Problem Set # 3
Due Tuesday, March 19th
(Assignments turned in after the beginning of lecture will not be graded)

1. (Public Goods) You have just received an important assignment as a consultant to the Prime Minister of a small country called Zilbermania. The Prime Minister is seeking advice on how to best manage a long-neglected but beautiful wildlife reserve called Giannini Park. Giannini Park has a total area of 100 acres, and the annual marginal maintenance cost (MC) is: $MC=2A$ where $A$ is the number of acres maintained. Using the valuation tools acquired in EEP101/ECON125, you have estimated the willingness to pay for acres of maintained park by the country's 5 citizens to be: $mb_1=20 - .4A$ (for each citizen, where $A$ is the number of maintained acres). Assume that $mb_1 \geq 0$ (i.e. citizens never dislike additional park acres being maintained).

a) The Prime Minister would like to see a report of the following (including your calculations):

i. What is the aggregate demand for acreage in Giannini Park and the optimal amount of maintained acres? Graph the aggregate demand and marginal cost curves as well as the optimal level of acreage.

ii. How much would the annual budget expenditure be if the optimal level of acreage in Giannini Park were maintained through the use of the central government's tax revenues? How much would each citizen pay in taxes for the park? Please label the area corresponding to budget expenditures and total consumer surplus (total consumer surplus for all citizens) on your graph.

iii. The Prime Minister is considering granting a concession to a private firm to operate the park (and the right to charge a "fair" admission fee equal to the shadow value of park acres to society). Suppose the firm were able to operate the park more efficiently than the government ($MC=1.8A$). What would be the number of maintained acres in Giannini Park, how much would the per-person entrance fee be, what is the firm's profit and consumer surplus for society? Please label the number of maintained acres, shadow value of acres, consumer surplus, and firm profits (producer surplus) on your graph (or a new one if you wish).

iv. If the Prime Minister were to give the park over to his (greedy) brother to run, how much of the park would his brother decide to maintain (at $MC=2A$)? What would be the per-visitor entry fee, consumer surplus, and his brother’s profits? Please label consumer and producer surplus on your graph.

b) You have just met with the Minister of Tourism and he says that you can expect 5 foreign tourists to visit Zilbermania each year. The willingness to pay (by each foreign tourist) for visiting Giannini Park is estimated at: $mb_2=40 - .5A$. Assume that $mb_2 \geq 0$ (i.e. foreign tourists never dislike additional park acres being maintained). Please show your calculations (the Prime Minister wants to be able to easily double-check your work) for the following questions:

i. What is the new aggregate demand for acreage in Giannini Park, the optimal amount of maintained acres, and new levels of government expenditures required to maintain the park? Graph the aggregate demand and marginal cost curves, government expenditures, and optimal level of acreage.

ii. Suppose that the government decided to fund the park at the social optimum entirely through a tax on foreigners (i.e. extra airport tax or visa fee- assume that it will not affect
the number of visitors coming to Zilbermania). Calculate and compare the total consumer surplus of citizens and of foreign tourists. Label these areas on the graph.

iii. If the (greedy) brother were operating the park and he could not distinguish between foreign and local tourists, what level of acreage and entry fee per person would he charge?

c) An NGO has offered to donate $2,000 per year to assist in the operational expenses of the park as long as the government of Zilbermania meets the following three conditions: a) the park must be managed by the government, b) no entrance fee is to be charged for local tourists (foreign tourists may be charged an entrance fee; assume park officials can determine who is a local and a foreigner), and c) the entire 100 acres of the park must be maintained.

Calculate how much the government should charge each of the foreign tourists and how much additional money (if any) they will need from their central budget if they were to accept the offer and meet the conditions.

2. (Technology Adoption) The Prime Minister has just read the following press release from the University of California, Berkeley:

   Worldwide, almost two billion people rely on wood, charcoal, dung, and crop residues as their primary cooking fuels. Respiratory infections, causally linked to exposure to particulate matter and other pollutants in smoke from cooking fires, are the leading cause of illness in many developing nations. This environmental pollution accounts for approximately 4% of the total global burden of disease.¹

The Prime Minister is aware of the fact that all five of his citizens use wood to cook their food. He worries about the high levels of pollution and the effects on health. He is happy with your work so far and has requested you to remain for another couple of weeks to help him formulate a policy that would help reduce this pollution problem (if you finish early, you can spend a week at the beach).

Your field research team has found the following information:

1. \[ Y = \sqrt{e} \]
   where \( Y \) = output (total amount of heat generated), \( e \) = amount of effective inputs

2. \[ e = h_i(\alpha)a_i \]
   where \( h_i(\alpha) \) is the percentage of input used in production, \( a_i \) is the amount of fuel input used in one year

3. \[ Z = (1-h_i(\alpha)a_i)TF \]
   where \( Z \) = annual pollution emission units, \( T \) = total cooking time in hours over one year, \( F \) = parameter representing fuel-specific pollution characteristics

Let us assume that there are no credit constraints, that all citizens are identical and that they are all rational. Let us assume that if the net gains from switching to gas stoves are positive over the first year, then all citizens will switch. Remember to consider the input costs for fuel (valued at the unit price for fuel) as well as for time (valued at the hourly wage). Show your calculations for each of the following questions. Note these questions are not cumulative (i.e. in question iii, we are no longer assuming the government is giving away stoves as was stated in question ii, etc.).

i. Calculate the net gains from switching from wood cooking fires to gas stoves for the first year of adoption (note \( T \) and \( a_i \) are already expressed in annual units). Assume the citizens attach no value to pollution (and there is no pollution tax).

ii. If the government decided to give stoves away to all citizens, would they use them? Explain why or why not.

iii. Advise the Prime Minister on what would be the minimum per unit subsidy on gas in order to encourage everyone to switch to using gas stoves.

iv. Although taxing pollution would not be feasible, you decide that one alternative would be to launch an education/awareness campaign that would make citizens aware of the negative effects of smoke on their health. What would be the minimum value for (each unit of) pollution that such an education campaign would need to “generate” in order for the citizens to adopt gas stoves? (hint: mathematically, this is the same as a per unit pollution tax)

**Short Essay**

3. Your short but exciting career as an international management consultant has left you exhausted and unsatisfied. You have decided to take a position as a university lecturer. You decide to use your experiences in Zilbermania for one of your seminars on optimal management of public goods (refer to question 1). Address the following issues in less than 1 page handwritten (or less than \( \frac{1}{2} \) page typed, single space). Note this is somewhat shorter than in previous problem sets.

i) Why the wildlife reserve might or might not be considered a *pure* public good.

ii) Which management policy you decided to recommend to the Prime Minister and why? Make sure to include a brief analysis of efficiency, distribution of welfare, and feasibility.