

Resource & Environmental Economics Field Examination  
**May 2018**

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. Do not use your name or social security number. Write on only one side of the page leaving at least one inch margins. Number each page, and make sure the pages are in order.

You have four questions to answer.

1. Suppose you want estimate the effect of climate change on the U.S. agricultural industry. Consider three different models that could be used to estimate how agricultural profits would respond to an increase in temperature: (i) an empirical production function (ii) a hedonic model, and (iii) a fixed effects model.
  - a) Describe each empirical model in detail. At a minimum, you should answer the following questions for each model. What are the necessary assumptions? How would you determine whether those assumptions are plausible? What data would you need? What concerns would you have about the estimates from each model?
  - b) Describe an alternative estimation method. Include a detailed description of the empirical model, assumptions, and data. Explain how this model address the concerns you listed for the models in part (a).
  
2. Climate change is wreaking havoc on New England's lobster industry. In Massachusetts, Connecticut, and Rhode Island, rising ocean temperatures and related stresses have led to a collapse in lobster populations, while in the Gulf of Maine, warmer waters are causing Maine lobsters to shed their shells earlier than usual. This early shedding has recently led to an oversupply of soft-shell lobsters. Soft-shell lobsters don't ship well and thus, are sold exclusively on the local market. Oversupply has resulted in a price collapse, contributing to financial hardships of local lobstermen. Researchers at the University of Maine recently partnered with these lobstermen to examine how to help them reduce income variability (i.e., you are interested in producer surplus). You have been hired to work with University of Maine researchers to develop harvesting schedules and intensities for the local lobster industry.

You should note that lobsters are not an endangered species, so your response should consider only the consumption value of lobsters. Also note that in Maine, lobsters are officially a common pool resource, although over time unofficial territorial

arrangements emerged in which lobster gangs lay claim to specific fishing territory and defend this territory by sabotaging intruders' lobstering equipment.

- a) First, you want to better understand the state of lobsters in the Gulf of Maine. Describe how you would model the Maine lobster population. What parameters of interest do you want to estimate?
  - b) Preliminary discussions with lobstermen have suggested that reducing lobster fishing during times when waters are extremely warm can help avoid a price collapse on the lobster market. Your team obtains the following historic data: monthly sea temperatures at various locations along the Gulf of Maine, monthly lobster landings by county (i.e., the volume of live catch in pounds, and its value in dollars), average lobster characteristics (size, weight, and shell type) for reported landings, number of active commercial lobster harvesters by county, and the direction and strength of wind and water currents. Discuss how you would use this data to estimate the effect of climate change on soft-shell lobster yields (note: you don't have to use all the data listed above).
  - c) Armed with an understanding of the local lobster population and marine conditions, you are now ready to develop harvesting schedules. Outline the basics of such a schedule. What factors will drive the timing or frequency of harvests? What factors would drive harvest intensity?
  - d) Your research team's main goal is to help lobstermen (i.e., producers). What does this imply about the slope of your indifference curves, if they were plotted relative to a benefits budget constraint?
3. Climate change has recently contributed to a heightened financial risk exposure of Maine lobstermen. A team of researchers from the University of Maine worked with Maine lobstermen to study the effects of climate change on the local lobster population and developed a new harvest schedule for the industry, designed to reduce income variability. Currently, Maine has a year-round lobster fishing season, and licensed lobstermen face very few restrictions beyond catch of a minimum lobster size (smaller lobsters cannot be harvested).

The Maine governor does not want to implement the new harvesting schedule unless it gains popular support and there are two ways in which such support could be obtained. First, the new schedule could go up for a vote in the state legislature, in which case only the state politicians get a vote. Second, a proposition to change the lobster harvest schedule could be included on the ballot of the next statewide election, in which case all eligible voters in the state of Maine will get a vote.

- a) Discuss why we might expect these two different votes to have different outcomes. Be sure to outline the main groups who would be affected by the change in the harvesting policy and discuss how each group would be affected. Consider also who the decision makers are under each type of vote and what incentives they face. Under which voting mechanism is the new schedule more likely to be adopted?
  - b) Discuss what types of strategies, outside of market forces, could be used with each of the two voting mechanisms. Who would be formulating these non-market strategies and who would be the target audience?
  - c) The Commissioner of Maine's Department of Marine Resources has proposed an alternative to the implementation of a new harvest schedule: converting the state lobster fishing industry into a state-run monopoly. Under this proposal, individual fishing licenses would be suspended, the state would establish a lobster fishing corporation, and hire lobstermen to work for this corporation. Discuss how the efficiency of lobster harvests would be affected under a state fishing monopoly and the new harvest schedule relative to the status quo (i.e., the current lobster fishing guidelines).
4. Suppose that you are asked to place a value on a new, unbuilt expansion of the gardens that are being built behind the AGLS building. You are considering using one of the two main types of stated choice methods: the contingent valuation method (CVM) or a choice experiment (CE).
- a) Briefly describe how you might use each of these methods to value the expansion project. Describe or state the critical question to be asked in your analysis.
  - b) What are some of the main criticisms of stated preference methods? Compared to other valuation approaches, what are some of the advantages of these methods for problems like the expansion of the gardens?
  - c) What are the relative advantages and disadvantages CVM versus CE?
  - d) Discuss whether each method and question you pose above yields a compensated or equivalent measure of the welfare change (or both, or neither). Does it matter whether the value estimate you obtain is a compensated or equivalent measure? Why? --- isn't estimation of a change in utility good enough?

5. A geologist has recently told a landowner (“Amy”), that there is a supply of water beneath her land. The geologist has explained that because the aquifer’s is shallow and under pressure, once a well is drilled, the water can be obtained at no cost. However, the geologist also explained that the aquifer does not recharge at all and that there is a limited quantity of water in the aquifer. If Amy uses water at the rate of  $q_t$  gallons per year, she can generate profits at the rate of  $\pi(q_t)$  per year, a monotonically increasing and concave function. The fixed cost to drill a well is  $C$ . Amy has money in the bank that is earning interest at the annual rate of  $r$ .

a) Suppose Amy is completely isolated so that she’s the only one that has access to the underlying aquifer. Using an economic model in which there is no uncertainty, demonstrate the economic conditions that would determine whether she would choose to drill the well.

b) Suppose Amy drills the well. A few years later, a town offers to purchase a relatively small amount of her water. Building on your economic model from part a, what is the minimum price per gallon that Amy would be willing to accept? Would that price change over time? Why?

c) Suppose that it turns out that there is an adjacent property owned by Bill that also has access to the aquifer such that if, for example, Amy and Bill both extract water at the same rate, the aquifer would be depleted twice as fast as when only one property were pumping at that rate. Neither Amy nor Bill have drilled a well. Bill could also generate profits at the rate of  $\pi(q_t)$  per year and would have to pay  $C$  to drill and faces the interest rate  $r$ .

Explain how theory would predict that an inefficient use of the resource would almost certainly arise if  $C=0$ . Describe how the concept of “tragedy of the commons” apply in this context. [A complete mathematical model is *not* required for this part.]

d) Under what circumstances would the news that Bill also has access to the aquifer change Amy’s decision? Under what circumstances would her decision not change? How can the cost of drilling,  $C$  play a critical role determining whether an economically efficient outcome results?

You may assume that Amy can choose to drill immediately, before Bill makes a choice, or can choose to wait to see if Bill drills. A complete mathematical model is not required for this part.