B.E. International Program

Faculty of Economics, Thammasat University

EE 320 Introductory Mathematical Economics

Semester 2/2013

Practice Problem 3 –Suggested Answers

Easy and moderate problems

1. (From Tubpun, 2010)

Suppose that the cost function is given by C = 33 + 2Q.

a) If the price per unit is $13, how many units of output should the producer sell in order to breakeven?

Ans. Q_{BE} = 3 units.

b) If the producer produces 20 units of output and sells at $13 per unit, what is the profit obtained by this producer?

Ans. Profit = $187

2. (From Dowling, 2012)

Given the following set of simultaneous equations for two related markets, beef (B) and pork (P):

$Q_{dB} = 82 - 3P_B + P_P$ and $Q_{sB} = -5 + 15P_B$

$Q_{dP} = 92 + 2P_B - 4P_P$ and $Q_{sP} = -6 + 32P_P$

a) What is the relationship between the demand for pork and the demand for beef?

Ans. Beef and pork are substitutes.

b) Find the equilibrium price and quantity for each market.

Ans. Beef market: P*= 5, Q* = 70 ; Pork market: P** = 3, Q** = 90

3. 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. $(Q_1^*, P_1^*) = (25.33, 13.67)$
$(Q_2^*, P_2^*) = (40, 9.5)$

4. (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

5. Given a simple macroeconomic model:

$Y = C + I$

$C = 100 + 0.6Y_d$

$I_0 = 40$

$Y_d = Y - T$

a) Suppose T is a lump-sum tax and is equal to 50. Find the equilibrium national income.

Ans. Y* = 275

b) Suppose T is a proportional tax where $T = 0.04Y$. Find the equilibrium national income.

Ans. Y* = 330.1887

c) Use graphs to illustrate the difference between the two equilibrium income levels obtained in part a) and part b).

See lectures.

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

Harder problems

7. 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 $(P_3^*, Q_3^*) = (6, 13)$

8. (Adapted from Tubpun, 2010)

Consider the demand and supply functions of a good:

$Q_d = 260 - 5P$ and $Q_s = -40 + 15P$

a) Find the equilibrium price and the corresponding quantity.

Ans. P* = 15, Q* = 185

b) In order to encourage the use of this good, the government subsidizes the producers by giving them $4 per unit of the good sold. Find the new equilibrium price and quantity after the government subsidization.

Ans. $P^*_{producer} = 16$, $P^*_{consumer} = 12$, Q** = 200

c) Use a graph to illustrate the impact of the subsidization program on the equilibrium price and quantity.

Ans. The new supply curve should be to the right of the original supply curve (i.e. shift parelly).

d) Find the amount of money the government needs for this subsidization program.

Ans. Total amount of subsidy = $800

9. 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

10. Market demand is the sum of the demands of all buyers. Similarly, market supply is the sum of the supplies of all sellers. Suppose that Nadech and Mark are the only two buyers in the coffee market, and individual demands of Nadech and Mark for coffee are $Q^D_{Nadech} = 5 - 3P^2$ and $Q^D_{Mark} = 4 - P^2$. Suppose further that Starbuck and Starbung are the only two sellers in the market, and their individual supplies for coffee are $Q^S_{Starbuck} = 2 + 5P$ and $Q^S_{Starbung} = 5 + 2P$. Find the market demand, market supply, equilibrium price, and equilibrium quantity.

Ans. Market demand is: $Q^D_{mkt} = 9 - 4P^2 \; if \; P \leq \sqrt{5/3}$, $Q^D_{mkt} = 4 - P^2 \; if \; P > \sqrt{5/3}$

Market supply is: $Q^S_{mkt} = 7 + 7P$,

$(P^*, Q^*) = (0.25, 8.75)$