B.E. International Program

Faculty of Economics, Thammasat University

PRACTICE PROBLEM SET 1

INTRODUCTORY MATHEMATICAL ECONOMICS

SEMESTER 1/2016

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.
[profit = 7.5Q+5000]

b) Determine break-even quantity and illustrate by the graph [Q=2,000]

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

a) Total revenue [TR=40Q]

b) Break-even quantity [Q = 100]

c) If the company require the minimum profit of 2,000 Baht, how many products company should produce? [Q = 200]

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 - Qd

Zander: Qd = 40 - 2P
Clark: Qd = 20 - 4P
Supply: QS = (3/2)P - 12

Answer the following questions:

a. Derive equation for market demand. Go step-by-step slowly. You can use whichever methods that we discuss in the class.

$Q = 80 - 7P; \quad 0 \le p < 5$ **(Z + A + C)**
$= 60 - 3P; \quad 5 \le p < 20$ **(Z + A)**
$= 0 \ , P \ge 20$ (all are out!)

b. What is the equilibrium price and quantity of oatmeal?
SOL: Q = 12; P = 16

c. Under equilibrium, are there any consumers rationed or excluded from the market?
SOL:Only Alex and Zander stay in the market, Clark is not.

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

a. Find "price elasticity" of demand for fried chicken with respect to price of fried chicken. [-5]
b. Find "cross-price elasticity" of demand for the drinks with respect to price of fried chicken. [-10]
c. 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. [Revenue should increase as elasticity should be greater than 5]

Question 4 (Tedious): Given the following information,

Price	**6**	**4**	**2**
Qd	0	4	8
Qs	120	80	40

Answer the following questions:

a. Demand equation for each individual consumer [Q = 12 - 2P]
b. Supply equation for each individual producer [Q=20P]
c. Suppose there are 10,000 identical consumers in the market, find the market demand equation. [Q = 10,000(12 - 2P)]
d. Suppose there are 10,000 identical producers in the market, find the market supply equation. [Q = 10,000(20P)]
e. Equilibrium price and quantity (also illustrate by graph)
   [P=12/22; Q = 200,000*(12/22)]
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.
   [Pd=10/22; Ps=12.2/22; Resource = (20,000)*(12.2/22)]

Question 5 (moderate): The IS-LM model

Consider the following IS-LM model

$C = 48 + 0.8*Y$
$I = 98 - b*r$
$Ms = 250$
$Md = 52 + 0.3*Y - 150*r$

where

C = consumption
Y = income
I = investment

r = interest rate
Ms = money supply
Md = money demand

a. Derive IS and LM equation. Graph the equations.
   IS: y = 730 - 5br
   LM: r = (-198+0.3y)*(1/150)
b. Suppose that b = 75, find the equilibrium income (Y*) and equilibrium interest rate (r*) [Y* = 700]
c. Now suppose instead that b = 0. Discuss the effectiveness of monetary policy. [Policy is NOT effective. In fact, monetary policy does not have any impacts on real GDP.]

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:

Demand: Q = 14000 – 10P
Supply: Q = 2000 + 20P

a) Find the equilibrium price and quantity of ice cream in July. [p=400, Q = 10000]

b) 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. [demand = -0.4; supply = 0.8]

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

c) Calculate the new equilibrium price and quantity in **July** for this ice cream market. [ps = 395; pd =410; Q=9900]

Question 7 (moderate)

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

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

Find the equilibrium of the model.

[P1=3.35 and P2= 3.45]

Question 8 (easy)

Let the national-income model be:

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

(a) Identify the endogenous variables.

(b) Give the economic meaning of the parameter g.

(c) Find the equilibrium national income.

(d) What restriction(s) on the parameters is needed for an economically reasonable solution to exist?

(a) Exo: I and T
Endo: Y C G

(b) g = marginal propensity to spend of government

(c) Y = (a-bT0)/(1-b-g);

(d) a-bT0 > 0 and (1-b-g) not equal to zero

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: Qc = 100 - p;

Love-it: p = 50 - Ql;

Just-live-with-it: Qj = 20 - p;

where Qc is the quantity demanded by crazy group, Ql is quantity demanded by love-it group, and Qj is the quantity demanded by just-love-with-it group.

a) 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.

Crazy: P < 100;
Love-it: P<50;
Just-live-with-it: P < 20;

b) At what domain set of prices, do all the three types of Iphone users stay active in the market?

[Sol: P < 20]

c) Find the function for market demand for Iphone. Be precise about what is needed to make your equation justified.

$$Q = \begin{cases} 0 & ; P \geq 100 \\ 100 - P & ; 50 \leq P < 100 \\ 150 - 2P & ; 20 \leq P < 50 \\ 170 - 3P & ; 0 \leq P < 100 \end{cases}$$

Suppose market supply equation is given by: p=4+3w+3/8 Q.

d) Find the equilibrium when w = 1/3 where w is wage rate for each unit of labor hired.

Q = 80 units P = $35

e) How much does each type of consumer consume in the equilibrium?

Crazy: P < 100; Q = 65 units
Love-it: P<50; Q = 15 units
Just-live-with-it: P < 20; excluded

f) 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.)

A drop in wage would increase the supply. Thus, it's likely that under the new equilibrium, more output will be produced.

Question 10: Nonlinear macroeconomics model

Find the equilibrium Y and C from the following:

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

[Y = 121; C = 91]

Question 11

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

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

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

a) $Q_1 = P_1^{-2} P_2^{-1}$; $Q_2 = P_1^{-1} P_2^{-2}$

b) $P_1 = a^{3/8}$; $P_2 = a^{-1/8}$

Question 12

Find the equilibrium solution of the following model:

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

[Sol: Q = 2, P =1]