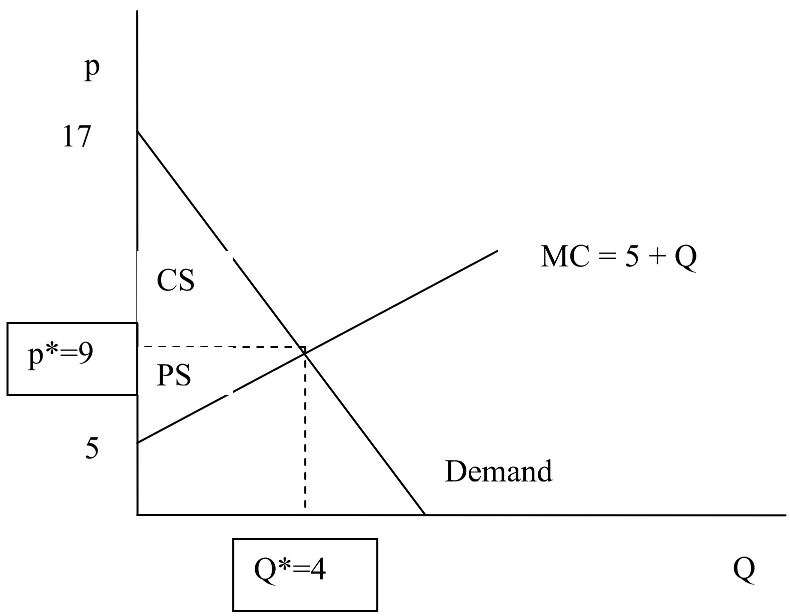
FRE/ECON374 Problem set 1 SOLUTIONS

1. A little village wants to invest in an aqueduct system. The aggregate inverse demand from the villagers is p = 17 – 2Q. The total cost of the system is defined by the following equation: $TC = 5Q + 1/2Q^2$.
   a) Show graphically the equilibrium price and quantity. Identify the consumer and producer surpluses.



   b) Compute the consumer and producer surpluses. What is the social surplus generated by the new system? **24**

   1. Supply = MC = 5 + Q

   2. Equilibrium price and quantity:

   17 – 2Q* = 5 + Q*

   Q*=4; p*=9

   3. Consumer surplus:

   CS = (17-9)(4)/2 = 16

   4. Producer surplus:

PS = (9-5)(4)/2 = 8

5. **Social surplus:**

   SS = CS + PS = 16 + 8 = 24

Suppose the villagers do not directly pay for the aqueduct service.

c) What will be the quantity consumed? **8.5**

   Replacing p by 0 in the demand equation: 0 = 17 – 2Q.

   The demand meets the price of 0 at a quantity of 8.5.

d) In that case, is it optimal for the village to build the new system? Hint: What is the social surplus under this circumstance? **No**

   1. **Total Benefits = 17*8.5/2 = 72.25**
   2. **Total Costs = 5*8.5 + ½$(8.5)^2$ = 78.625**
   3. **Net benefits = TB – TC = 72.25 – 78.625 = -6.375**
   4. **In this case, the net benefits (social surplus) from the new system are negative; it is not optimal to invest in it.**

2. The City of Vancouver studies the possibility of opening a new park (a public good). A report evaluating the willingness-to-pay for the park was given to the council. 40% of the population has an inverse demand of: p = 50 – Q; the other 40%, an inverse demand of: p = 40 – 2Q; and the remaining 20% has no interest in the park. Demands are in cents.

   Suppose the population is 1 million and there is no marginal cost in using the park. Under the circumstance that the City's budget allows to invest in every worthy project, what is the maximal amount of money the coucil should devote to the park? Write the steps to your answer. **$6.6 million**

   1. **Total benefit for the first type (CS1):**

      CS1 = 50*50/2 = $12.50

   2. **Total benefit for the second type (CS2):**

      CS2 = 40*20/2 = $4

   3. **Aggregate benefits (CS):**

      CS = 1 000 000(0.4*CS1 + 0.4*CS2) = $6 600 000

4. **The council should not spend more on the park that the total benefits that this park generates; which is $6.6 million.**

3. A fisherman has an opportunity to invest in a new boat at a cost of $2000. This new boat would allow the fisherman to increase his catches from 5000 to 6000 salmons per year, for the next five years. The price of each fish is $0.50, and will stay so for the future. Suppose the annual interest rate is 10%.
   a) What is the present value of the extra revenues the fisherman would get with this new boat, if he receives the first revenues in a year from now. **$1895.393**
      1. **Extra catch every year: 1000 (=6000-5000)**
      2. **Extra annual revenues: 1000*$0.5 = $500**
      3. **Present value of extra revenues:**

         $$\mathbf{PV = 500/(1.1) + 500/(1.1)^2 + 500/(1.1)^3 + 500/(1.1)^4 + 500/(1.1)^5}$$
   b) Should the fisherman invest in the boat? Why? **No**

      Net profits = PV of extra revenues – Cost of boat

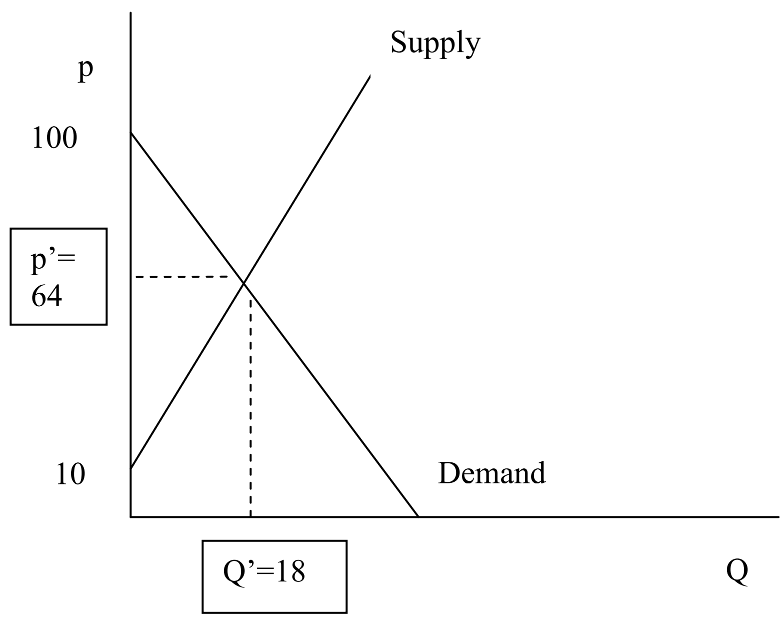
      = $1895.39 - $2000 = - $104.61

      The fisherman would suffer a lost of $104.61 by investing; he would be better off not buying the new boat.
   c) Suppose the fisherman can benefit from a social program that allows him to pay the boat at the same price but at the end of the fifth year. Should the fisherman invest in the boat? Why? **Yes**
      1. **The payment of the boat is now postponed in 5 years. The cost changes and the present value of it is $1241.84 (= $2000/(1.1)^5$).**
      2. **Net profits = $1895.39 - $1241.84 = $653.55**
      3. **The net profits are now positive and it is beneficial to invest in the boat.**

4. A competitive industry has an aggregate inverse demand of p = 100 – 2Q. The supply of the industry is represented by p = 10 + 3Q.

a) Compute the equilibrium price and quantity in this market and show it graphically. **p'=64; Q'=18**

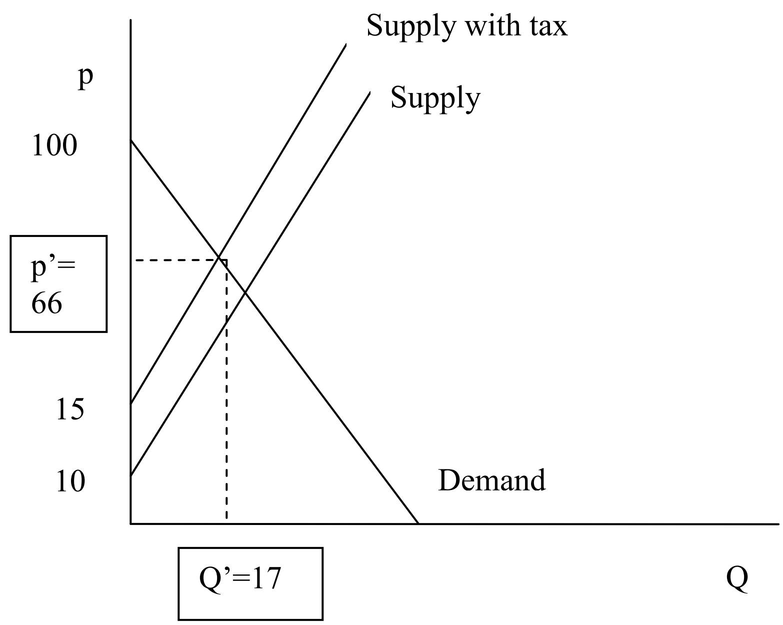
100 – 2Q' = 10 + 3Q'



Suppose this industry pollutes. In order to maximise the social surplus, the government sets a pollution tax of $5 per produced unit.

b) What are the new equilibrium price and quantity in this market? Show it on a new graph. **p*=66; Q*=17**

1. **New supply is p = (10+5) + 3Q**
2. **100 – 2Q* = 15 + 3Q***



Suppose there is a new technology that allows to produce the good at the same cost, but eliminating all pollution. The industry adopts the technology and the government cancels the tax.

c) What is the equilibrium price and quantity on this market with the new technology? **p''=64; Q''=18**

100 – 2Q'' = 10 + 3Q''

d) What is the change in the social surplus from the situation with the tax to the situation with the new technology? **87.5**

1. **SS with pollution = (100-10)*17)/2 = 722.5**
2. **SS with no pollution = (100-10)*18/2 = 810**
3. **Change in SS = 810 – 722.5 = 87.5**

e) Why is the social surplus increasing?

The social surplus increases because the industry no longer pollutes. The reduction of pollution represents in fact a decrease in the cost borne by the society.

Note: The increase in the social surplus DOES NOT come from the cancellation of the tax itself. The tax, in this case, was not a distortion, but allowed to internalise the negative externality (i.e. pollution).