Candidate instructions

ECON4910 - Environmental Economics

This is some important information about the written exam in ECON4910. Please read this carefully before you start answering the exam.

Date of exam: Friday, May 31, 2019

Time for exam: 14.30 - 17.30 (3 hours)

The problem set: The problem set consists of 4 questions with several subquestions. They will be given equal weight in the evaluation. Elaborate and explain all your calculated answers. If you believe the text in the problem is imprecise and that you need to make additional assumptions, please state your assumptions clearly as "Assumption 1: .....", etc.

Sketches: You may use sketches on all questions. You are to use the sketching sheets handed to you. You can use more than one sketching sheet per question. See instructions for filling out sketching sheets below. It is very important that you make sure to allocate time to fill in the headings (the code for each problem, candidate number, course code, date etc.) on the sheets that you will use to add to your answer. You will find the code for each problem under the problem text. You will NOT be given extra time to fill out the "general information" on the sketching.

Access: You will not have access to your exam right after submission. The reason is that the sketches with equations and graphs must be scanned in to your exam. You will get access to your exam within 2-3 days.

Resources allowed: No written or printed resources - or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences).

Grading: The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

Grades are given: Wednesday, June 19, 2019

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Question 1. Tradable permits

Suppose there are *n* = 10 identical firms and they emit pollution type A (CO_2) as well as B (SO_2). The aggregate harm for the consumers in the society is $c_A e_A + c_B e_B$, where $c_A = 5, c_B = 10$ and $e_A = \sum_i e_A^i \quad and \quad \sum_i e_B^i$. But it is costly to reduce emission, so each firm benefits from emitting and has the profit function:

$$\pi_i(e_i) = e_A^i(30 - e_A^i) + e_B^i(30 - e_B^i).$$

a. What is the socially optimal level of $CO_2(e_A^i)$?
b. Consider a permit market where a certain number of permits is given to the firms and they can trade them. Suppose furhter that each firm takes as given the prices for buying the right to pollute A, p_A, and B, p_B. Which quantity of e_B^i would firm *i* like to emit, as a function of the two prices?
c. To maximize social welfare, how many total (aggregate for all firms) permits for emitting CO_2 (A) should the industry receive as a whole?
d. If the planner also distribute the optimal number of SO_2 permits (B), what is then the equilibrium market price, p_B?
e. Which allocation(s) of the permits among the firms would you suggest, if you were advising the government? Explain in words and justify your answer.
f. How would your answer in the previous subquestion (e) change if the firms had heterogeneous abatement costs?

Fill in your answer here and/or on sketching paper

Maximum marks: 0

Attaching sketches to this question?
Use the following code:

X X X X X X X

2

Question 2. Conservation

There are two districts, *A* and *B*, and each $i \in \{A, B\}$ has a stock X_i of forest. If an amount $x_i \in [0, X_i]$ is illegally extracted, it is supplied to the market and each unit is sold at price *p*:

$$p = P - ax$$

where $x = x_A + x_B$. To discourage illeagal logging on one unit of the forest, the expected penalty when illeagally logging at the unit must be at least as large as the price *p*. The cost of raising the expected penalty at a unit of forest is *c*. The marginal value of conserving the forest $(X_i - x_i)$ is measured by the constant v_i for country *i*.

a. Based on your intuition, what do you think is the effect of a larger *c* on x_A and why?
b. District *A* may take x_B as given when deciding on x_A. Derive a formula showing how x_A depends on *A's* expectation of x_B. Explain the intuition for your formula.
c. Derive a formula showing how the total amount of logging, *x*, depens on *c*. Can you explain the similarity/difference to your answer in the first subquestion, above?
d. Suppose that *B* is goint to decide on x_B at some specific time, *t,* while *A* decide on x_A at a different time, *t'*. How is x_A, x_B and *x* depending on whether $t > t'$, $t < t'$, *or* $t = t'$?
e. Which of these sequences is preferred by district *A?*
f. Suppose Norway seeks to reduce *x*. How do you suggest that Norway does this, based on your model?

Fill in your answer here and/or on sketching paper

Maximum marks: 0

Attaching sketches to this question?
Use the following code:

X X X X X X X

3

Question 3. Prices vs. Quantities

a. Weitzman (1974) analyzed the choice between emission taxes and emission quotas when there is uncertainty in the marginal abatement cost. Try to explain the trade-offs involved in words, and the intuition for the optimal instrument choice.
b. Can you illustrate the trade-off (from question a) in (x,y)-diagrams, where you measure the abatement levels at the horizontal axis?

Fill in your answer here and/or on sketching paper

Maximum marks: 0

Attaching sketches to this question?
Use the following code:

X X X X X X X

4

Question 4

i. Explain how emissions affect welfare and how this relation will be depicted in a typical integrated assessment model of climate change. You can, but you do not have to, use formulas, but make sure to explain all steps.

Fill in your answer here and/or on sketching paper

ii. Explain the difference between the "optimal" scenario in the DICE integrated asessment model and the "Stern" scenario. In what assumptions do they differ? Why? Which is "optimal"? How do they differ (or coincide) in their policy recommentdations?

Fill in your answer here and/or on sketching paper

Maximum marks: 0

Attaching sketches to this question?

Use the following code:

X X X X X X X