



# B.E. International Program

Faculty of Economics, Thammasat University



## EE 320 Introductory Mathematical Economics

Semester 1/2016

### Homework 1

*Due 16 September 2016 before 3.00 pm at the BE office*

*There are six questions in total. Each of them is worth equally.*

1. Suppose that total cost function of Good Z is given by  $C(Q) = 270 + 24Q$ , where  $Q$  is the output level.

- (4 points) If the price of Good Z is \$30 per unit. Derive the profit function of Good Z, and determine the break-even quantity, and illustrate by graph.
- (2 points) Suppose that the producer of Good Z requires a minimum profit of \$2130. How many units of Good Z should the producer sell in the market?
- (4 points) Suppose now that the producer of Good Z becomes a monopolist and faces a given demand curve:  $P = 61 - Q$ . Derive the new total revenue and profit functions. What is the range of output should the producer produce in order to gain positive profits?

2. General market equilibrium.

- Consider the following system of equations:

$$Q_{d1} = a_0 + a_1P_1 + a_2P_2 + a_3P_3; \quad Q_{s1} = \alpha_0 + \alpha_1P_1$$

$$\begin{aligned} Q_{d2} &= b_0 + b_1P_1 + b_2P_2 & ; & & Q_{s2} &= \beta_0 + \beta_2P_2 \\ Q_{d3} &= c_0 + c_1P_1 + c_3P_3 & ; & & Q_{s3} &= \gamma_0 + \gamma_3P_3 \end{aligned}$$

where  $a_i, b_i, c_i$  (for  $i = 1, 2, 3$ ) and  $\alpha_0, \alpha_1, \beta_0, \beta_2, \gamma_0, \gamma_3$  are parameters. If  $a_2 > 0$  and  $a_3 < 0$ , what would be the signs of  $b_1, b_2, c_1$ , and  $c_3$ ? What are the relationships among the three goods?

b. Consider the following system of equations:

$$\begin{aligned} Q_{d1} &= 20 - P_1 + 2P_2 & ; & & Q_{s1} &= 2P_1 - 2 \\ Q_{d2} &= 18 + 3P_1 - 2P_2 & ; & & Q_{s2} &= 2 + 4P_2 \end{aligned}$$

Find the equilibrium price and quantity for the two goods.

3. Suppose the market demand function for an eco car for a group of consumers is given by:  $Q = 30 + 0.1Y - 2P$ , where  $P$  is the price of an eco car, and  $Y$  is the average income of these consumer (in \$1,000). Suppose also that the market supply function is:  $P = 0.5Q + 15$ .

- (2 points) Is the car considered as normal or inferior goods to this group of consumers. Explain.
- (4 points) Derive the income elasticity of demand and the price elasticity of demand for this eco car.
- (4 points) Suppose that the average income is \$15,000. Determine the equilibrium price and equilibrium quantity in this market.

4. Consider the following IS-LM model:

Commodity market:

$$\begin{aligned} Y &= C + I + G_0 \\ C &= C_0 + bY, & (C_0 > 0, 0 < b < 1) \\ I &= I_0 - ar + iY, & (I_0 > 0, a > 0, i > 0) \end{aligned}$$

Money market:

$$\begin{aligned} M_S &= M_0 \\ M_D &= mY - hr, & (m > 0, h > 0) \end{aligned}$$

- a. (4 points) Write out the explicit IS-LM system of equations, and determine the equilibrium national income (Y) and equilibrium interest rate (r).
- b. (2 points) Find the impact of an exogenous increase in money supply ( $M_0$ ) on the equilibrium national income found in part (a). Assume everything else remains constant.
- c. (2 points) Suppose that  $C_0 = 150$ ,  $I_0 = 100$ ,  $G_0 = 50$ ,  $b = 0.6$ ,  $a = 400$ ,  $h = 800$ ,  $M_0 = 100$ ,  $i = 0.1$  and  $m = 0.4$ . Find the equilibrium national income and interest rate.
- d. (2 points) Based on the information in part (c), if the government expenditure ( $G_0$ ) change by the amount  $\lambda$  ( $\lambda > 0$ ), all else constant, what is the *change* in the equilibrium interest rate?

5. The demand and supply curves in the market for wine are given by the following equations:

$$\text{Demand: } P = 40 - 0.25Q_d$$

$$\text{Supply: } Q_s = 2P + 4$$

where Q is the quantity of wine in bottles and P is the price per bottle of wine.

Answer the following questions:

- a. (1 point) Find the pre-tax equilibrium price and quantity, i.e. ( $P^*$ ,  $Q^*$ ).
- b. (3 point) Calculate the price elasticities of demand and supply at the equilibrium. Based on the values of calculated elasticities, what would the total revenue change if the market price can be increased by 1%?

Now suppose that the government in this economy has levied an excise tax of \$6 on the *producers* of wine.

- c. (2 points) Find the post-tax equilibrium price and quantity.
- d. (2 point) How much total tax revenue can government collect?
- e. (2 point) In terms of economic incidence, what percentages of the tax are borne by consumers and producers?

6. AIS, TRUE and DTAC all want to purchase some Samsung-S7 phones from Samsung inc. and hold these phones in their stock so that they can promote their new contract with the Samsung-S7. Their respective demand equations for Samsung-S7 phones are as follows:

AIS:	$P = 30 - Q_a$
TRUE:	$P = 100 - 5Q_t$
DTAC:	$Q_d = 40 - 2P$

where  $Q_a$  is the quantity of Samsung-S7 phones demanded by AIS,  $Q_t$  is the quantity of Samsung-S7 phones demanded by TRUE,  $Q_d$  is the quantity of Samsung-S7 phones demanded by DTAC, and  $P$  is the price per Samsung-S7 phone

6.1) (1 point) Justify the domain set of prices that allow all the three providers staying active in the market.

6.2) (3 points) Derive the equation for market demand curve and sketch the demand curve. Locate all the important points.

Now continue with a new piece of information given. On the supply side in this market suppose Samsung-S7, the manufacturer or provider of these phones, outsources their production of the Samsung-S7 phones to two firms, Firm A and Firm B. These firms' supply curves are given below where  $Q_a$  is the quantity of Samsung-S7 phones supplied by Firm A,  $Q_b$  is the quantity of Samsung-S7 phones supplied by Firm B, and  $P$  is the price per Samsung-S7 phone:

$$\text{Firm A: } P = 15 + Q_a$$

$$\text{Firm B: } P = 10 + 2Q_b$$

6.3) (3 points) Derive the market supply equation and sketch the supply curve. Locate all the important points.

6.4) ( 3 points) Based on the market demand equation in question (6.1), what is the equilibrium price and quantity in this market? Explain how you found your answer and how you decided which segments of the demand curve and the supply curve were the relevant segments to consider.