Agricultural and Resource Economics

Ph.D. Qualifying Examination –Microeconomic Theory

Tuesday, July 10, 2018

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.
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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.

1. Answer the following questions about consumer demand:

A. 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:

$$\begin{aligned}\omega_1 &= 0.4\\ \varepsilon_1 &= 1.8\\ \varepsilon_2 &= 0.4\\ \eta_{12} &= 0.6\\ \eta_{21} &= 0.8\end{aligned}$$

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

2. Agent 1 has the following utility function $U: R_+^3 \to R$:

$$U(x_A) = x_{A,1}^2 x_{A,2}^{1/3} x_{A,3}^{2/3}$$

with initial endowment vector $\omega^A = [\omega_1^1, 6, 7\,]$.

Agent 2 has the following utility function $V: R_+^3 \to R$:

$$V(x_B) = \frac{2x_{B,1}}{3} + \frac{x_{B,2}}{6} + \frac{x_{B,3}}{2}$$

with initial endowment vector $\omega^B = [1, 8, 4]$.

Agent 1 and Agent 2 are allowed to trade. Define an equilibrium in this economy.

Suppose that in equilibrium, Agent 1 consumes six units of good 1. What was ω_1^1? What was x_B?

3. Define the payoff function ω: $\{0,1\}^3 \times \{0,1\}^3 \rightarrow R \times R$ as $\omega(\sigma_A, \sigma_B)$ where σ_i denotes the strategy of player i with the following values:

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

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. Consider a market where each firm simultaneously and independently selects a quantity q_i. The inverse demand function for this market is given by $P(Q) = 50 - Q$, where $Q = \sum_{i=1}^{n} q_i$.

a) Suppose the market is monopolized by a single firm with constant marginal cost of production equal to c_1. Find the profit-maximizing output, price, and profit for the firm.

b) Compare the outcomes in (a) to that which would arise in a perfectly competitive market where all firms have $MC = c_2$, where $c_2 < c_1$.

c) Suppose that the above market is served by two identical firms with constant $MC = c_2$. Derive the Cournot equilibrium price and the quantity produced by each firm. Compare the aggregate quantity and price to the results in (a) and (b).

d) Finally, compare the results from (a), (b) and (c) to the outcomes of a Bertrand model for the same market.

5. Consider the following Cobb-Douglass production function:

$$q = f(x) = x_1^{\alpha} x_2^{\beta}$$

where $\alpha>0$, $\beta>0$, and $\alpha+\beta<1$.

a. Derive the factor demands $x_1(p,w_1,w_2)$ and $x_2(p,w_1,w_2)$ where p is the price of output and w_i is the price of factor i.

b. Derive the supply function $y(p, w_1,w_2)$.

c. Find the 3x3 matrix of marginal price effects. For which of these effects can you determine the sign?

d. Derive the profit function $\pi(p, w_1, w_2)$. What properties must the profit function exhibit? Verify that each of these properties holds.

e. Verify that Hotelling's Lemma holds for this profit function.

6. Suppose there is an economy with two consumer types: type A with population N_A and type B with population N_B. Both consumer types can allocate their resources to the purchases of two goods: an infinitely divisible general consumption good denoted $C \in R_+$ with price $p_C = 1$ (the numeraire) and a dichotomous *state-good* denoted $X \in \{0,1\}$ with price p_X (notice, the state-good **cannot** assume all integer values; it is either consumed, $X = 1$, or not consumed, $X = 0$). Type A consumers only receive utility from consumption of C, while type B consumers receive utility from both C and X. Utility depends on the consumption state $S \in \{0,1\}$ with $prob(S = 1) = q$>0. Consumers purchase goods before the consumption state is realized.

Let the utility of type A consumer with disposable income m_A be:

$$U_A(C, X; S) = \left(\frac{2}{4}\right)^S \ln(C)$$

A. What is the expected utility of type A consumers before the consumption state is realized?
B. Suppose the government can implement the following program: type A consumers pay a tax of t before the consumption state is realized and the government uses this revenue to reduce the probability $S = 1$ so that $prob(S = 1|t) = q/2$. What is the expected utility of type A consumers as a result of this government program?
C. If type A consumers maximize their expected utility, derive an expression for the maximum value of t they would be willing to accept to implement the policy described above?
D. If type A consumers have pre-tax disposable income of \$60,000 and $q = 0.10$, what is the consumer's maximum willingness to pay to see the government program implemented?

Let the utility of type B consumers with income m_B be:

$$U_B(C, X; S) = \left(\frac{2 + X}{4}\right)^S \ln(C)$$

E. What is the expected utility of type B consumers before the consumption state is realized if X is unavailable for purchase?
F. What is the expected utility of type B consumers before the consumption state is realized if X is purchased at price p_X?
G. If type B consumers maximize their expected utility, derive an expression for the maximum value of p_X they would be willing to pay to purchase X.
H. If type B consumers also have pre-tax disposable income of \$60,000, $q = 0.10$, and the government has not implemented a tax on type A consumers to reduce q, what is the maximum price p_X they would be willing to pay to purchase X?

Suppose, the consumption of X affects the likelihood that each state arises so that $prob(S = 1|X) = \frac{q}{2-X}$.

I. If the government maximizes a social welfare function that is the sum of individual expected utilities and could ban the consumption of X, would it choose to do so? Would doing so be Pareto optimal? Would it be Pareto improving relative to the free-market outcome?

J. Is the following statement true, false, or unknown: "Given the utility and state probability functions defined above, if $\{N_A > N_B; m_A = m_B =$ \$60,000; $q = 0.10\}$, then it is possible for type A and type B consumers to agree to an arrangement whereby type B consumers voluntarily set X=0."

K. In one or two sentences, identify a contemporary economic phenomenon for which the framework initiated here might help analysts develop sound policy advice based on principles of benefit cost analysis, Pareto efficiency, and Pareto improvement.

Agricultural and Resource Economics

Ph.D. Qualifying Examination –Microeconomic Theory

Monday, July 10, 2017

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1. Answer the following questions about consumer demand:

A. Suppose that a consumer can purchase 3 goods $\{x_1, x_2, x_3\}$ with $x_i \in R_+ \ \forall \ i$. 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. Prove that if the following are true, then consumer preferences do not satisfy a locally non-satiated rational preference ordering:

$$\begin{aligned} \omega_1 &= \ \ 0.4 \\ \varepsilon_1 &= \ \ 0.8 \\ \varepsilon_3 &= \ \ 1.5 \\ \eta_{11} &= -1.0 \\ \eta_{13} &= -0.76 \\ \eta_{31} &= -1.2 \end{aligned}$$

2. Agent 1 has the following utility function $U: R_+^3 \to R$:

$$U(x) = x_1^{1/2} x_2^{1/4} x_3^{1/4}$$

with initial endowment vector $\omega^1 = [4,4,\omega_3^1]$.

Agent 2 has the following utility function $V: R_+^3 \to R$:

$$V(y) = \frac{y_1}{2} + \frac{y_2}{4} + \frac{y_3}{2}$$

with initial endowment vector $\omega^2 = [3,5,2]$.

Agent 1 and Agent 2 are allowed to trade. Define an equilibrium in this economy.

Suppose that in equilibrium, Agent 1 consumes six units of good 1. What was ω_3^1?

3. Define the payoff function ω: $\{0,1\}^3 \times \{0,1\}^3 \rightarrow R \times R$ as $\omega(\sigma_A, \sigma_B)$ where σ_i denotes the strategy of player *i* with the following values:

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

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

4. An **incumbent** (denoted I) and a **possible entrant** (denoted E) play the following game:

First, the incumbent decides whether to be **passive** or **active**. Being active costs **C** and it is a sunk cost.

Then, Nature selects the opportunity cost of entry $k \in K$ (that is, the profit that the entrant could make in the best alternative investment) according to the cumulative distribution function F [thus, for every number x, $F(x)$ is the probability that the opportunity cost of entry k is less than or equal to x]. The value of k is revealed to both incumbent and possible entrant (and becomes common knowledge between them).

Then, the possible entrant decides whether or not to enter and if she enters then there is a simultaneous duopoly game (which we do not specify: it could be a Cournot game).

Let D_I and D_E be the incumbent's and entrant's profits, respectively, at the Nash equilibrium of the duopoly game following entry with a passive incumbent, and G_I and G_E be their respective profits at the Nash equilibrium of the duopoly game following entry with an active incumbent (G_I includes the cost C). Assume that if she is indifferent between entering and not entering, the entrant will choose to enter.

If the possible entrant stays out, her payoff is k (drawn from $F(x)$), whereas the incumbent's payoff is M if passive and $(M - C)$ if active.

Assume that $M > C > 0$. Production costs are zero for both firms.

(a) Draw the extensive form of this game for the case where $K = \{k_1, k_2\}$ (replace each duopoly game with the corresponding equilibrium payoffs; write all the payoffs).
(b) Provide a formal definition of a subgame-perfect equilibrium for the extensive form game.
(c) Assume instead that K = [A, B] (the closed interval between A and B, $0 < A < B$) and $A < G_E < D_E < B$. Under what conditions are the subgame-perfect equilibria characterized.

5. A naïve but unbiased government agent has the authority to divide a resource, a land area, between two equal-sized groups of constituents. The first group, "conservationists," includes those who wish to maintain some area that is undeveloped and providing nature-based (ecological or environmental) goods and services, many of which may be private goods and some of which may be public goods. The second group, "developers," wish to use the land to create homes and shopping areas, as well as areas for extraction of energy resources.

Suppose the government agent, seeking a fair and equitable division of the land resource, gives each group exactly 50% of the land. For **Scenarios (A)-(D)**, consider the subsequent statement in quotation marks ("...") and respond with True, False, or Uncertain, providing an rationale for your answer. This rationale should be based in economic theory using whatever combination of written, graphical, or mathematical analyses you feel best explains your logic. (The tools of economics include utility and demand theory, Edgeworth Box analysis, production theory, representative consumer or producer models, or others concepts, that may help you make your point.)

Scenario A: Suppose the agent implements this 50-50 division and imposes a constraint that a group can only use the land for their main mission (conservation-environment for group one; development for group two).

"The 50-50 allocation of land, under this constraint, is fair and is an efficient decision by the agent because it avoids an expensive public debate."

Scenario B: Suppose the land units are identical and produce no public goods (so conservation goods may be privately consumed with exclusivity, like food), and the agent imposes no other constraints, allowing the groups to alter the division.

"The land will remain in the 50-50 division if there exists markets for land, housing, energy, etc."

Scenario C: Suppose the agent implements this 50-50 division, land units are identical, and the agent imposes no other constraints, therefore allowing the groups to alter the division.

"The groups will maintain the 50-50 division unless they also each possess some other goods due to prior wealth."

Scenario D: Suppose the land units all fall within two different types, but within each type units can be managed to produce an identical set of goods and services (although the two land-types have different advantages for some goods). Suppose some conservation goods are public goods.

"The groups will be satisfied with the 50-50 division assuming the agent also split the two land-types equally, so free markets will not change the initial allocation even in a closed community with no other sources of goods that may be traded; then the market economy will efficiently use land resources based on the 50-50 division."

Agricultural and Resource Economics

Ph.D. Qualifying Examination – Microeconomic Theory

Wednesday, June 8, 2016

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1. General equilibrium – exchange economy

In an exchange (perfectly competitive) economy there are two individuals, Abby and Ben, and two goods, X and Y. Abby has an initial endowment $w^A = (4, 2)$, her preferences are represented by a utility function $u^A(X, Y) = 3 \ln X + \ln Y$. Ben has an initial endowment $w^B = (0, m)$ where $m > 0$, his preferences are represented by a utility function $u^B(X, Y) = \sqrt{XY}$. The individuals exchange goods at market prices $\$p$ for good X and $\$1$ for good Y.

(a) Derive the demand each consumer has for the two goods.

(b) As a function of m, find the competitive equilibrium price, $p^*(m)$, and the consumption bundles.

(c) How does the equilibrium price $p^*(m)$ change as m increases?

(d) Could there be a value of m for which in the equilibrium allocation Abby consumers the same amount of both goods, $X^A = Y^A$? If yes, find m, if not, briefly explain.

(e) Could there be a value of m for which in equilibrium allocation Ben consumers the same amount of both goods, $X^B = Y^B$? If yes, find m, if not, briefly explain.

(f) Take as given that there is value $m = m_0$ for which in equilibrium the allocation is $\left(X^A, Y^A\right) = (3.25, 6.5)$ and $\left(X^B, Y^B\right) = (0.75, 4.5)$. (i) Given $m = m_0$, is this allocation Pareto efficient? Briefly explain. (ii) Find m_0.

2. Answer the following questions about consumer demand:

A. Find the Marshallian demand functions associated with utility function $U: R^4_+ \to R$, price vector $p \in R^4_{++}$, and income $m \in R_{++}$, where

$$U = \min\{x_1^{\alpha} x_2^{1-\alpha}, \beta x_3 + x_4\}$$

B. Define the vector of budget shares:

$$\omega = \begin{bmatrix} 0.2 \\ \omega_2 \\ 0.3 \end{bmatrix},$$

the vector of income elasticities:

$$\varepsilon = \begin{bmatrix} 0.8 \\ \varepsilon_2 \\ 3.6 \end{bmatrix},$$

and the matrix of Marshallian demand elasticities:

$$E = \begin{bmatrix} -0.6 & \varepsilon_{12} & \varepsilon_{13} \\ \varepsilon_{21} & -1.2 & \varepsilon_{23} \\ -0.6 & \varepsilon_{32} & \varepsilon_{33} \end{bmatrix}.$$

Assuming that these elasticities follow from a rational preference ordering that satisfy the Strong Axiom of Revealed Preference, provide the missing income and price elasticities (round any decimals to 10^{-3}).

3. Consider two goods, $\{x_1, x_2\}$, with strictly positive prices, $\{p_1, p_2\}$. The indirect utility function for the h^{th} household with strictly positive income M^h is given by:

$$V^h(p_1, p_2, M) = (M^h - \alpha p_1 - \beta p_2)/(p_1^{\gamma} p_2^{(1-\gamma)})$$

where α, β, and γ are positive constants.

a. What properties must this function exhibit to be consistent with utility maximization?

b. Derive the Marshallian demand functions for x_1 and x_2. Why can α and β be interpreted as "necessary quantities" of these goods?

c. Derive the Hicksian demand functions for x_1 and x_2.

d. If there are H consumers with different incomes but having preferences defined by the indirect utility function above, show that an aggregate demand curve exists. Explain this intuitively.

e. Consider two price vectors: $p = (100, 100)$ and $p' = (144, 144)$. When prices are p, the consumer requires \$500 to reach utility V^*. When prices are p', the consumer requires \$720 to reach V^*. Now consider a new price vector $p'' = (122, 122)$. Can you predict which price income combination (p, \$500) or (p'', \$605) the consumer would prefer? Indicate why you believe your answer is correct.

4. Standard economic models of firm behavior assume that firms maximize profit. Yet, alternative objective functions can also be defined. This question examines the implications of maximizing "market share."

(1) For a price-taking firm with production function $q^{firm} = f(L,M)$ facing input prices W_L for labor and W_M for materials and a maximum expenditure budget of B^{firm}:
   a. Identify the equilibrium marginal conditions if the firm maximizes its share of total OUTPUT in the industry, where total industry output is fixed at Q^{tot} and the firm's market share is q^{firm} / Q^{tot}.
   b. How do these marginal conditions compare or contrast to the marginal conditions for a profit-maximizing firm if output sells for P and $P \cdot q^{firm} > B$ at the optimum?
   c. Compare the level of output relative to the level a profit maximizer would choose?

(2) For a price-taking firm with production function $q^{firm} = f(L,M)$ facing input prices W_L for labor and W_M for materials and a maximum expenditure budget of B^{firm}:
   a. Identify the equilibrium marginal conditions if the firm maximizes its share of total REVENUE in the industry, where total industry output is fixed at $R^{tot} = P \cdot Q^{tot}$ and the firm's market share is $P \cdot q^{firm} / [P \cdot Q^{tot}]$.
   b. How do these marginal conditions compare or contrast to the marginal conditions for a profit-maximizing firm?
   c. Compare the level of output relative to the level a profit maximize would choose?

(3) Now suppose the firm is a monopolist (in output) with market demand curve $Q = q^{Firm} = Q(P)$. For the monopolist who produces with production function $q^{firm} = f(L,M)$ facing input prices W_L for labor and W_M for materials (the same as for the price taking firm):
   a. Identify the equilibrium marginal conditions if the monopolist maximizes total REVENUE in the industry subject to maintaining a profit of at least π^0.
   b. How do these marginal conditions compare or contrast to the marginal conditions for a profit-maximizing monopolist?
   c. Compare the level of output this firm chooses relative to that of a profit maximizing monopolist?
   d. Compare the equilibrium price the monopolist receives relative to a profit maximizing monopolist.
   e. Under what conditions does the revenue maximizing monopolist (with minimum profit π^0) generate a greater level of net social benefit than the profit maximizing monopolist.

5. A prospective employee has a productivity x that is initially known by neither the employee nor prospective employers. Both the employee and employers view x as a random draw from the uniform distribution on the unit interval. The labor market is such that the employee will be paid his expected productivity. The employee is risk averse and firms are risk neutral in perfectly competitive output markets.

A. What is the equilibrium outcome in this market?

B. Assume now that before entering the job market the employee can take a test that costlessly and verifiably makes the employee's productivity known to all parties. For the employee, is it better to take the test or to not take the test? Why? How much would an employee be willing to pay to take or avoid taking the test? Is the test advantageous or disadvantageous for the employer?

C. Now, assume that the same costless test is automatically and necessarily taken by every employee. Suppose, however, that the result cannot be verified unless the employee makes it available and that the employee can choose whether to truthfully reveal their result after observing the result (employees can not lie about their test result). What is(are) the equilibrium in this market? In particular, which employee types will make the test available in equilibrium(equilibria)? How do equilibrium utilities compare to those from part A?

D. Suppose now, employees know their productivity but it remains unobservable to employers. There is a testing firm who can administer a test that reveals productivity and can provide a verified report to employers. The testing firm is a monopolist and it costs the firm c to administer the test. In equilibrium, what price will the monopoly charge for the test and who will take it? How does this price vary in c?

ARE – PHD Exam in Microeconomic Theory, June 18, 2015.

This exam is intended for 4 hours (9am – 1pm).

You may use snacks or drinks as you need to during the exam.

A professor is available in case there is a question of clarification, but he or she may decide to use the option of answering: "Do the best you can with the information provided."

1. Read the whole exam first.

2. You must address ***at least*** 4 of the 5 questions completely, including all of the parts under a particular question. Addressing a 5th question may help make up for deficiencies (if any) in your answers to the 4 questions you emphasize. The committee will be completely satisfied if you only answer 4 of the 5 questions.

3. Do your own work, without input from any other human by any means (including without reference to texts or other written materials).

1. Consider the Quasi-linear utility function of the form:

$$U(X0, X1, X2, X3) = c\,X0 + F(X1,X2,X3)$$

where the X's are all market goods and $c > 0$ is a constant while the first derivative of F with respect to Xi is also positive for $i = 1, 2, 3$.

1a. Show that the utility maximizing conditions for the consumer demands will will have no income effects for goods 1, 2, and 3. Assume an interior solution (prices are such that the consumer will consume a positive amount of all goods).

1a'. Discuss the implications of this situation for the Slutsky equation (also called Slutsky decomposition) using a graph that includes either indifference curves or Hicksian and Marshallian demand curves.

For parts 1b-1e **assume** $F(X1,X2,X3) = a1\ln(x1) + a2\ln(X2) + a3\ln(X3)$ where $0<ai<1$ for all i and $a1 + a2 + a3 < 1$, and still assume an interior solution to the utility maximization problem. Of course, this function for F(.) is part of the overall utility function that still involves X0 as above.

1b. Find an equation for the demand curves for X0 and for Xi for $i = 1,2,3$.

1c. Find an equation for the indirect utility function from 1b.

1d. Find an equation for the expenditure function from 1b.

1e. Provide an equation or a quantitative result for the difference between Compensating and Equivalent variation based on this utility function.

[Recall that Compensating Variation is sometimes called willingness to pay (WTP) to obtain a price decrease, and willingness to accept (WTA) to receive a price increase. Similarly, Equivalent Variation is sometimes called WTA to forego a price decrease, or WTP to avoid a price increase.]

1f. Discuss one application in which assuming a quasi-linear utility function might be appropriate or is common in literature you are aware of. In other words, how might this form of utility be useful in applied work?

2. Consider a monopolist who will be subjected to regulation. The monopolist faces a known demand function X(P) with X'(P)<0 and an unknown (to the regulator) marginal cost of production C, but C is a constant. The regulator plans to maximize the sum of producer's and consumer's surplus.

2a. **If** the constant marginal cost were to the regulator known, (i) explain what regulation the government should impose in order to maximize the sum of consumer and producer surplus, being sure to use a graphical analysis in your explanation(s). (ii) Explain what determines the division of net benefits between producers and consumers. (iii) Explain how the producer's surplus would or would not be different under regulation rather than unregulated monopoly, and (iv) show any difference graphically. (v) Using concepts associated with Pareto Efficiency or Pareto Optimality, describe the basic economics rationale for imposing regulations of this type in this particular case.

2b. Now, the constant marginal cost is NOT known actually known to the regulator (government). But suppose it has a value of C1 with probability of z1 and a value of C2 with a probability of z2 = 1 – z1, with 0<C1< C2 (but C1 and C2 are known to everyone, but Government does not know which one operates in the current year).

- (i) Identify the optimal conditions that the regulator would try to meet in setting a regulation that (a) sets the price P the firm can charge on all units for the year; (b) makes a transfer payment T from the government to the firm or from the firm to the government to assure that the firm does not go out of business in any year; (c) still is based on the concept of maximizing the sum of producer's and consumer's surplus.
- (ii) Give an intuitive explanation (perhaps using graphics as an aid) regarding why a risk-neutral regulator *would* or *would not* want to set P equal to the probability-weighted average of C1 and C2.
- (iii) Explain whether and why you expect the sum of transfer payments under regulation to be (a) zero, positive, or negative; (b) larger or smaller under the regulator's objective as compared to setting P equal to the probability-weighted average of C1 and C2. (You may ignore discounting.)

3. In the absence of markets, farm production and consumption in a self-subsistence economy are closely interrelated. Assuming that from a given bundle of inputs, two goods, X and Y (e.g., maize and corn), are produced and consumed, use both graphical and mathematical analysis to answer the following (parts a-d).

In answering below, feel free to make any additional assumptions you might deem necessary but clearly explain what your additional assumptions are. Needless to say, clear notation and labeling is essential.

(a) Formally show how the optimal allocation of production and consumption is determined by a typical farmer assuming NO markets and a given resource (input) endowment already possessed by the farmer.

Now, take the results from (a) above and now assume that markets for both X and Y are present so that farmers can produce, consume, buy and/or sell both goods.

(b) Graphically show all effects concerning the optimal production and consumption of X and Y.

(c) Express the conditions from (b) mathematically and explain their meaning.

(d) Compare the results obtained with and without a market. What can you conclude?

4. Farming is often used as an example of a perfectly competitive market. At an international level, however, it is often the case that a few countries are the dominant producers of a specific food product (e.g. wheat, coffee, sugar) and, in such cases, the market between countries can be characterized as oligopolistic. Consider the following example. Suppose that there are only 2 countries that produce wheat, indexed by i=1,2 (say, Canada and the U.S.) The quantity of wheat produced by each country is given by q_i. The profit for county i is denoted by $\Pi_i(q_i, q_j)$ where Π is twice continuously differentiable in both arguments.

a. Cournot duopoly. Suppose that each country chooses how much wheat to produce to maximize profits, taking the quantity of the other country as given. Give the necessary conditions that characterize a Nash equilibrium, if it exists, and provide conditions on Π_i that determine the slope of the reaction function of country i.

In the remaining parts of the question (parts b-g) assume that the inverse demand for wheat is linear and given by $P(Q) = \alpha - Q$, where $Q = q_1 + q_2$. In addition, assume that costs in each country are linear and country-specific so the costs of Canada and the U.S. are $c_1 q_1$ and $c_2 q_2$, respectively. Assume each country chooses how much wheat to produce, taking the quantity of the other country as given.

b. Solve for the Cournot reaction functions of each country.

c. Solve for the equilibrium level of output for each country.

d. If costs differ between countries, show which country will capture a larger share of the world market.

e. Suppose the government of each country offers a price subsidy, s_i, to its own producers (otherwise the problem is the same as above). Under what circumstances will the output of both countries increase relative to the case where there are no price subsidies?

f. Does a Nash equilibrium always exist for this model? Explain your answer. Do the price subsidies affect the existence or nonexistence of equilibria.

g. Cartel. Suppose now that the 2 countries cooperate to maximize their joint profits. How much wheat will each country produce? Explain why?

5. SHORT ANSWER QUESTIONS: Discuss what market failures, if any, arise in the following situations and indicate what government policies can restore efficiency. In answering the questions, indicate what efficiency conditions are violated (if any) by providing a careful graphical and mathematical analysis.

a. Land is used to produce a variety of products – corn, wheat, etc. If corn production expands (using more land), land prices rise causing production costs for wheat farmers to rise.

b. Water is used in agricultural production. Each farmer obtains water by drilling wells to reach underground streams. However, there is no market for water. As more wells are drilled, the cost to other farmers of extracting water rises because the holes have to be drilled deeper.

c. There is a limited supply of computer programmers and engineers, and these workers (inputs to production) are employed in several different industries, including manufacturing firms, software companies, etc. An increased demand for software programs leads to increased demand for, and wages of, computer programmers and, hence, to increased costs in manufacturing firms.

d. A biotechnology firm spends a large amount of money on research and development (R&D) to develop a better product (for example, a corn hybrid). Under the first scenario, once the product is developed, the government gives the firm an exclusive right to market the new product. Under the second scenario, suppose that after the firm develops a new product (through extensive R&D) any other firm can freely copy this product.

e. The government subsidizes agricultural producers of sugar in the form of price support for sugar (that is, prices set at a level higher than equilibrium price for sugar).

f. The government introduces a subsidy to agricultural producers of sugar in the form of lump-sum transfers. These lump-sum transfers depend only on the production of sugar in the ten years preceding the introduction of the policy.

PHD Preliminary Examination – Microeconomics – January 16, 2015 – 9am – 12 pm – Agricultural and Resource Economics

Choose 3 out of these 4 questions; answer all parts of the questions you choose. You have a maximum of three hours. As your answers will be photocopied for grading, please make sure you press down when writing, leave a 1 inch margin on both sides, top and bottom, and write only on 1 side of the page. Please write down any assumptions you make as a part of an answer. For questions requiring an explanation, grading will depend on the explanation or rationale.

1. You have studied utility theory and the relationship to demand curves. Consider a case with 2 goods, in quantities X and Y. Provide a GRAPHICAL explanation of how utility maximization is related to expenditure minimization. Use U(X,Y) to represent the utility function, V(.) to represent the indirect utility function, e (.) to represent the expenditure function, M to represent income, P_X and P_Y to represent the respective prices.

   Label the graphs appropriately to indicate **(1a)** how utility relates to the indirect utility function; **(1b)** how expenditure relates to the expenditure function. Provide a separate graph for utility maximization and for expenditure minimization to make your explanations clear. Be clear about how V(.) and e(.) are defined, and be clear about what the independent variables are. Label your graphs (and curves) identifying values of indirect utility and expenditure.
   (1c) Then below each of the graphs for (1a), illustrate the connections to the corresponding demand curves that would come from utility-maximization and expenditure-minimization, considering at least 3 price changes for one good. Full label your graphs.
   (1e) Discuss the use of these concepts for measuring a person's willingness to pay to have the price of X decline by 50%. Show how the indirect utility function *and* show how the expenditure function can be used to define willingness to pay (compensating variation).
   (1f) Discuss how compensating variation does or does not relate to consumer's surplus, using a demand-space graph, and show how the demand graphs differ for a normal versus an inferior good.

   In labeling your graphs, identify the relationship between the different types of demand curves and the indirect utility or the expenditure functions as may be appropriate (i.e., how are the demand curves related to V(.) and e(.)?). Make clear which indifference curves and which demand curves correspond to what level(s) of utility, indirect utility, or expenditure.

2. Consider the utility function $U = X^a Y^b$ where $a,b > 0$ and $a+b<1$.
(2a) Mathematically, find the Marshallian Demand Curves and the indirect utility function.
(2b) Then, ***use the corresponding indirect utility function*** to find the Hicksian demand functions. That is, show how to move from the indirect utility function to obtain an equation for the Hicksian demand curves. Explain your rationale.
(2c) Using the information available, demonstrate that the Slutsky equation holds true for this situation.
(2d) Explain why consumers' surplus is **not** a theoretically rigorous concept on which to measure welfare (such as, willingness to pay [compensating variation] for a price change).
(2e) Explain/show whether or not the expenditure function is a monotonic transformation of the utility function. Explain why this is important (briefly).
(2f) Consider the following statements, and answer: True, False, or Uncertain, and explain the rationale for your answer.

(i) "If the marginal utility of one good (X) is higher than the marginal utility of another good (Y), then a consumer is usually better off buying a large increase in the quantity of X."

(ii) "The marginal rate of substitution between X and Y is equal to the marginal willingness to pay for an additional unit of a good, if one good (Y) is designated as a numeraire such that its price (P_Y) equals \$1/unit."

3. Consider a monopolistic market for good Q.

3a. Explain the basic model for monopoly selling units of good Q in graphical and mathematical terms

3b. Answer True, False, or Uncertain to each of the following statements, and ***explain*** the rationale for your answer.

(i) "A monopolist selling Q will always sell at a price that exceeds average cost."

(ii) "For an industry with increasing returns to scale over the entire relevant-range of output (relevant to satisfy aggregate consumer demand), an unregulated monopoly represents a Pareto Improvement over perfect competition."

(iii) "Assuming consumer demand is large enough, so that a monopolist's production is in the region of decreasing returns to scale, a monopolist selling Q in two different cities (two different markets) will sell at the same price in both markets."

(iv) "If a monopolist's marginal cost of production is exactly equal to the horizontal sum of the marginal production costs from all its factories producing Q, then the social cost of producing Q will be identical as under perfect competition."

(v) "If Q is produced in the United States by a single firm, but Q is produced in many countries overseas (e.g., China, Indonesia, Australia), then Q will only be sold at the monopolist price in the United States if the U.S. government imposes protectionist tariffs (taxes) on imports from overseas."

4. Neo-classical duality theory has been widely used in economic analysis over the past couple of decades.

4a. Please clearly explain what is meant by neoclassical duality in the theory of the firm.

4b. Discuss the two primary dual production models (cost and profit) clearly distinguishing between short and long run specifications. The discussion should include any behavioral assumptions and provide two of the key graphical relationships for each of the two models.

4c. Now, using a dual profit model show the full system, in general form, and then the various economic relationships that can be obtained. Again, make sure to distinguish between short and long run specifications. Discuss any theoretical restrictions that might need to be imposed for this to work.

4d. From part 4c, explain how you might be able to determine, from a theoretical stand point, which specification might be more desirable (short or long run) in any particular application. Please illustrate this answer using a graph.