Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam Retake

July 15, 2019
9:00 a.m. to 1:00 p.m.

Your **810 Code #** ______________________

Please provide complete answers to all questions. You have 4 hours to complete the exam; allocate your time accordingly. Please follow all instructions listed below:

- Number your responses to the questions clearly.
- Write the last 4 digits of your Student ID number at the top right of each response page.
- Write the page number in the lower right hand corner of each response page.
- Write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited.
- Write only on one side of paper with a blue or black pen.
- Clearly box all final answers to numerical and algebraic problems

Question 1

Consider the utility function:

$$U(q_1, q_2) = (q_1 - \gamma_1)^{\beta_1}(q_2 - \gamma_2)^{\beta_2}$$

for constants $\gamma_1, \gamma_2, \beta_1$, and β_2 where $\beta_1 > 0, \beta_2 > 0$. Let m be income and p_1 and p_2 be the prices of q_1 and q_2, respectively.

(1.1) Why can we assume that $\beta_1 + \beta_2 = 1$? Explain intuitively or show explicitly.

(1.2) Does $\beta_1 \ln(q_1 - \gamma_1) + \beta_2 \ln(q_2 - \gamma_2)$ represent the same preference ordering? Explain intuitively or show explicitly.

(1.3) Set up the Lagrangean and derive the optimal solution for q_1 and q_2. You will notice that the demands appear "messy". Simplify them so that you have the following

$$q_1^* = \beta_1/p_1(m - p_1\gamma_1 - p_2\gamma_2) + \gamma_1$$

$$q_2^* = \beta_2/p_2(m - p_1\gamma_1 - p_2\gamma_2) + \gamma_2$$

(1.4) Given the optimal demands in (3), provide an intuitive explanation of the parameters $[\gamma_1, \gamma_2, \beta_1, \beta_2]$ as they relate to the consumer's optimal bundle.

Question 2 – Part A

Consider a perfectly competitive firm that employs the technology $q = 2K^{1/4}L^{3/5}N^{1/6}$, where q is output, K is capital (purchased at competitive price r), L is labor (purchased at competitive price w), and N is natural resources (purchased at competitive price h).

(2.1) Find the short-run input demands when K=16?

(2.2) Find the short-run cost function for this firm

(2.3) State and demonstrate the properties of the short-run cost function.

Question 3 – Part A

Consider a two agent (agent A and agent B) two good (good x_1 and good x_2) pure exchange economy. Suppose preferences for the two agents are $U^A = 2x_1^A + x_2^A$ and $U^B = x_1^B + 2x_2^B$. Each agent is endowment with an equal amount of each good $e_1^A = e_2^A = e_1^B = e_2^B = 5$.

(3.1.A) For this economy, draw an Edgeworth box diagram with the following: (a) initial endowment, (b) set of Pareto efficient allocations, and (c) core of the economy.

(3.2.A) Suppose you are the TA for an undergraduate microeconomics course. A student has been studying Pareto efficiency, the fundamental theorems of welfare economics, and different social welfare functions (e.g., utilitarian, Rawlsian, egalitarian, etc.). The student is confused. They see in your graph above that the initial endowment is not Pareto efficient. But they think it should be because "if society decides to follow a social welfare function with perfect equality among all agents, then the Pareto efficient outcome should be $x_1^A = x_2^A = x_1^B = x_2^B = 5$". VERY BRIEFLY explain to the student why an allocation where every consumer receives an equal quantity of each good is likely not Pareto efficient.

Question 3 – Part B

Consider a different pure-exchange economy that has two goods (x_1 and x_2) and 300 consumers. There are two different types of consumers (200 consumers are of the first type. 100 consumers are of the second type). For consumers $i = 1,2, \ldots ,200$, the preferences of consumer i can be represented as $u^i(x_1^i, x_2^i) = \ln(x_1^i) + \ln(x_2^i)$ and the initial endowment for each consumer is $e_1^i = 3$ and $e_2^i = 1$. For consumers $i = 201,202, \ldots ,300$, the preferences of consumer i can be represented as $u^i(x_1^i, x_2^i) = \ln(x_1^i) + \ln(x_2^i)$ and the initial endowment for each of these consumers is $e_1^i = 1$ and $e_2^i = 3$.

(3.1.B) Solve for the competitive equilibrium for this economy.

(3.2.B) Is the equilibrium you found Pareto efficient? VERY briefly explain why.

Question 4

Two friends named Carnivore and Herbivore (C and H for short) would like to go out for dinner. They have two potential restaurants: the Porterhouse Grill or the Grit. Carnivore first chooses which restaurant to go to, and knowing where Carnivore went, Herbivore also decides where to go. Carnivore prefers the Porterhouse Grill, Herbivore prefers the Grit. In this game a player gets a payoff of 3 if she eats at her preferred restaurant, a payoff of 1 if she eats at her not preferred restaurant, and a payoff of 0 if the two friends eat at different restaurants. The payoffs are common knowledge.

(4.1) Represent this game in extensive form.

(4.2) Find a subgame-perfect Nash equilibrium.

(4.3) Slightly modify this game. Suppose that Herbivore no longer automatically knows where Carnivore went to eat, but she can learn where Carnivore went to eat without any cost. I.e., in this modified game, Herbivore first chooses between Learn and Not-Learn. If she chooses to Learn, then she knows where Carnivore went to eat prior to making her decision where to go eat. If she chooses Not-Learn, she chooses where to go eat without learning where Carnivore went. Payoffs are the same as before. Represent this game in extensive form.

(4.4) Find a subgame-perfect equilibrium where both players go to the Grit as an outcome.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam
May 31, 2019
9:00 a.m. to 1:00 p.m.

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Question 1

Consider the utility function:

$$U(x, y) = \alpha y - \tfrac{1}{2}\beta^{-1}(x - \delta)^2$$

where $[\alpha > 0, \beta > 0, \delta > 0]$ are unknown constants. Let m be income and p_x and p_y be the prices of x and y, respectively.

(1.1) Is the utility function homothetic? Show your work.

(1.2) Derive the optimal solution for x and y.

(1.3) Sketch the indifference path. [Hint: set the parameters to some arbitrary constant, such as $\alpha = \beta = \delta = 1$]

(1.4) Draw a budget constraint and indicate an arbitrary solution given your answer above.

(1.5) Given your answers to (1)-(4), provide an intuitive explanation of the parameters $[\alpha, \beta, \delta]$ as they relate to the optimal demands.

Question 2 – Part A

Consider a firm that behaves in a perfectly competitive manner, producing one output with N-1 inputs according to the direct production function:

$$f: R_+^{N-1} \to R: x \equiv (x_1, \dots, x_{N-1}) \to f(x_1, \dots, x_{N-1}),$$

which is concave and differentiable, with a strictly positive gradient on R_{++}^{N-1}. Denote output price by $p > 0$ and the vector of input prices by $w \equiv (w_1, \dots, w_{N-1}) \in R_{++}^{N-1}$. Assume that the cost function:

$$C: R_+^{N-1} \times R_+ \to R: (w_1, \dots, w_{N-1}; q) \to C(w_1, \dots, w_{N-1}; q),$$

is differentiable and convex in q and that at the profit-maximizing solution, the all input and output quantities are positive.

(2.1.A) What is the relationship between the output price and the marginal cost at the profit-maximizing solution? Prove your answer.

(2.2.A) How does an increase in an input price affect the marginal cost at the profit-maximizing solution? Prove your answer.

Question 2 – Part B

In order to limit greenhouse gas emissions, a public authority imposes a fixed cap or quota k on the carbon emissions from the firm. All inputs may contribute to carbon emissions. The firm's emissions function is given by:

$$\eta: R_+^{N-1} \to R: x \equiv (x_1, \dots, x_{N-1}) \to \eta(x_1, \dots, x_{N-1}),$$

which is convex and differentiable with non-negative partial derivatives.

(2.1.B) Is it necessarily true that the production of a larger amount of output requires carbon emissions to increase? You may discuss your answer in a simple, two-dimensional case.

(2.2.B) Write the Kuhn-Tucker conditions for the profit-maximizing firm that faces a potentially constraining cap k on carbon emissions and discuss the implications of the size of the emissions cap on the Lagrange multiplier.

(2.3.B) Compare the Kuhn-Tucker conditions of the profit-maximizing problem of the firm under the emissions constraint with those of the standard profit-maximizing problem (without the emissions constraint).

(2.4.B) Argue that the profit-maximizing output of the firm cannot be higher under the emissions constraint than in the absence of such a constraint.

Question 3 – Part A

Consider a two agent (agent A and agent B) two good (good x and good y) pure exchange economy. Suppose total endowment of good x is 10 and good y is 20. Suppose goods x and y are perfect complements for agent A and also perfect complements for agent B. Assume agent A is endowed with 5 units of good x and 5 units of good y.

(3.1.A) For this economy, draw an Edgeworth box diagram with the following: (a) initial endowment, (b) contract curve, and (c) core of the economy.

Question 3 – Part B

Consider an economy with one consumer, two competitive firms, and two goods: food and labor/leisure. Let the price of food be denoted as p and normalize the price of labor/leisure to be 1. Expressing the consumer's consumption of food as x and her consumption of leisure as ℓ, her preferences are given by:

$$u(x, \ell) = \ln(x) + \ln(\ell).$$

Assume that her initial endowment of food is 0 units and her endowment of time for labor/leisure is 1. There are two firms owned by the consumer, both are able to produce food. Firm 1 is a profit maximizing firm that produces food using labor as an input. Letting firm 1's labor input be L_1 and its output y_1, firm 1's technology is characterized by the production function

$$y_1 = (L_1)^{\frac{1}{2}}.$$

Firm 2 also uses labor as an input to produce food. Let firm 2's labor input be L_2 and its output y_2, firm 2's technology is characterized by the production function

$$y_2 = (2L_2)^{\frac{1}{2}}.$$

(3.1.B) Solve for the competitive equilibrium for this economy.

(3.2.B) Could the representative agent obtain a higher level of utility by changing how much labor she supplies to the firms and consuming the output without going through the market process? VERY BRIEFLY explain why.

(3.3.B) Suppose you are a TA for an undergraduate microeconomic course. A freshman student is looking at your solution above and is confused. They ask: "Why would firm 1 produce any output? Shouldn't the answer be $L_1 = 0$ and $L_2 > 0$ because firm 2 is more productive than firm 1?" Briefly explain how you would help the student understand and answer their question.

Question 4

Consider a two player game. Player 1, named Capone, has a choice whether he wants to file his taxes honestly or whether he wants to file his taxes dishonestly. Player 2, named Ness, represents the government and must decide how much effort he wants to invest in auditing Capone. Ness may choose an audit intensity $\alpha \in [0,1]$, which has an associated cost to Ness of $c(\alpha) = 100\alpha^2$. If Capone files his taxes honestly, let Capone's payoff from the game be 0. If Ness audits an honest Capone, then Ness gets no benefit from the audit, thus yielding him a payoff of $(-100\alpha^2)$. If Capone cheats on his taxes, then his payoff will depend upon whether he is caught or not. If Capone cheats on his taxes and is caught, Capone gets a payoff of (-100) and Ness gets a payoff of $(100 - 100\alpha^2)$. If Capone cheats on his taxes but is not caught, then Capone gets a payoff of 50 and Ness gets a payoff of $(-100\alpha^2)$. The probability Capone is caught is dependent upon the audit intensity chosen by Ness. If Capone cheats and Ness audits with an intensity level α, then Capone is caught with a probability of α and Capone is not caught with a probability of $1 - \alpha$.

(4.1) Suppose that Ness is 100% certain that Capone is cheating on his taxes. In this case, what is Ness's best response audit intensity α?

(4.2) Suppose Ness is 100% certain that Capone is being honest on his taxes, what is Ness's best response audit intensity α?

(4.3) If Ness believes that Capone is honest on his taxes with a probability p, what is Ness's best response audit intensity α?

(4.4) For this game, is there a pure strategy Nash equilibrium? Either give a pure strategy Nash equilibrium or briefly explain why there is not one.

(4.5) For this game, Is there a mixed strategy Nash equilibrium? Either give a mixed strategy Nash equilibrium or briefly explain why there is not one.

(4.6) Consider different version of this game. Suppose there is some probability p that Capone is a BAD guy and some probability $1 - p$ that Capone is a GOOD guy. Capone knows what type of guy he is, but Ness does not (the probability p is common knowledge). Given the payoff matrixes below of the normal-form game, determine the perfect Bayesian equilibrium.

Capone is a Good Guy		**Ness**	
		Audit	**Don't Audit**
Capone	**Cheat**	(-3,-1)	(-1,-2)
	Don't Cheat	(-2,-1)	(0,0)

Capone is a Bad Guy		**Ness**	
		Audit	**Don't Audit**
Capone	**Cheat**	(0,0)	(2,-2)
	Don't Cheat	(-2,-1)	(-1,1)

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 24, 2018

9:00 a.m. to 2:00 p.m.

Your **810 Code #** ________________________

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Question 1

Consider an agent that derives utility from two private goods, x_1 and x_2, that are available in competitive markets at exogenous prices p_1 and p_2, and a public good G that is exogenous, but can be influenced by the public sector or non-profit organizations. The agent's utility function is given by:

$$U = \alpha \ln(x_1) + \beta \ln(x_2) + \gamma \ln(G)$$

where $\alpha, \beta, \gamma > 0$ are parameters of the utility function.

(1.1) Set up and solve the consumer private utility maximization problem, given income level y.

(1.2) Find the optimal value function associated with utility max; indicate the exogenous parameters of the function; demonstrate the known properties of this function.

(1.3) Derive a utility index associated with $p_1 = p_2 = y = G = 1$. Find the compensating surplus associated with $G = 2$. How can this information be used by the public sector or non-profit organization?

Question 2

Consider a perfectly competitive firm that employs the technology: $q = 2K^{0.21}L^{0.78}$.

(2.1) Calculate the *Marginal Product* and *Elasticity of Labor.*

(2.2) Derive the *Marginal Rate of Technical Substitution.*

(2.3) Derive the *Elasticity of Substitution* (show your work!)

(2.4) Find the isoquant for q = 4 units of output.

(2.5) Determine whether this production function exhibits Diminishing Marginal Returns to Capital and/or Labor.

(2.6) Find the returns to scale for this technology.

Question 3

Consider a risk-neutral entrepreneur deciding whether to undertake a research project that with probability λ will successfully develop a new product and with probability $1-\lambda$ will fail to develop a new product. To undertake the research project the entrepreneur needs to commit a fixed cost F and needs to hire labor x at the constant wage rate w. Labor in this setting is useful because it can affect the probability λ of a successful outcome according to:

$$\lambda = 1 - e^{-x}.$$

If the project is successful the entrepreneur will have monopoly rights for a one-time sale of the new product. The inverse demand for the new product is known to be:

$$p = a - y,$$

where p is the price of the new product and y is the quantity of new product. It is also known that, if the research project is successful, the new product can be produced under constant returns to scale with unit production cost of c (assume $0 < c < a$).

(3.1) Set up the appropriate optimization problem/s for this agent. Solve for the optimal amount of labor, x, and the optimal amount of new product, y, sold if the research process is successful.

(3.2) It is often argued that providing monopoly rights to innovators (e.g., patents) does not result in the socially desirable amount of research and of innovation. In the context of this simple model, provide a definition of "socially optimal" and compute the correct amount of research activity and of new product under your definition of optimality. Compare these optimal solutions with those of the previous question.

(3.3) Suppose that the government wants to entice the researcher/entrepreneur to supply the socially optimal amount of research activities and of new product. To achieve this objective, the joint use of two policies is considered: a tax/subsidy scheme in the market for the new product y, and a tax/subsidy scheme for the labor input x used in the actual development of the innovation. Determine the optimal level of these two policies and briefly discuss the economic implications.

Question 4 – Part A

Consider a pure exchange economy consisting of two consumers (denoted A and B) and two goods (denoted x_1 and x_2). Preferences and initial endowments for each consumer are given by

$$U^A(x_1^A, x_2^A) = \min(2x_1^A, x_2^A) \qquad (e_1^A, e_2^A) = (4,4)$$
$$U^B(x_1^B, x_2^B) = x_1^B + x_2^B \qquad (e_1^B, e_2^B) = (0,0)$$

(4.1) Draw an Edgeworth box with the following: (a) at least two indifference curves for each consumer noting the direction of increasing utility, (b) the set of Pareto efficient allocations for this economy, (c) core of this economy, and (d) the Walrasian equilibrium.

Question 4 – Part B

Consider a pure-exchange economy consisting of two-consumers (denoted A and B) and two goods (denoted x_1 and x_2). Consumer A has preferences represented as $U^A(x_1^A, x_2^A) = \ln(x_1^A) + \ln(x_2^A)$ and initial endowment $(e_1^A, e_2^A) = (Y, 0)$ where Y is a number greater than zero. Consumer B has preferences represented as

$$U^B(x_1^B, x_2^B) = \frac{(x_1^B)^{1-\gamma}}{1-\gamma} + x_2^B$$

And initial endowment $(e_1^B, e_2^B) = (0, Z)$ where Z is a number greater than zero and γ is a utility function parameter (assume $\gamma > 2$).

(4.2) Solve for the competitive equilibrium for this economy (*Note: assume Z is sufficiently large such that $x_2^B > 0$, i.e., an interior solution).* Box your final answer.

(4.3) Show that consumer A would obtain higher utility if she costlessly disposed of some of her endowment before engaging in trading.

(4.4) Briefly explain why consumer A is better off if she were to dispose of some of her endowment *(hint: think about the curvature of supply or demand).*

Question 5 – Part A

Suppose that you are the Teaching Assistant for undergraduate intermediate microeconomics. Students in this undergraduate class are currently learning about simple economic games like the prisoners dilemma and very simple sequential games. A student comes to your office hours and is confused about the difference and the connection between Nash equilibrium and subgame-perfect equilibrium.

(5.1) Briefly (1 page), at a level understandable to an undergraduate student, explain both types of equilibrium concepts and the difference and connection between them.

Question 5 – Part B

The department of agricultural and applied economics needs to fill a faculty position and has two job applicants. One applicant is a theorist and the other applicant is an econometrician who could be either very good or very bad. The decision of which candidate to hire depends on the votes of two faculty members that constitute the search committee: Professor X and Professor Y. Both of the faculty members agree that the correct decision is: hire the econometrician if she is very good, otherwise hire the theorist. Specifically, both Professor X and Professor Y get respective payoffs of 1 if the correct decision is made and 0 if the wrong decision is made. Professor X knows the quality of the econometrician candidate with certainty, while professor B assigns probability 0.9 to the event that the candidate is very good and 0.1 probability that she is very bad (*note: these beliefs are common knowledge among the members of the hiring committee).* The decision is made according to the following procedure. Each faculty member on the hiring committee has three alternatives: vote for the theorist, vote for the econometrician, or do not vote at all. The candidate that gets more votes than the other is hired. If both candidates get the same number of votes, then the decision is made by a flip of a coin in which case the payoffs to each faculty member on the hiring committee is ½.

(5.2) Formulate this hiring situation as a Bayesian game

(5.3) Find two Bayesian equilibria.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

July 30, 2018

9:00 a.m. to 2:00 p.m.

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Question 1

Consider the function $f(p_1, p_2, u) = \frac{8}{3}\left(\frac{3}{5}\right)^{\left(\frac{5}{8}\right)} p_1^{\beta} p_2^{\left(\frac{3}{8}\right)} u$ where p_1 and p_2 are prices and u is some minimally desired level of utility.

(1.1) Use the homogeneity property for an expenditure function that represents a continuous strictly convex, and locally nonsatiated preference relation $\succsim$ on $\Re^2_+$ to determine the value of β that makes this function a valid expenditure function.

(1.2) Derive the Hicksian demand for commodity 1 using this expenditure function

(1.3) Use duality to find an indirect utility function that is consistent with this expenditure function.

Question 2

(2.1) You are the teaching assistant for an intermediate undergraduate microeconomics course. A student asks you to explain the difference between *compensating variation (CV)* and *equivalent variation (EV)*. Intuitively explain, at an undergraduate level, the difference. Supplement your discussion using a figure with two goods (x, y) when the price of x rises (*one page max)*.

(2.2) Now demonstrate the difference by solving the following: a consumer's utility function is defined by $U(x,y) = xy$ subject to the budget constraint $I = p_x x + p_y y$. Let income $I = 18$, $p_x = 1$ and $p_y = 1$. Suppose p_x increases to 3. What is the CV and EV due to this price change?

Question 3

Consider a firm that has a monopoly position in two related goods. On the advice of consumer advocacy groups the government is considering breaking up the firm into two separate companies. The question is, are two monopolies better than one? Rather than looking at a stylized model, consider the following more explicit case. Suppose that there are two firms (1 and 2), each producing a good x_i at constant marginal cost c_i. Each firm has monopoly power in the production of its good. Assume the goods are perfect complements, and the demand for each good by the representative consumer is $x_i = (p_1 + p_2)^{-2}, i = 1,2$ where p_i is the price charge for one unit of x_i.

(3.1) Assuming the two firms act independently to maximize their own profit and the decisions occur in the following sequence. Firm 1 moves first and chooses p_1. Firm 2 moves second and chooses p_2 after observing p_1. Find the profit-maximizing prices p_1^* and p_2^*.

(3.2) Assume the two firms are merged into a single firm. The integrated firm maximizes profit over the sale of both goods. Set up and solve the appropriate optimization problem for the integrated firm (*hint: due to the nature of the two goods, solve for the price of the composite good* $\overline{p} = p_1 + p_2$).

(3.3) Compare the total profit of the two firms in part 1 and the profit of the integrated firm in part 2. Is integration beneficial to the firms? Why or why not?

(3.4) Define an appropriate welfare metric to answer the question of whether consumers are better off with two monopolies (part 1) or an integrated monopoly (part 2).

(3.5) For this explicit model, it was assumed the two goods are perfect complements. What role did this assumption play, i.e., how would the results have changed if demand functions for each good only depended upon its own price (e.g., $x_1(p_1)$ and $x_2(p_2)$)?

Question 4 – Part A

Consider a pure exchange economy consisting of two consumers (denoted A and B) and two goods (denoted x_1 and x_2). Preferences and initial endowments for each consumer are given by

$$U^A(x_1^A, x_2^A) = \min(2x_1^A, x_2^A) \qquad (e_1^A, e_2^A) = (2,1)$$
$$U^B(x_1^B, x_2^B) = \min(x_1^B, x_2^B) \qquad (e_1^B, e_2^B) = (2,3)$$

(4.1) Draw an Edgeworth box with the following: (a) at least two indifference curves for each consumer noting the direction of increasing utility, (b) the set of Pareto efficient allocations for this economy, (c) core of this economy, and (d) the Walrasian equilibrium.

Question 4 – Part B

Consider an economy consisting of a single consumer and a single firm that is owned by the consumer. The consumer is endowed with zero units of the consumption good and has 6 units of time. The consumer's time is divisible and may be allocated towards leisure activities or labor employed by the firm. The consumer's preferences are represented by the following utility function $u(\ell, x_2) = \min(x, \ell)$ where ℓ denotes the time consumer allocates to leisure and x is the consumption good. The firm produces the output good using labor according to the following production technology: $f(L) = L$. Negative consumption of goods or leisure is not permitted in this economy. Let p and w denote, respectively, the price of the consumption good and the wage rate, and normalize the price of the consumption good to one for the entire problem.

(4.1) What type of returns to scale does the production technology reflect? Solve for the firm's demand for labor, supply function, and profit function *(hint: all three should be piecewise functions due to the nature of the production technology)*.

(4.2) Solve for the consumer's demand function for the consumption good and the supply function for labor.

(4.3) Find the competitive equilibrium for this economy.

Question 5

Consider the following card game involving two players. At the beginning of the game, both players put \$1 into the "pot" that will be given to the winner of the game. Player 1 draws a card from a deck. With probability *r* the card is red, with probability *1-r* the card is black (*DO NOT ASSUME r=0.5 for this problem)*. Player 1 looks at the card to see what color it is, but does not show the card to player 2. Player 1 has a decision to make, she can either *Raise* or *Check*. If Player 1 *Checks*, the game is over. Player 1 wins the pot if the card is red, Player 2 wins the pot if the card is black. If Player 1 *Raises*, Player 2 has a decision to make, she can either *Meet* or she can *Pass*. If Player 2 *Passes*, the game ends and Player 1 wins the pot if the card is red, Player 2 wins the pot if the card is black. If Player 2 *Meets*, then each player puts an additional \$1 into the pot. The game ends, and Player 1 wins the pot if the card is red, Player 2 wins the pot if the card is black.

(5.1) Show the game in extensive form.

(5.2) Describe the expected payoffs for the normal form of the game.

(5.3) For what values of *r* is there a pure strategy Nash Equilibrium?

(5.4) Find a Nash equilibrium of the game in mixed strategies.

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Question 1

(1.1) State the standard properties of a profit function $\pi(p, w)$.

(1.2) Consider the production function $f(z_1, z_2) = \sqrt{z_1} + 2\sqrt{z_2}$ where input prices (w_1, w_2) are strictly positive ($(w_1, w_2) \gg 0$) and the output level is $q \geq 0$. Solve for (i) the cost function, (ii) conditional factor demands, (iii) the profit-maximizing input and output levels given an output price p.

Question 2

Consider a two-consumer, two-good pure exchange economy. Consumer 1 has a preference relation represented by the utility function: $U_1(x, y) = x^2 y$ for $x \geq 0$ and $y \geq 0$. Consumer 2 has a preference relation represented by the utility function: $U_2(x, y) = x^2 y$ for $x \geq 0$ and $y \geq 0$. Consumer 1's endowments for each good are $x = 5, y = 15$. Consumer 2's endowments for each good are $x = 15, y = 5$. *Note: For parts 1-3 below you do not need to give any explanations or proofs beyond the requirements stated.*

(2.1) Construct an Edgeworth box diagram to scale. Be sure to show and label the endowment allocation and typical indifference contours/sets including the directions of increasing preference for each consumer.

(2.2) Characterize the set of Pareto Efficient allocations and illustrate them on your diagram.

(2.3) Identify the competitive (Walras) equilibrium allocation including the equilibrium prices and illustrate it on your diagram.

Question 3

(3.1) A freshman student in a microeconomics course involving no calculus (i.e. only basic supply and demand and cost curve graphs are taught) is learning about the difference between different market structures. Clearly explain to the student using appropriate graphs and simplifications the differences between Bertrand competition, Cournot competition, competitive markets, and a monopoly. Key issues that should be explained include (but are not limited to), equilibrium prices and quantities and welfare. *Note: 3 pages max to answer this question.*

(3.2) Consider a Cournot game with 2 firms. The market inverse demand curve is given by $P(Q) = 500 - Q$, where $Q = q_1 + q_2$ and q_i is the quantity produced by firm i. Each firm's total cost is linear $C_1(q_1) = q_1$ and $C_2(q_2) = q_2$, respectively. What is each firm's best response as a function of the other firm's output? Graph these best response function on the same graph. Calculate the Nash Equilibrium and indicate it on the graph. Compute the associated payoffs for each firm.

(3.3) Calculate the cooperative equilibrium in which the two firms collude to behave like a monopolist. Is the cooperative solution a Nash Equilibrium?

Question 4

Consider an agent with logarithmic utility, U(w)=ln(w), and an initial wealth of $100,000 to invest. The agent has two assets to choose among (all $100,000 must be invested across the two available assets). The first is Google stock. Currently Google stock is trading in the market at $2 per share and has even odds of either staying at $2 or increasing to $4 one year from today. The second asset is a type of option. This asset returns $0 if Google stock moves up to $4 and returns $1 if the stock stays at $2. The price of the option is $0.25.

(4.1) Given the assumed utility function, what type of attitude towards risk does the agent have? What is the agent's Arrow-Pratt measure of absolute risk aversion?

(4.2) Graphically illustrate the payoff tree for the agent's portfolio letting x_G denote the number of dollars invested in Google stock and x_O denote the number of dollars invested in the Option.

(4.3) Solve for the agent's optimal investment in the two assets (fractional purchases are ok).

(4.4) If the investor was offered the opportunity to put her money in a savings account that guarantees a 50% return, R=(1+r)=1.5, would the investor prefer to invest in the savings account or Google Stock? Why? *Note: 2 sentences max for this question.*

Question 5

Consider the following "Battle of the Sexes" game

husband \ wife	Football	Antiques
Football	6, 3	3, 2
Antiques	-2, 1	4, 7

(5.1) Find all pure strategy Nash equilibriums.

(5.2) Calculate the probabilities necessary for the mixed strategy Nash Equilibrium. Be sure to explicitly state which probabilities are used by which players.

(5.3) Suppose instead of playing simultaneously, consider a sequential version of this game. Suppose the wife decides in the first stage which pure strategy to play and the husband decides in a second stage. Represent the game in extensive form and solve for the subgame perfect equilibrium of the game.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 25, 2017

9:00 a.m. to 2:00 p.m.

Your **810 Code #** ______________________

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Please follow all instructions listed below:

- Number your responses to the questions clearly.
- Write the last 4 digits of your Student ID number at the top right of each response page.
- Write the page number in the lower right hand corner of each response page.
- Write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited.
- Write only on one side of paper with a blue or black pen.
- Clearly box all final answers to numerical and algebraic problems

Question 1

(1.1) Derive and explain the Engel Aggregation associated with a demand system for n commodities (Hint: Recall, the Engel Aggregation starts with the budget identity).

(1.2) Let a consumer's preference relation be represented by the function $U(x_1, x_2) = x_1^{3/5} x_2^{4/5}$. Set up and solve this consumer Utility Maximization problem. Find the arguments that optimized the function and the optimal value function. List and *demonstrate* 4 of the properties of this optimal value function. Find the dual to the optimal value function in the simplest way possible.

Question 2

Consider a two-consumer, two-good pure exchange economy. Consumer 1 has a preference relation represented by the utility function: $U_1(x, y) = x^2 + y^2$ for $x \geq 0$ and $y \geq 0$. Consumer 2 has a preference relation represented by the utility function: $U_2(x, y) = x + y$ for $x \geq 0$ and $y \geq 0$. Consumer 1's endowments for each good are $x = 0, y = 20$. Consumer 2's endowments for each good are $x = 20, y = 0$. *Note: For parts 1-3 below you do not need to give any explanations or proofs beyond the requirements stated.*

(2.1) Construct an Edgeworth box diagram to scale on the graph paper provided. Be sure to show and label the endowment allocation and typical indifference contours/sets including the directions of increasing preference for each consumer.

(2.2) Characterize the set of Pareto Efficient allocations and illustrate them on your diagram.

(2.3) Identify the competitive (Walras) equilibrium allocation including the equilibrium prices and illustrate it on your diagram.

Question 3
A freshman student in a microeconomics course involving no calculus (i.e. only basic supply and demand and cost curve graphs are taught) is learning about the difference between perfect competition and monopoly. The student is trying to understand how short- and long-run (i) prices, (ii) quantities, and (iii) profits behave when there is a positive demand shift under different types of market competition. Graphically illustrate and explain i-iii in the short- and long-run for the case of (a) a market with perfect competition and (b) a monopoly.

Question 4
Assume there are ten firms operating in a perfectly competitive marketplace employing the technology $q = 4\bar{K}L^{1/4}N^{1/4}$ where K, L, and N denote capital, labor, and a natural resource respectively. Let $\bar{K} = 2$, the wage rate $w = \$10$, the price of the natural resource $h = \$40$, and the rental rate of capital $r = \$50$.

(4.1) Derive the individual and market short-run supply functions.

(4.2) Find and graph the market equilibrium if inverse demand is given by $P(Q) = 500 - 0.5Q$.

(4.3) Calculate individual firm profits and determine if the market is in long-run equilibrium (given the fixed level of capital $\bar{K}$).

Question 5
Consider a market characterized by the demand function $Q = 1 - P$ and a monopolist with a constant marginal cost c. There is a potential new firm that could enter the market. The potential entrant has the same marginal cost as the incumbent, c, but has a fixed entry cost $F = 0.1$. If the new firm enters the market, the incumbent firm has two options, play "passive" or play "aggressive". If the new firm enters and the incumbent is "passive", then Cournot competition is played. Alternatively, if the new firm enters and the monopoly plays "aggressive" by producing the competitive output (i.e., the quantity such that $P = c$), the new entrant will have losses if it enters the market. If the new firm does not enter, the incumbent firm behaves as a monopolist.

(5.1) Assuming that the marginal cost $c = 0$, compute the profits for both firms under (i) Monopoly, (ii) Cournot duopoly, and (iii) if the new firm enters and the incumbent plays "aggressive".

(5.2) Represent the game in extensive form where in the first stage the new entrant decides to enter or not enter. In the second stage the incumbent chooses to be passive or aggressive if entry occurs and continues as a monopoly if no entry occurs.

(5.3) Find the subgame perfect equilibrium of the game. Is the threat by the monopolist to be aggressive credible?

(5.4) Represent the game in normal form. Find the Nash equilibria of the game. Are there any N.E. that are not subgame perfect?

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam
Jun 2, 2016
10:00 a.m. to 3:00 p.m.

Your **810 Code #** ________________________

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Please follow all instructions listed below:

- Number your responses to the questions clearly.
- Write the last 4 digits of your Student ID number at the top right of each response page.
- Write the page number in the lower right hand corner of each response page.
- Write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited.
- Write only on one side of paper with a blue or black pen.
- Clearly box all final answers to numerical and algebraic problems

(1.1) Consider preferences represented by the utility function $U(x_1, x_2) = \ln(x_1) + 4\ln(x_2)$ facing market prices $p_1, p_2 > 0$. Let the consumer's wealth be denoted by $I > 0$. Setup a Lagrangian for maximizing utility subject to the budget constraint and solve for the Marshallian (uncompensated) demand functions for $x_1$and x_2.

(1.2) How do you interpret the Lagrange multiplier in the utility maximization problem?

(1.3) Find the Indirect Utility function. State and demonstrate three properties of the Indirect Uility function.

(1.4) Find the consumer's Expenditure function in the simplest way possible.

(1.5) State and demonstrate three properties of the Expenditure function.

(1.6) Derive the Hicksian (compensated) demand functions for $x_1$and x_2.

(2.1) Consider a pure exchange economy with 2 people (A and B) and 2 commodities denoted x_1 and x_2. The preferences of individuals A, and B are represented as:

$$U^A(x_1^A, x_2^A) = x_1^A + 2x_2^A \qquad\qquad U^B(x_1^B, x_2^B) = \min\{2x_1^B, x_2^B\}$$

where $\delta > 1$. Solve for the competitive equilibrium of this economy assuming initial endowments are:

$$e_1^A = 10, e_2^A = 10, \quad e_1^B = 10, e_2^B = 10,.$$

You do not have to show any work, but you must box the following (a) the setup of all optimization problems, (b) the demand functions for each agent, and (c) the final answer for the Walrasian Equilibrium. Clearly and precisely illustrate the equilibrium, initial endowment, core of the economy, and the set of Pareto Efficient Allocations

(2.2) Consider an economy consisting of a single consumer and a single firm that is owned by the consumer. The consumer is endowed with zero units of the consumption good and has 24 units of time. The consumer's time is divisible and may be allocated towards leisure activities or labor employed by the firm. The consumer's preferences are represented by the following utility function $u(\ell, x_2) = \ell^{2/3}x_2^{1/3}$ where ℓ denotes the time consumer allocates to leisure and x_2 is the consumption good. The firm produces the output good using labor according to the following production technology: $f(L) = 2L$. Negative consumption of goods or leisure is not permitted in this economy. Letting p and w denote, respectively, the price of the consumption good and the wage rate, solve for the competitive equilibrium for this economy (in your answer, normalize the price of the consumption good to 1). It is recommended that you clearly setup any relevant optimization problems, express and box relevant derived supply and demand functions in addition to boxing your final equilibrium solution.

(3.1) Suppose that you are a teaching assistant for a freshman microeconomics course that involves no calculus. A student comes to office hours and does not understand why the market equilibrium (in the absence of market failures) is efficient. Nor does the student understand why market power (e.g., monopoly and oligopoly) sometimes leads to inefficient market outcomes and sometimes leads to efficient market outcomes despite the existence of market power. Using graphs and language appropriate for a freshman student, help answer the student's question (2 pages MAX).

(3.2) Suppose that you are a teaching assistant for an intermediate undergraduate microeconomics course. A student studying duopolies comes to your office and is confused about the difference between Bertrand, Cournot, and Stackelberg models. Briefly (1 paragraph max) explain the three models.

(3.3) Consider a duopoly setting where the linear demand and cost functions are:

$$p = 14 - (q_1 + q_2)$$

$$c(q_j) = 2q_j + 5, j = 1,2$$

Derive the Cournot model equilibrium, Stackelberg model equilibrium, and the equilibrium under collusion.

(4.1) What are the pure strategy Nash equilibria in the following discrete-strategy-space game? Calculate the probabilities necessary for the mixed strategy Nash Equilibrium. Be sure to explicitly state which probabilities are used by which players.

Lennon \ McCartney	Compose Songs	Record Songs
Compose Songs	4, 4	2, 3
Record Songs	2, 1	3, 5

(4.2) AT&T is considering entering the Athens cellular phone market. Currently, Verizon wireless is the only firm providing cellular phone service in Athens. If AT&T enters, there could be a price war. If AT&T stays out, Verizon earns monopoly profits of $10 million and AT&T earns zero. If AT&T enters, it will incur an irreversible entry cost of $2 million. If there is a price war, each firm will earn $1 million. Verizon has the option of "accommodating entry" (i.e., not starting a price war). In this case, both firms would earn $4 million. The timing of this market is as follows: first, AT&T has to choose whether or not to enter the market. Then Verizon decides whether to "accommodate entry" or "engage in a price war". Illustrate this game in extensive form. Solve for the subgame perfect equilibrium.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam Retake
July 27, 2016
10:00 a.m. to 3:00 p.m.

Your **810 Code #** ________________________

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Please follow all instructions listed below:

- Number your responses to the questions clearly.
- Write the last 4 digits of your Student ID number at the top right of each response page.
- Write the page number in the lower right hand corner of each response page.
- Write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited.
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(1.1) On a single graph, carefully represent and label the following curves for a stylized firm: (i) Average Fixed Cost, (ii) Marginal Cost, (iii) Average Total Cost, (iv) Average Variable Cost, (v) Short Run supply Curve.

(1.2) A freshman student in a microeconomics course looking at your graph is confused about whether there is a relationship between the marginal cost curve and the average total cost curve. Explain to the student if or if not there is a relationship between the two.

(1.3) Theoretically define the firm's short run cost function; state and demonstrate two properties of this optimal value function.

(1.4) Consider a firm that uses labor L and capital K in its production process for output q. Given the production technology $q=LK$, and a market wage $w=\$16$ and capital rental rate $r=\$9$, solve for the firm's least-cost combination of inputs for producing a level of output q=144.

(1.5) Assuming that capital is fixed in the short run at a level $\overline{K} = 2$, solve for the firm's short run total cost function.

(2.1) Consider a pure exchange economy with 2 people (A and B) and 2 commodities denoted x_1 and x_2. The preferences of individuals A, and B are represented as:

$$U^A(x_1^A, x_2^A) = x_1^A + 2x_2^A \qquad\qquad U^B(x_1^B, x_2^B) = 2x_1^B + x_2^B$$

Solve (*note: you do not have to show any work if you do not want to*) for the set of Pareto Efficient Allocations and illustrate your result assuming initial endowments are:

$$e_1^A = 10, e_2^A = 10, \quad e_1^B = 10, e_2^B = 10.$$

(2.2) Consider a pure exchange economy with 2 people (A and B) and 2 commodities denoted x_1 and x_2. The preferences of individuals A, and B are represented as:

$$U^A(x_1^A, x_2^A) = \min\{x_1^A, x_2^A\} \qquad\qquad U^B(x_1^B, x_2^B) = \min\{4x_1^B, x_2^B\}$$

where initial endowments are:

$$e_1^A = 30, e_2^A = 0, \quad e_1^B = 0, e_2^B = 20.$$

If the agents are not permitted to have negative consumption of either of the goods, solve for the Walrasian equilibrium.

(2.3) One of the core issues in politics at the local, state, national, and global level is the issue of efficiency vs. equality or "fairness". Against this backdrop, in the next several questions provide a clear explanation with graphs (1 page each max) of the issue appropriate for the level of student asking the question.

(2.3.a) A freshman student in a microeconomics course makes the following statement: "If I were running for president I would increase taxes on goods that rich people purchase like yachts, luxury cars, mega-mansions, etc. and decrease taxes on goods that low income people purchase like budget cars, grocery staples, and smaller homes." Explain from an efficiency vs. equality and "fairness" perspective why and why not the student's proposal may or may not be a good idea.

(2.3.b) An intermediate undergraduate student makes the following statement: "In class we learned about the 1st and 2nd welfare theorems. If a society only cares about equality, it would be optimal to give each individual the same quantity of goods and services. That way everyone would have exactly the same, thus it would be perfectly equal and pareto optimal". Explain and illustrate if or if not the student is correct.

(3.1) The **University 16 Cinema** has a constant marginal cost of production = \$2.50. Through experience, the Cinema estimates demand for daytime, matinee showings to be $q_m = 51.25 - 2.5p_m$ and demand for prime-time, evening showings to be $q_p = 203.125 - 1.25p_p$. Can this firm engage in price discrimination? Why or why not?

(3.2) What is the profit-maximizing price strategy for this business? Explain.

(3.3) How much profit does **University 16 Cinema** earn under the optimal pricing strategy?

(4.1) Consider a game involving two players that works as follows. There is an initial pile of money with \$18. Player 1 gets to move first, then the second player, then the first player again, and finally player two gets to move again before the game ends. When it is a player's turn, the have two possible actions: grab (G) money or share (S) money. If the player grabs money, the player gets 2/3 of the current pile of money, the other player gets 1/3 of the pile of money, and the game is over. If the player shares, then the current pile of money is multiplied by 3/2 and the next player gets to do their turn. In the last stage of the game in which player two makes their last decision, if the player chooses to share then the pile of money is multiplied by 3/2, player two gets 1/3 of the pile and player 1 gets 2/3 of the pile. Represent the game in extensive form.

(4.2) Represent the game in matrix form.

(4.3) Find all Nash equilibria of the game.

Microeconometrics Prelim Exam 2015

Question 1

(1.1) State at least three and up to six key properties of a standard cost function.

(1.2) Consider the following 2-input production function for a competitive producer

$$f(z_1, z_2) = min\left\{z_1, \frac{\sqrt{z_2}}{\alpha}\right\},$$

where $\alpha > 0$. Solve for the cost function and the profit function associated with this technology. *Please simplify your answer.*

(1.3) Prove that the profit function you derived is or is not homogenous of degree one in prices.

(1.4) What is the maximum amount of money a competitive producer would be willing to pay to adopt a new technology that reduces α from an initial value of 1 to a new value of 0.5?

(1.5) Consider a different firm that has the following cost function $C(w_1, w_2, y) = \Psi w_1^{\alpha} w_2^{1-\alpha} y^b$ where $\alpha, b,$ and Ψ are constants. What property of the cost function can be used to easily derive the corresponding production function? Derive the production function.

Question 2

(2.1) Assume you know that the consumption of a gallon of gasoline to propel a motor vehicle involves a cost not directly borne by the consumer of the gallon of gasoline. (For example, internal combustion might cause harmful air pollution.) You, as energy czar, have a choice between two policy instruments to reduce the implied efficiency losses:

(i) a fuel economy standard, which specifies the minimum fuel efficiency (miles per gallon) that automobiles must achieve; or
(ii) a tax on gasoline.

As the Chairman of the Council of Economic Advisors, which would you recommend to the President? Why? Explain concisely but carefully, using algebra or graphs if appropriate.

(2.2) It is possible the President will ignore your recommendation, so you must be prepared to respond with a recommendation about how best to implement the President's choice.

(2.2.1) If the President picks the fuel the economy standard, would you recommend it apply only to cars newly produced each or, or would you recommend requiring the entire stock of existing cars to meet the standard? Explain.

(2.2.2) If the President picked the tax, would you recommend a fixed, per-gallon tax, or a proportional, ad valorem tax? Explain.

Question 3

(3.1) Give a formal definition (appropriate for a Ph.D. economist) and a simple explanation (understandable to a high-school student) of first- and second-order stochastic dominance. Briefly explain their implications for the choice made by an expected utility maximizing agent.

(3.2) Consider an investment decision for a risk-averse agent with wealth W that must be completely invested across two possible assets: Stocks and bonds. Each share of stock has a market price of p_1 and each bond has a market price of p_2. Fractional purchases are acceptable. At market close for the day, stocks have a 50/50 probability of being worth $\underline{p_1}$ or $\overline{p_1}$ where $0 < \underline{p_1} \leq \overline{p_1}$ and bonds have a 100% probability of being worth p_2. Assuming log utility over wealth, solve for the agent's quantity demand for stocks (negative purchases, i.e., short sales, are allowed) assuming that the price of each bond is $p_2 = 1$ and the price of the stock is $p_1 = 1$.

(3.3) For a risk averse agent to demand a positive quantity of stocks, what must be true of $\overline{p_1}$?

(3.4) Consider an agent who owns 1 share of the stock described above and has $W dollars of cash. The agent is not allowed to sell the stock, they must keep it. But, suppose that the agent is offered the opportunity to purchase insurance costing π per unit of insurance that in the event the price of the stock goes down to $\underline{p_1}$ each unit of insurance pays $p_1 - \underline{p_1}$. In the event that the stock price goes up to $\overline{p_1}$ each unit of insurance pays $0. Assuming the agent is risk neutral, what is the agent's demand for insurance, q, assuming negative and over insurance is not permitted by the insurance company (i.e., $0 \leq q \leq 1$).

Question 4

Consider a market for a good Q that has a linear inverse demand curve $P = 30 - Q$. This market has a large number of competitive producers that each has a constant marginal cost MC=$10 with no fixed costs.

(4.1) For this market, what is the competitive equilibrium price, quantity, and profit earned by each firm.

(4.2) If the firms in the industry could merge into a monopoly, what is the monopolists profit maximizing quantity, price, and profit? *Assume that the monopolist still has the same cost structure as the competitive firms above.*

(4.3) Suppose that the production in this industry generates a pollution externality that has a constant marginal damage of $10. What would the socially optimal quantity of output be? Briefly describe different solutions that could be implemented to achieve this socially optimal outcome.

Question 5

(Minority game): Three agents each have two possible actions. Whichever agent ends up in the minority (choosing a different action from the other two) wins. For simplicity, assume the winner receives a payoff of one, and the losers receive zero. Find the pure strategy Nash Equilibria. Recall, the strategic form of a three player, simultaneous game will require two matrices (with each cell having three payoffs – one for each player).

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 30, 2014
9:30 a.m. to 2:30 p.m.

Your **810 Code #** ________________________

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Please follow all instructions listed below:

- Number your responses to the questions clearly.
- Write the last 4 digits of your Student ID number at the top right of each response page.
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- Clearly box all final answers to numerical and algebraic problems

Question 1

(1.1) State four key properties of the indirect utility function.

(1.2) Suppose a consumer is indifferent between two different price vectors p and q. Consider a third price vector equal to $(p + q)/2$. Will the agent prefer price vector p or $(p + q)/2$ or be indifferent between the two? Briefly explain why.

(1.3) Consider the utility function $U(x_1, x_2) = \min(x_1, x_2)$. Derive the indirect utility function, the expenditure function, and Hicksian demand functions for this utility function.

(1.4) Present a graph illustrating the impact of a decrease in the price of good 1. Make sure to clearly label all relevant curves and the magnitude of the substitution and income effects.

Question 2

Standard microeconomic theory of perfectly competitive markets prescribes that an endogenously determined market price will emerge where all consumers who are willing and able to purchase a product will do so at that price. However, there are many examples of familiar goods where consumers of the same product pay different prices. For example, a web search of "first time buyer discounts" reveals the Comcast (an internet and cable TV service provider) and Kia (a car company) give discounts to first time buyers of their product. Limiting your response to 2 pages (including any relevant graphs), discuss the economics of first time buyer discounts by Comcast and Kia with particular attention to:

(2.1) How can first time customer discounts increase the profits of these firms?
(2.2) How can these two firms enforce this discriminatory pricing scheme?
(2.3) How can a firm without market power sustain price discrimination in the face of competition?

Question 3

Suppose that a wood pulp mill situated on a river bank releases pollutants into the river. The private marginal cost (*MC*) of producing wood pulp (in $ per ton) is given by the function: $MC=10+0.5Y$, where Y is tons of wood pulp produced. In addition, an external cost is incurred. Each ton of wood pulp produced results in pollutant flows into the river which cause damage valued at $10 per ton. This is an external cost as it is borne by the wider community but not by the polluting firm itself. The marginal benefit (*MB*) to society of each ton of produced pulp, in $, is given by $MB=30-0.5Y$.

(3.1) Draw a diagram illustrating the private marginal cost (*MC*), marginal benefit (*MB*), external marginal cost (*EMC*) and social marginal cost (*SMC*) functions. Find the profit-maximizing output of wood pulp assuming the mill can obtain marginal revenue equal to the marginal benefit to society derived from wood pulp. Find the output of wood pulp which maximizes social net benefits.

(3.2) Explain why the socially efficient output level of wood pulp is lower than the private profit maximizing output level. At which level would you set a tax so as to equalize them?

(3.3) State the First Fundamental Theorem of Welfare Economics (FFTWE). Would it hold in part (3.1)? Name and briefly discuss in what situations the FFTWE will not hold.

Question 4

(4.1) Consider an economy consisting of a single consumer, two firms, and two consumption goods. Consumers are endowed with zero units of the two consumption goods and one unit of time. Time is divisible and may be allocated towards leisure activities or labor. The consumer's preferences are represented by the following utility function $u(x_1, x_2, \ell) = \ln(x_1) + \ln(x_2)$ where x_1 and x_2 are the two consumption goods and ℓ denotes the time consumer allocates to leisure. The first firm, which may produced good x_1, has the production function $f(L_1) = \left(\frac{L_1}{8}\right)^{0.5}$ where L_1 is the labor used by the first firm to produce good x_1. The second firm, which may produced good x_2, has the production function $h(L_2) = \left(\frac{L_2}{8}\right)^{0.5}$ where L_2 is the labor used by the second firm to produce good x_2. Negative consumption of goods or leisure is not permitted in this economy. The single consumer is the owner of both firms. Solve for the competitive equilibrium for this economy (in your answer, normalize the wage rate to 1).

(4.2) Consider a two-agent (A and B) two-good (x_1 and x_2) pure exchange economy. Preferences for each agent are represented as $U^A(x_1^A, x_2^A) = x_1^A$ and $U^B(x_1^B, x_2^B) = x_2^B$. Each agent is endowed with fifty units of each good. Express the Walrasian equilibria for this economy. Draw an Edgeworth box for this economy. In your figure you must show (i) indifference curves for each agent, (ii) all Walrasian equilibria for the economy, and (iii) all Pareto Efficient allocations for this economy.

Question 5

Consider a second-price auction for a single good with two bidders (1 and 2) who are only permitted to submit a bid of either zero or 2/3 ($b_i \in \{0, 2/3\}, i = 1,2$). These are the only bids that are permitted in this auction (i.e., bidder 1 must submit a bid of either zero or 2/3 and bidder 2 must submit a bid of either zero or 2/3). Each bidder is risk-neutral and has a private valuation drawn from i.i.d random variables that are uniformly distributed on the interval ($V_i \sim U[0,1], i = 1,2$). After observing his own valuation, each bidder independently submits their bid for the good. The highest bidder is the winner of the auction and must pay the amount of the losing bid. Ties are resolved by a fair coin toss, with the winner of the coin toss winning the auction.

(5.1) Solve for the Bayesian-Nash equilibrium of this auction with only two allowable bids (*Remember, a strategy for the game must, for each possible private valuation, specify which of the two permitted bids is placed by each bidder).*

(5.2) In a standard second price auction (i.e., one where bidders are not restricted to only two bid options) bidders never have an incentive to submit a bid greater than their personal values. Explain whether this property holds in this modified auction where only two bid options are permitted.

(5.3) How does the efficiency of the Bayesian-Nash equilibrium of a standard second-price auction game compare to the Bayesian-Nash equilibrium of the modified second-price auction game where only 0 or 2/3 bids are permitted?

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

June 7, 2013
9:30 a.m. to 2:30 p.m.

Your **810 Code #** ______________________

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Number your responses to the questions clearly and write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited. It is essential that you state all assumptions clearly and demonstrate your command of economic reasoning.

1. In agricultural markets, spatial monopsonies can arise. For example, farm production and procurement for processing of canning tomatoes might be characterized by monopsony market power. In answering the questions below consider the canning tomato industry when developing your answers. Production of canning tomatoes requires inputs of labor, land and machinery, and purchased materials. Production of processed canned tomatoes requires inputs of canning tomatoes, labor, capital, energy, and other purchased materials.

   a. Discuss factors that can lead to markets characterized by a small number of purchasers (processors like tomatoes canners) of an input within a regional market area.

   b. Suppose you are trying to determine the extent of a regional market for canning tomatoes. Develop two different tests to determine if transactions at three different locations are within the same market area. In answering this question be sure to define all terms and discuss data needs, estimation procedures, and how you would interpret the results.

   c. Often when researchers find evidence that prices in two different regions are cointegrated, they conclude that markets are competitive. Is this conclusion correct? Explain why or why not.

   d. Suppose you determine from (b) that transactions at different locations are in different market areas. Set up and discuss a specific test procedure to determine if tomato processors in a specific market are actually exerting monopsony market power in procuring canning tomatoes. In answering this question be sure to: 1) develop specific estimating equations including specific functional forms; 2) show how those equations incorporate or can be tested for standard conditions required for profit maximization; 3) define all terms and discuss; 4) discuss data needs and estimation procedures to obtain results; and 5) how you would interpret the results.

2. Consider an economy with two goods (a consumption commodity, x, and leisure, ℓ), two firms capable of producing the consumption commodity, and one consumer. Let the price of the consumption commodity, x, be denoted as , p, and the price of leisure be normalized to 1. Assume that the consumer has an initial endowment of 0 units of the consumption commodity and 1 unit time that may be allocated across labor and leisure activities. The agent's preferences can be represented as:

$$U(x, \ell) = \log(x) + \log(\ell)$$

Assuming that the consumer owns both firms, the production technologies can be represented as:

$$y_1 = (L_1)^{\frac{1}{2}}$$

$$y_2 = (2L_2)^{\frac{1}{2}}$$

where y_1 and y_2 denote the output from firm 1 and 2 respectively and L_1 and L_2 denote the (positive) labor input used for production at firm 1 and 2, respectively.

a. Define (but do not solve for) a competitive equilibrium for this economy

b. Solve for the competitive equilibrium for this economy.

c. State the First Fundamental Theorem of Welfare Economics. Briefly discuss whether it applies to the solution in part B.

d. Consider a pure exchange economy with 2 people (person A and person B) and 2 commodities denoted x_1 and x_2. Initial endowments for each individual are $e_1^A = e_1^B = e_2^A = e_2^B = 10$. Solve for the set of Pareto Efficient allocations if preferences are represented as:

$$U^A = (x_1^A) \quad + (x_2^A) \qquad\qquad U^B = \min\{x_1^B, x_2^B\}$$

3. Suppose that the inverse demand curve for paper is $p = 200 - Q$, the private marginal cost (unregulated competitive market supply) is $MC^P = 80 + Q$, and the marginal harm from gunk (a waste product) is $MC^G = Q$.

a. What is an externality? Describe an example of a negative externality and how it might be treated in government/third party regulatory policy or law. Describe an example of a positive externality and its value to a near producer or consumer.

b. What is the unregulated competitive equilibrium of the supply/demand situation described above?

c. What is the social optimum? What specific tax (per unit of output of gunk) results in the social optimum?

d. What is the unregulated monopoly equilibrium?

e. How would you optimally regulate the monopoly? What is the resulting equilibrium?

f. Let $H = G - G$ be the amount that gunk, G, is reduced from the competitive level, G. The benefit of reducing gunk is $B(H) - AH^{\alpha}$. The cost is $C(H) = H^{\beta}$. If the benefit is increasing but at a diminishing rate as H increases, and the cost is rising at an increasing rate, what are the possible ranges of values for A, α, and β?

4. Three consumers are to be asked to vote on whether to provide a pre-designed public good that costs \$99. If a majority votes in favor, the public good is provided and each pays \$33. True valuations of the good are $r_1 = 90$, $r_2 = 40$, and $r_3 = 30$, and each consumer knows the others' valuations.

a. Which outcome is Pareto optimal: provision or non-provision of the public good? Which outcome will be selected by majority vote?

b. Now suppose each consumer announces her willingness to pay, b_j (not necessarily equal to r_j), for the public good. If $\sum_j b_j \geq 99$ the good is provided and each consumer pays b_j. What is a Nash equilibrium of this game?

5. Consider a lawsuit involving a plaintiff (i.e., the person that files a lawsuit requesting compensation for damages) and a defendant (i.e., the person being sued who will have to compensate the plaintiff if he loses the trial). There is, determined by nature at the beginning of the lawsuit, a 1/3 probability that the plaintiff will be victorious in the trial and a 2/3 probability that the defendant will be victorious in the trial. The plaintiff observes whether he will be victorious, the defendant does not observe whether he will be victorious. If the plaintiff wins he receives a payoff of \$3 and the defendant has a payoff of \$-4. If the plaintiff loses he receives a payoff of \$-1 and the defendant has a payoff of \$0.

After nature reveals to the plaintiff who would win the trial, the plaintiff has the opportunity to propose a low or high settlement of either $m=\$1$ or $m=\$2$. If the defendant accepts the settlement offer, they do not go to trial and the plaintiff has a payoff of \$$m$ and the defendant has a payoff of \$-m. If the defendant rejects the settlement offer, they go to trial and receive the payoffs described above.

To summarize, the steps of the game are as follows. Nature decides who will win the lawsuit. The plaintiff observes who will win the lawsuit. The plaintiff decides whether to offer a low settlement or a high settlement. The defendant decides to accept or reject the settlement offer. If accepted, there is no trial. If rejected, they proceed with the trial.

a. Represent the game in extensive form. Label everything.
b. Solve for the equilibrium of this game (a weak perfect Bayesian equilibrium is preferred, but you may use any equilibrium concept that you prefer that is appropriate for this type of game).

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 25, 2012
9:30 a.m. to 2:30 p.m.

Your **810 Code #**

Please provide complete answers to all questions. You have 5 hours to complete the exam; allocate your time accordingly. Number your responses to the questions clearly and write your answers legibly and orderly. Illegible writing may cause your answers to not be correctly credited. It is essential that you state all assumptions clearly and demonstrate your command of economic reasoning.

1. Consider a pure exchange economy with two goods (x, y) and two people $(1,2)$ where the total endowment of each good is $e_{x,1} + e_{x,2} = \overline{e}_x = 12$ and $e_{y,1} + e_{y,2} = \overline{e}_y = 12$. Assume preferences are given by: $U_1(x_1, y_1) = x_1 + y_1$ and $U_2(x_2, y_2) = 2\ln(x_2) + \ln(y_2)$.

   a) Assuming initial endowments of $e_{x,1} = 3$, $e_{x,2} = 9$, $e_{y,1} = 9$, $e_{y,2} = 3$, solve for the Walrasian equilibrium.

   b) For this economy find the set of Pareto efficient allocations. Illustrate precisely the set of Pareto efficient allocations on a graph. Discuss which (and how) Pareto efficient allocations in this economy can be supported as a competitive equilibrium.

   c) Consider the social welfare function, $W(U_1(x_1, y_1), U_2(x_2, y_2)) = \min\ \{x_1, x_2, y_1, y_2\}$. Solve for the commodity allocations that will maximize social welfare. Given the specification of preferences, is this allocation Pareto efficient? Explain why this social welfare function is economically not the most sensible.

2. Academic journals, such as the *American Journal of Agricultural Economics*, charge different subscription rates to institutions (college libraries, etc.), individual academics, and students. Explain this in terms of the theory of price discrimination. What would you predict about the pattern of relative subscription rates across these subscriber groups? Some journals are owned by profit-maximizing firms (publishing companies) and others are owned by learned societies (with contracted publication). What difference, if any, would you expect this to make to (a) the level of their rates, and (b) the pattern of price discrimination? (Use graphical analysis and/or mathematical illustration to support your written discussion in detail.)

3. A producer of widgets in a perfectly competitive market has estimated the following variable cost function for its output, y:

$VC = y^3 - 8y^2 + 24y$

Fixed costs of production are \$8.

a. Set up the profit maximization problem for this firm.

b. Derive the supply function for this firm. (**Hint:** You will need to use the average variable cost function to derive <u>the complete</u> supply function.)

c. Graph the supply function. Show both the average variable cost curve and the marginal cost curve. Be sure to label the axes of your graph.

d. Evaluate **graphically** and **mathematically** the impact of a tax τ that is imposed on each unit of output. Graph the changes in the total cost, marginal cost and average cost curves. Indicate the new equilibrium price, p_τ, and quantity, q_τ.

e. Now consider a generic cost function C(q,w,r), where q is output, w is the wage rate, and r is the capital rental rate. State the properties of the cost function and briefly discuss each property.

4. Three individuals, *A*, *B*, and *C* have decided to buy land for a public park they will share between the three of them in the nature of a public good denoted by *Z*. The inverse demand functions for the three individuals are:

$P_A = 20 - Z$
$P_B = 30 - Z$
$P_C = 40 - Z$

a. With $MC = 78$ for this public good, determine the Pareto-Efficient level of *Z*.
b. At the Pareto-Efficient level of *Z*, how much should each individual pay for their new park (e.g., what are the associated Lindahl prices)?
c. From a theoretical perspective, why would you expect the Lindahl prices to be different for each individual?

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 27, 2011
10:00 a.m. - 3:00 p.m.

1. The theory of consumer behavior gives us several theorems. Such as:

   a. Slutsky equation.
   b. Homogeneity condition.
   c. Symmetry condition.
   d. Engel aggregation condition for income elasticities.

For each theorem, you should complete the following tasks:

   (i) Specify algebraically what each theorem states.
   (ii) Explain in words what you think the algebra says.
   (iii) Discuss explicitly how important and what useful role each theorem plays in empirical analysis conducted by the applied economists when actually estimating demand functions.

2. Consider a price-taking firm that produces an output q using inputs z_1 and z_2 according to the production function $f(z_1, z_2) = \sqrt{\min\{\alpha_1 z_1, \alpha_2 z_2\}}$ where $\alpha_i > 0, i = 1,2$. Let p be the output price and w_1, w_2 denote input prices.

   a. Derive the cost function of this firm.
   b. Derive the profit function of this firm.
   c. Derive the firm's supply function q(p). What is the sufficient condition for q^* to be a maximum?
   d. Determine whether the technology of this firm displays increasing, constant, or decreasing returns to scale.
   e. Suppose that initially $\alpha_1 = \alpha_2 = 1$ and a new technology becomes available such that $\alpha_1 = 2$. What is the maximum amount that the producer is willing to pay for access to this technology?

3. Consider a pure exchange economy consisting of two-consumers (denoted A and B) and two goods (denoted x_1 and x_2). Preferences and initial endowments for each consumer are given by

$$U^A(x_1^A, x_2^A) = (x_1^A x_2^A)^2 \qquad (e_1^A, e_2^A) = (4,4)$$

$$U^B(x_1^B, x_2^B) = \ln(x_1^B) + 2\ln(x_2^B) \qquad (e_1^B, e_2^B) = (1,6)$$

   a. Solve for the set of Pareto-efficient allocations in this economy.
   b. Solve for the Walrasian equilibrium in this economy.
   c. Solve for the commodity allocations that would maximize social welfare under a Nietzschean social welfare function $W = max(U^A, U^B)$.
   d. Graph an Edgeworth box for this economy. Label indifference curves for each agent, initial endowments, the Walrasian equilibrium, the contract curve, and the core.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 27, 2011
10:00 a.m. - 3:00 p.m.

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   a. Solve for the set of Pareto-efficient allocations in this economy.
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   d. Graph an Edgeworth box for this economy. Label indifference curves for each agent, initial endowments, the Walrasian equilibrium, the contract curve, and the core.

4. Assume two competing firms selling a homogeneous product. The market price, P, is determined by (inverse) market demand:

$$P = a - bQ, \text{ if } a > bQ, \ P = 0 \text{ otherwise,}$$

where $Q = (q_1 + q_2)$ is total output. The cost function for each firm is represented by:

$$C_i = c^0 q_i + d, \quad i = 1, 2.$$

If we let $a = 14$, $b = 1$, $c^0 = 2$, and $d = 5$, answer the following questions (show all work):

a. What are the Cournot reaction functions?
b. What are the Cournot equilibrium outputs, price(s), firm profits, consumer surplus, and deadweight loss?
c. If firm one is a leader and firm two a follower, what are the Stackelberg equilibrium outputs, price(s) , firm profits, consumer surplus, and deadweight loss?
d. If the two firms collude, what is the equilibrium total output, price, and total profit?

5. Assume that in an economy there is one private good, Q (that is rival and exclusive in consumption), and one public good, y (that is non-rival and non-exclusive in consumption).

a. Define what is meant by a rival, exclusive private good and give an example.
b. Define what is meant by a non-rival, non-exclusive public good and give an example.
c. Suppose the production possibilities curve for this economy is given by: $y^2 + Q^2 = 320{,}000$ and the economy has 100 households with identical preferences for the public and private goods given by: $U = x_j y, j = 1, 2, ..., 100$, where $Q = \sum_{j=1}^{100} x_j$.
Determine the optimal levels of Q and y.

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 28, 2010
10:00 a.m. - 3:00 p.m.

Your 810 Code #__________________

Please provide complete answers to all questions. You have **5** hours to complete the exam, so you should allocate your time accordingly. Number your answers clearly to correspond to each question. It is very important to write your answers **legibly**. Illegible writings may cause your answers not being correctly credited.

1. Describe briefly why economic efficiency (Pareto Efficiency) is a necessary condition for maximizing social welfare. State the three necessary conditions for economic efficiency (Pareto Efficiency) using mathematical equations and provide an economic interpretation of these equations (that is, explain what these equations mean).

2. Suppose a consumer's preferences are described by an indirect utility function, $v(p, y)$, where p is a vector of prices for goods and services that the consumer consumed, and $y > 0$ is the consumer's total income or budget available for purchasing the goods and services in the market.

a. Explain in words how you can use v to derive (i) the consumer's (Marshallian) demand functions, (ii) his/her expenditure function, (iii) his/her Hicksian demand functions.

b. Suppose that the consumer's indirect utility function is given by

$$v(p,y) = \frac{y}{2}\frac{1}{\sqrt{p_1 p_2}}.$$

Using the procedure you outlined in a, derive the following:

(i) The (Marshallian) demand functions.

(ii) The expenditure function.

(iii) The Hicksian demand functions.

c. Discuss the concept of duality and explain how important and useful this concept is in the theory of demand. For example, illustrate how you might derive the Hicksian demand functions, if you are given a utility function such as, $u(q_1, q_2) = \sqrt{q_1 q_2}$.

3. Assume that you know the cost function:

$$c(r, w, Q) = 1.96013 * Q * r^{\frac{2}{5}} * w^{\frac{3}{5}},$$

where Q is output, r is the price of capital (K) and w is the price of labor (L).

a. Derive the production function $Q(K, L)$. What technology is associated with this cost function?

b. Will the long-run profit function be well defined for this technology? Why or why not?

4. Two graduate students, Joe and Harry, found themselves locked in Conner Hall over the two-week winter holiday break with no way to get out of the building and no way to phone or email for help since a severe winter storm has knocked out all communications to the building. Joe and Harry, intending to survive for at least the two-week break discover that there are 200 units of food, Q (bags of chips, peanuts, etc.) in the Conner Hall vending machine. The utility functions for Joe and Harry are:

Joe: $U_J = Q_J^{1/2}$

Harry: $U_H = 1/2Q_H^{1/2}$

Where, $Q_J + Q_H = 200$

a. If the 200 food units are allocated equally between Joe and Harry, how much utility will each receive?

b. How should the 200 food units be allocated between Joe and Harry to assure equality of utility?

c. Assume Joe and Harry develop the social welfare function: $SW = Q_J^2 Q_H$. How will the 200 units of food now be allocated to maximize social welfare?

5. A single firm has a total monopoly in the production of flims. Its long-run total cost and demand curves are given by the following equations:

$LTC = 6.9Q + .003Q^2$ and $P = 12.65 - .022Q$,

where total cost is expressed in thousands of dollars per annum, Q is annual output, expressed in thousands of flims, and P is the price per flim expressed in dollars.

a. Calculate the annual output, the price, and the firm's pure profit, when pure profit is maximized.

b. The government is considering the imposition of an *ad valorem* sales tax on flims of 10% of the price (net of tax). The government also wishes to consider alternative policies of a per-unit excise tax on flims, or an annual license fee on the firm, at such rates as to yield the same tax revenue as the proposed *ad valorem* tax.

(i) Calculate the output, prices, and pure profit (net of tax) for each of the three options, on the assumption that the firm would in each case maximize its pure profit net of tax.

(ii) Compare the impact of the taxes on the firm and on consumers. Which tax would you recommend and why?

Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 27, 2011
10:00 a.m. - 3:00 p.m.

1. The theory of consumer behavior gives us several theorems. Such as:

   a. Slutsky equation.
   b. Homogeneity condition.
   c. Symmetry condition.
   d. Engel aggregation condition for income elasticities.

For each theorem, you should complete the following tasks:

   (i) Specify algebraically what each theorem states.
   (ii) Explain in words what you think the algebra says.
   (iii) Discuss explicitly how important and what useful role each theorem plays in empirical analysis conducted by the applied economists when actually estimating demand functions.

2. Consider a price-taking firm that produces an output q using inputs z_1 and z_2 according to the production function $f(z_1, z_2) = \sqrt{\min\{\alpha_1 z_1, \alpha_2 z_2\}}$ where $\alpha_i > 0, i = 1,2$. Let p be the output price and w_1, w_2 denote input prices.

   a. Derive the cost function of this firm.
   b. Derive the profit function of this firm.
   c. Derive the firm's supply function q(p). What is the sufficient condition for q^* to be a maximum?
   d. Determine whether the technology of this firm displays increasing, constant, or decreasing returns to scale.
   e. Suppose that initially $\alpha_1 = \alpha_2 = 1$ and a new technology becomes available such that $\alpha_1 = 2$. What is the maximum amount that the producer is willing to pay for access to this technology?

3. Consider a pure exchange economy consisting of two-consumers (denoted A and B) and two goods (denoted x_1 and x_2). Preferences and initial endowments for each consumer are given by

$$U^A(x_1^A, x_2^A) = (x_1^A x_2^A)^2 \qquad (e_1^A, e_2^A) = (4,4)$$

$$U^B(x_1^B, x_2^B) = \ln(x_1^B) + 2\ln(x_2^B) \qquad (e_1^B, e_2^B) = (1,6)$$

   a. Solve for the set of Pareto-efficient allocations in this economy.
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   c. Solve for the commodity allocations that would maximize social welfare under a Nietzschean social welfare function $W = max(U^A, U^B)$.
   d. Graph an Edgeworth box for this economy. Label indifference curves for each agent, initial endowments, the Walrasian equilibrium, the contract curve, and the core.

4. Assume two competing firms selling a homogeneous product. The market price, P, is determined by (inverse) market demand:

$$P = a - bQ, \text{ if } a > bQ, \ P = 0 \text{ otherwise,}$$

where $Q = (q_1 + q_2)$ is total output. The cost function for each firm is represented by:

$$C_i = c^0 q_i + d, \quad i = 1, 2.$$

If we let $a = 14$, $b = 1$, $c^0 = 2$, and $d = 5$, answer the following questions (show all work):

a. What are the Cournot reaction functions?
b. What are the Cournot equilibrium outputs, price(s), firm profits, consumer surplus, and deadweight loss?
c. If firm one is a leader and firm two a follower, what are the Stackelberg equilibrium outputs, price(s) , firm profits, consumer surplus, and deadweight loss?
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5. Assume that in an economy there is one private good, Q (that is rival and exclusive in consumption), and one public good, y (that is non-rival and non-exclusive in consumption).

a. Define what is meant by a rival, exclusive private good and give an example.
b. Define what is meant by a non-rival, non-exclusive public good and give an example.
c. Suppose the production possibilities curve for this economy is given by: $y^2 + Q^2 = 320{,}000$ and the economy has 100 households with identical preferences for the public and private goods given by: $U = x_j y, j = 1, 2, ..., 100$, where $Q = \sum_{j=1}^{100} x_j$.

Determine the optimal levels of Q and y.

University of Georgia

Department of Agricultural and Applied Economics

Microeconomics Qualifier **May 2009**

Your 810 Code # ________________

Please provide complete answers to all five questions. Number you answers clearly to correspond to each question

1. Suppose a firm faces a production function $f(x_1, x_2) = x_1^{1/3} x_2^{1/3}$.

   a. Derive the firm's conditional factor demands, $x_1^c(w_1, w_2, y), and\ x_2^c(w_1, w_2, y)$, and the cost function $c(w_1, w_2, y)$, where w_1 and w_2 are input prices and y is output.

   b. Assume that the firm is a price-taker and derive the firm's supply function $y(w_1, w_2, p)$ where p is output price.

   c. Derive the unconditional factor demand for x_1.

2. Consider an industry with two firms producing the same product. The cost functions of both firms are identical and given by

$$c(y) = y^2 + 1.$$

The inverse demand curve for the product is

$$P(Y) = 150 - 2Y$$
$$Y = y_1 + y_2$$

   a. Find the competitive equilibrium price and level of industry output.

   b. Calculate the Cournot equilibrium price and amount of output for each firm.

   c. Calculate the cartel price and amount of output in the industry.

   d. Calculate the Stackelberg equilibrium price and output of each firm assuming that firm 1 behaves as a leader, and firm 2 behaves as a follower.

3. Consider the utility functions for three consumers:,

$$U_1 = 2R^{\left(\frac{1}{2}\right)} + x_1,\ U_2 = R^{\left(\frac{1}{2}\right)} + x_2,\ and\ U_3 = 3R^{\left(\frac{1}{2}\right)} + x_3,$$

where R represents miles of a scenic river to be protected.

Assume that the price of each good is equal to \$1.00. Recreation use of the river by the three consumers is nonrival in nature (e.g., congestion is not a problem).

a. State the mathematical condition for Pareto Efficient provision of river miles. Interpret this condition in words. How is this condition different from the mathematical condition for Pareto Efficient provision of a rival, exclusive private good such as bottled water?

b. What is the Pareto Efficient (equilibrium) miles of scenic river to be protected and the Lindahl price (maximum WTP) each consumer should pay to protect river miles?

c. Illustrate your answer to part (b) above graphically.

4. A small exchange economy consists of two consumers, Aplha and Beta, and two goods, X and Y. Alpha and Beta each have an initial endowment of 10 units of X and 6 units of Y. Alpha's utility function is:

$$U_A\ (X_A, Y_A) = X_A^{.25}\ Y_A^{.75}$$

Beta's utility function is:

$$U_B\ (X_B, Y_B) = X_B^{.75}\ Y_B^{.25}$$

If exchange is allowed between Alpha and Beta and the price of Y, P_Y, is assumed to be 1,

a. What will be the equilibrium price of X?

b. What will be the final consumption level of each good for Alpha and Beta?

5. Discuss the concept of elasticity in general, as well as, specifically, own- and cross-price elasticities and income elasticity.

a. Why is the estimation of elasticities important to researchers of consumer demand, sellers of consumer goods and services, and policy makers?

b. If you conducted an empirical study of demand for a consumer good and found the own-price elasticity to be positive and statistically significantly different from zero, say at the 1% significance level. What would you do or how might you explain (justify) this unexpected result? Would you conclude or suggest that the product in question is Giffen goods?

University of Georgia
Department of Agricultural and Applied Economics

Microeconomics Qualifier **June 2008**

Your 810 Code # _______________.

Please provide complete answers to all five questions. It is highly likely that failure to provide answers to all five questions will result in not passing the qualifier. Good Luck.

Clear, concise, and legible answers on the writing pad provided are encouraged.

1. Given utility $u = 10x_1^{1/4}x_2^{1/4}$, with associated prices for x_1 and x_2 as p_1 and p_2, respectively

a. Derive the Hicksian demand functions and expenditure function and show they are equal to

$$h_1(\bar{p},u) = (u^2/100)(p_2/p_1)^{1/2},$$

$$h_2(\bar{p},u) = (u^2/100)(p_1/p_2)^{1/2},$$

$$e(\bar{p},u) = (u^2/50)(p_1p_2)^{1/2}.$$

b. Using indifference curves, graphically derive a Hicksian and Marshallian demand function for an increase in the price of x_1 from p_1^0 to p_1^1 holding the price of x_2 constant. Using your graphs, illustrate the substitution and income effect of the in the price change. Next, write out and explain the Slutsky equation and how it relates to your graphical analysis.

c. Verify the Slutsky equation for the given utility function.

2. A manufacturing firm produces output using a single plant. The relevant cost function is $STC(Q) = 400 + 4Q^2$. The firm's demand function is $D(p) = 200 - ¼p$.

a. Find the firm's profit maximizing output, price, and profit.

b. Suppose the single plant is restricted by a municipal ordinance ("law") to producing only 40 units. How much would the firm be willing to pay the city to relax this constraint?

c. Suppose the firm has three plants, all of which are identical (and no constraint on output). Find the firm's optimal decisions. Is production greater or less than in part (a)? Explain why?

d. Suppose that the third plant, instead of the common cost function of the other two plants has cost function $STC(Q) = 200 + 12Q^2$. Now what are the optimal decisions?

3. Consider a street of length L miles, represented by the interval [0, L]. At every point on this street lives a consumer. Each consumer considers buying at most one unit of a particular commodity. If the consumer does not buy the commodity, her utility is zero. If she buys one unit of the commodity offered at location x at price p, her utility is equal to $E - p - |x - y|$, where y is the point where the consumer is located.

a. Consider first the case where there is exactly one firm, located at point L/2. The firm has to decide how much to spend on advertising and what price to charge. Advertising makes consumers aware of the firm's existence and its price. If the firm wants to inform consumers that live within a miles from it, it has to spend \$(ca) on advertising, where c is the unit cost of advertising. Thus, for example, if the firm spends \$100 on advertising, then the consumers that live within 100/c miles on either side of the firm will be aware of the firm's existence and the price it charges, so that the firm's potential market will be the segment $[(L/2) - (100/c), (L/2) + (100/c)]$. Find the firm's profit-maximizing price and advertising expenditure, assuming that production costs are linear: $c(q) = kq$, $(k \geq 0)$.

Note your answer should cover all the possible values of the parameters (L, E, c, and k).

b. Calculate the profit-maximizing price and advertising expenditure and the corresponding profits in the following two special cases: (1) $E = 16$, $L = 10$, $k = 2$, $c = 4$, and (2) $E = 10$, $L = 17$, $k = 6$, and $c = 4$.

c. Consider now the case where $E = \infty$ (consumers have an infinite reservation price), k=0 (production costs are zero), and there are two firms, one located at point 0 and the other at point L. Each firm has to decide how much to spend on advertising (as before, if it spends \$A on advertising then its potential market is the set of consumers who live within A/c miles of the firm, in the relevant direction) and how much to charge for its product. To further simplify the analysis, let $c = 1$. The products they sell are in every other respect (i.e., apart from location) identical. Find the subgame-perfect equilibrium of the two-stage game where the firms first simultaneously set their prices and then (having observed each other's prices) they simultaneously decide how much to spend on advertising.

4. Consider an economy with two firms and two consumers. Firm one is owned by consumer A; it produces paper products (y) from trees (x) according to the production function: $y = 2x$.

Firm two is owned by consumer B. It produces building products (q) from trees according to the production function: $q = 3x$.

Each consumer initially owns ten units of trees (logs).
Consumer A's preferences are given by: $u_A(y, q) = y^{0.4} q^{0.6}$.
Consumer B's preferences are given by: $u_B(y, q) = 10 + 0.5\mathit{ln}y + 0.5\mathit{ln}q$.

a. Solve the competition equilibrium problem and state the market clearing prices for trees (logs), paper products, and building products.

b. How many units of paper and building products are consumed by consumers A and B?

c. How many units of trees (logs) do each firm use?

d. Would you expect the above competitive equilibrium to be Pareto Efficient? Why or why not?

5. Consider the following utility functions for three consumers

$$u_1 = 2R^{1/2} + x_1, \qquad u_2 = R^{1/2} + x_2, \text{ and} \qquad u_3 = 3R^{1/2} + x_3,$$

where *R* represents miles of a scenic river to be protected. Assume that the price of each good is equal to \$1.00. Recreation use of the river by the three consumers is nonrival in nature (e.g., congestion is not a problem).

a. State the mathematical condition for a Pareto efficient provision of river miles. Interpret this condition in words. How is this condition different from the mathematical condition for Pareto efficient provision of a rival, exclusive private good such as bottled water?

b. What is the Pareto efficient (equilibrium) miles of scenic river to be protected and the Lindahl price (maximum WTP) each consumer should pay to protect river miles?

c. Illustrate your answer to part (b) above graphically.

University of Georgia
Department of Agricultural and Applied Economics

Microeconomics Qualifier **July 2007**

Last four digits of you SS# ________________.

Please provide complete answers to all five questions. Good Luck.

1. Consider the following utility function

$$U(x, y) = x + \alpha \ln y.$$

The variables x and y indicate quantities of two commodities, and p_x and p_y are the corresponding prices with I as exogenous income. Suppose that p_x falls from p_x' to p_x''.

a. Calculate the agent's willingness to pay for this price change.

b. How does this measure compare with the relevant area under the Marshallian demand curve for commodity x? Explain.

2. Using labor L, a farmer produces corn, c, that is susceptible to various insect pests. Following conventional practice, the farmer sprays the corn with the recommended pesticide, s, in the suggested dosages for corn earworms, e. The pesticide is effective against a wide range of insects, including a parasitic wasp, b, that feeds on corn earworms. The following relationships hold

$$c = f(L, e),$$

$$e = g[s, b(s)].$$

The farmer is surprised to find that corn yield declines after the pesticide application. Write the yield function for corn, show the effect of pesticide on corn yield, and explain what happened to corn yield using your results. What might the farmer do the following season to change this outcome?

3. The owner of an amusement park sells output ("rides") to n identical consumers. She currently charges a price, p, per ride but no admission charge to the park. Each consumer chooses q rides according to the same downward-sloping demand function q(p). The (short run) marginal cost of "producing" a ride is zero.

An economist tells the owner that she would make more money if she charged an entry fee and reduced the price per ride.

a. Is the economist right? Explain.

b. What are the profit-maximizing entry fee and associated ride price?

c. Is the entry fee scheme Pareto optimal? Is it Pareto preferred to the linear pricing scheme? Explain

d. Does the entry fee improve social welfare? Explain.

4. The grassy common area in a residential subdivision is a public good for the 60 households who live in the subdivision. The neighborhood association has an annual cost of upkeep for this land of \$500 per acre. This cost is met by charging households a mandatory fee. Forty of the households have children and 20 do not. Each household with children has $q_c = 19 - p_c$ as its demand for the grassy area, where q_c is measured in acres and p_c is the annual fee per acre. Demand for the grassy area by a childless household is $q_n = 24 - 2p_n$.

a. What is the Pareto efficient size of the common area? Determine the mandatory fees for the households.

b. If the neighborhood association is unable to use nonlinear pricing and instead employs linear pricing, what is the second-best Pareto efficient annual fee per acre for the efficient size in part (a)?

c. What is the difference in consumer surplus between the Pareto efficient and the second-best Pareto efficient solution?

5. Consider an economy with two commodities and a consumer whose utility function is written as

$$U(x_1, x_2) = ln(3 - x_1) + ln x_2,$$

where x_1 is interpreted as labor supplied. There is one firm that produces commodity x_2 using commodity x_1 as an input according to the following technology

$$x_2 = (x_1 - 1)^{1/2}, \text{ if } x_1 \geq 1, \text{ zero otherwise.}$$

a. Determine the Pareto optimum for this economy.

b. Explain the second Fundamental Welfare Theorem.

c. Calculate the prices and any transfer needed to support the Pareto optimal as a competitive equilibrium. Explain.

5. Every morning 6,000 commuters must travel from East ATL to West ATL. The commuters all try to minimize the time it takes to get to work. There are two ways to make the trip. They can drive straight across town through the middle of ATL or they can take the Perimeter around town. The Perimeter is never congested, but it takes 45 minutes to make the trip. The through town method is a shorter distance, but it can take more or less time than the Perimeter depending on how many cars take that route. If N is the number of commuters taking the direct route, the number of minutes the commute takes using the direct route is $20 + N/100$.

a. Assuming that no tolls are charged for using either road, in equilibrium how many commuters will take the direct route? What is the total number of person-minutes per day spent by commuters traveling from East ATL to West ATL?

b. If a planner could control access to each road in order to minimize the total number of person minutes per day spent on this commute, how many commuters would he allow to take the direct route? How long would it take these direct route commuters to get to work? What would be the total number of person-minutes per day spent by commuters traveling from East ATL to West ATL?

c. If commuters value the time saved on their commutes at $\$w$ per minute, what toll would the ATL government have to charge for using the direct route in order to minimize the total person-minutes spent per day on the commute?

University of Georgia
Department of Agricultural and Applied Economics

Microeconomics Qualifier **May 2007**

Last four digits of your SS# ________________.

Please provide complete answers to all five questions. Good Luck.

1. Given a utility function of the form:

$$U(x_1, x_2) = lnx_1 + x_2$$

a. Derive the household's Marshallian demand functions. For each commodity determine if it is a gross complement or substitute for the other commodity.

b. Derive the household's Hicksian demand functions.

c. Calculate the income elasticity of demand for both commodities. For each commodity determine if it is a normal or inferior and a necessary or luxury good.

d. Provide an example for commodity x_1 which would generally fit most household preferences. Justify your answer.

2. Organic matter (soil carbon), *M*, is an important component of crop production systems. Conservation tillage and other conservation production systems seek to increase organic matter because it has been observed that organic matter has two effects on the production function - improvement in efficiency of the system and substitution for fertilizer inputs by adding nutrients. The first effect causes an upward shift in the production function, represented as *A(M)* and thus, is a Hicks neutral effect. The latter shifts the slope of the production function.

The substitution effect for inorganic fertilizer is generally known and can be measured with soil tests. However, organic matter may also exhibit substitution or complementary effects with other factors of production including pesticides and soil water.

The production function that incorporates organic matter effects is

$$Y = A(M)f[M, X(M), F(M)],$$

where *Y* denotes yield, *F(M)* represents fertilizer, and *X(M)* is a vector of other inputs. The productivity effect is $0 \le A(M)$. This component is greater than one for the conservation system and is at best equal to one for the conventional tillage system, but could be less than one if organic matter is depleted over time and the system becomes unsustainable. Organic matter is itself an input, since it supplies nutrients, which is dependent on the organic matter in the conservation system, some of which depend on organic matter levels. Both fertilizer and other inputs are invariant to organic matter in the conventional system because the farmer fails to recognize the effect of organic matter on the production function. Ignoring the effect of organic matter on fertilizer and other inputs results in imperfect information and understatement of the benefits of conservation tillage systems.

a. Determine the total effect of organic matter on yield.

b. Describe the total productivity effects when i) organic matter is a complement to other inputs, ii) organic matter is a substitute for other inputs, and iii) organic matter effects are ignored.

3. Consider a monopoly retailer of a good who faces an inverse demand curve $p = 1 - q$, where p is the price and q is quantity. The retailer must buy the good from a wholesaler who produces the good at cost c. The cost c takes on the values 0 with probability s and ½ with probability $1 - s$. The firms are risk neutral, and the wholesaler has a reservation payoff of 0. After c is realized, the retailer offers the wholesaler a menu of contracts specifying the terms at which the retailer will buy the good. The wholesaler may accept one contract or reject them all.

a. Suppose the wholesaler and retailer first both obverse c, after which the retailer offers a contract or menu of contracts to the wholesaler. Find the optimal contract.

b. Now suppose c is private information so that only the wholesaler observes c. The retailer, knowing the distribution of c, offers the wholesaler a menu of contracts. Using a mechanism design approach, find the optimal menu. How does it depend on s?

c. Now suppose that the retailer is faced by a potential hit-and-run entrant, who forces the retailer to offer only contracts that give the retailer zero expected profit, c is still private information for the wholesaler. Find the optimal menu of contracts.

4. Consider an economy with two consumers, George and Dan, and a fixed amount of one consumption good, $\bar{x}$. George's utility depends only on his consumption of x, x_G; Dan derives pleasure from both his own consumption, x_D, and George's consumption, x_G. The original endowment of x is $(\bar{x}_G, \bar{x}_D)$ where $\bar{x}_G + \bar{x}_D = \bar{x}$. State the conditions that must hold if the endowment point is not on the utility possibility frontier. How could the economy move to a Pareto optimum if these conditions hold?

Department of Agricultural and Applied Economics
Microeconomic Theory Qualifier Exam
May 2006

1. Consider the utility function of the form

$$U(x_1, x_2) = x_1^2 x_2^2,$$

with the associated budget constraint

$$I = p_1x_1 + p_2x_2.$$

a. Derive the first-order conditions for this consumer's utility maximization problem. Provide an economic interpretation of these conditions (define your terms).

b. Derive the consumer's demand functions – Marshallian and Hicksian – for x_1 and x_2.

c. Would the utility function $U(x_1, x_2) = \ln x_1 + \ln x_2$ generate a different set of Marshallian demand functions than derived in part b? Why or why not?

d. Using your knowledge of economic theory, explain the difference between the Marshallian (ordinary) demand function and the Hicksian (compensated) demand function. As part of your answer, indicate whether Marshallian and Hicksian demand functions include the substitution effect, income effect, or both of these effects (you also need to define briefly what is meant by the substitution effect and income effect).

S eqn $\quad \underbrace{\frac{\partial x_1(P,I)}{\partial P_1}}_{TE} = \underbrace{\frac{\partial h_1(P,u)}{\partial P_1}}_{SE} - \underbrace{\frac{\partial x_1(P,I)}{\partial I} \cdot x_1}_{IE}$

2. Suppose that an individual has three uses for his time: sleeping, working, and consuming goods. Let:

S = hours of sleep
L = hours of work
C = hours of consumption.

Consumption, of course, is costly, so assume that consumption costs a flat rate of 10 cents per minute. Consequently:

cost of consumption = \$6 x C.

Suppose that the individual receives utility form sleeping and consumption given by

$$U(S,C) = S^{1/4}\ C^{3/4}.$$

Finally, assume that the individual's entire income comes from working and that for his work he receives \$4 per hour. If he is to maximize utility over a 24-hour period, how many hours should be spent sleeping, working, and consuming?

$C_c = 6C$

$w = 4$

$C_s = 4S$

3. The nation Zealand is "small" since its demand for imported goods is too small to influence world prices. It can import as many peanuts as desired at a price of \$10 per bag. The domestic supply and demand for peanuts in a year are given by the following equations.

$$Q_s = 50 + 5p$$

$$Q_d = 400 - 10p$$

a. Determine the change in consumer surplus, producer surplus, and net welfare if Zealand switched from a closed economy to an economy that allowed the free trade of peanuts. Show your results graphically.

b. Suppose that after free trade for a few years, the government of Zealand decides to enact a quota limiting peanut imports to 50 bags. What would the new domestic price be under this import quota? What is the net change in welfare caused by switching from free trade to an import quota of 50 bags?

c. Suppose the government decides to end the quota and instead adopt a specific tariff. Specifically, the government wants to set a tariff that limits imports to 50 bags. What is the value of the tariff that the government would need to impose to limit imports to 50 bags? How is the net welfare impacted with a tariff relative to the net effects with an import quota (as in part b)? Who is the primary loser in the switch from an import quota to a tariff?

4. A single golf club serves the two towns of Athens and Oconee. Demand from *each* of 100 residents of Athens and 50 residents of Oconee is given by Q_A and Q_O defined below, where Q is the per person demand for rounds of golf and P is the per-round price. The club has a constant average and marginal cost of \$6:

$$Q_A = 100 - P$$

$$Q_O = 80 - 2P$$

a. If the golf club can price discriminate between residents of each town, what price will it charge Athens residents? What is the consumer surplus for *each* Athen's resident? What price will the club charge for Oconee residents? What is the consumer surplus for *each* resident of Oconee? What will be the club's total profit?

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b. Now assume that the club CANNOT price discriminate between the residents. What price will the club charge? What quantity will the Athens residents purchase? What is the consumer surplus for each Athens resident? What quantity will residents from Oconee purchase? What is the consumer surplus for each resident of Oconee?

c. Instead of the simple per-round fee, the club decides to charge a membership fee and a per-round fee. What price per round (p) and membership fee (m) will the club charge for residents of both towns if they CAN price discriminate between the two groups. What is consumer surplus for residents from each town?

$100 = 100 = 100 - P$

$-0 = P$

5. Consider the following production function: $q = K^{.25} L^{.75}$.

a. Derive the conditional input demands for K (capital) and L (labour) to minimize the cost of producing q_0 given capital and labor prices of r and w, respectively.

b. Derive the long-run total cost function associated with this production function.

6. Jim's PPF is $0.5X_1 + X_2 = 30$. If goods can be traded at $P_1/P_2=2$ and Jim's utility function is $U = 0.5X_1 + 0.5X_2$, how much X_1 and X_2 will Jim produce and consume? Show your answer graphically and explain your answer in terms of conditions for producer and consumer equilibrium.

$X_2 = 30 - .5X_1$

Department of Agricultural and Applied Economics
Microeconomic Theory Qualifier Exam
May 2005

Note: You will have four hours to complete this exam. Please allocate your time accordingly and wisely. Read each question carefully and answer all parts of each question documenting your answers and showing your work.

1. Consider the utility function defined by

$$u(\bar{x}) = x_1 x_2.$$

a. Derive the demand functions.

b. Show that the demand functions are homogeneous of degree zero in P & I.

c. Derive the Engel Curves.

d. Can any commodities be inferior.

e. Derive the indirect utility function and show that it is decreasing in its arguments.

f. Verify Roy's Theorem.

g. Derive the expenditure function and show that it is homogeneous of degree one and nondecreasing in prices.

h. Verify Hotelling's theorem.

i. Derive the Slutsky equation, and

j. Determine whether the commodities are (net) complements or substitutes.

2. You have been hired by the Acme Gum Ball Company to finish the work of the famous and highly paid, but somewhat disorganized, economic consultant, R. You find that R has collected information on the productivity of LABOR in the main factory in Trenton NJ, Acme Manufacturing Facility #1, in order to advise the company on optimal employment.

Unfortunately, almost all of the computer files on this project were accidentally over-written. The only surviving file reports the following facts:

1st fact: Marginal Productivity of Labor in Manufacturing Facility #1 (holding all other factors constant) is:

$$MP_L = \partial Q / \partial L = 1.2\,(K/L)^{.4}$$

where:

L = workers employed per hour
Q(L) = cases of gum balls produced per hour.

2nd fact: When no labor is employed there is no output, q(0) = 0
3rd fact: The production function is Cobb-Douglas with constant returns to scale.

A. What is the production function for gum balls?

B. When you visit Facility #1 in Trenton you learn:

In the short run K is fixed at 20 and labor is the only input that can be altered.
The wholesale price of gum balls, the price at which the firm sells, is $10.00 per case.
The wage rate the firm pays is 15.00 per hour.

Given these facts, how many workers should the firm employ and what is the profit maximizing output of gum balls per hour? (Round Labor, L, to the nearest whole number of workers. Gum balls, Q, can be produced in fractional cases.)

3. Consider the model of the multiplant monopolist: a monopolist produces the same good in two different plants and sells it at one price. Suppose the demand curve for this good is given by $P = 100 - .25Q$ while the cost function in plant one is given by

$$C_1 = Q_1^2/20 + 18Q_1 + 10$$

and the cost function in plant two is given by

$$C_2 = Q_2^2/40 + 21Q_2 + 5$$

(Of course, $Q_1 + Q_2 = Q$)

Calculate the profit-maximizing output for each plant, the price charged in the single market, and total profits for the monopolist.

4. The Georgia Banks, a highly productive shrimping area off the coast of Georgia, can be divided into two zones in terms of shrimp population. Zone 1 has the higher population per square mile but is subject to severe diminishing returns to effort. The daily shrimp catch (in tons) in Zone 1 is

$$F_1 = 200(X_1) - 2(X_1)^2$$

where X_1 is the number of boats fishing there. Zone 2 has fewer shrimp per mile but is larger, and diminishing returns are less of a problem. Its daily shrimp catch is

$$F_2 = 100(X_2) - (X_2)^2$$

where X_2 is the number of boats fishing in Zone 2. The marginal shrimp catch MSC in each zone can be represented as

$$MSC_1 = 200 - 4(X_1) \qquad\qquad MSC_2 = 100 - 2(X_2).$$

There are 100 boats now licensed by the U.S. government to catch shrimp in these two zones. The shrimp are sold at \$100 per ton. Total cost (capital and operating) per boat is constant at \$1,000 per day. Answer the following questions about this situation:

a. If the boats are allowed to catch shrimp where they want, with no government restriction, how many will catch shrimp in each zone? What will be the gross value of the catch?

b. If the U.S. government can restrict the boats, how many should be allocated to each zone? What will be the gross value of the catch? Assume the total number of boats remains at 100.

c. If additional shrimpers want to buy boats and join the fleet, should a government wishing to maximize the net value of the catch grant them licenses? Why or why not?

5. Two firms produce a homogenous product. Let p denote the product's price with the output level of firm 1 represented by q_1 and the output level of firm 2 by q_2. The aggregate industry output is $Q = q_1 + q_2$. Aggregate industry (inverse) demand is given by $p = \alpha - \beta Q$. The cost functions of the two firms are $c_1(q_1) = q_1^2$ and $c_2(q_2) = q_2^2$.

a. Suppose that firm 1 is a Stackelberg leader in choosing its quantity. How much output will each firm produce in equilibrium?

b. Now assume that the firms choose their output levels simultaneously in Cournot competition. What are the equilibrium output levels in this case?

c. Now suppose the firms collude and agree to share total profits equally. What is the optimal industry output?