

EGT2
ENGINEERING TRIPOS PART IIA

Friday 9 May 2025 14.00 to 15.40

Module 3E1

BUSINESS ECONOMICS

*Answer not more than **two** questions.*

All questions carry the same number of marks.

*The **approximate** percentage of marks allocated to each part of a question is indicated in the right margin.*

*Write your candidate number **not** your name on the cover sheet.*

STATIONERY REQUIREMENTS

Single-sided script paper.

SPECIAL REQUIREMENTS TO BE SUPPLIED FOR THIS EXAM

CUED approved calculator allowed.

10 minutes reading time is allowed for this paper at the start of the exam.

You may not start to read the questions printed on the subsequent pages of this question paper until instructed to do so.

You may not remove any stationery from the Examination Room.

1 A pharmaceutical company assumes two types of markets: $P = 60 - Q$ (North Market) and $P = 40 - Q$ (South Market). Provide your reasoning/calculations when answering the questions below.

(a) Assume that the marginal cost of producing the drug is £10. If the monopolist is forced to charge the same price in each market (uniform pricing), calculate the equilibrium price, quantity, profit, consumer surplus, producer surplus and total surplus. Illustrate your answer using a diagram. [25%]

Uniform Pricing

Invert individual market demands:

$$q = 60 - P, P \leq 60$$

$$q = 40 - P, P \leq 40$$

Aggregate Demand:

$$Q = 60 - P, 40 \leq P \leq 60$$

$$Q = 100 - 2P, P < 40$$

Invert Aggregate demand:

$$P = 60 - Q, Q \leq 20$$

$$P = 50 - Q/2, Q > 20$$

Marginal Revenue

$$P = 60 - 2Q, Q \leq 20$$

$$P = 50 - Q, Q > 20$$

Equilibrium:

Assume both markets are active and check later:

$$MR = MC$$

$$50 - Q = 10$$

$$Q = 40 \text{ (assumption is satisfied)}$$

Substitute $Q = 40$ into aggregate market demand.

$$P = 30$$

$$\text{Profit: } (P - MC) * Q = (30 - 10) * 40 = 20 * 40 = 800$$

Consumer Surplus is the area of the triangle above $P = 40$ and the trapezoid for which P is between 30 and 40.

$$CS = (60 - 40) * 20 / 2 + [(20 + 40) / 2] * 10 = 200 + 300 = 500$$

Or you can also compute CS for each market separately and add them up:

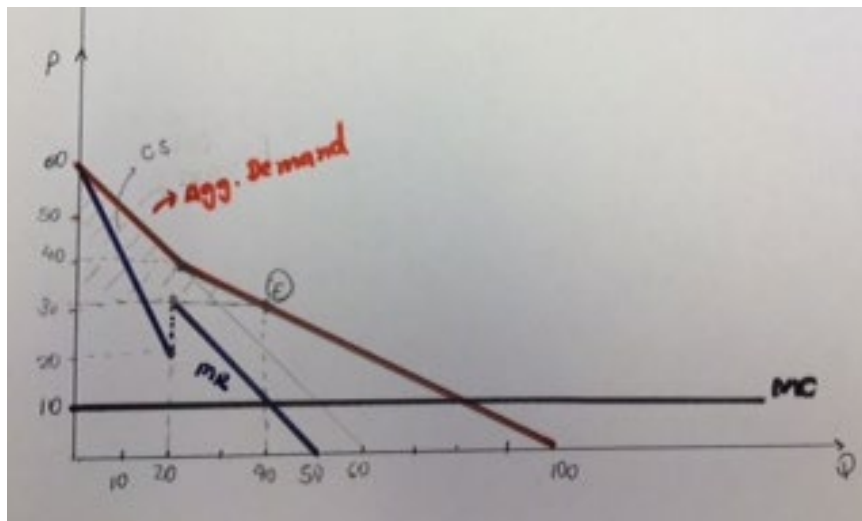
$$\text{North: } P = 30, q = 30, CS = (60 - 30) * 30 / 2 = 450$$

$$\text{South: } P = 30, q = 10, CS = (40 - 30) * 10 / 2 = 50$$

Producer Surplus equals profits since no fixed costs.

$$PS = 800$$

$$\text{Total Surplus} = 500 + 800 = 1,300$$



(b) Assume that the marginal cost of producing the drug is £10. What happens compared to (a) if the company is allowed to charge a different price to each market (price discriminate), instead? [25%]

Under third-degree price discrimination:

North Market

$$P = 60 - q$$

$$MR = 60 - 2q$$

In equilibrium, $MR = MC$

$$60 - 2q = 10$$

$$50 = 2q$$

$$q_n = 25$$

$$p_n = 60 - 25 = 35$$

South Market

$$P = 40 - q$$

$$MR = 40 - 2q$$

In equilibrium, $MR = MC$

$$40 - 2q = 10$$

$$30 = 2q$$

$$q = 15$$

$$p = 40 - 15 = 25$$

$$\text{Profit: } (35 - 10) \cdot 25 + (25 - 10) \cdot 15 = 625 + 225 = 850$$

Consumer Surplus:

$$\text{North: } (60 - 35) \cdot 25 / 2 = 312.5$$

$$\text{South: } (40 - 25) \cdot 15 / 2 = 112.5$$

$$TS = 312.5 + 112.5 = 425$$

$$\text{Total Surplus} = 425 + 850 = 1,275$$

Firm is better off because it could have chosen to keep prices at 30, but instead chose a price combination of \$35 in the North market and \$25 in the South that gives it a larger profit.

North is worse off under price discrimination because their price goes up. South is better

off with price discrimination because their price goes down.
Overall, welfare is lower. North loses more than what South and monopolist make.

(c) The company is now required to pay a tariff which increases its marginal cost to \$35. If the monopolist is forced to charge the same price in each market (uniform pricing), calculate the equilibrium price, quantity, profit, consumer surplus, producer surplus and total surplus. What happens if the firm can price discriminate? [40%]

Assume both markets are active and check later:

$$MR=50-Q, Q>20$$

$$MR=MC$$

$$50-Q=35$$

$Q=15$, contradiction.

Thus, only North is served under uniform pricing

$$MR=60-2Q, Q\leq 20 \text{ (will check)}$$

$$MR=MC$$

$$60-2Q = 35$$

$Q=12.5$ (since $12.5 < 20$, assumption is satisfied)

Substitute into market demand to find the price:

$$P=60-12.5 = 47.5$$

$$\text{Profit} = (47.5-35)*12.5=156.25$$

$$CS = (60-47.5)*12.5/2 = 78.13$$

$$\text{Total Surplus} = PS+CS = 156.25+78.13=234.38$$

Allow price discrimination

North Market

$$P = 60-q$$

$$MR=60-2q$$

In equilibrium, $MR=MC$

$$60-2q=35$$

$$q_n=12.5$$

$$p_n=60-12.5=47.5$$

South Market

$$P = 40-q$$

$$MR=40-2q$$

In equilibrium, $MR=MC$

$$40-2q=35$$

$$5=2q$$

$$q=2.5$$

$$p=40-2.5=37.5$$

$$\text{Profit: } (47.5-35)*12.5+(37.5-35)*2.5 = 162.5$$

Consumer Surplus:

$$\text{North: } (60-47.5)*12.5/2 = 78.125$$

$$\text{South: } (37.5-35)*2.5/2 = 3.125$$

$$TS = 243.75$$

North market is charged the same price under price discrimination as compared to uniform pricing, but under price discrimination South market is offered $q=2.5$, which of course increases surplus from c).

- (d) What have you learned from (a) – (c) about price discrimination? [10%]
Third degree price discrimination is beneficial if some markets are not served under uniform pricing. Price discrimination facilitates access to the market for the consumers for whom the price was previously too high to make any purchase at all.

2 Two firms produce luxury auto seat covers: Northwest Seat Covers (NW) and J&J Seat Cover Company (J&J). The market demand for these seat covers is represented by the inverse demand function: $P = 100 - Q$, where Q is the total quantity produced by both firms. Each firm has a cost function given by $C(q) = 10q$.

- (a) Construct a 2x2 matrix for the two players, assuming that the options for each firm are either to collude or to compete by choosing quantities simultaneously. [50%]

Profits from Cournot Competition

Firm 1:

$$MR = MC$$

$$100 - 2q_1 - q_2 = 10$$

$$q_1 = (90 - q_2)/2 \text{ (firm 1's best response)}$$

Similarly,

$$q_2 = (90 - q_1)/2 \text{ (firm 2's best response)}$$

To find the Cournot-Nash equilibrium, substitute firm 2's best response quantity into firm 1's best response

$$2q_1 = 90 - [(90 - q_1)/2]$$

Now solve for q_1

$$q_1 = 30 \text{ and } q_2 = 30$$

$$Q = 60, P = 40$$

Profit to each firm:

$$\pi_i = [40-10]*30 = 900$$

Profits from Cartel

$$MR = MC$$

$$100-2Q = 10$$

$$90 = 2Q$$

$$Q = 45, P = 55, q = 22.5$$

$$\pi = [55-10]*45 = 2025$$

$$\text{Profit to each firm} = 1012.5$$

Profits from Collude, Compete

Assume firm 2 will choose $q_2 = 22.5$

Then, firm 1's BR is $q_1 = (90-22.5)/2 = 33.75$

$$Q = 56.25, P = 43.75$$

$$\pi_1 = [43.75-10]*33.75 = 1139.063$$

$$\pi_2 = [43.75-10]*22.5 = 759.375$$

		J&J	
		Produce Cournot q	Produce Cartel q
NW	Produce Cournot q	900, 900	1139.063, 759.375
	Produce Cartel q	759.375, 1139.063	1012.5, 1012.5

- (b) Using your results from (a) explain why cartels (collusions) exist despite them being highly unstable. [20%]

In the game matrix, note that producing the Cournot quantity is a dominant for both firms. So, the game is dominance solvable and the NE is (30, 30) which results in profits of 1125 to each firm. This is a prisoner's dilemma since both firms have a dominant strategy (game is dominance solvable) but the NE outcome is pareto inferior, i.e. both firms would be better off by colluding. Advanced: Grim strategy or Tit-for-tat supporting the equilibrium (with calculations). Cartels are highly unstable because the incentive to cheat is strong in the one-shot game. In a repeated game, depending on discount factors, firms may be willing to cooperate (collude)/

- (c) Assume that NW is a more sophisticated firm and chooses quantity before J&J does. Determine price, quantities produced by firms and profits. Using your results from (a) and (c), explain how the order of play (simultaneous x sequential) impact profits? [30%]

Profits from Stackelberg Competition

Firm 1: Leader

BR for Firm 2 is:

$$q_2 = (90 - q_1)/2$$

To find the Stackelberg equilibrium, substitute firm 2's best response quantity into firm 1's Profit function

$$\pi_1 = (100 - q_1 - q_2) q_1 - 10 q_1$$

$$\pi_1 = [100 - q_1 - (90 - q_1)/2] q_1 - 10 q_1$$

FOC

$$(-1 + 1/2) q_1 + [100 - q_1 - 45 + q_1/2] - 10 = 0$$

$$45 - q_1/2 - q_1/2 = 0$$

$$q_1 = 45, q_2 = 22.5$$

$$Q = 67.5$$

$$P = 32.5$$

Profit to each firm:

$$\pi_1 = [32.5 - 10] \cdot 45 = 1012.5$$

$$\pi_2 = [32.5 - 10] \cdot 22.5 = 506.25$$

Discuss commitment and first-mover advantage.

3 Discuss **two** types of market failure from the following three choices: Market Power, Information Asymmetry, Externality. Discuss what is meant by them, provide real life examples that illustrate them and the consequences for society in terms of welfare. Discuss ways to mitigate them. You may use diagrams in your answer. [50%]

Market power: comparison of competitive equilibrium x monopoly, monopolistic competition. Impact on quantity and price. Discussion of welfare effects. Diagram. Mitigation: regulation and caveats (information heavy, firms with high fixed costs)

Asymmetric information: define moral hazard and adverse selection and why they deviate from optimal equilibrium. Discuss mitigation strategies for each one.

Externality: definition, diagram comparing MC and MCs and approaches to mitigate externality such as bargaining, emission allowances, direct measures, taxes or subsidies.

END OF PAPER