ECO 201: ELEMENTS OF MICROECONOMICS

SAMPLE QUESTIONS AND ANSWERS

Demand, Supply and Elasticities

1) Consider the demand equation $Q = 25 - 3P$, where Q represents quantity demanded and p the selling price

a. calculate the arc – price elasticity of demand when $P_1 = 4$ and $P_2 = 3$

b. calculate the point price elasticity of demand at these prices. Is the demand for this good elastic or inelastic at these prices?

c. what, if anything, can you say about the relationship between price elasticity of demand and total revenue at these prices?

d. what is the price elasticity of demand at the price that maximizes total revenue?

Solution

a. the arc – price elasticity of demand is given by

$$Ed = \frac{(Q_{2-}Q_1)(P_1 + P_2)}{(P_2 - P_1)(Q_1 + Q_2)}.$$

Solving for Q_1 and Q_2 at the given prices yields

$$Q_1 = 25 - 3(4) = 25 - 12 = 13$$

$$Q_2 = 25 - 3(3) = 25 - 9 = 16$$

$$\therefore Ed = \frac{16-13}{3-4} . \frac{3+4}{13+16} = \quad -0.724$$

b. The point-price elasticity of demand is given by the expression

$$Ed = \frac{dQ}{dP} \times \frac{P}{Q}$$

Thus, at $p = 4$ and $p = 3$

$$Ed = -3 \times \frac{4}{13} = -\frac{12}{13} = -0.923 ------(p = 4)$$

$$Ed = -3 \times \frac{3}{16} = \frac{-9}{16} = -0.563 -------(p = 3)$$

At both prices demand is price inelastic c). total revenue is given by the expresses

$$TR == PQ = P(25 - 3P) = 25P - 3P^2$$

For P=4

TR=4(13) =$52

And for P=3

TR=3(16) =$48

These illustrates that total revenue will decline as the price falls in the inelastic region of the linear demand function.

d) Maximizing the expression for total revenue yields

$$\frac{dTR}{dP} = 25\text{-}6P = 0$$

Solving for p, we write

P= $\frac{25}{6} = 4.167$

$$TR = 25(4.167) - 3(4.167)^2 = 104.175 - 52.092 = \$52.083$$

$$Ed = \frac{-3(4.167)}{25\text{-}3(4.167)} = \frac{-12.5}{12.5} = -1$$

Thus, total revenue is maximized where marginal revenue is equal to zero, where the point-price elasticity of demand is equal to one.

2). If the market demand function is given by the function

$Q_1 = 20 - 2P_1 - 0.5P_2 + 0.01Y$ $p_1 = 5$, $p_2 = 10$ and $Y = 2000$

Where Q_1 is the qty of good 1

P_1 is the price of good 1

p_2 is the price of another commodity

Y is income

Calculate:

i) cross elasticity of demand at $p_1 = 5$, $p_2 = 10$ and $Y = 2000$ and indicate the type of commodity

ii. Income elasticity of demand for commodity 1 when $p_1 = 5,$ $p_2 = 10$ and $Y = 1000$ and indicate the type of commodity

Solution

i) $Q_1 = 20 - 2P_1 - 0.5P_2 + 0.01Y$

Substitute $p_1 = 5$, $p_2 = 10$ and $Y = 2000$

=> Q=25

$E_c = \frac{dQ_1}{dP_2} \times \frac{P_2}{Q_1} = -0.5 \times \frac{10}{25} = -0.2$ **Complement**

ii. Substitute when $P_1 = 5$ $P_2 = 10,$ $Y = 100$

=> $Q_1 = 15,$

$E_y = \frac{dQ_1}{dY} \times \frac{Y}{Q_1} = 0.01 \times \frac{1000}{15} = 0.67$ **Normal good**

3) Another commonly used demand curve is he constant elasticity demand curve given by this general formula: $Q = aP^{-b}$ where and b are positive constant. The corresponding inverse demand curve is $p = a^{\frac{1}{b}} Q^{-\frac{1}{b}}$

In Q=Ina-blnp

Because it is linear in the logs the constant elasticity demand curve is sometimes called a **log linear demand curve.** For the constant elasticity demand curve the price elasticity is always equal to the exponent –b

Eg. If $Q = 200P^{-\frac{1}{2}}$ what is the price elasticity of demand

Answer

This is a constant elasticity of demand curve, so the price elasticity of demand is equal to $-\frac{1}{2}$ everywhere along the demand curve.

Proof

$Q = ap^{-b}$ For this demand curve

$\frac{\partial Q}{\partial P} = -bap^{-(b+1)}$

But

$$Ed = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

$$= -bap^{-(b+1)} \frac{p}{ap^{-b}}$$

$= -b$ Hence proof.

4) Consider the following straight line demand and Supply equations

$$Qd = a - bp$$

$$Qs = c + dp$$

If a tax rate of t is imposed the post tax supply function will be $Qs = c + d(p - t)$

Equilibrium before imposition of tax

$$Qd = Qs$$

$$a - bp = c + dp$$

$$a - c = dp + bp$$

$$a - c = p(d + b)$$

$$\Rightarrow p^* = \frac{a - c}{b + d}$$

$$Q = a - b\left(\frac{a - c}{b + d}\right)$$

$$Q(b + d) = a(b + d) - b(a - c)$$

$$Q(b + d) = ab + ad - ab + bc$$

$$Q(b + d) = ad + bc$$

$$Q^* = \frac{ad + bc}{b + d}$$

Equilibrium after imposition of tax

$$Qd = a - bp$$

$$Qs = c + d(p - t) = Qs = c + dp - dt$$

$$Qd = Qs$$

$$a - bp = C + dp - dt$$

$$a - c \ = dp + bp - dt$$

$$a - c \ = dt = dp + bp$$

$$a - c \ + dt = p(b + d)$$

$$p = \frac{a - c + dt}{(b + d)}$$

$$p^* = \frac{a - c}{b + d} + \frac{dt}{b + d}$$

$\therefore$ the post tax price will be higher than the pre-tax price.

Post tax equilibrium quantity

$$Q^* = a - b(p^*)$$

$$Q^* = a - b\left(\frac{a - c}{b + d} + \frac{dt}{b + d}\right)$$

$$Q^*(b + d) = a(b + d) - b(a + dt)$$

$$Q^*(b + d) = ab + ad - ab + bc - bdt$$

$$Q^+(b + d) = ad + bc - bdt$$

$$Q^* = \frac{ad + bc - bdt}{b + d}$$

$$Q^* = \frac{ad + bc}{b + d} - \frac{bdt}{b + d}$$

This shows that the post tax equilibrium quantity is less than the pre tax equilibrium quantity.

Numerical example

$$Qd = 220 - 5p$$

$$Qs = -20 + 3p$$

Tax $= ¢10.00$

Post tax supply function is

$$Q_{S_t} = -20 + 3(p - 10)$$

$$= -20 + 3p - 30$$

$$Q_{S_t} = -50 + 3p$$

Equilibrium before tax

$Qd = Qs$

$p^* = 30$, $Q^* = 70$

Equilibrium after tax

$Qd = Q_{St}$

$p^* = 33.75$

$Q^* = 51$

Amount of tax borne by the consumer= ¢$33.75 - 30 = 3.75$

Amount of tax borne by the producer $=$¢$10 - 3.75 = 6.25$

From the tax sharing the demand for the good is fairly elastic

TRY QUESTIONS

Practice questions: Attempt the following questions. You may find it interesting and helpful to practice in groups of ten heads per group or smaller. Take note of any difficulties and report to members of other groups or students of the class and seek help from friends. These practice questions will not count towards your assessment for the semester, at least for now, but it is recommended that you tackle them religiously.

1A).The following table shows the quantities of apples bought by Kojo, Ama and Benita. Use the information to answer the questions that follow:

Price per Apple	Quantity bought by Kojo	Quantity bought by Ama	Quantity bought by Benita
$0.5	9	7	3
$1.0	8	6	2
$1.5	7	5	1
$2.0	6	4	0
$2.5	5	3	0
$3.0	4	2	0
$3.5	3	1	0
$4.0	2	0	0

i. Calculate the market demand schedule given that Kojo, Ama and Benita are the only consumers in the apples market
ii. Sketch the market demand curve
iii. Determine the market demand equation and hence or otherwise, find the slope of the market demand curve

1B). You have the following individual demand tables for beer.

Price per bottle($)	John	Lizzy	Alex	Karim
2	4	36	24	0
4	4	32	20	0
6	0	28	16	0
8	0	24	12	0
10	0	20	8	0
12	0	16	4	0
14	0	12	0	0
16	0	8	0	0

i. Determine the market demand table and expression
ii. Graph the individual and market demand curves on the same axes
iii. If the current market price is $4, what is the total market demand? What happens to total market demand if the price rises to $8?
iv. Suppose an advertising campaign increases demand by 50 percent. Illustrate graphically what will happen to the individual and market demand curves. Now obtain a new expression for the market demand function, taking note of the effect of advertisement.

2A).Suppose the demand and supply for milk in kotokuraba market is described by the following equations $Q^d = 600 - 100P$ and $Q^S = 150P - 150$, where Q^d *and* Q^S are the quantity demanded and quantity supplied respectively, and P is price.

i. Determine the equilibrium price and quantity
ii. Calculate the price elasticity of demand and supply at the equilibrium
iii. Would a government-set price of $4 per unit create a surplus or shortage of milk? How much? Is $4 a price ceiling or a price floor?
iv. Suppose the government has a change of heart and imposes a tax of $1 per gallon of milk on dairy products
    a) What is the effect of the tax on the supply equation? On the demand equation
    b) What is the new equilibrium price and quantity?
    c) Determine the direction or burden of tax?

B).The following table gives the quantities of gasoline demanded and supplied in Los Angeles in a recent month.

Price Per gallon	Quantity Demanded (Millions of gallons)	Quantity Supplied (millions of gallons)
i. $1.20	170	80
ii. $1.30	156	105
iii. $1.40	140	140
iv. $1.50	123	175
v. $1.60	100	210
$1.70	95	238

i. Graph the demand and supply curves
ii. Find the equilibrium price and quantity
iii. Illustrate on your graph how a rise in the price of cars would affect the gasoline market
iv. The California state governor, alarmed by the recent increases in gas prices, imposes a price ceiling of $1.20 on gasoline products per gallon. How will this affect the market? Specifically calculate the resulting shortage or surplus?

3A).The demand and supply equations for eggs in a local supermarket can be modelled as follows: $Q^d = 15 - 4P \text{ and } Q^S = -1 + 4P$

a. Determine the equilibrium in this market
b. Investigate whether or not each of these prices is a price floor, price ceiling or neither
   i. P=$3.00 ii. P=$1.50 iii. P=$2.00 iv. P=$2.25 v. P=$2.50

B). Using the principle of horizontal summation, show how one obtains the market demand from three consumers of a product (kofi(K), Akosua(A) and Muoteng(M)) respectively of the form: $P = 500 - Q_K^d$, $P = 500 - Q_A^d$ and $P = 500 - Q_M^d$

Given that the market supply equation is $Q^S = 300$;

i. Sketch the market demand and supply curves on the same graph
ii. Calculate the equilibrium price and quantity.

4). Determine the equilibrium in a market in which demand and supply are defined by the following equations:

i. $Q^d = 500 - 2P,\ Q^S = 4p - 100$ ii.$Q^d = 10 - P,\ Q^S = 2P - 5$

iii. $Q^d = 28 - 2P,\ Q^S = 4 + 4P$ $iv. Q^d = 150 - 0.5P,\ Q^S = -20 + 0.45P$
v. $Q^d = 600 - 2P,\ Q^S = 300 + 4P$ $vi. Q^d = 100 - 2P,\ Q^S = 2P$
vii.$Q^d = 50 - P,\ Q^S = 5 + 2P$ $viii. P = 200 - Q^d, P = 50 + Q^S$
ix. $P = 10 - 0.2Q^d, P = 2 + 0.2Q^S$ $X. Q^d = 100 - 5P,\ Q^S = 50 + 5P$
xi. $Q^d + 2P - 18 = 0,\ Q^S - P + 1 = 0.$ $xii. P = 100 - Q^d, P = 10 + 2Q^S$
xiii. $Q^d = 500 - 50P\ , Q^S = -25 + 25P$

5A) .Suppose the demand and supply functions for sleek Nokia phones in Ghana can be modelled by the following expressions $P = 120 - 3Q^d \text{ and } P = 5Q^S \text{ respectively}.$

i. Determine the equilibrium price and quantity
ii. Find the consumer and producer surpluses
iii. Estimate the price elasticity of demand and supply at the equilibrium.

B).Given the following demand function for product X: $Q_X^d = 10 - 2P_X$,
Calculate the price elasticity of demand at the point $P_X = \$2$.

C).There are 10000 identical individual consumers in the market for commodity X, each of whom has a demand function given by $Q_X^d = 12 - 2P_X$, ceteris paribus, and 1000 identical producers of commodity X, each with a supply function given by $Q_X^S = 20P_X$. Determine the equilibrium price and quantity?

6A).The demand curve for a product is $P = 100 - 2Q^d$, where P is the product's price (in dollars per pound) and $Q^d$is the quantity demanded (in millions pounds per year). If the supply curve for the product is $P = 50 + 3Q^S$ where $Q^S$is the quantity supplied (in millions pounds per year).

i. Calculate the equilibrium price and quantity
ii. Find the total surplus in the market(i.e. consumer's surplus + producer's surplus)
iii. If the actual price of the product is $70 per pound, would you expect the price to rise or fall? If so, by how much?

B).Suppose the demand for product X has been estimated as

$Q_X^d = 3848 - 2P_X + 0.004I + 3P_Y$,where

Q_X^d *is the quantity demanded of product X,* P_X*is the price of product X per unit,* *I is the median family income and* P_Y *is the price of related goods.*

i. Develop a demand schedule (table) for product X over the price range $P_X = \$400\ to\ P_X = \$800\ if\ I = \$12000\ and\ P_Y = \$600$.
(Hint use $50 changes in P_X over the range)
ii. Assuming the above values for I and P_Y, write an equation for the demand curve of product X.
iii. Sketch the demand curve for product X
iv. How will the demand curve for product X change if median family income rises?
v. What economic relationship exists between product X and product Y.

C).The demand and supply functions of pineapple juice in Apewosika is described by the following equations $Q^d = 220 - 5P\ and\ Q^S = -20 + 3P$ respectively.

i. calculate the equilibrium price and quantity
ii. suppose a per unit tax of ten Ghana cedis is imposed on pineapple juice, determine the new equilibrium price and quantity
iii. what will happen to equilibrium price? Equilibrium quantity?
iv. Determine how the tax is shared between demanders and sellers of pineapple juice?
v. How much tax revenue will the government raise?

7A).The demand schedule for oranges in a veteran city is as shown in the table:

	PRICE ($)	QUANTITY
i. A	80	20
ii. B	100	18
iii. C	120	16

i. Calculate the price elasticity of demand between
   a) A and B b) B and C
ii. Comment on the results above
iii. Derive an expression for the demand curve

B). Simplify these expressions and find the equilibrium price and quantity;

$Q^d = \sum_{X=1}^{3}(X^2 - PX + 4)$.

$Q^S = \sum_{i=1}^{3}(P + 3i)$.

C).The demand for beer in Japan is given by the following equation:

$Q^d = 700 - 2P - P_N + 0.1I$ where p is the price of beer, P_N is the price of nuts, and I is average consumer income.

i. What happens to the demand for beer when the price of nuts goes up? Are beer and nuts substitutes or complements?

ii. What happens to the demand of beer when average income rises? Is beer a normal good or an inferior good?

iii. Graph the demand curve for beer when $P_N = \$100\ and\ I = \$10000$.

8A). A demand curve can be represented by an equation showing how quantity demanded (Q^d) depends on the good's price (P). Calculate the price elasticity of demand when price goes up from$12 to$16 for each of the following demand equations:

i. $Q^d = 50 - \frac{1}{2}P$ ii. $Q^d = 12$ iii. $Q^d = \frac{1}{P}$

B). Distinguish between the following: demand and quantity demanded, demand schedule and demand curve, change in demand and change in quantity demanded.

C). List and explain any five factors which you think can influence an individual's demand for a commodity, say X.