



**PRACTICE PROBLEM SET 1**

**INTRODUCTORY MATHEMATICAL ECONOMICS**

**SEMESTER 1/2017**

**Question 1(Easy):** Simple break-even analysis

1.1 Product A has a fixed cost at 5,000 Baht and variable cost for 7.5 baht per unit and price for 10 Baht per unit.

- a) Construct the profit function of the producer of product A.
- b) Determine break-even quantity and illustrate by the graph

1.2 Let  $TC = 2,000 + 20Q$  and price per unit is 40 Baht per unit. Determine the following:

- a) Total revenue
- b) Break-even quantity
- c) If the company requires the minimum profit of 2,000 Baht, how many products company should produce?

**Question 2 (Moderate):** Individual vs market demand

Alex, Zander, and Clark are the only three consumers in the market for oatmeal. They have the following individual demand curves for oatmeal. The market supply curve for oatmeal is also provided to you.

Alex:  $P = 20 - Q_d$

Zander:  $Q_d = 40 - 2P$

Clark:  $Q_d = 20 - 4P$   
 Supply:  $Q_s = (3/2)P - 12$

Answer the following questions:

- Derive equation for market demand. Go step-by-step slowly. You can use whichever methods that we discuss in the class.
- What is the equilibrium price and quantity of oatmeal?
- Under equilibrium, are there any consumers rationed or excluded from the market?

**Question 3 (Easy)**

In June, KFC lowers the price of fried chicken from 50 Baht per piece to 30 Baht per piece. Then, KFC can sell more fried chicken from 600 pieces to 1,800 pieces and the sale of the drinks increases from 300 to 1,500 cups.

From the above information, answer the following questions

- Find “price elasticity” of demand for fried chicken with respect to price of fried chicken.
- Find “cross-price elasticity” of demand for the drinks with respect to price of fried chicken.
- Holding other things remain constant, if the fried chicken’s price drops to be 25 Baht per piece, would the total revenue from selling fried chicken and drinks increase or not? Explain.

**Question 4 (Tedious):** Given the following information,

<b>Price</b>	<b>6</b>	<b>4</b>	<b>2</b>
<b>Qd</b>	0	4	8
<b>Qs</b>	120	80	40

Answer the following questions:

- Demand equation for each individual consumer

- b. Supply equation for each individual producer
- c. Suppose there are 10,000 identical consumers in the market, find the market demand equation.
- d. Suppose there are 10,000 identical producers in the market, find the market supply equation.
- e. Equilibrium price and quantity (also illustrate by graph)
- f. If government provides subsidy (to sellers) for each unit sold, 0.1 Baht per unit, find the total amount of money required for the subsidy program.

**Question 5 (moderate):** The IS-LM model

Consider the following IS-LM model

$$C = 48 + 0.8*Y$$

$$I = 98 - b*r$$

$$M_s = 250$$

$$M_d = 52 + 0.3*Y - 150*r$$

where

C = consumption

Y = income

I = investment

r = interest rate

M<sub>s</sub> = money supply

M<sub>d</sub> = money demand

- a. Derive IS and LM equation. Graph the equations.
- b. Suppose that  $b = 75$ , find the equilibrium income ( $Y^*$ ) and equilibrium interest rate ( $r^*$ )
- c. Now suppose instead that  $b = 0$ . Discuss the effectiveness of monetary policy.

**Question 6 (moderate):** Consider the ice cream market in Bangkok. In July, the ice cream market demand and supply curves are given by the following equations where  $Q$  is the quantity of ice cream units and  $P$  is the price in dollars per unit of ice cream:

$$\text{Demand: } Q = 14000 - 10P$$

$$\text{Supply: } Q = 2000 + 20P$$

- Find the equilibrium price and quantity of ice cream in July.
- Calculate the price elasticity of demand and supply at the equilibrium price in July. Use the point elasticity formula to compute the values of these two elasticity.

Suppose that the city of Bangkok imposes on producers an excise tax of B15 per unit of ice cream.

- Calculate the new equilibrium price and quantity in **July** for this ice cream market.

**Question 7 (moderate)**

The demand and supply functions of a two-commodity model are as follows:

$$\begin{aligned} Q_{d1} &= 18 - 3P_1 + P_2 & Q_{d2} &= 12 + P_1 - 2P_2 \\ Q_{s1} &= -2 + 4P_1 & Q_{s2} &= -2 + 3P_2 \end{aligned}$$

Find the equilibrium of the model.

**Question 8 (easy)**

Let the national-income model be:

$$\begin{aligned} Y &= C + I_0 + G \\ C &= a + b(Y - T_0) & (a > 0, 0 < b < 1) \\ G &= gY & (0 < g < 1) \end{aligned}$$

- Identify the endogenous variables.
- Give the economic meaning of the parameter  $g$ .
- Find the equilibrium national income.
- What restriction(s) on the parameters is needed for an economically reasonable solution to exist?

### Question 9 (HARD)

A study has shown that there are three groups of Iphone users, namely, *crazy*, *love-it*, and *just-live-with-it*. Demand for Iphone of each group can be given by:

crazy:  $Q_c = 100 - p$ ;

Love-it:  $p = 50 - Q_l$ ;

Just-live-with-it:  $Q_j = 20 - p$ ;

where  $Q_c$  is the quantity demanded by *crazy* group,  $Q_l$  is quantity demanded by *love-it* group, and  $Q_j$  is the quantity demanded by *just-live-with-it* group.

- Find the domain set of price that justifies the demand equation for each group of Iphone user. And, rewrite each demand function in a more appropriate way.
- At what domain set of prices, do all the three types of Iphone users stay active in the market?
- Find the function for market demand for Iphone. Be precise about what is needed to make your equation justified.

Now, suppose that market supply equation is given by:  $p=4+3w+3/8 Q$ .

- Find the equilibrium when  $w = 1/3$  where  $w$  is wage rate for each unit of labor hired.
- How much does each type of consumer consume in the equilibrium?
- What is the likely effect on market equilibrium when wage drops? State your prediction and develop intuition for your result. (Note: Answer to this question could be made in qualitative sense. You don't need to get into algebraic solution with numbers solved.)

### Question 10: (Tricky) *Nonlinear* macroeconomics model

Find the equilibrium  $Y$  and  $C$  from the following:

$$Y = C + I_0 + G_0, \quad C = 25 + 6Y^{1/2}, \quad I_0 = 16, \quad G_0 = 14.$$

### Question 11 (tedious)

In a 2-good market equilibrium model, the inverse demand functions are given by

$$P_1 = Q_1^{-\frac{2}{3}} Q_2^{\frac{1}{3}}, \quad P_2 = Q_1^{\frac{1}{3}} Q_2^{-\frac{2}{3}}.$$

- (a) Find the demand functions  $Q_1 = D^1(P_1, P_2)$  and  $Q_2 = D^2(P_1, P_2)$ .  
(b) Suppose that the supply functions are

$$Q_1 = a^{-1} P_1, \quad Q_2 = P_2.$$

Find the equilibrium prices  $(P_1^*, P_2^*)$  and quantities  $(Q_1^*, Q_2^*)$  as functions of  $a$ .

### Question 12 (Easy)

Find the equilibrium solution of the following model:

$$Q_d = 3 - P^2, \quad Q_s = 6P - 4, \quad Q_s = Q_d.$$

### Question 13 (moderate)

Price support V.S. Price guarantee

- a. Suppose that the supply and demand for rice are given by the following equations where  $Q$  is the quantity in units of rice and  $P$  is the price per unit of rice:

$$\text{Supply of rice: } Q = (1/2)P - 3$$

$$\text{Demand for rice: } Q = 27 - (1/3)P$$

What are the equilibrium price and quantity in the rice market without government intervention? Illustrate your answer with a well labeled graph.

- b. The government tries to raise rice prices using a *price support program*. It sets the price at \$54 per unit of rice, and *commits to buy any leftover rice*. Given this

program, how much rice do consumers buy? How much rice does the government buy? What is the cost of the program to the government?

c. Now, suppose the government still wants to keep the price of rice at \$54 per unit of rice, but instead of implementing a price support program the government decides to enact a price guarantee program that will *subsidize* the rice producers. Under this scenario, how much rice will consumers buy? What is the cost of the program to the government? Illustrate your answer with a well labeled graph.

d. Given the market and the programs described in this problem answer the following questions and provide a rationale for your answer to each question. Which program will the consumers prefer? Which program will the producers prefer? Which program will the government prefer?

e. Could you think of any reason for the government to prefer the price guarantee program?

### **Question 14 (Moderate)**

\*This questions doesn't require your prior knowledge in calculus.

Consider the milk market in the U.S. There are a number of companies selling milk, so that the market is perfectly competitive. Let's look at Kemps, a firm that produces milk. Assume that Kemp's total cost is given by the following equation:

$$TC = q^2 + 8q + 5$$

where q denotes units of milk.

The market price is \$50 per unit of milk.

a) Given the above information, how many gallons of rice will Kemps produce in the short run?

b) Given your answer in (a), find the short run profit for Kemps. Show your work.