Resource & Environmental Economics Field Examination

May 2006

Instructions:

You have 4 hours to complete the exam. This time commences at the end of the 15-minute reading period during which no writing is allowed.

Please use your assigned "alpha letter" on every page to identify your exam and number each page. Do not use your name or social security number. Write on only one side of the page leaving at least one inch margins. Upon turning in the exam make sure the pages are in order.

You have four questions to answer.

Answer four of following five questions.

1. Very common specifications of estimable functions used by applied economists today are based on the random utility model. (As examples, consider the simple dichotomous choice-contingent valuation model or a model of recreation demand where we have data only on whether a person went to a single recreational destination or not.) Most of these applications specify the utility function as linear in income, as well as linear in other terms.

   a. What restrictions does the linear specification impose and how does this affect the resulting measures of welfare?

   b. Is this outcome desirable? Why or why not?

   c. If one were to relax this restriction, how would the resulting welfare measures be different, and can we be certain that there are closed-form expressions for them? If it helps your explanations, provide a mathematical example.

2. Simple models of optimal forest management assume that a single plot of land (a "stand") is planted in a single species, grows for T years, and is then harvested and sold. The forest is then replanted and the process is continued over and over again. The rate of growth is typically specified as either a function of the volume of timber at time t or as a function of the stand's age. In addition, standing forests yield amenity values (such as wildlife habitat) that increase with stand age but increase at a decreasing rate. The optimization problem, therefore, is one of choosing the appropriate rotation length, T, examining the trade off between the value of current consumption and the value of future growth but also considering environmental amenities.

   a. Set up a model that could be used to identify the optimal rotation length.

   b. Tell how the solution might vary with changes in wood value, amenity values, and interest rates.

3. Carbon dioxide is a stock pollutant in the sense that it is the global stock of CO_2 in the atmosphere that leads to global warming. At the same time, there is a property rights failure because CO_2 is emitted by every country on the globe.

Let z_{it} represent the emissions of CO_2 by the ith country at time t, and x_t the global stock of CO_2 at time t. Each nation, i, gets benefits $B_i(z_{it})$ as a function of their emissions of CO_2 but suffers damages, $D_i(x_t)$ due to climate change. Assume that the global stock of CO_2 increases with each nation's emissions and that the stock increases as long as $\sum_i z_{it} > 0$.

a. Specify a general theoretical model to show the characteristics of the globally efficient path for CO_2 emissions assuming that nations have elected a social planner to represent their interests. From the general framework, discuss the economic intuition behind the first-order conditions.

b. Would a decentralized approach in which independent optimization is pursued by each nation lead to the globally efficient solution? Show why or why not?

c. Now consider an international tax policy on greenhouse gasses. What are the theoretical characteristics of the time path for taxes that could lead to a global optimum?

d. Suppose you are given the task of developing an empirical representation of the theoretical model. Spell out the general steps that you would follow and the methods that you would employ in order to estimate the functions $D_i(x_t)$.

4. Suppose that you need to, for one policy purpose or another, estimate the value that people have for an improvement in drinking water quality at selected places in the United States. One reason might be that people are complaining about the cost of treatment in conjunction with this improvement. Think carefully about the fact that some people may be using water from private wells, community wells, or public drinking water systems. Ideally, you would like to estimate the benefits or values for all of these different people.

a. Explain how you could use one market and one nonmarket valuation method. Why would these methods yield appropriate values and what would be the advantage of each when compared to the other

b. Do you believe that nonuse values will be important in this context?

c. Will your approaches uncover nonuse values? Why or why not?

d. Now, to perhaps make it more interesting, would your answers to the first three parts change if you had to do this in a developing country context? If so, how? Carefully explain, using a particular country as an example if you wish, the practical ramifications of using any particular approach in a developing country context.

5. A very narrow mountain valley is underlain by a 200-mile long aquifer (called Valley Aquifer or VA) that has some similarities to a river in that (i) its underground waters naturally flow in a single direction (from north to south), (ii) pumpers are located sequentially along its length, and (iii) return flows are normally a significant source of recharge water for the aquifer. Farms in the valley are mainly irrigating high-valued orchard crops (fruits) and grapes on the mountainsides. Farms are distributed down the valley from north to south. Orchards and vineyards are costly to establish and maintain, so water supply reliability affects farmer behavior.

   In its undeveloped state, VA contained a large amount of water, but decades of open-access management has greatly depleted the water in storage. Natural flows into the aquifer originate at its most northern point, inferring that more northerly farms have more secure access to water, which then becomes successively depleted "downstream" (i.e. to the south) during the growing season. Even though open-access water institutions have essentially favored more northern farms, more southern farms have soils and microclimates that make them more productive.

   In contrast to their opinions 20 years ago, most irrigators now believe that open-access water law is flawed because of the highly depleted state of the aquifer. Pumping depths and costs are much higher than they used to be, and many groundwater wells are no longer reliable sources of water. As a consequence of these changed attitudes, a major revision of water institutions may be possible. Thus, the following questions are now interesting to voters:

   a. From an economist's perspective, what are the major issues in need of better management and what has gone wrong?

   b. Describe 2 separate reforms that may be advantageous to the irrigation community and explain why these might be beneficial given the major issues present in the VA situation.

   c. If you were commissioned to study this setting in order to quantitatively model the performance of one of the above two alternative reforms,

      i. How would you structure the model?

      ii. What techniques would you undertake?

      iii. What type(s) of results would be generated?

      iv. How would these results illuminate the decisions to be made?