1. (5 points) Your Aunt Sue believes that all government regulation is bad. “The Environmental Protection Agency stifles business and damages our economy,” she often rants. What arguments would you use to convince your aunt that some environmental regulation can be economically efficient.

A complete answer should include some discussion of (1) the fact that the private sector will not take into account external costs and (2) that at the extreme level, where no pollution has been cleaned up, the marginal benefit of pollution reductions almost always exceeds the marginal cost. Hence, reducing pollution would be socially efficient because it would result in an increase in the net benefits to society. (3) Or mention that government regulation can lead to an allocation with maximum net benefit, for example, a fishery where taxation forces fisherman to stop fishing at an effort where profits are maximized. (4) If you talked about preserving or protecting the environment or natural resources through regulation, or perhaps carbon trading, but didn’t mention specifically the idea of maximizing net benefits, then you received partial credit depending upon your answer.

2. The figure below shows the growth of a single stand of forest.

![Graph of forest growth](image)

a. (3 points) Based on the biological criterion, what would be the optimal rotation length? MAI is maximized by at a rotation length of 60 years.

b. (3 points) What is the intuitive motivation for the biological criterion and why do economists favor an alternative approach?

If followed, the biological criterion will maximize the volume of timber extracted from a piece of land. This ignores the benefits of the forest, most notably the profits that are earned from harvesting timber.

c. (6 points) Suppose that you are managing the forest for a single rotation and your discount rate is 5% per year. After paying harvesting costs, you earn $10 per cubic foot of timber. Which of the three rotation lengths would you prefer: 30 years, 40 years, or 50 years? You must write the three equations that you type into your calculator. If you don’t have a calculator, simply explain how you would choose between the 3 options once you got the results from your calculator.

\[
NPV_{30\ years} = 10 \times 100 \times (1 + 0.05)^{-30} = 231.37
\]

\[
NPV_{40\ years} = 10 \times 200 \times (1 + 0.05)^{-40} = 284.08
\]

\[
NPV_{50\ years} = 10 \times 300 \times (1 + 0.05)^{-50} = 261.61
\]

40 years would be preferred since it yields the highest net present value.
d. (3 points) Suppose that you are managing the forest for a single rotation and your discount rate were 0% per year? After paying harvesting costs, you earn $10 per cubic foot of timber. What would be the optimal rotation length? Explain.

With a 0% discount rate you would manage to maximize the volume of timber. This occurs at a rotation of 100 years.

Some students asked about whether this was between the 3 options in part c. If they do that analysis they should come up with 50 as an optimum. 1 point was taken off if the right answer is given to that question.

3. The graph below indicates the marginal benefits and marginal costs associated with using a resource in each of two periods. The stock of the resource can only be used in these two periods and you discount benefits and costs in the second period at the rate of 20%.

![Graph showing marginal benefits and marginal costs](image)

a. (5 points) In the blank graph provided, draw the marginal user cost curve assuming that there are 10 units of initial stock. Be sure to label your line and axes.

1 point vertical axis labeled correctly $ or PV of $
1 point – horizontal axis labeled indicating consumption in period one
1 point – MUC curve starts at 0,0
1 point – MUC is a straight line ending that reaches 10
1 point – MUC curve ends or passes through the point 10,10, indicating that they discounted correctly.

b. (5 points) Now assume that there are 12 units of the initial stock. Draw the revised marginal user cost curve and explain why it is different from the line drawn in part a.

2 points The marginal user cost curve is shifted 2 units to the right and for the first 2 units consumed today the MUC is zero.
3 points Explanation that because there are now 12 units the first 2 units can be consumed without diminishing the amount that will want to be consumed in period 2. The most that will be consumed in any period is 10, so the MUC of the first 2 is zero.

4. (5 points) Drawing on points made in the presentations by Dr. Ed Powell of TXU and/or Paul Rolke of Our Land Our Lives, explain why you believe that TXU should or should not be allowed to build new coal-fired power plants. If you mentioned topics (more than one) that were covered during the talk, and the answer was logical, then you received full credit.
5. The figure below shows the weekly sustainable yield that can be obtained by lobster fishermen. Suppose that each pound of lobster can be sold for $1 while the cost to the fishermen of each cage is $2.

Identify the numerical value for each of the following. Make explanatory notes or notations on the figure in order to receive full credit.

a. (2 points) The level of effort that would lead to the maximum sustainable yield.
   200—needed to provide an explanation in graph by marking the point or saying verbally that this is where the revenue is highest on the curve

b. (4 points) The level of effort that would result in the open-access equilibrium
   250-- To receive full credit you had to demonstrate either through the graph or verbally that you understood that this point is where the revenue equals the costs, and the profits are thus zero.

c. (4 points) The level of effort that would be sought if lobster fishermen were able to organize in order to maximize the total profits earned in the fishery.
   100—An answer between 100 and 125 was accepted, however, you had to somehow demonstrate how you arrived at the answer, either by drawing a line tangent to the curve, or saying something like where the vertical distance between the revenue and cost curves is greatest, or show how you tested different points and arrived at the max profit point.

6. In NutrientNet trading exercise that we completed during class there was a 2:1 trading ratio, meaning that nonpoint sources had to reduce their load by 2 pounds in order to generate 1 credit.

a. (3 points) Suppose that the trading ratio were increased to 3:1. What would happen to the price at which credits were traded? Explain
   The price should go up since the cost to the producers of credits (the nonpoint sources) is increased by this rule.

b. (3 points) If the trading ratio were increased to 3:1, what do you think would happen to the total pollution reduced by program?
   The idea is that going from 2:1 to 3:1 would not increase credit prices that much, thus, the market would function much the same way as at 2:1, however, the reduction in pollution would be greater because each credit is now 3 pounds as opposed to 2 pounds per credit. If you said that pollution reductions would only go down you received 2 point if you said that the increase in the trading ratio choked off the market so that point sources decided instead to just implement a BMP, thereby just reducing their loading by the amount required. Or said that the cost per credits went up considerably, thus, there was no incentive to participate by farmers, and reductions would decrease.
c. (4 points) What do you think would happen to the price and total pollution reduced if the ratio were increased to an extreme level, say 100:1?

The price asked by nonpoint sources would go way up. Hence, they would probably ask a price higher than any point source would be willing to pay and there would be few if any trades at this high price. Because trading is choked off, the environmental benefit that is achieved by the trading ratio (at an economic cost) is lost and the total pollution reductions would actually go down. A very high trading ratio is bad economics and bad for the environment. This question asked both about effects on price and pollution reduction, so you had to answer both parts in order to receive full credit.

7. (10 points) Based on what you read in the article, have farmers in Iowa traditionally managed their pollution problems in an economically efficient manner?

The key point here is that you use the explain how efficiency is not satisfied in the situation prior to taking any action, i.e., in the time when there are all the fish kills. To receive full credit you must explain what is meant by efficiency and how this applies in this context. If you simply mentioned some of the environmental harm and then claimed that this was inefficient, you received around 5 points. There were a number of ways to do this. For example, you could say that nutrient run-off from the farms is an externality and when external costs are not internalized by producers they will tend to emit inefficiently high levels of pollutants. By inefficiently high, I mean that the marginal social cost of the pollution is greater than the marginal social benefit achieved through the agricultural production that led to the pollution.

8. (10 points) Have the efforts promoted by Jon Judson led to a more efficient outcome? Be sure to be very specific about what you mean by more efficient.

Again, the key here is that you must tie the events discussed in the article to the economic notion of efficiency. In this case there was a fairly simple approach that a few students got and that was to point out that the Judson's got money from “wealthy Iowans who built their homes around an artificial lake that was becoming cloudy.” They willingly paid for the clean up and the farmers willingly changed their practices. That’s a Pareto Improvement which we know means that the outcome is more efficient.


By ELIZABETH BECKER

DEDHAM, Iowa - By the time the Raccoon River winds through the western hills here, passing corn fields and livestock pens before reaching Des Moines miles to the east, it is so polluted the city has to put it through a special nutrient filter to meet government standards for drinking water.

The culprits are not industrial plants or mines belching toxins into the river. They are Iowa farms, which send fertilizer and animal wastes into the groundwater and into the river.

Increasing pollution from the countryside is causing headaches for metropolitan water agencies and dead zones in the open seas.

In the last six years there have been 152 fish kills in Iowa alone – leaving 5.7 million fish floating dead in rivers and lakes polluted by fertilizer runoff or leakage from hog and cattle manure lagoons. Half of Iowa’s lake beaches were temporarily closed last year because of agricultural pollution.

For Mr. McMullen, the water manager in Des Moines, about 70 miles east of here, there is little doubt that agriculture and livestock are the source of his city's water problems. Two Iowa State University scientists recently reported how huge hog manure lagoons were seeping into the state's groundwater.

"The water quality this December is the worst we've had in winter," Mr. McMullen said. "And we're expecting the worst spring on record."

While farmers may be reluctant to accept responsibility for water pollution, they can be eager to be part of the solution. Jon Judson, a farmer and biologist, persuaded his neighbors to plant borders of native big blue stem and switch grasses to filter runoff.

Mr. Judson's mission was financed by wealthy Iowans who built their homes around an artificial lake that was becoming cloudy. The money from his wealthy neighbors was used to pay farmers to plant borders of native big blue stem and switch grasses to filter runoff.

Now, through the fog covering his farm, Mr. Judson can point to nearby fields where every stream is lined with frozen grasses and new bare trees break the monotony of low Iowa sky.

"Once farmers saw the benefits they brought to a neighbor, then it wasn't hard to get them to put conservation into practice on their land," he said.

"They saw what they had forgotten - that it pays to take care of your soil and water."