



3. Consider three policy alternatives A, B, and C. The cost and effectiveness of each policy is summarized below.

Cost and Effectiveness	Policy Alternatives		
	A	B	C
Cost (millions of \$)	100	108	150
Lives Saved per year	10	12	10

Please use cost-effectiveness analysis to choose the best policy.

4. A city is considering preserving 1,000 hectares of woodland. The annual recreational and environmental benefits are estimated as \$100,000 a year. The interest rate will be 5% per annum. What is the maximum amount the city would be willing to pay to preserve the land for 50 years? (You do not need to derive the final numbers.)

5. John only cares about housing ( $H$ ) and air quality ( $A$ ). His utility function is  $U(H, A) = AH$ . Suppose his (life-time) income is 15 and the price of housing is 5.

(a) If air quality is  $A = 1$ , how much housing will Jose purchase?

(b) Suppose air quality rises to  $A = 2$ . What is the new consumption point?

- (c) How much would John be willing to pay to increase air quality from 1 to 2.
6. Suppose we have an isolated island with no trade with other regions. A polluting electricity power plant damages the crops in the region close to the factory. Other agricultural land areas are not subject to the pollution. If we were to clean up the pollution, would we expect the change in land price fully reflect the benefits of cleaner air?
7. Consider the defensive expenditure approach. Now we have the data of facemask consumption and the data of air quality.
- (a) How will you monetize the cost of air pollution?
- (b) Suppose one facemask costs \$1.5. Wearing a mask can reduce the risk level from  $8 \times 10^{-7}$  to  $6 \times 10^{-7}$ . Please calculate the Value of a Statistical Life.
8. Suppose the Kunshan government needs to assess the environmental damages caused by the power plant near DKU. The local government conducts a contingent valuation study on campus. The collected WTP is used to calculate the cost of power plant pollution. Is there any potential issue in this study?

9. Assume an economy of two firms and two consumers. The two firms pollute. Firm one has the abatement cost function of  $AC_1(e) = \frac{1}{2}e^2 - 5e$  where  $e$  is the quantify of emissions from the firm. Firm two has the abatement cost function of  $AC_2(e) = e^2 - 8e$ . Consumer one has marginal damage  $MD_1(e) = e$  while consumer two has the marginal damage of  $MD_2(e) = 2e$ , where  $e$  in this case is the total amount of emissions the consumer is exposed to.
- (a) Derive the marginal savings function for each firm and the aggregate marginal savings function.
- (b) Derive the aggregate marginal damage.
- (c) What is the social optimal level of pollution and the appropriate Pigovian fee?
- (d) Under the social optimum, please calculate the emissions from each firm.
10. China is going to launch the national Emission Trading Scheme late this year. The covered industry is the electricity sector, which has monopoly power. Can China set its carbon tax at the same level of Pigovian fee? Why?

11. The Rocky Mashed Potato Factory produces output at costs  $C = Q^2$ , where  $Q$  is the quantity of mashed potatoes produced, in tons. In addition, 2 units of emissions are produced for each ton of mashed potatoes. Pollution damage is \$2 for each unit of emissions. The firm's output sells competitively for \$10 per ton.

(a) What is the Pigovian fee for per unit of emissions?

(b) How many tons of mashed potatoes will the Rocky Mashed Potato Factory produce? How much does it pay in emission fees? What are its profits?

12. Consider the choice of climate policy instruments under uncertainty. Suppose that marginal damages of greenhouse gas (GHG) emissions are known while marginal savings (or marginal costs of emissions) are uncertain. Should we choose carbon tax or cap-and-trade? Why? Please illustrate your answers graphically.

