Econ 496, Natural Resource Economics
Winter 2012
Suggested answers for Assignment 2

1. (a) Yes, everyone could be made better off if smoking were allowed. First note that allowing smoking is socially optimal since it creates the highest possible total surplus ($0.75 - 0.50 =$ \$0.25 per person). Second, every one can be better off if the smokers could pay the non-smokers between 51 and 74 cents each for the right to smoke. That way the smokers will enjoy a surplus of $\$(0.75 - payment)$, and the non-smokers will enjoy a surplus of $\$\,(payment - \$0.50)$.

   (b) In this case, the social efficient outcome is a room where smoking is allowed. If the property rights belong to the smokers the social optimum has already been achieved. If the property rights belong to the non-smokers, according to Coase's Theorem, the efficient outcome can be achieved through negotiations as long as there are insignificant negotiation and transaction costs. The only difference is that in the former case the smokers will enjoy the entire surplus while in the latter the non-smokers can get their hands into that surplus.

   (c) If the non-smokers have the property rights and unanimity is required, negotiations might break down easily. This is because it is enough for one non-smoker to hold out waiting for a larger portion of the payments.

2. (a) Cost effectiveness requires that, given the target of 50 units is reached, the production allocation should be such that the resulting marginal costs will be equal, i.e.,

$$\begin{cases} MC_i\left(q_i\right) = MC_j\left(q_j\right), \quad \text{for every } i \neq j \text{, with } i, j = 1, 2, 3. \\ q_1 + q_2 + q_3 = 50. \end{cases}$$

   Therefore, we get

$$\begin{cases} MC_1 = MC_2, \\ MC_1 = MC_3, \\ MC_2 = MC_3, \\ q_1 + q_2 + q_3 = 50. \end{cases}$$

   By substituting the marginal cost expressions above we get

$$\begin{cases} 28 = 12 + q_2 \\ 28 = 2q_3, \\ 12 + q_2 = 2q_3, \\ q_1 + q_2 + q_3 = 50. \end{cases}$$

   The first equation yields $28 = 12 + q_2 \Rightarrow q_2^* = 16$, while the second equation yields $28 = 2q_3 \Rightarrow q_3^* = 14$ (note that these two answers satisfy the third equation). Substituting these answers in the fourth equation we get $q_1^* + 16 + 14 = 50 \Rightarrow q_1^* = 20$.

(b) As in part (a), cost effectiveness requires that, given the target of 18 units is reached, the production allocation should be such that the resulting marginal costs will be equal, i.e.,

$$\begin{cases} MC_i\left(q_i\right) = MC_j\left(q_j\right), & \text{for every } i \neq j, \text{ with } i, j = 1, 2, 3. \\ q_1 + q_2 + q_3 = 18. \end{cases}$$

Therefore, we get

$$\begin{cases} MC_1 = MC_2, \\ MC_1 = MC_3, \\ MC_2 = MC_3, \\ q_1 + q_2 + q_3 = 18. \end{cases}$$

By substituting the marginal cost expressions above we get

$$\begin{cases} 28 = 12 + q_2 \\ 28 = 2q_3, \\ 12 + q_2 = 2q_3, \\ q_1 + q_2 + q_3 = 18. \end{cases}$$

Exactly as in part (a), the first equation yields $28 = 12 + q_2 \Rightarrow q_2^* = 16$, while the second equation yields $28 = 2q_3 \Rightarrow q_3^* = 14$ (note that these two answers satisfy the third equation). Substituting these answers in the fourth equation we get $q_1^* + 16 + 14 = 18 \Rightarrow q_1^* = -12$. Obviously, this cannot be the answer as negative quantities make no sense. However, the calculations above indicate that method 1 is "relatively too expensive" for that level of production (hence negative q_1). Therefore, we set $q_1^* = 0$ and we solve the following system

$$\begin{cases} MC_2 = MC_3, \\ q_2 + q_3 = 18. \end{cases}$$

By substitution we get

$$\begin{cases} 12 + q_2 = 2q_3 \\ q_2 + q_3 = 18. \end{cases}$$

Solving this 2×2 system yields $q_2^* = 8$, and $q_3^* = 10$.

3. (a) The market demand will be

	Q = 1	**Q = 2**	**Q = 3**
Aggregate WTP	$4 + 6 + 3 = \$13$	$3 + 4 + 2 = \$9$	$2 + 2 + 1 = \$5$

Therefore, comparing to the marginal cost, the social optimal quantity is $Q = 2$ units, since for that quantity the difference between marginal social cost and the marginal social benefit is minimized with the marginal social benefit still being greater than the marginal social cost.

(b) No, a private firm cannot supply 2 units of that good. If each one of the three people is acting individually, they will be comparing their own private marginal benefit (WTP) to the marginal cost of production. By doing so, Sarah and Ethan won't be willing to fund the production of that good at all as their willingness to pay for the first unit ($4 and $3, correspondingly) is less than the marginal cost ($6). Only Walid will be willing to pay for the provision of one unit of that good as his willingness to pay for the first unit is equal to the marginal cost of the first unit ($6). Therefore, the private solution is $Q = 1$ and Sarah and Ethan will be free-riding due to the non-excludability of that good.

(c) In the case of the new marginal cost, our findings in part (a) do not change: the social optimal remains at $Q = 2$ as for that quantity we get $MB_S = MC_S = \$9$. However, it is straightforward to see that the market will fail to provide any quantity of that good as no individual is willing to pay for the first unit (the WTP of each person is less than $7 which is the marginal cost of the first unit).

4. (a) False. The Pigouvian tax should be equal to

$$t_P = MC_E(Q^*) \Rightarrow t_P = MC_S(Q^*) - MC_P(Q^*) \Rightarrow t_P = MC_S(Q^*) - MC_P(Q^*)$$

From the supply we get

$$Q = -2 + P \Rightarrow P = 2 + Q \Rightarrow MC_P = 2 + Q.$$

Therefore,

$$t_P = (3 + 2Q^*) - (2 + Q^*) = \$6 \text{ per unit.}$$

(b) True. For identical demands per period, constant marginal costs over time, and constant discount rate, the price of non-renewable resource increases at a rate equal to the interest rate.

(c) False. Large projects usually disperse their costs over a large population, so the individual costs become insignificant (risk-pooling).

(d) True. It has been shown that CVMs show higher WTP than WTA when the valuation has to do with the same good, although in theory these two values should have been the same.

(e) False. Open access resources are non-excludable and INDIVISIBLE.