Microeconomics December 2024

Part 1 – multiple questions

Question	Answer
1	D
2	E
3	B
4	A
5	C
6	C
7	E
8	B
9	D
10	A
11	C
12	D
13	B
14	A
15	B
16	C

Part 2 – longer questions

I have chosen to answer question 2 and 3.

Question 2

(a) The two firms have homogenous products and same marginal costs. To find the Nash equilibrium outputs, the formula for the Cournot Nash equilibrium is used.

$$q_1 = \frac{a - 2m_1 + m_2}{3b}$$
$$q_2 = \frac{a - 2m_2 + m_1}{3b}$$

Because their marginal costs and demand are the same, the optimal output for the firms will be equal:

$$q_1 = \frac{(200) - 2(40) + (40)}{3(2)} = 26.67$$
$$q_2 = \frac{(200) - 2(40) + (40)}{3(2)} = 26.67$$

Inserting the aggregate optimal quantities in the inverse demand function to get the price:

$$P_f = 200 - 2(26.67 + 26.67) - (0) = 146.67$$

Inserting quantity, price, and marginal cost in the formula for profit:

$$\pi = (p * q) - (mc * q)$$
$$\pi_1 = (146.67 * 26.67) - (40 * 26.67) = 2844.89 \text{ kroner}$$
$$\pi_2 = (146.67 * 26.67) - (40 * 26.67) = 2844.89 \text{ kroner}$$

The Cournot Nash equilibrium outputs are (26.67, 26.67), so the two firms both produce 26.67 units, and their corresponding profit is 2844.89 kroner.

(a) The firms now have different products, and different marginal costs. To find their optimal output, the output that maximizes profit must be found.

Profit for Firm 1, that produces ordinary gløgg:

$$\pi_o = \left(100 - 2Q_o - Q_f\right)Q_o - 10(Q_o)$$

Setting the derivative with respect to Q_o to 0 and isolates for Q_o, to find the best response to Firm 2's output:

$$\frac{\partial \pi_o}{\partial Q_o} = 0 \rightarrow \boldsymbol{Q_o = -0.25 \cdot (Q_f - 90)}$$

Profit for Firm 2, that produces fancy gløgg:

$$\pi_f = \left(200 - 2Q_f - Q_o\right)Q_f - 40(Q_f)$$

Setting the derivative with respect to Q_f to 0 and isolates for Q_f, to find the best response to Firm 1's output:

$$\frac{\partial \pi_f}{\partial Q_f} = 0 \rightarrow \boldsymbol{Q_f = -0.25 \cdot (Q_o - 160)}$$

Solving two equations with two unknowns:

$$\boldsymbol{Q_o = -0.25 \cdot (Q_f - 90)} \text{ and } \boldsymbol{Q_f = -0.25 \cdot (Q_o - 160)}$$

$$Q_o = 13.33$$
$$Q_n = 36.67$$

Profit for Firm 1, that produces ordinary gløgg:

$$\pi_o(13.33) = (100 - 2(13.33) - 36.67)13.33 - 10(13.33) = 359.64 \text{ kroner}$$

Profit for Firm 2, that produces fancy gløgg:

$$\pi_f(36.67) = (200 - 2(36.67) - 13.33)36.67 - 40(36.67) = 2{,}689.01 \text{ kroner}$$

The Nash equilibrium output for ordinary gløgg and fancy gløgg is (13.33, 36.67) where Firm 1 produces 13.33 units, and Firm 2 produces 36.67 units. This gives Firm 1 a profit of 359.64 kroner, and Firm 2 a profit of 2,689.01 kroner.

(b) Finding out the scenario where the firms have the same kind of gløgg with a price competition.

When they have the same demand, and the same marginal costs (because they are producing the same kind of gløgg), a duopoly will set their price at their marginal cost, because or else the other firm would underprice them and get all the consumers.

If the firms both choose ordinary gløgg, they will set their prices at 10 kroner. This gives an aggregate quantity of:

$$10 = 100 - 2Q_o - Q_f \rightarrow Q_o = 45$$
$$\frac{45}{2} = 22.5 \text{ units}$$

Each firm produces 22.5 units at a price of 10, and their profit is.

$$(10 - 10)22.5 = 0 \text{ kroner}$$

When price is sat at marginal cost, both firm's profit will be 0 kroner. The same scenario is happening in the case of both firms producing fancy gløgg (they will set their prices at 40 kroner and have a marginal cost of 40 kroner). When they produce different kinds of gløgg they will both get a positive profit.

Because Firm 2 wants a positive profit its best response to Firm 1 choosing to produce ordinary gløgg is to produce fancy gløgg. And Firm 2's best response to Firm 1 choosing to produce fancy gløgg is to produce ordinary gløgg.

From (b) we know that if Firm 1 chooses to produce ordinary gløgg (and Firm 2 fancy), it will get a profit of 359.64 kroner, and it will get a profit of 2,689.01 kroner (if Firm 2 produces ordinary), if it chooses to produce fancy gløgg.

The Subgame Perfect Nash equilibrium is:

- **The strategy for Firm 2 is to choose to produce ordinary gløgg, if Firm 1 produces fancy gløgg, and for Firm 2 to choose to produce fancy gløgg,**
- **The strategy for Firm 1 is to produces fancy gløgg.**

In this Subgame Perfect Nash equilibrium Firm 2 will get a profit of 359.64 kroner, and Firm 1 will get a profit of 2,689.01 kroner.

Question 3

(a) Because it is a Cobb-Douglas function, it needs to consume positive quantities of all goods given that Y (the budget) is positive, because that is the only way to increase the utility to beyond zero. The demand for the first good in a Cobb-Douglas function is given by:

$$x_1 = \frac{\alpha_1}{\alpha_1 + \alpha_2}\frac{Y}{p_1}$$

For the consumers with preferences like Albert their demand is:

$$D^A(p_1, Y) = 1{,}000 \cdot \frac{0.4}{0.4 + 0.6}\frac{1000}{p_1} = \frac{400{,}000}{p_1}$$

For the consumers with preferences like Albert their demand is:

$$D^B(p_1, Y) = 1{,}000 \cdot \frac{0.6}{0.6 + 0.4}\frac{1000}{p_1} = \frac{600{,}000}{p_1}$$

The aggregate demand is:

$$D = D^A(p_1, Y) + D^B(p_1, Y)$$
$$D = \frac{400{,}000}{p_1} + \frac{600{,}000}{p_1} = \frac{1{,}000{,}000}{p_1}$$

The aggregate demand for good 1 is $D = \frac{1{,}000{,}000}{p_1}$.

(b) The equilibrium price and quantity in a competitive market is found by setting the demand and supply function equal.

The inverse demand function is:

$$Q = \frac{1{,}000{,}000}{p_1} \rightarrow p_1 = \frac{1{,}000{,}000}{D}$$

$$\frac{1{,}000{,}000}{Q} = 0.16Q \rightarrow Q = 2{,}500 \text{ units}$$

Inserting quantity in inverse demand function to get the price:

$$p_1 = \frac{1{,}000{,}000}{2{,}500} = 400 \text{ euros}$$

The competitive market equilibrium price for the first good is 400 euros, and the quantity is 2,500 units.

(c) The socially optimal level of output is found by adding the negative externality to the supply function, and then setting the social supply equal to the demand.

$$P = 0.16Q + 0.09Q = 0.25Q$$

$$\frac{1{,}000{,}000}{Q} = 0.25Q \rightarrow 2{,}000 \text{ units}$$

The socially optimal level of output of the first good is 2,000 units, which is 500 units less than the equilibrium without the negative externality. This is because there is an environmental negative externality which means that the production of units is damaging the environment, so it would be optimal to produce fewer units.

(d) The price at the social optimum should be 500 euros. The price paid by consumers should be equal to producers corresponding to an output of 2,000. Thus, inserting the quantity of 2,000 and setting the supply plus a tax equal to the 500-euro price:

$$P = 0.16Q \rightarrow 500 = 0.16(2000) + t \rightarrow t = 180 \text{ euros}$$

Bertha's consumption in (b) was:

$$x_1 = \frac{\alpha}{\alpha + \beta}\frac{\text{budget}}{P_{x_1}}$$
$$x_1 = 0.6\frac{1000}{400} = 1.5$$
$$x_2 = 0.4\frac{1000}{100} = 4$$

This gave her a utility of:

$$1.5^{0.6}4^{0.4} = 2.22$$

To attain the utility in (b) with the tax, she needs to have a utility of 2.22:

$$\left(0.6\frac{B}{580}\right)^{0.6}\left(0.4\frac{B}{100}\right)^{0.4} = 2.22 \rightarrow B = 1{,}249.38$$

$$1{,}249.38 - 1{,}000 = 249.38 \text{ euros}$$

Consumers should pay a tax of 180 euros, and to maintain Bertha's utility level of (b), she would need to get 249-38 euros more.