

This exam is designed to test your broad knowledge of microeconomics. There are three sections: one required and two choice sections. You must complete both problems in the required section and one choice problem in each of the two choice sections, giving you a total of four problems to complete during the allotted time. The required problems are in section A and the choice problems are in sections B and C. If you should answer more than one choice question in a section, only the first will be considered.

IMPORTANT. You are expected to adhere to the following guidelines in completing the exam for your answer to be considered complete. Incomplete answers will be evaluated accordingly.

- Write legibly. **Number all pages with the question number and the page number (e.g., A1-1, A1-2, etc.) and organize your answers to questions in the same order as they were given to you in the exam. Begin your answer to each question on a new page and identify the question number.**
- Provide clear, concise discussion to your answers.
- Explicitly state all assumptions you make in a problem. Graders will not take unstated assumptions for granted. Do not make so many assumptions as to trivialize or assume the problem away.
- Define any notation you use in a problem and label all graphs completely.
- Explain your steps in any mathematical derivations. Simplify your final answers completely.
- When you turn in your exam answers double check to make sure you have included all the pages to each question number, in order. The pages you submit as your answer are the only ones that will be considered.
- To simplify copying, please leave one-inch borders on top, bottom and sides.

PART A: Required Questions - Answer both of the following questions

QUESTION A1: "GAMES"

Consider a t period game, with n profit maximizing firms that each has an infinite production capacity. In this game, in each period, each firm chooses quantity at the same time (without observing the quantity the other firms choose). In this market there are no fixed costs and the inverse demand curve is equal to $P = \theta - Q$, where $Q = \sum_{i=1}^n q_i$. In this game firms are identical except for cost structures. There are dominant firms, which each have a marginal cost of production equal to c_l and non-dominant firms, which each have a per unit marginal cost of c_h . Assume that there are n_d dominant firms and n_n non-dominant firms.

- a) First, assume that $t=1$, $n_d=1$ and $n_n=1$. Provide the market equilibrium quantity, market price, and the profit that each firm will make and the consumer surplus in the industry.
- b) Assume that $t=1$, $n_d=0$ and $n_n=4$. First, provide the quantity that each firm will produce and the profit that each firm will make. After you have provided this quantity, next consider what would happen if a 5th non-dominant firm is thinking about entering the industry. How much would each firm (individually) be willing to pay to deter this firm from entering?
- c) Assume that $t=\infty$, $n_d=0$ and $n_n=4$. Also assume that each firm has a discount rate equal to .8. First, think about the potential equilibrium where firms work together to split the monopoly profit. What is the infinitely repeated value of the stream of profits for each firm if all firms work together? After you have provided these profit numbers, next consider what would happen if the firms are working together and a 5th non-dominant firm is thinking about entering the industry. How much would the firms would be willing to pay (collectively) to deter this firm from entering?
- d) Assume that $t=\infty$, $n_d=1$ and $n_n=1$. Also, assume $\theta = 10,000$, $c_h = 4,000$, $c_l = 2,000$ and each firm has a discount rate equal to .7. Consider the possibility that an upstream firm can create a contract mechanism in which the dominant firm and the non-dominant firm to work together. For this contract to take place both firms must agree to the contract, and if they agree they will split the monopoly profit (50/50 split). Note that because the dominant firm has a cost advantage, if the contract is executed the dominant firm will produce the full quantity and then the profits will be divided via a 50/50 split. In this game is there an equilibrium, where the firms choose to accept the upstream firm contract mechanism? If so, how much would the firms collectively and individually be willing to pay for this mechanism? If not, explain why not.

QUESTION A2: "SURPLUS"

Suppose $U(x_1, x_2) = x_1 x_2$, where x_1 is wheat and x_2 is the numeraire good. Suppose income is \$100 and the price of the numeraire good is \$1. The price of wheat falls from \$1 to \$0.25 due to the success of an irrigation project funded by the World Bank.

- a) Derive the Marshallian demand functions and the expenditure function.
- b) Evaluate consumers' gains in terms of compensating variation (CV).
- c) Explain whether the change in Consumer Surplus (CS) will overestimate, underestimate, or exactly equal the CV measure. For your explanation use both a graph and an economic explanation of why this occurs.
- d) Calculate the change in CS.

PART B: Choice. Answer either B1 or B2. If you answer both, only B1 will be graded.

QUESTION B1: "DUALITY"

Solve the problems below:

- a) Suppose you observe the demand functions $x_1 = \frac{\alpha y}{p_1}$ and $x_2 = \frac{(1-\alpha)y}{p_1}$. Derive the utility function. Show all steps.
- b) After all that work, you remember that the corresponding utility function for the demand functions in (a) is $U(x_1, x_2) = x_1^\alpha x_2^{1-\alpha}$. Use duality to derive $x_1^h(p_1, p_2, U)$.
- c) Is the Hicksian demand for good 1 that you derived in (b) homogeneous in prices and if so, what degree? Explain your result intuitively.
- d) Suppose you have the utility function $U(x_1, x_2, x_3) = x_1 + \min\{x_2, x_3\}$. Derive the Marshallian demand functions.

QUESTION B2: “DECISIONS, DECISIONS”

Richard, a National Merit scholar, also has an aptitude for baseball. He is trying to decide whether to go to Harvard (his father's alma mater) in which case he will receive lifetime earnings of 30 million (with probability of 1) or accept an offer from the Los Angeles Dodgers (a major league baseball team) to join their farm-team. This however, is a risky proposition. Richard estimates that if he chooses this option, there is a 40% chance he makes it in the big leagues, in which case his lifetime earnings will be 150 Million, and is a 60% chance that he will not make it, in which case he will become insurance salesman, with a lifelong earnings of 10 million. Richard's utility function with respect to wealth is: $u(x) = x^{.8}$.

- a) What is Richard's expected utility from each career path? What are the certainty equivalents for both career paths? Which career path will Richard take?
- b) In this section assume that Richard's father really wants Richard to work at the family law firm. First, provide the required subsidy to incentive this choice (this is zero if Richard already is choosing law). Second, instead of a subsidy, assume that Richard's father attempts to change Richard's behavior (using information) by changing Richard's prior about the probability he will make it in the big leagues. What probabilistic belief about the chances of successfully making it to pro baseball must Richard have to choose law instead of baseball.
- c) Now assume that in order to try to be a professional baseball, Richard must use performance-enhancing steroids, which have a possibility of causing kidney disease. Specifically, steroids have a 40% chance of causing kidney disease, and if acquired, kidney disease would have a utility cost of 1,700,000 (assume that getting into the big leagues and getting kidney disease are independent of each other). Given this additional piece of information calculate Richard's expected utility from both baseball and joining the family law firm. Which option will Richard choose?
- d) In this problem assume that Richard has the option of hiring an agent. With the added exposure, Richard's probability of making it to the big leagues (increased to .5 chance of making it in the big leagues and .5 chance of become insurance salesman). Also, the agent only charges Richard if he makes it to the pros. What percentage of Richard's professional income (of the 150 million) would Richard be willing to pay for these services (if successful in the pros)?

PART C: Choice. Answer either C1 or C2. If you answer both, only C1 will be graded.

QUESTION C1: “ODDS AND ENDS”

Please answer each of the following:

a) Consider a consumer who consumes two goods, x and y . The price of x is p_x and the price of y is p_y . Show (and explain) why the following statement is either TRUE/FALSE/ OR UNCERTAIN:

“The consumer will prefer a lump-sum subsidy to a per unit subsidy on x if the two subsidies provide the consumer with the same monetary amount.”

If the statement is UNCERTAIN be sure to provide the conditions under which it is true or false.

b) Suppose a firm has a production function of

$$q = AK^\alpha L^\beta,$$

where the price of K is r and the price of L is w . The firm is price-taking in both the input and output markets. Find the firm’s indirect cost function $[TC = f(w, r, q)]$ and provide a consistency check for econometric estimation of the indirect cost function.

c) The *Rail Runner* provides train service between Albuquerque and Santa Fe on a daily basis. The price, p , is \$2.75 per ride. However, there is an increasing concern because the service is losing money and is requesting an increase in the price of a ticket from the Public Utility Commission in order to increase total revenue (TR). A group of concerned citizens is arguing that the price should be lowered to attract more riders. Assume the demand function for the *Rail Runner* (where R is measured in rides per day) is given by:

$$R = 5000 - 1000p.$$

If the goal is to increase TR, which side is correct? Should the price be increased or decreased? Explain your logic and your estimations.

d) Consider the following statement and state if it is TRUE/FALSE/UNCERTAIN. Provide a justification for your answer.

“For a competitive firm using a decreasing-returns-to-scale technology, the conditional factor demand curve for input i , $x_i(\mathbf{w}, y)$ is always downward-sloping with respect to its own price. (Note that \mathbf{w} is a vector of input prices and y is a given level of output.)”

QUESTION C2: "EQUILIBRIUM"

Consider an economy that produces widgets in a competitive market. Each firm in this competitive industry has the same production technology, given by:

$$y = k^{1/6} l^{1/3}.$$

Where y is the amount of widgets produced, k is the amount of capital used and l is the amount of labor required. Each firm also incurs a fixed cost of \$1/6. Labor is traded in a competitive market and the unit price is \$1 per unit (firms are price takers and so they can purchase as much labor at this price as they want). Firms are also price-takers in the capital market at a price of \$1/2 per unit. In the short-run the amount of capital cannot be changed and firms cannot enter or depart the industry. In the intermediate run, firms still cannot enter or leave the industry, but they can vary the amount of capital used. In the long-run, the amount of capital can be varied and firms are free to enter or depart the industry.

Demand for widgets is given by

$$D(p) = 400 - 100p,$$

where p is the price of a widget and $D(p)$ is the quantity demanded at p .

a) What is the long-run equilibrium for this market? Please provide the long-run equilibrium price, quantity and number of firms.

b) Suppose now, that there has been a shift in the demand for widgets. Demand is now described by:

$$D(p) = 750 - 150p.$$

Utilizing your answers from a), what is the short-run equilibrium price and profit per firm?

c) What are the intermediate equilibrium price and the long-run equilibrium price?

d) Given your results in a) through c), draw a graph in Price/Quantity space that depicts the short, intermediate, and long-run supply curves, the two demand curves, and the equilibrium conditions. Are these results consistent with the expected elasticities of supply in the short, intermediate, and long run? Explain.