14.41 Problem Set #2
Due October 3, 2003

1) Yellowstone is located 10 minutes away from city A and 20 minutes away from city B. Cities A and B have 200,000 inhabitants each and residents in both cities have the same income and preferences for national parks.

Assume that the cost for an individual to go to a national park is represented by the cost of the time it takes her to get into the park. Also assume that the cost of time for individuals in cities A and B is $.50 per minute.

You observe that each inhabitant of city A goes to Yellowstone 10 times a year while each inhabitant of city B goes only 5 times a year. Assume that the only people who go to Yellowstone are the residents of cities A and B.

Suppose that the cost of running Yellowstone is $1,500,000 a year and that the social rate of discount is 10%. Also assume that the park lasts forever.

(a) Compute the cost per visit to Yellowstone for an inhabitant of each city.

(b) Assuming that those two observations (cost per visit and # of visits per inhabitant of city A, and cost per visit and # of visits per inhabitant of city B) correspond to two points of the same linear individual demand curve for Yellowstone, derive that demand curve. What is the consumer surplus for inhabitants of each city? What is the total consumer surplus?

(c) There is a timber developer who wants to buy Yellowstone to run his business. He is offering $100 million for the park. Should the park be sold?

(d) An alternative approach to valuing Yellowstone is to conduct a survey and ask people how much they value it. What are the pros and cons of this approach?

2) The town of Stepford has 100 identical people, each of whom earns a wage of $6/hour in the perfectly competitive labor market. They are considering building a road that will save each of them 10 minutes a day of commuting time, forever.

(a) What is the social benefit of a new road, assuming a 10% daily discount rate? A 20% daily discount rate?

(b) Assume all costs to building the road accrue today, and that the benefits don't begin until tomorrow. Over what range of road costs would the project be worth it, with a 10% discount rate? With a 20% discount rate?

(c) It turns out that there is uncertainty as to the cost of the road. A professional analyst determines that the project will cost $500 with probability 2/3 and $1500 with probability 1/3. The costs, whatever they turn out to be, will be shared equally by all Stepford residents through a lump-sum tax τ paid today.

First assume that residents are risk-neutral. Is it worth it to build the road if the discount rate is 10%? 20%?

(d) Before the road is built, 101 new people move to Stepford. They each have a wage of $2/hour. They, too, will save 10 minutes a day. What is the new social benefit of the road? Is it worth it to build the road if the discount rate is 10%? If the residents vote on whether to build the road and finance it with a lump-sum tax, will it be built?

(e) The old residents vote with their feet and found a new town before building a road, but now that they are older, they have become risk-averse. In particular, each person's utility of consumption (which is equal to after-tax income) is:

$$U_{consumption} = \ln(\text{consumption})$$

Assume for simplicity that the workday is fixed at 8 hours, so each person has total income $48. Is it worth it to build the road if the discount rate is 10%? 20%?

[Hint: Calculate the expected loss in utility from paying for the road, which is the sum of the possible utility losses, weighted by their respective probability of occurrence.

Then find the guaranteed cost, g, for the road that would cause the same loss in utility as is expected from the gamble.

G is the *certainty equivalent* cost of the road, and is the right thing to compare to the benefit of the road.]

3) Residents of Burntown and Sparksville are closet pyromaniacs who love their Fourth of July fireworks. The residents in both cities are identical except they differ about their favorite color - some people (Reds) like red fireworks a lot and blue fireworks only a little, while others have the reverse preference (Blues).

Assume initially that people can only attend firework displays in their hometown. Assume that initially there is one red and one blue resident in each town.

The marginal benefits from fireworks are diminishing and the costs are constant and funded from general tax revenue from the towns' residents. In particular, assume that the utility of reds is given by $U(c, r, b) = c + 20 \log(r) + 10 \log(b)$. And for blues, $U(c, r, b) = c + 10 \log(b) + 20 \log(r)$; where c is private consumption, and r and b are the number of red and blue fireworks shot on the 4th. The price of both red and blue fireworks is 1, and each consumer has income y.

(a) What is the private level of provision in each town assuming no government provision? Is there an interior solution to this problem? Is there a Nash equilibrium?

The next parts will ask you to compare the socially optimal provision of the public good in each city and the average utility of the residents under various conditions:

(b) Assume that people are unable to move across towns. Find the socially optimal values of b and r in each town.

(c) Assume that people can move across towns and have completely sorted into a town of reds and a town of Blues (i.e. assume that the two reds live in one city and the two blues live in the other). Find the socially optimal values of b and r in each town. Contrast with (b).

(d) Assume that the towns are able to coordinate and get together half way between the towns and offer a joint display where everyone can attend. Find the social optimal value of b and r for the joint display.

(e) Rank the outcomes in (b), (c), and (d) in terms of total social welfare. Explain the ranking that emerges.

4) For several years, the US experienced budget surpluses. Some members of Congress proposed that we spend part of the surplus on education, but they couldn't agree on how the money should be spent. Identify the key economic aspects of the following questions in your answer.

(a) The federal Hope Scholarship program, which began in 1998, gives families who pay income taxes (those with incomes above about $20,000/year) a credit of up to $1500 against their federal income taxes for money spent on the first two years of college. Congressman A, whose district is in the suburbs, says that we should increase the amount of the Hope Scholarship program because people who go to college earn more and are better able to support their families. Is Congressman A correct? Evaluate his point as a justification for this program.

(b) Congressman B, whose district is in the inner city, says that we should spend more to improve our public elementary schools instead, because everyone goes to elementary school but only middle-class and upper-class people go to college. Evaluate this rationale for government spending on elementary education

(c) Congressman C, a former public economics student, overhears their conversation and says that the government shouldn't spend any more money on elementary education because each family has already chosen its preferred level of elementary education spending. Explain what her argument is and why you do or do not think it applies.

(d) Congressman D, a Republican, says that we should give each community a block grant that must be spent on local education. Congressman E, a Democrat, argues that we should instead have a program where we provide matching grants to localities to match their spending on hiring teachers. Which proposal is *likely* to lead to the largest increase in education spending, and why (use graphs in your answer)? Under what conditions would the reverse occur instead?

(e) The state of Massachusetts is also considering increasing its spending on education due to a state budget surplus. One proposal is to lower tuition at state universities by $1000. A second proposal is to give state residents a $1000 grant they can use to attend any university in the state. Discuss how these two proposals will affect college attendance and private spending on education. Explain which proposal you would support and why.