

# Microeconomics 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  $\alpha$  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  $\Psi$  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  $\pi$  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).