Department of Agricultural & Applied Economics
Microeconomics Qualifying Exam

May 24, 2018

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

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.