Problem Set 1

1. A U.S. manufacturer of particleboard furniture is considering investing in a new stamping machine. The machine is expected to have a useful life of five years, after which the machine can be sold as scrap for an estimated $5,000. The firm plans to issue bonds to pay for the machine and intends to treat the interest rate on the bonds as the relevant discount rate for evaluating the project. The machine will cost the firm $175,000, all of which must be paid at the beginning of the project. The new stamping machine will reduce production costs by $50,000 per year, for each year of the machine’s life. The firm treats all of the cost savings as if they occur at the end of the year.

Should the firm plan to undertake the investment project, bonds will be issued in approximately three months. The firm has estimated the supply and demand for loanable funds as:

\[
L_D = 25,000,000 - 125,000,000r \\
L_S = 2,500,000 + 62,500,000r
\]

where

\(L_D\) is the demand for loanable funds
\(L_S\) is the supply of loanable funds
\(r\) is the interest rate

a. Given the information above, should the firm undertake the investment in the stamping machine? Show your calculations.

b. Assume that the demand for loanable funds shifts upward 3,750,000 (i.e. 3,750,000 more demand at every interest rate). What impact will this increase in demand have on the interest rate and on the firm’s stamping machine project? (Assume the firm learns of the change in demand before accepting the project.)

2. According to the Wall Street Journal, merger and acquisition activity in the first quarter of 2004 rose to $5.3 billion – an investment level not seen since the second quarter of 2001. Approximately three-fourths of the 78 first-quarter deals occurred between information technology (IT) companies. The largest IT transaction of the quarter was EMC’s $625 million acquisition of VMWare. The VMWare acquisition broadened EMC’s core data storage device business to include software technology enabling multiple operating systems – such as Microsoft’s Windows, Linux and Novell Inc.’s Netware – to simultaneously and independently run on the same Intel-based server or workstation. Suppose that at the time of the acquisition the weak economy led many analysts to project that VMWare’s profits would grow at a constant rate of 1% for the foreseeable future, and that the company’s annual net income was $50.72 million. If EMC’s estimated opportunity cost of funds is 10%, as an analyst how would you view the acquisition? Would your conclusion change if you knew that EMC had credible information that the economy was on the verge of an expansion period that would boost VMWare’s projected annual growth rate to 3% for the foreseeable future? Explain.
Demand and Supply

The demand schedule (or demand function or curve) for a good shows the total quantities (Q) that buyers are willing and able to buy at various prices (P) in some period of time. For example, here is a demand function illustrating the very special but convenient case of linear demand (with Q measured in some physical unit of quantity such as tons and P measured in dollars):

\[ Q = 2100 - 50P \]

Sometimes it is convenient to express this in the inverse form showing the prices that buyers are willing to pay for various quantities. (P is a function of Q.) This is called the demand-price function.

3. a. State the demand-price function corresponding to the above demand function.
   
   b. Plot the corresponding demand curve on graph paper - with Q on the horizontal axis and P on the vertical axis. Label this demand D₁.

I. The Case of Fixed Supply

A supply schedule (or function or curve) defined analogously shows the total quantities (Q) that sellers are willing to sell at various prices (P) in a given period of time. One very special case is that of a fixed supply, where the quantity supplied is a constant, independent of price, such as

\[ Q = 1200 \]

(This type of supply may apply, for example, in the short period of time when a given quantity of a perishable commodity is brought to market and must be sold at any price or go to waste; or, in a slightly different meaning of supply, again in the short run, it may apply to a service such as housing, or even in the long run to the services of a permanent resource such as land.)

4. a. Plot the above supply curve on your diagram and label it S₁. What is the equilibrium price in this market?
   
   b. Suppose that demand now increases suddenly to:

   \[ Q = 2700 - 50P \]

   State the corresponding demand-price function, and plot it on your diagram, labeling it D₂.

   c. Determine the equilibrium price for this new demand.

5. Suppose that consumers, indignant about this price increase, persuade the government to institute a price-ceiling equal to the former price (found in question 4a). What are the quantity demanded and the quantity supplied at this controlled price? Is there a shortage or a surplus in this market? How much?
II. The Case of Constant Cost

As another special case, assume that, in any time frame, any relevant quantity of the good can be produced at a constant cost of $18 per unit. (This unit cost is a “full cost” - i.e. the minimum cost per unit that producers must be able to cover if they are willing to go on producing indefinitely.)

This implies that the industry's supply-price function is given by:

\[ P = 18 \]

6. a. Plot this on your diagram, labeling it S₂. Using D₁, what is the equilibrium quantity in this market?

b. If demand now increases to D₂, what is the new equilibrium (price and quantity) in this market?

7. Suppose the government wishes to prevent this increase in output (note: equilibrium quantity in question 6b is larger than in question 6a) and institutes a license (or permit) for each unit of output produced. How much should the government charge (per unit of output) for this license if only the original output (in question 6a) is desired? (Hint: How much will the market price have to increase so consumers will only wish to purchase the original quantity?)

III. The Case of Increasing Cost

As a somewhat more general case, assume that the supply function is:

\[ Q = -600 + 100P; \text{ where } P > 6 \]

Supply curves may be positively sloped in the long run because, as the industry's output expands, (a) the prices of needed labor, raw materials, etc. are bid up, or (b) the outputs of higher cost producers are needed. For shorter time horizons, supply curves are almost certainly positively sloped as the industry's output approached its current capacity.

8. a. What is the supply-price function corresponding to this supply function?

b. Plot this supply curve on your diagram, labeling it S₃. Using the original demand, D₁, what is the equilibrium (price and quantity) in this market?

c. If demand now increases, as before, to D₂, calculate the new equilibrium price and quantity?

9. Given an increase in the level of demand, using a separate graph in each of the cases below, give a graphical example (using both supply and demand curves) of cases where there is an increase in:
   a. the price but not the quantity bought and sold.
   b. the quantity bought and sold but not the price.
   c. both price and quantity bought and sold.
IV. The Effects of Specific Taxes

A specific tax is a tax of so many dollars or cents per physical unit of the good. If a specific tax is imposed, the new equilibrium condition is:

\[ P_d - P_s = t \]

That is, the price paid by the consumer \( P_d \) exceeds the seller's supply price \( P_s \) by the amount of the tax \( t \).

With the original demand \( D_1 \), in each of the foregoing cases, assume that a tax of \( t = \$6 \) is imposed.

10. a. In the fixed supply (Case I), calculate the new price paid by consumers \( P_d \), price kept by the sellers \( P_s \), quantity bought and sold \( Q^* \), total tax revenue to the government \( T \), where \( T = t \) times \( Q^* \), and the net change in price paid by consumers \( \Delta P_d \).

b. Repeat question 10a. for the constant cost supply (Case II).

c. Repeat question 10a. for the increasing cost supply (Case III).

11. This problem illustrates the effects of a specific tax on the price of a good when the tax is applied to markets with very different supply functions. Given a specific tax, graphically show how the equilibrium price can:
   a. increase by an amount equal to the tax.
   b. increase by an amount less than the tax.
   c. remain the same.