PhD Qualifier Examination

Department of Agricultural Economics

August 7, 2020

Instructions

This exam consists of **six** questions. You must answer all questions. If you need an assumption to complete a question, state the assumption clearly and proceed. Be as clear as possible in your answer. You have four hours to complete the exam. Show all your work. If necessary, use math, graphical analysis and provide definitions of key concepts.

- Be sure to put your assigned letter and no other identifying information on each page of your answer sheets.
- Also, put the question number and answer page number (e.g. 4-1) at the top of each page.
- Write on only one side of your paper and leave at least 1 inch margins on all sides.
- Make sure your writing is clear and easy to read.
- Turn in your final copy with all pages in order.

GOOD LUCK!

1. (15 points) Consider an iid sample $\{Y_i, X_i\}, i = 1, \ldots, N$. Suppose you know the relationship between X and Y takes the form:

$$Y_i = \beta_0 + X_i\beta_1 + e_i \exp(X_i\alpha)$$

where e_i is an iid error with mean zero and variance one, and $\alpha \neq 0$.

   (a) Let $\hat{\beta} = (\hat{\beta}_0, \hat{\beta}_1)$ be the OLS estimate of $\beta = (\beta_0, \beta_1)$. Discuss the statistical properties of $\hat{\beta}$ in terms of consistency and asymptotic efficiency.

   (b) Propose an estimator for α.

   (c) Propose an asymptotically efficient estimator of β.

2. (15 points) A business analyst estimates a saving function for the U.S. economy based on the use of cross-sectional data from a survey of 10,000 households:

$$S = 10 + 0.15Y \tag{1}$$

where S=sales measured in dollars, and Y=household income measured in dollars. However, 40 percent of the observations associated with dollar sales are zero. The remaining 60 percent of the sample have non-zero values of dollar sales.

   (a) Besides household income, what other explanatory variables might be considered in this analysis? Describe why these variables may be important?

   (b) Describe the appropriate model(s) to employ in this situation. Discuss appropriate estimation procedure(s).

   (c) How would you obtain appropriate marginal effects in this econometric analysis?

3. (20 points) Consider a three-card poker game. There are only Ace (A), King (K), and Queen (Q) in a deck where Ace is the highest and Queen is the weakest card. Each player gets exactly one card and each possible allocation is equally likely.

   The game proceeds as follows. Player 1 moves first and chooses whether to fold or bid. If she folds, the game ends with a payoff of -1 for player 1 and 1 for player 2. If she bids, then it is player 2's turn to choose whether to fold or bid. If player 2 folds, then the game ends with a payoff of 1 for player 1 and -1 for player 2. If she bids, then the player with the higher card wins for a payoff of 2, while the losing player gets -2.

   (a) What is the appropriate equilibrium concept to apply to this game?

   (b) Let $p_i(C)$ for $C \in \{A, K, Q\}$ denote the probability of bidding for player $i = \{1, 2\}$ given that the player holds a card C. Does player 1 have a dominant strategy in this game?

   (c) Consider player 2's optimal response to player 1's choice to bid. For each card realization C for player 2, derive player 2's posterior belief regarding player 1's card and the corresponding optimal response $p_2(C)$ given this posterior belief.

   (d) Given the optimal strategy derived in part c), consider player 1's optimal decision for any card realization C. Would player 1 ever choose to bid if she is holding a King? How about a Queen?

   (e) Derive the unique equilibrium of this game by carefully specifying the equilibrium strategies $p_i^*(C)$ for each player.

(f) What are the expected payoffs for each player in the equilibrium you derived above? Does any of the players have an advantage in this game?

4. (20 points) Suppose that an individual seller possesses a single indivisible object that she values at zero and wishes to sell. There are n risk neutral individuals (the buyers) interested in purchasing the object. Each buyer's valuation v_i is an iid draw from a uniform distribution on $[0, 1]$. Suppose that each buyer privately observes her valuation only after inspecting the object. Suppose that the seller posts an entry fee ψ and announces that any buyer paying this fee will be allowed to inspect the object and participate in a first price sealed bid auction with no reserve price. Bidders will observe how many other bidders have paid the entry fee before submitting their bid.

   (a) What is the ex-ante social surplus in this setting?

   (b) Consider the subgame, in which M bidders have entered the auction. Find the symmetric Bayesian Nash equilibrium bidding strategy of the participants in the auction.

   (c) What is the expected equilibrium payoff of a bidder who learns that his valuation is v and observes that M bidders have entered the auction?

   (d) What is the ex-ante equilibrium payoff of a bidder from entering the auction if he is expecting $M - 1$ other bidders to enter the auction.

   (e) What entry fee $\psi(M)$ should the auctioneer set in order to induce entry by exactly M bidders in the auction? Calculate the expected equilibrium revenue by the seller when she sets the entry fee to $\psi(M)$.

   (f) Find the optimal entry fee ψ^* by the seller.

   (g) Is the mechanism with an entry fee ψ^* optimal for the seller? Is it ex-ante efficient? Is it ex-post efficient?

5. (15 points) Consider n firms in a one-input one-output economy, with production functions $f_1(L) = \sqrt{L}$, $f_2(L) = 2\sqrt{L}$,...,$f_n(L) = n\sqrt{L}$. Suppose that these firms merge into a single firm.

   (a) Show that the resulting firm's production set is represented by a production function of the form
   $$g(L) = \varphi\sqrt{L}$$
   for some $\varphi > 0$. Calculate φ.

   (b) Suppose now that the firm with production function $g(L) = \varphi\sqrt{L}$ is a price taker. Normalize the price of the input to 1 and let p be the price of the output. If the firm is a price taker, what is the firm's profit as a function of p?

6. (15 points) Suppose now that the firm described in question 5 operates in an uncertain market in which price follows a uniform distribution on $[0, 2]$.

   (a) What is the firm's expected profit in this market?

   (b) Suppose that the (same) firm is an expected profit maximizer. What is the maximum that the firm would be willing to pay to avoid the uncertainty of the market, i.e., to receive with probability one the profit they would obtain in a market with deterministic price equal to the average price in the market. Interpret.