B.E. International Program

Faculty of Economics, Thammasat University

EE 320 Introductory Mathematical Economics

Semester 1/2015

Practice Problem for Topic 3 –Suggested Answers

1. Consider the following system of equations:

$$Q_{d1} = 20 - P_1 + 2P_2 \qquad Q_{s1} = -2 + 2P_1$$

$$Q_{d2} = 18 + 3P_1 - 2P_2 \qquad Q_{s2} = 2 + 4P_2$$

a) What relationship in demand do these two goods have?
   Ans. They are substitutes.

b) Find the inverse demand functions for both goods (i.e. write as $P_i = f(Q_{d1}, Q_{d2})$).
   Ans. $P_1 = 0.5Q_{d1} + 0.5Q_{d2} - 19$
   $P_2 = 0.75Q_{d1} + 0.25Q_{d2} - 19.5$

c) Find the equilibrium price and quantity for the two goods.
   Ans. $(Q_1^*, P_1^*) = (25.33,\ 13.67)$
   $(Q_2^*, P_2^*) = (40,\ 9.5)$

2. (Adapted from Sydsaeter and Hammond, 2006)

Consider the demand and supply functions:

$Q_d = 150 - 0.5P$ and $Q_s = 20 + 2P$

a) Find the equilibrium price and the corresponding quantity.

   Ans. P* = 52, Q* = 124

b) Suppose a tax of $2 per unit is imposed on the producer. How will this influence the equilibrium price?

   Ans. $P^*_{producer} = 51.6$, $P^*_{consumer} = 53.6$, Q** = 123.2

c) Compute the total revenue obtained by the producer before and after the tax in part (b) is imposed.

Ans. $TR_{beforeTax} = 6448$, $TR_{afterTax} = 6357.12$

d) Suppose now that a 20% tax is imposed on the producer. How does this tax affect the equilibrium price and quantity?

Ans. $P^*_{producer} = 49.52$, $P^*_{consumer} = 61.9$, $Q^{**} = 119.05$

3. Let the national-income model be:

$$Y = C + I_0 + G_0 + X_0 - M$$
$$C = C_0 + bY_d, \quad (C_0 > 0,\ 0 < b < 1)$$
$$Y_d = Y - T, \quad \text{where } T \text{ is a constant}$$
$$M = M_0 + mY, \quad (M_0 > 0,\ 0 < m < 1)$$

a) Find the equilibrium level of national income.

Ans. $Y^* = \frac{C_0 - bT + I_0 + G_0 + X_0 - M_0}{1 - b + m}$

b) Find the impact of an exogenous increase in government expenditure on the equilibrium national income (i.e. $\frac{\Delta Y^*}{\Delta G} = ?$). Assume everything else remains constant.

Ans. $\frac{\Delta Y^*}{\Delta G} = \frac{1}{1 - b + m}$

c) Given that $C_0 = 70$, $b = 0.8$, $I = I_0 = 80$, $G = G_0 = 75$, $T = 25$, $X = X_0 = 65$, $M_0 = 40$, and $m = 0.3$, find the equilibrium national income.

Ans. $Y^* = 460$

d) From part c., if T = 40, what is the change in the equilibrium national income?

Ans. $\Delta Y^* = -24$

4. Consider the following system of equations:

$$Q_{d1} = 23 - 5P_1 + P_2 + P_3 \qquad Q_{s1} = -8 + 6P_1$$
$$Q_{d2} = 15 + P_1 - 3P_2 + 2P_3 \qquad Q_{s2} = -11 + 3P_2$$
$$Q_{d3} = 19 + P_1 + 2P_2 - 4P_3 \qquad Q_{s3} = -5 + 3P_3$$

a) What is the relationship between the three goods?

Ans. The three goods are substitutes.

b) Find the equilibrium price and quantity for the three goods.

Ans. $(P_1^*, Q_1^*) = (4,\ 16)$, $(P_2^*, Q_2^*) = (7,\ 10)$, and $(P_3^*, Q_3^*) = (6,\ 13)$

5. Consider the following IS-LM model:

$$Y = C + I + G$$

$$C = 100 + 0.8Y_d$$

$$I = 80 - 100r$$

$$G = 100$$

$$Y_d = Y - T$$

$$T = 0.25Y$$

$$M_s = 2500$$

$$M_d = M_{tp} + M_z,$$

$$M_{tp} = 0.1Y$$

$$M_z = 2500 - 150r$$

where M_{tp} = transaction-precautionary demand for money and M_z = speculative demand for money

a) Write the IS and LM equations
Ans. IS: Y = 700 – 250r; LM: Y = 1500r

b) Find the equilibrium national income and rate of interest
Ans. Y* = 600; r* = 0.4

c) If the investment function is now $I = 300 - 100r$, find the equilibrium national income and interest rate. Use an IS-LM diagram to illustrate the impact of this change in investment.
Ans. New IS: Y = 1250 – 250r; r* = 0.714, Y* = 1071.429

d) Suppose that the money supply increases to 2563, find the equilibrium national income and interest rate. Also, use an IS-LM diagram to illustrate the impact of the change in money supply.
Ans. New LM: Y = 630 + 1500r; r* = 0.04, Y* = 690

6. 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.

   Elasticity = - 5

b. Find "cross-price elasticity" of demand for the drinks with respect to price of fried chicken.

   Elasticity = - 10 (complement product)

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.

   If demand for chicken is elastic, a decrease in price will increase total revenue.

   For the revenue that can be generated from drinks, it's always increase if you reduce the price of fried chicken. Both products are complementary product. You can sell more drinks at the given price of drinks, so it's evidently that revenue from drinks must increase.

7. Given the following information

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

Answer the following questions:

a. Find demand equation for each individual consumer Q = 12-2p
b. Derive 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 = 3; Q = 60,000]

f. If government provides subsidy (to sellers) for each unit sold, $1 per unit, find the amount of subsidy. [70,000]

g. (Optional) Calculate the gain in consumer and producer surplus from subsidy program. [35,000 and 35,000]

8. A company is operating under constant average cost equal to $20 per unit of production. It also faces with a fixed cost in the operation equal to $2000. Suppose that price per unit of output that the company can sell to the market is equal to $40. Answer the following questions:

a) Find the total revenue function and break-even quantity [Q=100]

b) If the company requires the minimum profit of $2,000, how much is the quantity of output that firm should produce? [Q=200]

9. Let Qd = 800 - 50Pd and Qs = -700 + 100Ps, if government imposes excise tax on customers for $ 3 per unit.

a) Find the equilibrium price and quantity after the tax. [Ps=$9 , Pd = 12, Q*=200 units]

b) Calculate consumer's tax burden, producer's tax burden and government's tax revenue [$400, $200, $600]