Environmental and Resource Economics, AGEC 350
Fall 2013 Final Exam (with grading rubric and selected answers) 100 points
You are allowed two 3×5 inch notecard with handwritten notes on both sides.

1. (10 points) Your Aunt Sue is an environmental fanatic. She loves clean air and, literally, hugs trees. She has recently been organizing a campaign to make all pollution illegal. Write a short e-mail message in every-day language explaining why it would not be socially efficient to try to eliminate all pollution. (For full credit, your answer should communicate what is meant by socially efficient and demonstrate understanding of the first equimarginal principle, without using any technical language)

Dear Aunt Sue,

1. Is the e-mail message written in every-day language /2
2. Is it clear that social net benefits are considered /2
3. Are marginal concepts used correctly to explain that the marginal cost of abatement will be greater than the MB when pollution is pushed to 0? /3
4. Is the intuition behind the 1st equimarginal principle communicated? /10

2. RAT Repeat. Amy, the owner of a mine can extract and sell her ore either this year or next year. The cost of extraction is $2 per unit. She knows that she can sell the ore today for $12/unit and in one year for $14/unit. She discounts future benefits and costs at the rate of 20% per year.

a. (4 points) Calculate the present value of net benefits of one unit in both periods. (no calculator should be necessary, but if you are not confident, simply write the equations you would punch into a calculator).

\[
PV(NB)_{\text{this year}} = \frac{10}{1.2^0} = PV(NB)_{\text{next year}} = \frac{12}{1.2^1} = 10
\]

b. (6 points) Amy has 2 cousins, Betty and Carol, who also own mines facing the same prices and costs. Betty’s discount rate is 10% and Carol’s discount rate is 30%. What percent of their ore would you predict that each of the 3 cousins extract in each period? (If unsure, explain why you are unsure)

<table>
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<tr>
<th></th>
<th>Amy</th>
<th>Betty</th>
<th>Carol</th>
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<tbody>
<tr>
<td>% Extracted this year</td>
<td>Amy</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>% Extracted next year</td>
<td>the rest</td>
<td>100%</td>
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2. b Clear indication that any split between the 2 periods works for Amy (1 point if 50-50 is indicated) 2
3. One point for each of Betty & Carol’s 4 /6

3. RAT Repeat Suppose that I am willing to pay $600 for anti-lock brakes that reduce my annual chance of dying in a car accident from 3 in 10,000 (0.0003) to 2 in 10,000 (0.0002).

a. Based on this choice, what would be an estimate of the minimum value that I place on a statistical life? (write a number or the equation that you would type into your calculator).

3. a $600/(0.0003-0.0002) = $600/0.0001 = $6,000,000 4 /4
b. An environmental policy has been proposed that is expected to save 2 lives per year in a city of 1 million people. The annual cost to businesses to comply with this policy is estimated to be $1 million. Using your answer to 3.a to estimate the value of a statistical life, would this policy pass a benefit cost test? Explain

3.b Cost per statistical life = $1M/2 = $500,000
Yes or Yes if benefits (equation from 3.a) > $1M/2

4. (10 points) The figure below is the start of a graph presenting the microeconomic theory of fertility.

a. (6 points) Fill in all of the blanks, including the labels for the two axes

![Graph of microeconomic theory of fertility]

(b)________________________

4 a) $ per child /1
b) # of children /1
c) MC after development /1
d) MC before development /1
e) WTP before /1
f) WTP after /1
g) Shift in WTP curve: after development less demand for children /2
Shift in MC curve: after development the MC of children goes up. /2 /10

5. (5 points) Congratulations, you are on the city council. You have just voted to try to encourage more recycling in your city in order to achieve a goal.

a. (2 points) State a goal that the city council might be seeking to achieve.

5.a Is this goal something that a city should be seeking to achieve and can recycling reasonably be at least part of the answer? 2

b. (3 points) Give a brief explanation as to why recycling is a correct policy to achieve this goal.

5.a Does the explanation make sense and is it reasonable? 3 /5
6. (10 points) The graph below presents the sustainable yield curve and total cost curve for a fishery as a function of the effort at work in the fishery. Effort is measured in terms of the number of boats fishing full time in the fishery. Currently there are 200 boats operating in the fishery.

![Graph of sustainable yield curve and total cost curve](image)

a. (4 points) Based on the information provided in the graph, in the absence of regulation, do you believe that the number of boats will change? If so, to what level will effort increase and why?

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<tr>
<td>6.a Yes</td>
<td>1</td>
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<tr>
<td>6.a 800</td>
<td>1</td>
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<tr>
<td>6.a some discussion of how incentives lead to open access equilibrium</td>
<td>2</td>
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b. (6 points) What is an incentive-based policy that might be introduced in this fishery to lead to an efficient outcome? What would be the policy’s goal, and how would this goal be achieved? For full credit as much economic detail as possible should be provided given the information that is provided in the figure.

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<td>6.b A tax, TR, or command-and-control policy should be mentioned</td>
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<tr>
<td>6.b The goal should be to limit the effort to 400 boats</td>
<td>2</td>
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<tr>
<td>6.b Tax policy: a tax of $75,000 per boat would work. ITQ approach the equilibrium price 400 rights or traded at $75,000 each.</td>
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7. An economist is on a two-day camping trip. He has brought along food with exactly 3,000 calories, which is as much as he would possibly like for 1 day, but less than he would like to have for 2 days. His marginal willingness to pay for additional calorie on each day is presented in the figure above.

a. (2 points) Indicate on the figure the total amount that the economist would be willing to pay for 500 calories on day 1.

b. (2 points) Indicate on the figure the amount that the economist would be willing to pay for his 1000th calorie on day 1.

c. (3 points) Because he knows that he needs his energy for the second day, he discounts the benefits of his 2nd day consumption at the rate of 33.33%. Hence, what is the present value of the marginal benefit of his first calorie of day-2 consumption? (write an equation if you like)

d) $\frac{4\epsilon}{1.3333}=3\epsilon$

d. (3 points) The economist wants to consume the efficient quantity of his food on the first day of his trip. Explain in words how he would determine the efficient quantity.

d) He would seek to consume up to the point where the PV(MWTP) is equal across periods

e. (4 points) The economist knows that he must be aware of user cost when deciding how much to eat. Explain in simple language the general principle of user cost and how that applies to this problem.

e) Answer should show general understanding of user cost as the sacrifice in future net benefits associated with consumption today

Answer should talk about the fact that user cost is the benefits from eating tomorrow

f. (4 points) Indicate on the graph the economist’s user cost curve assuming that he discounts day-2 consumption at the rate of 33.33%

f) Starts at zero and is upward sloping

Has kinks at 2000 and 2500

Height hits maximum at 3¢

Clippings Questions
Your answers to these questions should be well written paragraphs, that

(1) show that you understand all the underlined concepts,
(2) Be sure to apply the economic concepts to the context of the article, and
(3) as appropriate, use details from the article in your argument.

8. (5 points) Some observers of the situation described in the article might conclude that the fact
that the energy producers are using more and more of the water is fine; it is an economically
efficient allocation. Briefly summarize this argument.

| 8 Does the answer demonstrate an understanding of the principle of an economically efficient allocation? | /2 |
| Does the answer show an appreciation of the idea that if the marginal net benefit to a user is greater, the efficient allocation gives the resource to that user? | /3 | /5 |

9. (12 points) Identify two of the three characteristics of efficient property rights and, for each
of these, using evidence from the article, explain how the characteristic is not perfectly
satisfied in this case.

Characteristic #1:

Characteristic #2:

| 9. Are two of the 3 characteristics mentioned: (Enforceability, Exclusivity, Transferability) | /4 |
| For each, does the answer demonstrate an understanding of the characteristic as applied to this problem | /4 |
| For each, is appropriate evidence from the article used | /4 | /12 |

10. (10 points) Drawing if appropriate on your answer to question 9, provide an argument why
there may be a market failure such that markets may not lead to a socially efficient use of
water in Colorado.

| 10 Answer should refer to the fact that efficient property rights are not satisfied | /2 |
| The answer should probably refer to the fact that there are externalities associated with water sales. Other strong arguments might be acceptable. | /3 |
| Does the answer use appropriate evidence to back up its arguments | /3 |
| Is the answer well written | /2 | /10 |
GREELEY, Colo. — A new race for water is rippling through the drought-scorched heartland, pitting farmers against oil and gas interests. A single hydraulic fracturing well can require five million gallons of water, and energy companies are flocking to water auctions, farm ponds, irrigation ditches and municipal fire hydrants to get what they need.

That thirst is complicating the long and emotional struggle over who drinks and who does not in the arid West. Farmers and environmental activists say they are worried that deep-pocketed energy companies will end up using all of the scarce water to drill deep wells that use the technique of hydraulic fracturing.

“It’s not a level playing field,” said Peter V. Anderson, who grows corn and alfalfa on the parched plains of eastern Colorado. “A farmer cannot compete with the oil and gas companies for that water. Their return is a hell of a lot better than ours.”

To fill their storage tanks, energy producers lease surplus water from cities or buy treated wastewater that would otherwise be discharged back into rivers. In some cases, they buy water rights directly from farmers or other users — a process that in Colorado requires court approval.

In average years, farmers and ranchers like Mr. Anderson pay about $30 for an acre foot of water, a price that can rise to $100 when water is scarce. But oil and gas companies are paying as much as $1,000 to $2,000 for an equal amount of treated water from city pipes.

Farmers are worried. “We’re not going to be able to raise the food we need,” said Ben Rainbolt, executive director of the Rocky Mountain Farmers Union.

In the spring, during an annual auction of surplus water in northern Colorado, the farmers were consistently outbid by water haulers who supply hydraulic fracturing wells. “Energy companies are moving quickly to shore up supplies,” said Reagan Waskom, director of the Colorado Water Institute at Colorado State University. “They’re going to find it, and they’re going to pay what they need to pay, and it’s on an order of magnitude of what crop producers can afford to pay.”

Oil and gas companies estimate that they will use about 6.5 billion gallons of water in Colorado. While this is more than is used to make snow on the ski slopes or green the state’s golf courses, it is paltry compared with the what is needed for irrigation and agriculture, which accounts for 85.5 percent of Colorado’s water use.

Despite the drought and worries about water supplies, several cities — and even farmers with water to spare — are starting to line up as eager sellers. Aurora, a suburb of Denver, approved a $9.5 million deal to lease 2.4 billion gallons of effluent water over five years.

Even though that water did not come from drinking supplies, it drew protests from opponents of hydraulic fracturing. “The water we discharge into the river in Aurora is used again over and over as it flows down the river. Other cities treat it out and use it for drinking water. Farmers use it for irrigation. Fish and birds use it for critical habitat and fishermen, bird watchers and hunters all benefit from that.” “However,” commented councilwoman Maggie Miller, “when the water is pumped into a gas well deep underground, that’s the end of it. It may not affect us here, but there are consequences, and it’s not right that we ignore those consequences.”