



EE 320 Introductory Mathematical Economics
Semester 1/2019

Homework 1

Due Sept, 19th 2019

There are five 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.
 - a. (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.
 - b. (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?
 - c. (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.

a. Consider the following system of equations:

$$\begin{aligned}Q_{d1} &= a_0 + a_1P_1 + a_2P_2 + a_3P_3; & Q_{s1} &= \alpha_0 + \alpha_1P_1 \\Q_{d2} &= b_0 + b_1P_1 + b_2P_2 \quad ; & Q_{s2} &= \beta_0 + \beta_2P_2 \\Q_{d3} &= c_0 + c_1P_1 + c_3P_3 \quad ; & Q_{s3} &= \gamma_0 + \gamma_3P_3\end{aligned}$$

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:

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

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.

- c. (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:

$$Y = C + I + G_0$$

$$C = C_0 + bY, \quad (C_0 > 0, 0 < b < 1)$$

$$I = I_0 - ar + iY, \quad (I_0 > 0, a > 0, i > 0)$$

Money market:

$$\frac{M_S}{P} = \frac{M_0}{P_0}$$

$$L_D = mY - hr, \quad (m > 0, h > 0)$$

- 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 $C_0 = 150$, $I_0 = 100$, $G_0 = 50$, $b = 0.6$, $a = 400$, $h = 800$, $M_0 = 100$, $i = 0.1$, $P_0 = 1$, and $m = 0.4$. Find the equilibrium national income and interest rate.
- d. (2 points) Based on the information in part (c), if the autonomous consumption (C_0) change by the amount λ ($\lambda > 0$), all else constant, what is the *change* in the equilibrium national income?

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 prices 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?