the deadweight loss of monopoly in this market?

Problem 3 (20 points)

The tables below gives market share data for three paper product markets

Facial tissue

Company	% share
Kimberly-Clark	48
Procter & Gamble	30
Scott	7
Georgia Pacific	6
Other	9

Toilet paper

Company	% share
Procter & Gamble	30
Scott	20
James River	16
Georgia Pacific	12
Kimberly-Clark	6
Other	16

Paper towels

Company	% share
Procter & Gamble	37
Scott	18
James River	12
Georgia Pacific	11
Scott	4
Other	18

a (5). Calculate the CR_4 for each market.

b (5). Calculate the HHI for each market.

c (10). Which market do you think is the most concentrated?

Problem 4 (15 points)

Assume that the total cost function is $C = 100 + 4q + 4q^2$.

a (5). Derive the average and marginal cost functions.

b (10). Is there any range of production characterized by scale economies?

Problem 5 (25 points)

Assume that the following relationship holds between capacity and average cost for the cement industry

Table 1. Cost calculations for the cement industry

Capacity	AC
250	28.78
500	25.73
750	23.63
1,000	21.63
1,250	21.00
1,500	20.75
1,750	20.95
2,000	21.50

a (5). Indicate the production level at which scale economies are exhausted.

b (20). Calculate the scale economy index for production levels 500, 750, 1000, 1,250, 1,500, and 1,750.

Problem Set 1: Answers

Problem 1

a. We obtain the equilibrium quantity Q^* by setting demand equal to supply

$$1,000 - 0.025Q = 200 + 0.75Q \Rightarrow 800 = 0.775Q \Rightarrow Q^* = 1,032.26.$$

We obtain the equilibrium price P^* by plugging Q^* into the demand or supply equation

$$P^* = 1,000 - 0.025Q^* = 974.19.$$

b. The consumer and producer surplus in equilibrium are

$$CS^* = \frac{1}{2}(1,000 - 974.19)1,032.26 = \$13,321.$$

$$PS^* = \frac{1}{2}(974.19 - 200)1,032.26 = \$399,583.$$

Problem 2

a. We obtain the equilibrium quantity in the competitive market by setting the price equal to marginal cost and solving for Q

$$P = MC \Rightarrow 3 - \frac{Q}{16,000} = 1 \Rightarrow Q^C = 32,000$$

The equilibrium price in the competitive market is equal to marginal cost. Therefore, $P^C = 1$.

b. We obtain the equilibrium quantity in the monopolized market by setting marginal revenue equal to marginal cost and solving for Q. We first need to calculate the marginal revenue

$$P(Q) = 3 - \frac{Q}{16,000} \Rightarrow TR(Q) = P(Q)Q = 3Q - \frac{Q^2}{16,000}$$

$$MR(Q) = TR'(Q) = 3 - \frac{2Q}{16,000} = 3 - \frac{Q}{8,000}$$

$$MR = MC \Rightarrow 3 - \frac{Q}{8,000} = 1 \Rightarrow \frac{Q}{8,000} = 2 \Rightarrow Q^M = 16,000.$$

The equilibrium price in the monopolized market is

$$P^M = 3 - \frac{Q^M}{16,000} = 3 - 1 = 2.$$

c. The deadweight loss due to the monopoly is given by

$$DWL = \frac{1}{2}(2 - 1)(32,000 - 16,000) = 8,000.$$

Problem 3

a. The CR_4's for the three markets are

$$CR_4^{FT} = 0.48 + 0.30 + 0.07 + 0.06 = 0.91$$

$$CR_4^{TP} = 0.30 + 0.20 + 0.16 + 0.12 = 0.78$$

$$CR_4^{PT} = 0.37 + 0.18 + 0.12 + 0.11 = 0.78.$$

b. The HHIs for the three markets are

$$HHI^{FT} = 48^2 + 30^2 + 7^2 + 6^2 + 9^2 = 3,370.$$

$$HHI^{TP} = 30^2 + 20^2 + 16^2 + 12^2 + 6^2 + 16^2 = 1,992.$$

$$HHI^{PT} = 37^2 + 18^2 + 12^2 + 11^2 + 4^2 + 18^2 = 2,298.$$

c. The facial tissue market exhibits the most concentration—it has the highest CR_4 and HHI. Notice that two firms control 78% of the market.

Problem 4

a. The average and marginal cost functions are:

$$AC(q) = \frac{C(q)}{q} = \frac{100 + 4q + 4q^2}{q} = \frac{100}{q} + 4 + 4q$$

$$MC(q) = C'(q) = 4 + 8q$$

b. To find the range of production characterized by scale economies, we equate $AC(q)$ with $MC(q)$

$$AC(q) = MC(q) \Rightarrow \frac{100}{q} + 4 + 4q = 4 + 8q \Rightarrow \frac{100}{q} = 4q \Rightarrow \frac{100 - 4q^2}{q} = 0 \Rightarrow$$

$$100 - 4q^2 = 0 \Rightarrow 100 = 4q^2 \Rightarrow q^2 = 25 \Rightarrow q = 5.$$

For $q \in [0, 5]$, production is characterized by scale economies. At $q = 5$, scale economies are exhausted.

Problem 5

a. Average costs start to rise once we move from 1,500 to 1,750 units of output. You can also compute a discrete measure of marginal cost and compare it with average cost. As the table below shows, once we go beyond 1,500 units the marginal cost is higher than average cost.

Capacity	AC	TC	ΔTC	Δcapacity	MC_1	MC_2	S_1=AC/MC_1	S_2=AC/MC_2
250	28.78	7,195	5,670	250	22.68		1.27	
500	25.73	12,865	4,858	250	19.43	21.06	1.32	1.22
750	23.63	17,723	3,908	250	15.63	17.53	1.51	1.35
1,000	21.63	21,630	4,620	250	18.48	17.06	1.17	1.27
1,250	21.00	26,250	4,875	250	19.50	18.99	1.08	1.11
1,500	20.75	31,125	5,538	250	22.15	20.83	0.94	1.00
1,750	20.95	36,663	6,338	250	25.35	23.75	0.83	0.88
2,000	21.50	43,000						

Here is an example of the discrete marginal cost calculation (MC_1) when capacity is 250

$$MC_1 = \frac{\Delta TC}{\Delta Capacity} = \frac{500 \times 25.73 - 250 \times 28.78}{500 - 250} = \frac{5,670}{250} = 22.68$$

It is also common to compute the average marginal cost (MC_2) when we have large changes in output. For example, when capacity is 500, we can calculate the average marginal cost as follows

$$MC_2 = \frac{22.68 + 19.43}{2} = 21.06$$

b. The last two columns of the table above provide the scale economy index for the two alternative measures of marginal cost.