

**RESOURCE ECONOMICS PRELIMINARY EXAMINATION**  
**January 23, 1998**

You have until 8:15 to read the exam and ask any clarification questions. You then have four hours to complete the examination. Exams will be collected promptly.

Part I: Answer all of the following three questions
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1. The population of the world continues to increase, but now there appears to be economic growth in many areas of the world as well. For example, China is experiencing both population and GNP growth. Many questions are being asked regarding the food and energy demands of our future global economy. To different degrees, both food and energy production utilize depletable resources – especially topsoil and agriculturally suited lands in the case of food and fossil fuels in the case of energy. The food and energy issues are also intertwined. Food production uses energy-intensive inputs such as fertilizers and machinery, and high starch foods such as corn offer a potentially important energy sources via ethanol production. Use economic theory to discuss the idea that the planet may be headed for a catastrophic shortage of food and energy. Explain the changes that can be expected to occur as demands mount and supplies fall. Identify important changes that can be expected to reinforce or moderate the possibility of social collapse.
  
2. Despite U.S. progress in lowering average new car emissions over the past 20 years, many urban areas of the country continue to exceed ambient standards. The reasons may be that the number of cars and the mileage driven in these areas continue to increase relentlessly. One approach suggested for curbing emissions is to levy a significantly higher tax on fuel. Identify advantages and disadvantages of this strategy. Would a fuel tax policy be an optimal policy? Why/why not? Propose an alternative policy option and discuss its merits as contrasted to those of a higher fuel tax. Which policy, the fuel tax or your proposal, is economically preferred and why?
  
3. Broadly speaking, man can withdraw (divert) water from waterways for application in agriculture, commerce, or households or man can leave water in waterways to serve instream demands for recreation, biodiversity, and pollution assimilation. Suppose that interesting aspects of resource allocation in this setting are as follows:
  - instream uses are nonexclusive,
  - instream uses are nonrival with one another,
  - diversionary uses are rival with one another,
  - instream uses are rival with diversionary uses, and
  - there are no costs incurred in providing instream demands (except for the opportunity costs relating to forgone diversions), but diversions must be pumped, treated, pressurized, and transported.

In the specific situation you are studying, a water basin has  $W$  units of water available. There are two instream demands with total benefit functions given by

$B_n(w_n)$ ,  $n=1,2$ ; and there is one diversionary demand with a total benefit function  $B_d(w_d)$ . The total cost function for supplying diverted water is  $C_d(w_d)$ . First derivatives of all four functions are positive, and second derivatives are as expected.

- a. Formulate and justify an optimization problem that is consistent with the situation and bulleted items just given. Derive and interpret first order conditions.
- b. To drive home your interpretation of first order conditions, provide a graphical model of optimal allocation. Be sure to include all marginal benefit and marginal cost curves somewhere. Explain the model's components and what it illustrates.

Part II: Answer one of the following two questions
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4. Define, explain, and contrast equivalent variation, equivalent surplus, compensating variation, compensating surplus, and consumer surplus measures of welfare change. Discuss all differences and similarities. Under what circumstances are each of these measures preferred over the others? How can obtainable information be used by an analyst to realistically compute each of these measures?
5. In environmental and natural resource economics the following concepts are very important: open access, public goods, externalities, congestion, and common pool resources. In many cases, these concepts are related to some form of misallocation.
  - a. Discuss each of these five concepts and provide a clear example of each.
  - b. For each concept, identify its relation to resource misallocation problems.
  - c. Is it always advisable to suggest that the government intervene to solve these resource allocation problems? Why or why not?