**Problem Set 2**
(Due Thursday, March 2 in class)

We encourage you to work together, but each person must submit his/her own responses. **PLEASE WRITE YOUR NAME, SID, AND SECTION NUMBER ON EACH PAGE.**

**Question 1** True, false, or uncertain. Please answer and provide a SHORT explanation. (Please correct in a meaningful way if false, not just by adding the word “not.”)

a) If a policy maker is uncertain about the true demand curve, a tax is a preferred policy tool.

*Uncertain:* It depends on the elasticity of demand. Only if demand is inelastic, would a tax be a preferred policy tool, as the outcome will be closer to the targeted optimal outcome. If demand is elastic however, a standard or quota would be preferred as it would be closer to the optimal outcome.

b) The Coase theorem tells us that there is no reason to regulate externalities as long as property rights are clearly defined.

*False:* In order to invoke the Coase theorem, we also need two additional assumptions (full information and zero transaction costs). Only under these three assumptions does the Coase theorem hold, which states that there is no need for intervention in cases of externalities as outcomes will be pareto optimal regardless of initial distribution of rights.

**Question 2** After listening to all the practical examples in class, you feel that it is time to go and employ what you learned in the real world. So you decide to quit university and become an orange farmer. You purchase a piece of land with beautiful orange trees, and now need to decide what technology to use to spray pesticide (x) against a common pest, the Asian citrus leafminer. You inherited a contract for aerial spaying (I=0) when buying the land, but could invest in precision applicators instead (I=1). Assume that the cost of the pesticide and the relevant technology used are your only relevant input costs at this time and that the wholesale price for a pound of oranges is constant at $.50 cent due to a marketing order. The aerial application (K0) comes at no extra cost, while the precision application (K1) would require an additional investment of $150. Residue from pesticide application contaminates groundwater. As a result, a tax might be imposed on orange farmers based on the level of pesticides detected in groundwater.

For simplicity, assume that technology 0 is only 50% effective, while technology 1 ensures total effectiveness based on a given environmental quality (q=.5) of your purchased land \[g(0.0)=0.5; \ g(0.1)=1\]. The input price or price of pesticides is $2 per gallon and your production function is given by \[f(x,g(q,I))=100+80e-e^2\], where e stands for effective input and \(e=x \ g(q,I)\).

I. Describe how you would go about deciding between the two technologies based on what you learned in class.

*Use a two-step approach of first computing optimal decisions under both technologies and (continuous choice) and secondly compare profits under both. Adopt the technology that yields the highest profit (discrete choice). Note that if both technologies yield negative profits, neither would be used.*

II. Write down your objective mathematically.
\[
\max_{x_i} p \cdot f[x_i, g(q, I)] - w \cdot x_i - \nu \cdot [1 - g(q, I)] \cdot x_i - K_i,
\]

where \( e = x_i \cdot g(q, I) \)

III. Solve for your optimal input use given the two technologies without a pollution tax.

\[
\max_{x_i} p \cdot f[x_i, g(q, I)] - w \cdot x_i - K_i
\]

\[
\max_{x_i} .5 \cdot [100 + 80(\cdot 5 \cdot x_i) - (\cdot 5 \cdot x_i)^2] - w \cdot x_i - 0, and
\]

\[
\max_{x_i} .5 \cdot [100 + 80x_i - x_i^2] - w \cdot x_i - 150
\]

\( x_0 = 72, \quad x_1 = 38 \)

IV. Solve for your optimal input use given the two technologies with a pollution tax of $4 per unit of pesticide that runs off into groundwater \([1-g(q, I)]\).

\[
\max_{x_i} p \cdot f[x_i, g(q, I)] - w \cdot x_i - \nu \cdot [1 - g(q, I)] \cdot x_i - K_i
\]

\[
\max_{x_i} .5 \cdot [100 + 80(\cdot 5 \cdot x_i) - (\cdot 5 \cdot x_i)^2] - 2 \cdot x_i - 4 \cdot (1 - \cdot 5 \cdot x_i) - 0, and
\]

\[
\max_{x_i} .5 \cdot [100 + 80x_i - x_i^2] - w \cdot x_i - 150
\]

\( x_0 = 64, \quad x_1 = 38 \)

V. Would you adopt (install precision applicators) if no tax is in place? What if legislation was past to require you to pay the above described tax?

\[
\text{output}^{\text{max}}_0 = 1684, \quad \text{output}^{\text{max}}_1 = \text{output}^{\text{loc}}_1 = 1696
\]

\[
\text{output}^{\text{loc}}_0 = 1636
\]

\[
\text{profit}^{\text{max}}_0 = .5 \cdot 1684 - 2 \cdot 72 = 698, \quad \text{profit}^{\text{loc}}_1 = \text{profit}^{\text{loc}}_1 = .5 \cdot 1696 - 2 \cdot 38 - 150 = 622
\]

\[
\text{profit}^{\text{loc}}_0 = .5 \cdot 1684 - 2 \cdot 64 - 4 \cdot (\cdot 5 \cdot 64) = 562
\]

you would not install precision applicators without a tax, but would install them with a tax.

**Question 3** Externality and policy essay

Read the four articles under “Related Readings” on the course website talking about San Francisco’s proposed tax on grocery bags. The following questions are based on these readings, the reader, and the lecture slides, but many of them also ask to give your personal opinion. Some questions may not have a single “right” answer, but you can still lose points for failing to support your contentions adequately. That said, conciseness is always appreciated and we ask you to try to limit your essay to no more than 1.5 pages! (Please type or write legible.)

I. These articles are dealing with trying to internalize the cost of an externality. Give at least three examples of the types of social costs associated with the distribution of plastic bags at supermarkets. (No numbers are needed.)

A good answer should mention these points [but can have more]:

There are direct effects attributed to bag litter on a range of public programs. There are six times more plastic particles than plankton by weight floating around in the Pacific Ocean. There are two
plastic garbage patches that are each the size of Texas. These plastic fragments collect pollutants, which are biomagnified up the food chain when mistaken for plankton by creatures who eat plankton for food. Plastic bags cost money for regular trash collection and also cost money to remove from the recycling stream. [these are mentioned in the article. Any other 3, correct examples will be accepted].

II. What is a Pigouvian tax? List other instruments that could be used to try to internalize this externality.
Pigouvian tax is a tax levied on externalities per unit. For example, it’s a tax on a polluters output in an amount just equal to the marginal environmental damage caused by the pollution. Other ways to deal with externalities are setting quotas, selling permits [tradable and not tradable], reward/subsidize positive externalities [not use of plastic bags] etc.

III. Who are the two main groups fighting the regulation, and why are they opposed to it? (Explain how the proposed regulation would likely affect them.)
The American Plastics Council and The California Grocers Association oppose this fee. They are opposed to it because they will lose revenue as a result of this fee. The Plastic producers obviously will see a decrease in demand for their products, and Groceries are those who bear the direct cost of the fee since the fee will be levied on them. They have to pass on this expense in terms of higher product prices to customers, which would not make their customers happy. [there are many other reasons as well].

IV. How would you as a consultant hired to examine the regulation go about finding the “socially optimal” tax?
To find the optimal tax, a consultant should estimate a measure of externality cost, combining different channels through which plastic bags are harming the society. [this can also be thought of as potential benefit of the tax as the tax should internalize these costs]. Also, one should estimate benefits and cost of the absence/reduction or price increase of bags for the society [very difficult task!]. In both cases, opportunity costs in addition to direct costs should be taken into account such as using resources currently used for clean up in education, consumers buying canvas bags etc. Then the optimal tax can be determined based on the relevant marginal social benefits and costs.

V. Do you support the proposed tax? Why or why not? (Try to also think of aspects of using grocery bags not considered in the articles.)
Either yes or no is acceptable as long as you give some reasons using economic cost-benefit-analysis logic.
One issue worth mentioning in this context is the convenience associated with plastic grocery bags for consumers.

VI. Based on your answers above (in III. particularly) and considering political power of the involved interest groups, what would be a likely outcome of the proposed regulation?
Given the two opposing groups and their potential substantial loss combined with their likely considerate political power through lobbying etc., it is unlikely that such a tax goes into effect. An agreement where grocery chains voluntary pledge to reduce plastic bag use and maybe credit consumers if they bring their own bags is a more likely outcome.

VII. After you answered VI, try to find information on a settlement (e.g. search online) and briefly state it.
See article #5 posted