Econ 303 - Intermediate Microeconomic Theory
College of William and Mary November 6, 2012
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Midterm 2

You have until 12:20pm to complete the exam, be certain to use your time wisely. Answer all questions directly on the exam. You must show all of your work to receive full credit. Non-graphing calculators may be used (no graphing calculators or phones can be used). You may leave answers as fractions. Unless a problem says otherwise, you can assume that firms can produce fractions of units and charge non-integer prices (so a firm could produce 82.4 units and sell at a price of \$5.325 per unit). Remember to put your name on the exam. Good luck!

Name: **ID Number:**

1. (10 points) It costs a truck manufacturer \$100,000 to set up a factory. Once the factory is set up, each additional truck built by the manufacturer adds \$5,000 to the manufacturer's total costs.

   (a) Write down expressions for the manufacturer's average total costs, average fixed costs, average variable costs and marginal costs as functions of the number of trucks produced, T.

   (b) Graph the average total cost, average variable cost and marginal cost curves on a graph with trucks on the horizontal axis and price on the vertical axis.

2. (30 points) A farm produces vegetables using water and fertilizer. The pounds of vegetables produced, V, is given by the following function:

$$f(W, F) = W^2 F^2 \tag{1}$$

where W is the number of gallons of water used and F is the number of pounds of fertilizer used. Given this production function, the marginal product of water and the marginal product of fertilizer are the following:

$$MP_W = 2WF^2 \tag{2}$$

$$MP_F = 2W^2 F \tag{3}$$

The price of a gallon of water is \$1 and the price of a pound of fertilizer is \$16. The price of a pound of vegetables is \$20.

(a) Determine which of the following properties hold for this production function: diminishing marginal product of each input, diminishing technical rate of substitution, monotonicity, convexity. For each, explain in one sentence why it does or does not hold.

(b) On a graph with with fertilizer on the horizontal axis and water on the vertical axis, draw the isoquant passing through the point (5 gallons of water, 15 pounds of fertilizer) and label the slope of the isoquant at this point with its numerical value.

(c) Find an expression for the optimal amount of fertilizer as a function of vegetables, $F(V)$, and the optimal amound of water as a function of vegetables, $W(V)$.

(d) What is the lowest possible cost of producing 256 pounds of vegetables?

3. (25 points) A window factory makes windows (W) out of frames (F) and panes of glass (G). Each window requires one frame and four panes of glass. The cost of a frame is \$10. The cost of each pane of glass is \$5. The factory can sell windows for \$50 each.

   (a) Write down a production function $f(F, G)$ that gives the number of windows the factory can produce as a function of number of frames and panes of glass it uses.

   (b) In the short run, the firm has 20 window frames but can order as much glass as it wants to use. What is the profit-maximizing amount of glass the firm should use in the short run, how many windows will they produce and what will the factory's total costs be?

   (c) In the long run both frames and glass are variable inputs. Suppose that the firm wants to produce the same number of windows in the long run as the number it produced in part (b). Will the costs of producing this many windows in the long run be more expensive, less expensive or the same as the costs you found in part (b)? Be certain to justify your answer.

4. (20 points) Suppose that there are two types of consumers of coffee. Each consumer of type A has the following demand for coffee:

$$C_A(p) = 20 - 2p \tag{4}$$

where $C_A(p)$ is the number of cups of coffee demanded when the price of a cup of coffee is p. Each consumer of the type B has the following demand funtion:

$$C_B(p) = 10 - \frac{1}{2}p \tag{5}$$

where $C_B(p)$ is the number of cups of coffee demanded when the price of a cup of coffee is p. There are 10 consumers of type A and 10 consumers of type B.

(a) Calculate the price elasticity of demand for each consumer type at a price of \$4.

(b) Would you expect the price elasticity of demand for all beverages (including coffee) to be larger or smaller in magnitude than the elasticities you found in part (a)? Be certain to explain your answer

(c) Derive an expression for the overall market demand as a function of price, $C(p)$, and graph the demand curve labeling any relevant slopes, intercepts and kinks with their numerical values.

(d) Using the market demand function you found in part (c), is the price elasticity of demand for the market as a whole at a price of \$4 larger or smaller than the elasticities you found for the individual consumers? Explain why your result makes intuitive sense (in other words, explain why you could have predicted that result even without calculating the elasticity).

5. (15 points) Consider the market for a life-saving drug. Since the drug is life-saving, demand for the drug does not depend on price. Demand is always equal to 500 units no matter what the price is. The supply curve is an upward sloping line.

   (a) On a graph with quantity on the horizontal axis and price on the vertical axis, show the demand curve and the supply curve assuming that the equilibrium price for the drug is \$20.

   (b) On the same graph you drew above, show the change in consumer surplus, change in producer surplus and tax revenue resulting from a quantity tax of \$5 a unit placed on suppliers. Whenever possible, label these items with their numerical values. (Note: If one of these items does not exist, write that beside the graph. For example, if there was no tax revenue you would not be able to show that on the graph. Instead you would just write "tax revenue = 0" on the side.)

   (c) Which of the values from part (b) would change if the same tax were placed on consumers rather than suppliers?