

**OPTIMAL EMISSIONS AND BENEFIT-COST ANALYSIS**

1.  $MAC_1$  and  $MAC_2$  are two different societal marginal abatement cost functions. Which one is more likely to be associated with an optimal level of pollution that is at or near zero? Why?

$$MAC_1 = 10 - 0.2E$$

$$MAC_2 = 1/E$$

2. It is well documented that the emissions of carbon monoxide (CO) from combustible engines, (e.g. auto engines), increase in colder climates. This in turn implies that damages associated with CO emissions are expected to be less severe in summer months than in winter. However, air quality control authorities use a standard for CO that is uniform throughout the year with no allowance for seasonal effects. Use this information and the following model to answer the questions below:

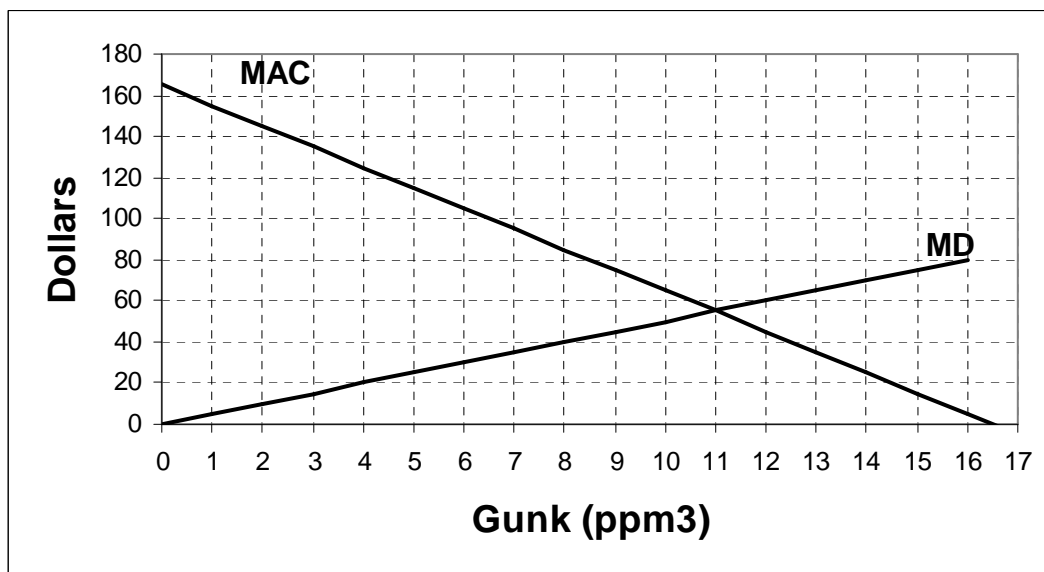
$$\text{MD of CO in winter} = 0.5E$$

$$\text{MD of CO in summer} = 0.2E$$

$$\text{MAC of CO} = 60 - 0.1E$$

where E is the level of CO emissions.

- Graph the MD and MAC functions on the same graph.
  - Assume the government sets a uniform standard for both winter and summer at  $E = 100$ . Support or refute this policy based on the criterion of allocative efficiency, using your model to explain your response.
  - If you were in charge of setting policy for CO emissions, what action would you recommend to assure an allocatively efficient outcome across the two seasons?
3. This problem deals with a pollutant called gunk, which is discharged into a stream from a paper mill. Suppose that gunk is currently regulated at a level of 10 parts per cubic meter ( $\text{ppm}^3$ ).



- What is the change in net monetary benefits to society as a whole if the regulations are tightened to allow only 9  $\text{ppm}^3$ ?
- What is the total cost of achieving a goal of 12  $\text{ppm}^3$ ?
- Redraw the diagram above (you don't need to include the numbers on the axes) to illustrate the impact on the efficient pollution level if:
  - Families leave town because jobs are scarce.
  - Canoeing and fishing become more popular.
  - A new paper producing process reduces the amount of gunk per unit of paper produced.

4. One of the strengths of the contingent value method is its ability to capture existence value. How can the researcher take advantage of this, yet avoid some of the biases associated with such a survey-based approach?
5. Suppose industry abatement costs rise from \$850 million in 2002 to \$1,000 million in 2003 in nominal terms, and that the CPI is 100 in 2002 and 106 in 2003.
  - a) Evaluate the change in costs over the period in real terms, first in 2002 dollars, and then in 2003 dollars.
  - b) Are your answers the same? Explain why or why not.
6. What is the difference between cost effectiveness analysis and cost-benefit analysis?
7. What reasons suggest that the social discount rate should be less than the risk-free real market rate of interest?
8. List the potential biases associated with contingent valuation.
9. Assume that you have data that suggest that if:
  - i) travel cost is greater than or equal to \$15, 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's surplus for the individual whose travel costs are equal to \$5.
10. If construction workers are willing to accept a 1/2,000 annual risk of death if their income increases by \$3,000 per year, what is the collective willingness to be compensated to accept the loss of one life?
11. Now it is time for your first consulting job as an environmental economist. The Forest Service would like to know whether they should set aside some National Forest land, previously slated to be logged, for hiking. You are helping to do a travel-cost analysis to estimate the benefits of the set-aside.

Survey data has been gathered from 500 hikers who visited a forest in a neighboring state. Using a statistical technique called regression analysis, you have controlled for differences in income, employment status, age and other important factors that might affect the number of hiking trips taken. Taking these factors into account, you have developed the following relationship:

Cost to get to Hiking Areas	# of Hiking Trips Per Person Per Year
\$20	8
\$40	6
\$80	2

- a) Graph the demand curve for hiking trips as a function of the "price" -- the travel cost.
  - b) Based on demographic information about the people living in the vicinity of the proposed park, you have estimated that 50,000 people will take an average of 4 hiking trips per year. For the average person, calculate: (i) the consumer surplus for a single visit to the new park by a visitor with travel costs of \$20; (ii) the total consumer surplus for an average visitor; and (iii) the total expected consumer surplus per year from the proposed park.
12. Assume that you are dealing with a very small country with one lake, one electric utility, and 1,000 people who fish in the lake. Let the inverse demand for recreational fishing trips be described as:
- $$D_f = 200 - 10(\text{TRIPS}) + 10(\text{CATCH PER DAY})$$
- Let the inverse demand for megawatt hours (MWH) of electricity be described as:
- $$D_e = 100 - 0.001(\text{MWH}).$$
- Assume that emissions for the power plant affect the quality of the fishing. A particular policy results in a reduction in emissions that increased catch per day from 5 to 10 while increasing the costs of producing electricity from \$7 per MWH to \$8 MWH. If each of the 1,000 people who fish have a travel cost of \$10 to gain access to the lake, does the policy increase or decrease net social benefits?

13. Assume that a dam costs \$20 million to build in 1 year and that, beginning in the 2nd year, the dam yields net benefits of \$2 million per year for 30 years. If the discount rate is equal to 5 percent, what is the net present value of the dam?
14. Over the last two years, emission abatement costs in industry X have been about \$1 million per year. A new regulation will lead to abatement costs of \$1.8 million per year. Does this mean that the regulation will cause increased abatement costs of \$800,000 per year? Explain.
15. A tax on gasoline is proposed in order to raise money for pollution control activity of several public agencies. The tax will be 10 cents per gallon, and last year 10.3 million gallons of gasoline were used by motorists (this is strictly an illustrative number). Does this mean that we can anticipate \$1,030,000 in revenues from this tax? Explain.
16. Survey 10 other students, asking them how much they would be willing to pay for one visit to their favorite beach. What qualifying questions did your respondents ask before they could assign a dollar value? What are some factors influencing people's willingness-to-pay value?
17. Suppose the costs of an environmental pollution-control program are expected to be equal to \$80 per year, and that benefits will be \$50 per year for 50 years, then \$150 per year thereafter. At a discount rate of 4 percent, what are the net benefits of this program? What would the net benefits be at a discount rate of 2 percent? Comment on the difference.
18. Below are some illustrative numbers for benefits and costs arising from a program to restrict emissions of a pollutant. Current emissions are 10 tons per month. Identify the emission level at which net benefits would be maximized. Show that this is not the same as the emission level that gives the highest benefit-cost ratio. Explain the discrepancy.

Emissions (tons/month)	Benefits (\$ millions)	Costs (\$ millions)
10	0	0
9	4	2
8	8	4
7	18	6
6	32	9
5	44	14
4	54	21
3	62	36
2	68	48
1	72	64
0	74	86

19. As an aide to Governor Blabla, you are given the task of recommending whether or not the state should locate a low-level nuclear waste facility in a rural county. The nuclear industry provides you with a cost-benefit study they've conducted that gives you the following information:

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COST-BENEFIT SUMMARY FOR PROPOSED NUCLEAR WASTE FACILITY  
Prepared by the Center for the Objective Study of Nuclear Issues

Conclusion: The project will result in Net Benefits of \$3 billion, with a benefit-cost ratio of 13. While these figures, of course, depend on the assumptions of the study, the very large Net Benefit figure, along with the extraordinarily large benefit-cost ratio both indicate that the project will remain attractive under most plausible assumptions. We, therefore, strongly recommend initiating the proposal.

Assumptions:

1. Discount rate of 10%.
2. Principal costs:
  - a) worker exposure.
  - b) risk of accidental exposure during transport.
  - c) reduction to zero of the land value at the storage site.
  - d) construction and maintenance.
3. Principal benefits:
  - a) reduced exposure at current temporary storage sites.
  - b) job creation -- 1000 temporary, 200 permanent jobs.
  - c) extends life of existing nuclear power plants by ten years --
    - i) lower electricity costs for consumers
    - ii) saves 7000 jobs
  - d) increased profits for local service industries.

Note: Benefits under point b) and c(ii) are given double weight, due to high unemployment in the county.

4. Risk Assessment:
  - a) exposure/fatality assumptions from the US Department of Energy.
  - b) probability of fatal exposure due to transport accident: 1/100,000 miles. Source: US Department of Energy.
  - c) value of a statistical life: \$1 million.

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Questions:

- a) Do you believe the report?
- b) See if you can find at least 4 separate problems with the study.
- c) What further information would you like to have prior to making a recommendation to the governor?