Multiple Choice

Question	Answer
1	b
2	b
3	e
4	b
5	e
6	d
7	a
8	c
9	d
10	a
11	a
12	d
13	a
14	c
15	a
16	c

Longer Questions

I have chosen to answer question 1 and question 2.

a)

What we know:

$Q = 1200 - 2p$

$MC = 300$

$FC = 10000$

Inverse demand function: $p = 600 - 0.5q$

I will compare the profits with the investment and without the investment in the duopoly market:

Denote Company A firm 1 and denote Company B firm 2

Without investment:

Profit function for firm 1:

$$\pi_1 = \pi_2 = (600 - 0.5(q_1 + q_2)q_1 - 300q_1 - 10000$$

This is a standard Curnout competition problem so, by the formulas derived in class, The Nash equilibrium quantities are given by:

$$q_1 = q_2 = \frac{600 - 2 * 300 + 300}{3 * 0.5} = 200$$

The corresponding profit for firm 1 is then given by:

$$\pi_1 = (600 - 0.5(200 + 200) * 200 - 300 * 200 - 10000 = 10000$$

With investment:

Profit function for firm 1:

$$\pi_1 = (600 - 0.5(q_1 + q_2)q_1 - 200q_1 - 10000 - 20000$$

This is a standard Curnout competition problem so, by the formulas derived in class, The Nash equilibrium quantities are given by:

$$q_1 = \frac{600 - 2 * 200 + 300}{3 * 0.5} = 333.333$$

$$q_2 = \frac{600 - 2 * 300 + 200}{3 * 0.5} = 133.333$$

The corresponding profit for firm 1 is then given by:

$$\pi_1 = (600 - 0.5(333.333 + 133.333)q_1 - 200q_1 - 10000 - 20000 = 25555.6$$

Thus, when we compare the profit without investment 10000 to the profit with investment 25555.6, we can see that firm 1 would make the investment.

b)

We have the profit, if firm 1 does not invest, from a)

With investment:

Profit function for firm 1:

$$\pi_1 = (600 - 0.5(q_1 + q_2)q_1 - 200q_1 - 10000 - 20000$$

This is a standard Curnout competition problem so, by the formulas derived in class, The Nash equilibrium quantities are given by:

$$q_1 = q_2 = \frac{600 - 2 * 200 + 200}{3 * 0.5} = 266.667$$

The corresponding profit for firm 1 is then given by:

$$\pi_1 = (600 - 0.5(266.667 + 266.667) * 266.667 - 200 * 266.667 - 10000 - 20000 = 5555.51$$

Thus, when we compare the profit without investment of 10000 to the profit with investment 5555.51, we can see that firm 1 would not make the investment.

c)

Reasoning: If Firm 1 purchases the investment, Firm 2 will be able to "free ride" the investment. In other words, Firm 1 creates a **positive externality** for firms in the industry, making it a **public good** which increases the profits for ALL firms in the industry.

Now, the benefit is not only for the one firm, but for both firms, creating a lower profit for the firm who undertakes the investment.

a)

$f(L, M, K) = L^{0.5} * M^{0.5} * K$

Denmark:

I will find the short run cost function:

First, I will find the marginal products:

$$MP_L = 0.5 * \frac{f(L, M, K)}{L}$$

$$MP_M = 0.5 * \frac{f(L, M, K)}{M}$$

Then, I will use the cost minimizing condition to find the relationship:

$$\frac{0.5 * \frac{f(L, M, K)}{L}}{400} = \frac{0.5 * \frac{f(L, M, K)}{M}}{100}$$

Thus, $M = 4L$, thus:

$$q = L^{0.5} * (4L)^{0.5} * 10$$

We can then solve for L:

$$L = \frac{q}{20}$$

We can put this into the cost function:

$$C(q) = 400 * \left(\frac{q}{20}\right) + 100 * \left(4 * \frac{q}{20}\right) + 100 * 10 = 40q + 1000$$

Thus the cost function for Novo in Denmark is $40q + 1000$, and it exhibits economies of scale, since AC is decreasing in Q.

I will calculate the monopoly profit

I will find the marginal cost for the firm:

$$MC = C(q)' = 40$$

I will then find the optimal quantity at $MR = MC$:

$$60 - 0.2Q = 40$$

$$Q = 100$$

And the corresponding price:

$$P = 60 - 0.1Q = 50$$

Profit would then be:

$$50 * 100 - (40 * 100 + 1000) = 0$$

Poland:

Then, I will use the cost minimizing condition to find the relationship:

$$\frac{0.5 * \frac{f(L,M,K)}{L}}{200} = \frac{0.5 * \frac{f(L,M,K)}{M}}{50}$$

Thus, $M = 4L$:

The cost function would then be:

$$C(q) = 200 * \left(\frac{q}{20}\right) + 50 * \left(4 * \frac{q}{20}\right) + 100 * 10 = 20q + 1000$$

Thus, the cost function for Novo in Poland is $20q + 1000$, and it exhibits economies of scale, since AC is decreasing in Q.

I will calculate the monopoly profit

I will find the marginal cost for the firm:

$$MC = C(q)' = 20$$

I will then find the optimal quantity at $MR = MC$:

$$60 - 0.2Q = 20$$

$$Q = 200$$

And the corresponding price:

$$P = 60 - 0.1 * 200 = 40$$

Profit would then be:

$$200 * 40 - (20 * 200 + 1000) = 3000$$

Thus, Novo will choose to produce in Poland, since the profit of 3000 is higher than 0 in Denmark.

It will produce with an output of $Q = 200$

The optimal combination of input would be:

$$200 = L^{0.5} * 4L^{0.5} * 10$$

$$L = 10$$

$$M = 4 * 10 = 40$$

b)

I will find the short-run cost function in Poland, when labor is also fixed:

$$q = 10^{0.5} * M^{0.5} * 10$$

Then solve for M:

$$m = 0.001q^2$$

And the cost function would then be:

$$C(q) = 200 * 10 + 50 * (0.001q^2) + 100 * 10 = 0.05q^2 + 3000$$

Thus the cost function would be $C(q) = 0.05q^2 + 3000$, and this cost function would have economies of scale at lower output levels and diseconomies of scale at higher output levels.

c)

We have the profit in Denmark from a).

I will find the profit in Poland:

I will find the marginal cost for the firm:

$$MC = C(q)' = 0.1$$

I will then find the optimal quantity at $MR = MC$:

$$60 - 0.2Q = 0.01$$

$$Q = 299.5$$

And the corresponding price:

$$60 - 0.1 * 299.5 = 30.05$$

The profit would then be:

$$30.005 * 299.95 - (0.1 * 299.95 + 3000) = 5970$$

Thus, Novo would choose to produce in Poland, since the profit is higher.

When output is fixed at 1000 units.

$$P = 60 - 0.001 * 1000 = 59$$

Profit in Poland:

$$1000 * 59 - (0.05 * 1000^2 + 3000) = 55990$$

Profit in Denmark:

$$1000 * 59 - (25 * 1000 + 1000) = 33000$$

Thus Novo would still choose to produce in Poland.

They would always choose Poland in this example.

But a reason why, the choice may depend on the demand it faces and its flexibility is because of economies of scale.