Ph.D. MICROECONOMICS CORE EXAM
August 2017

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 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, and in order. The pages you submit as your answer are the only ones that will be considered.
- To simplify copying, please leave 1 inch borders.

PART A: REQUIRED QUESTIONS

Both problems in Part A (A1 and A2) are required. Answer all parts of all questions.

QUESTION A1

Consider a short-run market, where a consumer who consumes strawberries (*q*), has a demand function for strawberries (*q*) of: $q = a - bP + cM$, where *a, b,* and *c* are constants (and all > 0), *P* is the per unit price for strawberries and *M* is the consumer's budget. Further, one producer's indirect cost function that is indicative of all strawberry producers can be described by $\tilde{C} = \frac{q}{d}\left(\sqrt{w} + \sqrt{r}\right)^2$, where d is a constant, > 0, and *w* and *r* are the per unit costs of inputs to produce strawberries, labor (L) and capital (K), respectively.

a) Find the supply function for this strawberry supplier. Interpret the results.

b) Suppose the consumer above is representative of all strawberry consumers in this area and the producer is representative of all strawberry producers that supply this market. There are J consumers and I producers. Find the optimal price and quantity of strawberries sold in this market, if everyone involved is a price taker. Show that the optimal level of strawberries sold increases as the number of consumers increases.

c) Compare your quantity results above to that of a monopolist producer as well as to that of two identical producers whose supply the market. Discuss your results in your comparison.

d) Consider the representative producer. Find the production function consistent with this producer's characteristics and find the economies of scope. Discuss these results.

QUESTION A2

Consider a game where there are 3 players: a domestic firm, a foreign firm, and a domestic government. In this game, the domestic government moves first by setting the per-unit tariff (represented by t) charged to the foreign firm. Next, the foreign and domestic firm move simultaneously choosing the quantity produced (the domestic firm's quantity is represented by q_i and the foreign firm's quantity is represented by q_j). The objective of each firm is to maximize profit. The government's objective function is to maximize social welfare: $W_i = \frac{1}{2}{Q_i}^2 + \pi_i + tq_j$. In this industry the inverse market demand curve is $P = \theta - \beta Q_i$ (where $Q_i = q_i + q_j$) and the firms produce a homogeneous product. Each firm has a fixed costs equal to F, the marginal cost for the domestic firm is equal to c_i, and the cost for the foreign firm is equal to c_j. Assume that $c_i = 2c_j$.

a) First, assume that there is a free trade agreement in which the government cannot implement a tariff. Provide the subgame perfect Nash equilibrium quantities for this game. Provide the domestic welfare in this industry.

b) When there is a free trade agreement, under what conditions (assuming subgame perfection) will the domestic firm shut down?

c) Next, assume that there is no free trade agreement. What is the optimal tariff?

d) Assume $\beta = 1$, $\theta = 100$, $c_j = 25$, and F=50. Provide the domestic welfare under the free trade agreement (part a) and the non-free trade situation (part c) under this assumption. Compare this number with the welfare results under free trade (results from a). How much surplus is gained from implementing the tariff?

PART B: CHOICE QUESTIONS

Answer all parts of either question B1 or B2. If you complete more than one problem, only B1 will be considered.

QUESTION B1

Alfred consumes two goods, pizza (x) and soda (y). Assume that these are normal goods. Alfred's preferences are defined by the utility function $U(x, y) = xy$. Alfred has income (m) of \$100. Let soda cost \$1 per can. Suppose the price of a pizza falls from \$8 to \$3.

a) Draw a graph in utility space and another in (p_x, x) space that illustrates the compensating variation (CV) for pizzas. Label each of the lines you draw and all of your axes. You should have two graphs in total.

b) In words, define CV. Then, represent CV explicitly in terms of differences in expenditure functions.

c) Calculate the CV for the price change in pizzas using the expenditure approach. Then, verify your answer using the integration approach.

d) True/False/Uncertain: In this problem, CV is larger than equivalent variation (EV). You must explain your answer using mathematical and/or graphical analysis.

QUESTION B2

Complete each of the following problems:

a) Find and interpret the elasticity of scale for $y = x_1^{\alpha} x_2^{\beta}$.

b) True/False/Uncertain (prove that the statement is true or false. If uncertain, show under what conditions it's true and under what conditions it's false). The second order condition shows that the following optimization problem is indeed a minimization problem;
$z = xy \quad s.t.\ 6 = x + y$

c) Suppose the absolute value of own price elasticity of demand for q_1 is 1.3, the income elasticity is 0.75, p_1 = \$4, q_1 = 4, and income is \$150. Given this information, find the difference in the estimate of consumer welfare between the ordinary and compensated demand functions. Explain the difference, utilizing the appropriate theory and, theoretically, explain how the difference in welfare measures can become increasingly large.

d) Consider a perfectly competitive market with a supply of $P = 2q$ and a demand of $q = 30 - 0.3P$. There is a capacity constraint in the market of $q \leq 10$. Find if this is a binding constraint or not, if not, what is the optimal price and quantity. If it is binding, what is the marginal cost of capital and what is the optimal level of production?

PART C: CHOICE QUESTIONS

Answer all parts of either question C1 or C2. If you complete more than one problem, only C1 will be considered.

QUESTION C1

In this game Seller Sally (who owns the painting) values a painting at $200 and buyer Bill values it at $300 (both valuations are in current - first period - dollars). The game begins in the first period by Bill making an offer to Sally. Sally can either accept or make a counteroffer. In the second period, if Sally doesn't accept in the first period, Bill accepts or rejects the counteroffer. Both are impatient and discount future income, for Sally, a dollar in the second time period is only worth $1/(1+ .06) whereas for Bill, a dollar in the second time period is only worth $1/(1 + .03). Assume that whenever a player is indifferent between accepting or rejecting, they accept. If the final choice is "accept", Sally sells the painting to Bill. At that stage, Sally gets [offer – $200] while Bill gets [$300 – offer]. If the final choice is "reject", both players get 0.

a) What are the subgame-perfect Nash equilibria of this two-period game?

b) In a second version of the game, there are three periods. Again, in this game, the first offer is made by Bill, and in the second period Sally can counter-offer. But, in this game, there is a third period, where if both previous bids are rejected (Bill's initial bid and Sally's counter offer), Bill can make a third offer. Note that money in the third period is discounted twice. What are the subgame-perfect Nash equilibria of this game?

c) Now suppose there is a fourth period. Everything is the same as part b, except now there is a fourth period, where if Sally doesn't accept in the third period (and all previous offers were not accepted), Sally's makes another counteroffer. Note, money in the fourth period is discounted three times. What are the subgame-perfect Nash equilibria of this game?

d) Finally, discuss the subgame-perfect Nash equilibria of a game with 100 possible periods.

QUESTION C2

In this problem, there is a risk neutral principle (i.e., maximizes expected profit), who outsources production to an agent. There is only one firm in this industry (i.e., it is a monopolistic structure), and this industry has an inverse demand curve for industry equal to $P = 5{,}000 - 10q$. The principle offers a take-it or leave-it offer to the agent, who can have three potential types, a low marginal cost type (where marginal costs is $\theta_l = 200$), an average cost type (where marginal costs is $\theta_a = 500$), and a high marginal cost type (where marginal costs is $\theta_h = 1{,}000$). The probability of the agent being low cost is $P(\theta_l) = .25$, the probability that the agent is average cost is $P(\theta_a) = .5$, and the probability that the agent is high cost is $P(\theta_h) = .25$.

a) Usually in these types of problems it is assumed that the principle has incomplete information regarding the agent's type and that the principle offers a bundled contract paying a lump sum transfer payment of t_i for the production of q_i units (where $i \in \{l, a, h\}$). Explain why this type of contract is better for the principle than other types of compensations structure (for instance a uniform per unit compensation structure).

b) In this part assume that the principle has perfect information regarding the agent's type (i.e., the principle observes the agents type before the contract is offered). Provide the optimal contract that the principle would offer the agent (provide t_i and q_i for all types of agents).

c) In this part assume that the principle has incomplete information (i.e. does not observe the agent's type before the contract is offered). Provide the principal's objective function and all participation and incentive compatibility constraints (some may not be binding). Suggest which constraints you think would be binding and why.

d) Under the condition of incomplete information, provide the optimal contract that the principle would offer the agent (provide all t_i and q_i for all types of agents). What is the principles expected profit?