PROBLEM SET 2

1. A policymaker has a good estimate of the marginal social cost of using a chemical, which is \( MSC = 2 + x \) when \( x \) is the level of chemical use. However, the marginal benefits are not known. The policymaker knows that estimation of benefits tends to either be too high or too low. If:

- The true MB (= Demand) is \( P = 20 - .5x \).
- There is a 50% chance of overestimation, so that estimated demand is \( P = 30 - .5x \).
- A 50% chance of underestimation so that \( P = 10 - .5x \).

(a) Compare outcomes under tax vs. direct control. Which policy is more desirable?

(b) How will your answers change if:

- True demand is \( P = 20 - 3x \)
- High demand is \( P = 30 - 3x \)
- Low demand is \( P = 10 - .3x \)?

(c) What are the implications of your findings?

2. An industry consists of 10 firms, and each has its own fixed input/output of pollution/output coefficients and output capacity (see Table 1).

Table 1: Technology and capacity distribution

<table>
<thead>
<tr>
<th>Firm Number</th>
<th>Labor/output</th>
<th>Pollution /output</th>
<th>Output capacity</th>
</tr>
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<td>10</td>
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</table>
(A) If output price P=$10 and labor cost w=$2, what will be the output before the environmental regulations are introduced? (firms with zero profits are assumed to operate?)

(B) Suppose the government aims to reduce aggregate pollution to 1600 units through a constraint of pollution per unit of output. What will be the level of the regulation?

(C) Suppose a pollution tax of a $1 per unit of pollution is considered as an alternative to the standard. What will be its impacts on aggregate pollution? Aggregate Profits? Output?

(D) Compare the results of parts (B) and (C)?

3. Suppose a country has $N$ citizens. The marginal benefits are each derived from the wildlife existence: $MB = 10 - .2x$, when $x$ is the volume of wildlife. The marginal cost of wildlife is $10 + x$.

(A) (i) What is the optimal level of wildlife, if the country has only 1 person?

(ii) What is the optimal level, if there are 6 people?

(iii) What is the optimal level, if there is a very large number of people?

(B) Now suppose that $MB$ represents marginal benefits of an access to a reservation, where the wildlife is located and access can be controlled.

(i) If there are 5 people and the safari is controlled by a monopolist, how much is the entry (access) fee?

(ii) Suppose the government regulates the price so that the entry fee will “simulate” competitive price.

- What will be the fee?
- How will the surplus be contributed within the economy?

(iii) Suppose the entry fee is designed, so the costs are covered.

- What will be the fee?
- How will economic surplus be distributed?

(C) Now suppose that there are 5 rich people with $MB_R = 10 - .2x$ and 10 poor people with $MB_p = 2 - .01x$.

(i) What is the optimal level of $x$?
(ii) If access can be controlled, what will be the monopoly solution? Is it socially optimal?