

Agricultural and Resource Economics
Ph.D. Qualifying Examination – Applied Microeconometrics
Friday, June 14, 2019

Instructions:

- 1) You will have 4 hours to complete the exam.
- 2) There are six questions on six pages. You must answer all six questions.
- 3) You may not use outside resources, including textbooks, notes, calculators, or electronic devices.
- 4) Show all your work on the paper provided.
- 5) Leave one-inch margins and only write on one side of each sheet.
- 6) Do not place your name on any of your answer pages.
- 7) Clearly number each sheet with the question and page number in the upper right corner.
- 8) Submit your exam unstapled ordered by question number and page number.
- 9) If you need clarification about a question or believe there is a typographical error, raise your hand and the exam invigilator will assist you.
- 10) You may consume drinks and/or snacks, as long as doing so does not distract other students.
- 11) Students may use the restroom if they inform the invigilator, but only one student may be absent from the examination room at a time.
- 12) Students may not leave the examination early.

Question 1.

Suppose that a consumer can purchase 3 goods $\{x_1, x_2, x_3\}$ at strictly positive prices. Let ω_i denote the budget share of good i ; ε_i denote the expenditure elasticity of good i ; and η_{ij} denote the Marshallian price elasticity of good i with respect to the price of good j . You know the following information:

$$\omega_3 = +0.3$$

$$\varepsilon_1 = +1.2$$

$$\varepsilon_3 = +0.5$$

$$\eta_{13} = -0.9$$

$$\eta_{31} = -0.6$$

If consumer preferences satisfy a locally non-satiated rational preference ordering, what are the values of η_{22} , η_{23} , and η_{32} ?

Question 2

A researcher estimates the following regression equation with eight-hundred ninety-two observations:

$$\log q_i = \alpha_i + \beta_i \log m + \gamma_{ii} \log p_i + \gamma_{ij} \log p_j + \gamma_{ik} \log p_k + \varepsilon_i$$

where q_i denotes quantity demanded of good i , p_i denotes the price of good i , and m denotes total expenditure, and \log denotes the natural logarithm.

They report the following coefficient estimates and covariance matrix.

α_i	=	4.28
β_i	=	0.12
γ_{ii}	=	-1.20
γ_{ij}	=	-0.23
γ_{ik}	=	-0.57

$$\Omega = \begin{vmatrix} 1.2119 & .0812 & .0067 & .0038 & .0118 \\ & .0064 & .0032 & .0013 & .0023 \\ & & .0144 & .0072 & .0026 \\ & & & .0152 & .0014 \\ & & & & .0276 \end{vmatrix}$$

- Propose a statistical test of the proposition that good i is normal that only uses the information reported by the researcher. Clearly define the null hypothesis, the test statistic, and its distribution.
- Using the test defined in (a), calculate the value of the test statistic. Can you reject at the null hypothesis at the five percent significance level? How does the result of your test inform the proposition that good i is normal?
- Propose a statistical test of the proposition that good i and good j are substitutes that only uses the information reported by the researcher. Clearly define the null hypothesis, the test statistic, and its distribution.
- Using the test defined in (c), calculate the value of the test statistic. Can you reject at the null hypothesis at the five percent significance level? How does the result of your test inform the proposition that good i and good j are substitutes?
- Propose a statistical test of the proposition that the cross-price elasticity of good i with respect to good j is the same as the cross-price elasticity of good j with respect to good k that only uses the information reported by the researcher. Clearly define the null hypothesis, the test statistic, and its distribution.
- Using the test defined in (e), calculate the value of the test statistic. Can you reject at the null hypothesis at the five percent significance level? How does the result of your test inform the proposition that the cross-price elasticity of good i with respect to good j is the same as the cross-price elasticity of good j with respect to good k ?

Question 3.

Define the payoff function $\omega: \{0,1\}^3 \times \{0,1\}^3 \rightarrow R \times R$ as:

$$\omega = \begin{bmatrix} (-1,0) & (4,-1) & (-6,3) \\ (-2,-4) & (2,0) & (-2,2) \\ (3,0) & (-2,1) & (4,-3) \end{bmatrix}$$

where element $\omega_{i,j} = (\omega^A(i,j), \omega^B(i,j))$ denotes the payoff to player A and the payoff to player B when player A selects action i and player B selects action j .

Does there exist a Nash equilibrium in which Player A plays a mixed strategy $\rho = (\rho_1, \rho_2, \rho_3)$ such that $\rho_1 = 0; \rho_2 \in (0,1); \rho_3 \in (0,1)$? If yes, provide the Nash equilibrium strategies employed by both players in such an equilibrium.

4. A researcher wishes to recover the causal effect of university governance structure on faculty retention. Universities can organize themselves on a continuum from one extreme of pure administrative autocracy where all key operating decisions are made by university administrators without input from faculty (e.g., department heads and deans make all hiring, promotion, tenure, resource allocation decisions, etc.) to pure faculty democracy where all key operating decisions are made by faculty through consultation (e.g., faculty votes determine who is hired, promoted, receives tenure, is appointed to endowed chairs, etc).

Suppose that the researcher has a validated measure of university governance structure that ranges on the unit interval from zero equaling autocracy to unity equaling democracy (do not focus your response on the measurement of faculty governance) for a large collection of institutions in the United States. Suppose the researcher also has data on the percentage of faculty in a year that voluntarily leave their university position.

4.a. Describe a mechanism through which the available measure of university governance structure is positively (causally) related to faculty retention, i.e., more democracy causes a smaller fraction of faculty to leave the university. Then, describe a mechanism through which the available measure of university governance structure is negatively related to faculty retention

4.b. Explain why estimating the relationship between university governance structure and faculty retention using OLS might yield inconsistent estimates of the causal effect of governance structure on retention. Under what conditions would your estimate be upward biased? Under what conditions would your estimate be downward biased? Be specific.

The researcher proposes the following instrumental variable for university governance structure: the ratio of university administrators to faculty.

4.c. List each of the assumptions necessary for the IV estimate to be interpreted as the LATE of university governance structure on faculty retention when the ratio of administrators to faculty is used as an instrument. For each assumption, explain intuitively what is required for the proposed instrument to meet the stated requirement.

4.d. For each of the assumptions, provide an intuitive example of when the proposed instrument may fail that requirement.

Question 5

Assume that utility is given by the following function $U: \mathbb{R}_+^3 \rightarrow \mathbb{R}$

$$U(X, Y, Z) = X^{0.2} Y^{0.8} Z^{0.2},$$

where the price of good i is denoted $p_i \in \mathbb{R}_+$ and agents have endowed income of $m \in \mathbb{R}_+$.

- a. Derive the expenditure function.
- b. Provide four properties of the expenditure function and show that each holds for the utility function above.
- c. Derive the compensated demand functions for goods X , Y , and Z .
- d. Derive the indirect utility function.
- e. Provide four properties of the indirect utility function and show that each holds for the utility function above.
- f. Derive the uncompensated demand functions for goods X , Y , and Z .
- g. Provide the general algebraic expression of the Slutsky equation for good Y . Intuitively summarize its meaning. Show that the Slutsky equation holds for good Y given the utility function above.

Question 6

For each of the following statements (in quotations), answer *True*, *False*, or *Uncertain* and use economic theory (reasoning, graphs, or math) to defend your answers. Be clear about your assumptions or alternative assumptions that help you address each issue. Grading will depend on the rationale supporting your answers.

6a. *Acme Corporation* has two manufacturing plants: *Old Factory* constructed in 1984 and *New Factory* constructed in 2015. Both plants are capacity constrained and exhibit decreasing marginal productivity. The marginal cost of production at *New Factory* is less than the marginal cost of the first unit produced at *Old Factory* up to unit q_1 . It is costless for *Acme Corporation* to let either plant sit idle (over the relevant timeframe).

Statement 1 True, False, or Uncertain: “The firm should produce the maximum quantity that is possible at *New Factory* and only produce at *Old Factory* when they hit that capacity constraint.”

6b. *Country A* and *Country B* have engaged in cyclical production for many decades across many supply chains. For example, *Country A* extracts bauxite (aluminum ore) that is shipped to country *Country B*, where it is smelted and rolled into aluminum sheets, which are then shipped to *Country A*, where they are molded and used in the construction of airplanes that are sold in both *Country A* and *Country B*. There are other supply chains where *Country B* produces raw materials that are shipped to *Country A* for the production of intermediate goods, that are then shipped to *Country B* for use in the production of final consumer goods that are generally sold in both countries.

Statement 2 True, False, or Uncertain: “It would be more profitable for firms in both countries if production is reorganized so that the country producing the raw materials for each good is also producing the needed intermediate goods and then assembling the final product for use at home and for export to the other country.”

Statement 3 True, False, or Uncertain: “If *Country A* imposes a tax on importing intermediate goods produced from raw materials originating in *Country A*, this tax will reduce the volume of intermediate goods imported and stimulate a Pareto Improvement because the costs of following the cyclical trade production process decreases the profitability of firms in *Country A*.”

6c. Compensating variation is alternatively referred to as the willingness to pay, while equivalent variation is alternatively referred to as the willingness to accept. Define a *situation* as a consumption bundle and accompanying market price vector.

Statement 4 True, False, or Uncertain: “If Thomas Chen is willing to pay more to change from *situation A* to *situation B* than he is to change from *situation A* to *situation C*, then *situation B* must provide higher utility to Thomas Chen than *situation C*.”