Problem Set 7

This problem set will not be graded and does not need to be turned in. However, the problem set does cover topics that will be on the final exam, so it is highly recommended that you work through the problems in the same way you would for a graded problem set. Solutions for this problem set will be posted on Blackboard.

1. **Taxing Gasoline**

   The market for gasoline is competitive, with many firms offering an identical product. The demand for gallons of gasoline is given by:

   $$D(p) = 2000 - 400p \tag{1}$$

   where p is the price of a gallon of gasoline. The marginal costs for producers of gasoline are given by:

   $$MC_{\text{firm}}(g) = \frac{1}{1000}g \tag{2}$$

   where g is the total number of gallons of gasoline produced industry-wide. Every unit of gasoline consumed causes environmental damage. The size of this damage depends on the current level of gasoline being used. The additional damage to the environment caused by the consumption of one more gallon of gasoline is given by:

   $$MC_{\text{env}}(g) = \frac{1}{2000}g \tag{3}$$

   (a) In the absence of any government regulation, what will the market price for gasoline be and how many gallons of gasoline will be sold?

   (b) Find the consumer surplus, producer surplus, and total environmental damage at the equilibrium in part (a). Based on your answers explain why there is a role for government regulation in this market.

   (c) Suppose that the government decides to tax consumers to achieve the socially efficient level of gasoline production. A quantity tax will be used meaning that the government will levy a tax of the amount t on each gallon of gasoline sold. What will the new equilibrium quantity of gasoline be if the government sets the quantity tax to be equal to the MC_{env} at the equilibrium quantity of gas you found in part a?

   (d) Show graphically why the tax in part (c) does not lead to the most efficient outcome. What value of t will lead to the socially efficient level of gasoline?

(e) Now suppose that the environmental damage can be cleaned up and that the costs of cleanup are equal to the dollar value of the environmental damage (so if a gallon of gasoline causes \$5 in environmental damage, it would cost \$5 to undo that environmental damage). Instead of using a tax to achieve the socially efficient level of gasoline, the government decides to simply make firms pay for the cleanup costs associated with whatever gasoline they sell. What would the new equilibrium price and quantity of gasoline be under this plan?

(f) Would consumers prefer the tax in part (d) or the cleanup plan in part (e)? Which of the plans would the firms prefer?

2. **Cleaning the Bathroom**

Two roommates share a bathroom. They are trying to figure out how they will divide up the task of cleaning the bathroom. Each roommate gets a private benefit of \$50 from having a clean bathroom for the week. It would take a total of one hour each week to clean the bathroom. This one hour can be split between the roommates so that each would need to spend half an hour. Assume that the bathroom is either clean or it isn't, there is no in between. So there are no benefits from spending less than one hour total between the two roommates partially cleaning bathroom.

(a) Suppose that roommate A is out of town for the month so he cannot possibly help clean the bathroom. If roommate B values his time at \$20 per half hour, will he clean the bathroom?

(b) Now suppose that roommate A returns. Roommate A also values his time at \$20 per half hour. If roommate A observes roommate B taking the actions you found in part (a), what is roommate A's best response (do no cleaning, clean for half an hour, clean for an hour)?

(c) Write down a payoff matrix showing the outcomes of all possible combinations of actions by the roommates (no cleaning, half hour of cleaning, full hour of cleaning are the possible actions for one roommate). Note that there are nine possible combinations of actions.

(d) Given your payoff matrix in part (c), what will the eqilibrium outcome be? Explain your answer.

(e) Now assume that both roommates actually value a half hour of their time at \$30. How will this change the payoff matrix and the equilibrium outcome?

(f) The roommates are seeking a way around this public goods problem. They propose the following: Roommate A will pay an additional X dollars in rent per week and roommate B will pay X dollars less in rent each week. In exchange for this, roommate B will spend one hour cleaning the bathroom each week. For what values of X would roommate A agree to this deal? For what values of X would roommate B agree to this deal? Assume the roommates value their time at \$30 per half hour.

    (g) Given your answers to parts (e) and (f), will the roommates reach an agreement? How will this deal change total surplus? Be as specific as possible.