

**Econ 358: Environmental Economics**  
**Spring 2005**  
**Midterm Exam: SOLUTIONS**

**Instructions:** Answer 1 question from each of the four sections. I will grade only 4 solutions, so if you answer more than 1 question per section, I will grade only the first question answered in each section. Write all answers in bluebooks. Please read each question *carefully* and answer *each and every* part. Each question is worth 25 points. Good luck!

**Section I. Externalities and public goods**

1. Assume that the demand curve for an environmental good is fully coincidental with the marginal social benefit function and can be described as  $MSB = MPB = 24 - 2q$ , where  $q$  refers to the quantity of the good. Assume that the marginal private cost function can be described by  $MPC = q$ , and that marginal social costs are always double the marginal private cost.

A. Determine an equation for the marginal social costs (MSC).

$MSC = 2q$

B. Graph the functions and algebraically determine

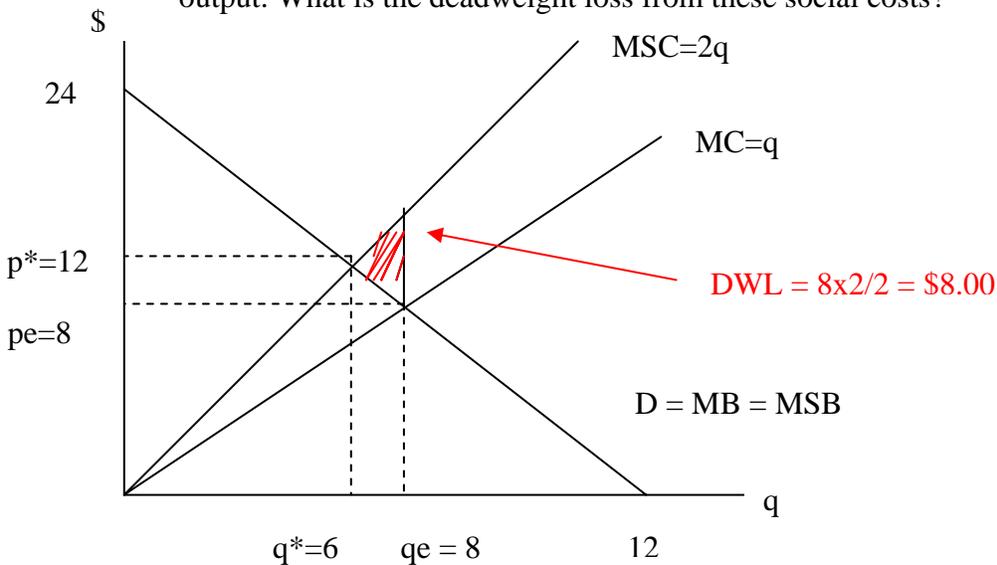
i. the market level of output

$MPC = MPB$  so  $24 - 2q = q$  and  $q = 8$ .

ii. the optimal level of output

$MSC = MSB$  so  $24 - 2q = 2q$  and  $q = 6$ .

C. Calculate social welfare at the market level of output and at the optimal level of output. What is the deadweight loss from these social costs?



$\text{Efficient social welfare} = (24 - 0) \times (6) / 2 = \$72.00$

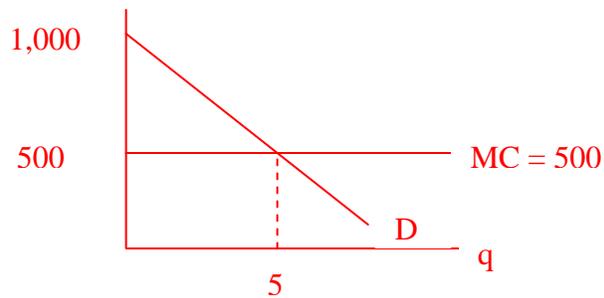
$\text{Market equilibrium SW} = (24 - 0) \times (8) / 2 = \$96.00$

2. Suppose the state is trying to decide how many miles of a very scenic river it should preserve. There are 100 people in the community, each of whom has an identical demand function given by  $P=10-1.0q$ , where  $q$  is the number of miles preserved and  $P$  is the per mile price he or she is willing to pay for  $q$  miles of preserved river.

- A. If the marginal cost of preservation is \$500 per mile, how many miles would be preserved in an efficient allocation?

This is a public good, so add the 100 demand curves vertically. This yields:  
 $P = 1,000 - 100q$ . This demand curve would intersect the MC curve when  $P = 500$ , which occurs at  $q = 5$

- B. What are the net benefits associated with the preservation project?



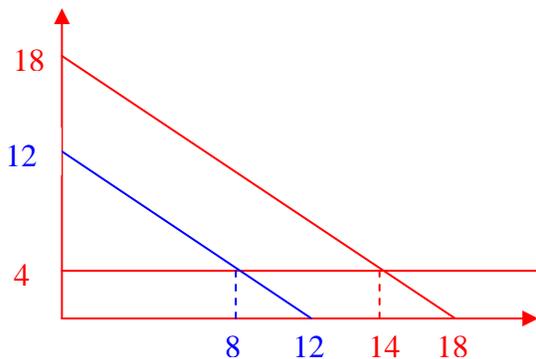
$$\frac{1}{2} * (\$1,000 - \$500) * 5 = \$1250.$$

## Section II. Pollution solutions

3. Ronald Coase argued that the imposition of a tax would not be necessary to correct for market externalities.
- A. What was the basis for Coase's belief? **Coase argued that a market would develop for the externality. Those individuals involved in the externality would arrive at an agreement about the appropriate level of the externality.**
  - B. Under what circumstances does the Coase theorem apply? **The Coase Theorem applies if the transactions costs associated with the negotiation are small.**
  - C. Give an example of a situation in which bargaining between two parties would lead to an efficient solution. Be as specific as you can, providing each party's willingness to pay and the prices at which they will come to an agreement. Describe how property rights are defined, and how changing this would change the solution.  
**Answers will vary. As long as there is a difference between parties WTP and WTA, bargaining can help lead to an efficient outcome (as long as transactions costs are low)**

4. With the aid of a graph

- A. Illustrate the optimal level of pollution abatement if  $MAC = 18 - E$ , where  $E$  represents pollution emission and a tax of \$4 is applied to the market.
- B. What is the optimal level of emission?
- C. How would your graph change if the  $MAC = 12 - E$ ?
- D. What is the new optimal level of emission?



The optimal level of pollution emissions when  $MAC = 18 - E$  and a tax = 4 is where  $18 - E = 4$ .  $E = 14$ . This optimal level will change with the change in MAC. The optimal level of pollution emissions when  $MAC = 12 - E$  and a tax = 4 is where  $12 - E = 4$ ;  $E = 8$ .

### Section III. Environmental valuation and decision making

5. Assume that the data you have suggest that if:

- i. Travel cost is greater than or equal to \$30, no trips are taken
- ii. If travel costs are zero, 100 trips are taken.

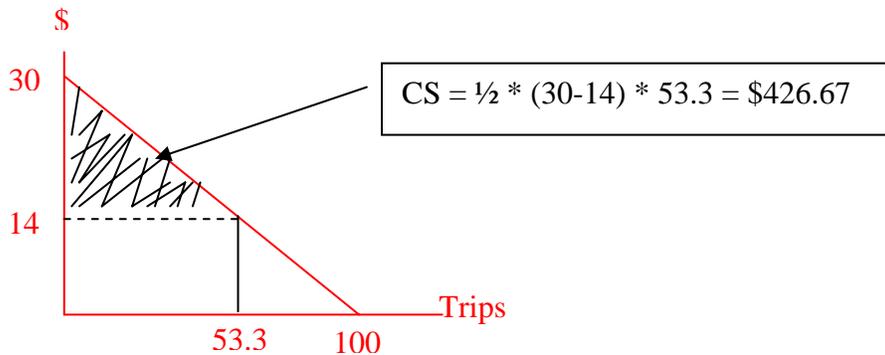
- A. Draw a travel cost demand curve based on these data.
- B. Calculate ordinary consumer surplus for the individual whose travel costs are equal to \$14.
- C. Explain potential biases your analysis may have included.

The information provides the end points of a straight line.  $P = 30 - (30/100)*Q$

After find equation for straight line, plug in \$14 for price and solve for quantity.

$$14 = 30 - (30/100)*Q \Rightarrow Q = 53.3 \text{ trips}$$

Calculate consumer surplus, which is area below demand curve and above price at \$14.



May not be accounting for true opportunity cost of time, may be incorrectly including travel costs for multiple stops on trip, and may include sample bias from frequent visitors.

6. Assume that the costs and benefits associated with a proposed government project are as follows:

<u>Year</u>	<u>Benefits</u>	<u>Cost</u>
	<u>(\$ millions)</u>	
1	200	500
2	500	500
3	1500	500
4	800	200

- A. If the discount rate is 5 percent, calculate the present value of the net benefits for this project (show your work).

$$\frac{(200 - 500)}{(1 + 0.05)^0} + \frac{(500 - 500)}{(1 + 0.05)^1} + \frac{(1500 - 500)}{(1 + 0.05)^2} + \frac{(800 - 200)}{(1 + 0.05)^3} = \$1125.33$$

- B. Not all of the benefits associated with this project are easily quantifiable in dollar terms. What can be done to account for these factors?

It is important to note these benefits and discuss their potential importance, do sensitivity analysis, discuss how results depend on assumptions.

## Section IV. The economics of climate change

### 7. Greenhouse warming

- A. Describe the greenhouse warming phenomenon.

The accumulation of a variety of gases such as carbon dioxide, methane, and nitrous oxide which traps radiation (heat) that would normally escape into the earth's atmosphere.

- B. What are the natural sources of greenhouse warming? What anthropogenic activities contribute to greenhouse warming?

Natural sources – decaying animals and plants and wetlands.

Anthropogenic sources – burning fossil fuel, deforestation, emissions from ruminants, wet rice cultivation, and emissions from coal mines, oil and natural gas wells.

- C. What are the economic consequences of global warming? What factors might make these consequences more severe?

Possible effects include a rise in sea level, possible increase in the intensity of storms, effects on forests and other ecosystems, biodiversity, agricultural effects, and effects on comfort level. These consequences are more severe for less developed countries. The ability to adapt to these changes will also be linked to the magnitude of the change.

### 8. The importance of surprises

- A. Why should policy makers be cautious about the potential consequences of global climate change? Explain the two types of thresholds associated with emissions of any type of pollutant.
- B. Provide an example of each type of threshold effect.

There is the potential of unpredicted consequences which result from the possible existence of threshold effects. There are two types of threshold effects. The first is where no damages are generated until the threshold is crossed. For example, a rise in summer temperatures may lead to a small increase in average temperatures which may lead to a large increase in the length or frequency of severe hot spells, which could lead to the demise of heat-sensitive plants. The second type of threshold is when marginal changes in emissions lead to marginal increases in damages until a threshold is crossed and then marginal changes lead to very large increases in damages. An example of this is if global warming progresses to the point where the tundra permafrost begins to melt. This will lead to anaerobic decay of organic matter on such a scale that there will be a massive release of methane. This will intensify global warming.