

Group Homework 1

Semester 2/2022 EE320 Introductory mathematical economics

Due date: Feb 3rd 2022 (before midnight /B.E. moodle).

Note: Late homework will not be accepted. Use the format of filename as required; this will cost you two points if you don't follow the instruction.

1. Consider the market for good x. Suppose that the market demand equation is given by

$$P_x = 8 - bQ_x^d + cP_y; \quad b > 0 \text{ and } c > 0$$

and the equation for market supply is given by

$$P_x = 20 + dQ_x^s; \quad d > 0$$

where P_x is price of good X, P_y is price of good Y, Q_x^d is quantity demanded for good X and Q_x^s is quantity supplied for good X. Answer the following questions.

- a) What is(are) the endogenous variable(s) in the model? What is(are) the exogenous variable(s) in the model?

- b) Specify condition(s) under which the market equilibrium for good x is guaranteed to exist. What restrictions do we need to place on the values of P_y so that the market equilibrium exists?
 - c) Solve for the equilibrium price (P_x^*) and equilibrium quantity (Q_x^*) of the market for good x .
 - d) Calculate the magnitude of the response of equilibrium quantity to the change in exogenous variable(s).
2. (an old midterm exam question) Consider a market with 10 identical consumers. Each of the consumer's demand function is given by:

$$P = 10 + k_1 P_x + k_2 Y - Q_j^d,$$

where P is the unit price of the product sold in this market, Q_j^d is the amount of quantity demanded by the j -th consumer, P_x is the price of product x , and Y is the level of income. Assume further that the industry is controlled by two producers, each of whom has the following supply function:

$$P = 5 + k_3 W + Q_1^s, \quad \text{and}$$

$$P = 20 + k_4 T + 2Q_2^s,$$

where Q_1^s and Q_2^s are the amount of quantity supplied by the first and second producer, respectively. W is the price of gasoline and T is the level of technology. All the parameters are STRICTLY positive.

Use the information given to answer the following questions:

- a. Is “product x” considered as a *substitute* product or a *complementary* product?
- b. Derive the market demand equation.

Now, I supplement two pieces of information to be used in the remaining parts of this question. That is, I assume that

(i) $0 < (20 + k_4T) < (5 + k_3W)$ and (ii) $10 + k_1P_x + k_2Y > 5 + k_3W$

- c. What does the first condition mean in terms of the relative cost advantages between the two firms? Given your interpretation, derive the market supply equation.
- d. Given (i) and (ii), state the condition under which the market ceases to have only *single* firm that stays active in the business?

Continue with the information given above, but now consider a specific case where the value of coefficients and exogenous variables are given in the following table:

Coefficients	k_1	k_2	k_3	k_4
Value	2	2	3	1

Variables	Y	P_x	w	T
Value	5	10	10	5

- e. Solve for the equilibrium price *and* quantity.

- f. Suppose that the government provides a subsidy of \$5 for each unit of output that the consumers have purchased. Calculate the benefit that consumers and each of the two producers receive under the subsidy program.

3. Consider a simple macroeconomics model given below

$$C = 0.3Y_d - k_1r; \quad k_1 > 0.$$

$$I = 0.5Y - k_2r; \quad k_2 > 0.$$

$$Y_d = Y - T$$

$$G = G_0$$

$$T = T_0$$

$$M^d = k_3Y - k_4r; \quad k_3 > 0 \text{ and } k_4 > 0.$$

$$M^s = M_0$$

where $Y = GDP$, $C = \text{consumption}$, $I = \text{investment}$, $G = \text{government purchase}$, $T = \text{tax}$, $r = \text{interest rate}$, $M^d = \text{money demand}$, and $M^s = \text{money supply}$

- Write the system of linear equations in matrix form with two variables included, namely Y and r .
- Solve for the equilibrium solution (Y^*, r^*)
- Has fiscal policy, for example, the change in government purchase, become *more effective* if both k_1 and k_2 are getting bigger? Show your numerical result, and explain your result with some economic intuitions. (Hint: how do we measure the effectiveness of a policy?)

4. Let the demand function be $P = 14 - 3Q$ and the supply function be $P = 4 + 2Q$. Suppose that the government imposes tax by \$ t per unit of output. This tax is assumed to impose on consumer. Answer the following questions.
- Find the equilibrium under pre-tax situation. That is, when " t " is set to equal to zero.
 - State the condition that links between consumer's and producer's price
 - Find the equilibrium after tax. (Hint: your solution should be written in terms of " t ".)
 - Calculate the consumers' and producers' burden. Which group is paying more for the tax under the equilibrium?
 - Find the expression of the revenue that the government can collect from the market under the equilibrium.
 - If the government were to collect tax so that total revenue is maximized, what is the appropriate level of unit tax, " t ", that it should impose to the market?

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