Ecn 100 - Intermediate Microeconomic Theory
University of California - Davis December 10, 2009
Instructor: John Parman

Final Exam - Solutions

You have until 12:30pm to complete this exam. Be certain to put your name, id number and section on both the exam and your scantron sheet and fill in test form A on the scantron. Answer all multiple choice questions on your scantron sheet. Choose the single best answer for each question; if you fill in multiple answers for a question you will be marked wrong. Answer the long answer questions directly on the exam. You must show your work for full credit. Answers may be left as fractions. Please place a box around final answers when appropriate. Good luck!

Name: **ID Number:** **Section:**

SECTION I: MULTIPLE CHOICE (60 points)

1. A monopolist with constant marginal costs in an industry with a downward sloping demand curve will:
   (a) Produce more if the firm can only charge a single price per unit than if it can use first-degree price discrimination.
   (b) Produce less if the firm can only charge a single price per unit than if it can use first-degree price discrimination.
   (c) Produce the same quantity whether it charges a single price per unit or uses first-degree price discrimination.
   (d) Produce more than the efficient quantity if it can use first-degree price discrimination.

   (b) If the firm can only charge a single price, it will choose the quantity at which the marginal revenue curve intersects the marginal cost curve. If the firm can use first-degree price discrimination, they will choose the quantity at which the marginal cost curve intersects the demand curve (which is to the right of where the marginal cost curve intersects the marginal revenue curve).

2. Suppose that a firm has two factories, A and B. The cost of producing y at factory A is $4y^2$. The cost of producing y at factory B is $2y^2$. To minimize costs, the firm will:
   (a) Split output evenly between the two factories.
   (b) Use both factories but produce more at factory A than at factory B.
   (c) Use both factories but produce more at factory B than at factory A.
   (d) None of the above.

   (c) Note that both factories have increasing marginal costs. Producing everything at one factory would therefore be more expensive than splitting output between factories. The firm will split output such that marginal costs are equal between the two factories ($8y_A = 4y_B$). This will lead to the firm producing twice as much at factory B as at factory A.

3. Suppose that instead of the cost functions given in Question 2, the cost of producing y at factory A is $4y$ and the cost of producing y at factory B is $2y$. Given these costs, the firm will minimize total costs by:

(a) Splitting output evenly between the two factories.
(b) Using both factories but producing more at factory A than at factory B.
(c) Using both factories but producing more at factory B than at factory A.
(d) None of the above.

(d) Now both factories have constant marginal costs but the marginal cost at factory A is larger than the marginal cost at factory B. This means that no matter how much the firm is already producing, it will always be cheaper to produce the next unit at factory B. So all units will be produced at factory B.

4. Which of the following statements is true about industry supply in a perfectly competitive industry:

(a) The long run supply curve will be upward sloping.
(b) The long run supply curve will be downward sloping.
(c) The long run supply curve will be a vertical line.
(d) The long run supply curve will be a horizontal line.

(d) In a competitive industry long run profits must be zero. This means that the long run price will be equal to the minimum of the average cost curve giving an industry supply curve that is a horizontal line at that price.

5. If coffee and tea are perfect substitutes, which of the following can we say for certain?

(a) A consumer will buy only coffee if the price of coffee is less than the price of tea.
(b) A consumer will buy positive quantities of both coffee and tea.
(c) A consumer will spend all of her money on tea if the ratio of marginal utility to price is greater for tea than for coffee.
(d) Both (a) and (c).

(c) If coffee and tea are perfect substitutes, what matters is the ratio of marginal utility to price for each. Whichever good gives more utility per dollar will be the good that the consumer spends all of her money on.

6. Suppose that a monopolist has constant, positive marginal costs and faces a downward sloping demand curve. If the monopolist is currently producing at its profit-maximizing quantity:

(a) Revenue will decrease if the monopolist increases its quantity.
(b) Marginal revenue will decrease if the monopolist increases its quantity.
(c) Costs will decrease if the monopolist increases its quantity.
(d) Marginal costs will decrease if the monopolist increases its quantity.

(b) A larger quantity will lead to greater total costs but the same marginal costs (since marginal costs are constant in this case). Revenue will increase since marginal revenue is positive but marginal revenue will decrease (the marginal revenue curve is downward sloping).

7. If a competitive firm faces a market price that is in between the minimum of the firm's average cost curve and the minimum of the firm's average variable cost curve, the firm:

(a) Should shut down.
(b) Will have positive profits but negative producer surplus.

(c) Will have negative profits but positive producer surplus.
(d) Will have negative profits and negative producer surplus.
(e) Will have positive profits and positive producer surplus.

(c) Average cost will be greater than price leading to negative profits on each unit sold. However, price will be above average variable cost so the firm will be covering all of its variable costs and some of its fixed costs, leading to positive producer surplus.

8. Suppose consumers have downward sloping demand curves and firms have upward sloping marginal cost curves. In a competitive industry, a tax placed on consumers producers will:
   (a) Increase the price received by producers in the short run but have no effect on the long run price received by producers.
   (b) Decrease the price received by producers in the short run but have no effect on the long run price received by producers.
   (c) Increase the price received by producers in the short run and in the long run.
   (d) Decrease the price received by producers in the short run and in the long run.

   (b) In the short run, the tax will lower the price received by producers. This will lead to negative profits and drive firms out of the market until the price received by producers returns to its original level.

9. Suppose that magazines and coffee are complements. If the price of magazines increases:
   (a) The sign of the substitution and income effects for coffee will both be positive.
   (b) The sign of the substitution and income effects for coffee will both be negative.
   (c) The substitution effect will be positive and the income effect will be negative for coffee.
   (d) The substitution effect will be negative and the income effect will be positive for coffee.

   (c) Because coffee and magazines are complements, the net change in coffee consumption will be negative. Since coffee became relatively cheaper, the substitution effect for coffee will be positive. This means that the income effect must be negative to get a negative overall change.

10. If preferences are strictly convex and bundle A and bundle B give a consumer the same level of utility, then:
    (a) The consumer would prefer an average of the two bundles to either one of the individual bundles.
    (b) The consumer would have concave indifference curves.
    (c) The consumer would have an increasing marginal rate of substitution.
    (d) The consumer's indifference curves would have the same slope at bundle A and bundle B.

    (a) Convex preferences tell us that we have convex indifference curves. If the bundles give the same level of utility, they will lie along the same indifference curve. Since the indifference curve is convex, the slope of the indifference curve will be different at the two different bundles.

11. Which of the following is definitely true at the efficient quantity?

(a) Consumer surplus is at its maximum.
(b) Producer surplus is at its maximum.
(c) Profits are zero.
(d) Total surplus is at its maximum.

(d) Being at the efficient quantity just tells us that total surplus is at its maximum. It does not tell us how that surplus is divided between consumers and producers.

12. A competitive firm's cost function is given by $C(y) = 10y^2 - 10$. Which of the following is not true?

(a) The difference between profits and producer surplus is \$10.
(b) The firm will produce at all positive prices.
(c) The firm will earn profits at all positive prices.
(d) The firm has increasing marginal costs.

(c) *Note that cost function was changed to* $C(y) = 10y^2 + 10$. For low prices, marginal cost will be above average variable cost but below average cost. At these prices, the firm will produce but will have negative profits.

13. Suppose that capital is fixed in the short run but labor is a variable input. Capital and labor are the only inputs used in production. Which of the following would definitely not affect the short run level of production if it changed?

(a) The price of output.
(b) The wage.
(c) The fixed level of capital.
(d) The price of capital.

(d) The price of capital will affect profits by changing fixed costs but will not influence the decision of what to produce. The level of capital may matter if the level of capital affects the marginal product of labor.

14. There are only two consumers in the market for hamburgers. The two consumers have identical, linear demand curves. The market demand curve will be:

(a) Linear and twice as steep as the individual demand curve.
(b) Linear and half as steep as the individual demand curve.
(c) Linear and exactly as steep as the individual demand cure.
(d) Kinked at some point in the middle of the demand curve.

(b) Suppose that when the price drops by \$1, an individual consumer increases demand by an amount x. The slope of the individual demand curve would then be $\frac{1}{x}$. If each consumer increases their demand by x when the price drops by a dollar, total demand will increase by $2x$. So the slope of the market demand curve will be $\frac{1}{2x}$.

15. Suppose that demand for Coke is more elastic than demand for Pepsi and that consumers are currently buying the same amount of Coke and Pepsi. Assume Coke and Pepsi are both ordinary goods. If both Coke and Pepsi increase their prices by 10%:

(a) Demand for both will increase but demand for Coke will increase by a larger percentage.

(b) Demand for both will decrease but demand for Coke will decrease by a larger percentage.
(c) Demand for both will increase but demand for Pepsi will increase by a larger percentage.
(d) Demand for both will decrease but demand for Pepsi will decrease by a larger percentage.

(b) Since both are ordinary goods, demand will decrease with an increase in price. The more elastic demand is, the greater the decrease in the quantity demanded will be.

16. If a competitive firm's supply curve has a positive slope and the firm is currently producing a positive amount of output, then at its current level of output:

(a) It's marginal costs will be increasing.
(b) It's marginal costs will be constant.
(c) It's marginal costs will be decreasing.
(d) Either (a) or (b) could be true.

(a) The supply curve for a competitive firm is just its marginal cost curve above the minimum of the average variable cost curve. If the supply curve is upward sloping the marginal cost curve will be upward sloping.

17. A consumer has a diminishing marginal rate of substitution and is currently at a bundle that is at a point of tangency between the budget line and an indifference curve. Which of the following is true?

(a) All other bundles along the same indifference curve will cost more than the current bundle.
(b) All other bundles along the budget line will cost more than the current bundle.
(c) All other bundles along the same indifference curve will lead to greater utility.
(d) All other bundles along the same indifference curve will lead to lower utility.

(a) With convex indifference curves (implied by the diminishing marginal rate of substitution), all other bundles on the indifference curve will lie above the budget line. Therefore all of those other bundles will cost more than the current bundle.

18. Suppose that a competitive firm is maximizing profits and producing a positive quantity of output. Which of the following is not necessarily true at the firm's current level of output?

(a) Price is equal to marginal revenue.
(b) Price is equal to marginal cost.
(c) Marginal cost is greater than or equal to average cost.
(d) Marginal cost is greater than or equal to average variable cost.

(c) Price may be below average cost leading to negative profits. We only know for certain that price is equal to or above the average variable cost.

19. A quantity tax placed on consumers will tend to:

(a) Increase the number of firms in the long run in a competitive industry.
(b) Decrease the number of firms in the long run in a competitive industry.
(c) Increase the price received by producers in the long run in a competitive industry.
(d) Decrease the price received by producers in the long run in a competitive industry.

(b) The quantity tax will initially lower the price received by firms, turning profits negative. This will cause firms to exit the industry.

20. Suppose that the industry demand curve is linear and downward sloping. If the demand curve became flatter but still had the same vertical intercept as before:
    (a) The monopoly quantity and profits would both increase.
    (b) The monopoly quantity and profits would both decrease.
    (c) The monopoly quantity would increase but profits could go up or down.
    (d) The monopoly quantity would decrease but profits would go up or down.

    (a) If the demand curve became flatter, the marginal revenue curve would also become flatter. This will move the intersection between the marginal revenue and marginal cost curves further to the right. So the new monopoly quantity will be higher. The monopoly could still sell its old quantity if it wanted to and could now sell it at a higher price given the new demand curve so the monopoly will certainly be able to earn greater profits.

21. For a normal, ordinary good:
    (a) The Engel curve will be upward sloping and the demand curve will be downward sloping.
    (b) The Engel curve will be downward sloping and the demand curve will be upward sloping.
    (c) Both the Engel curve and demand curve will be downward sloping.
    (d) Both the Engel curve and demand curve will be upward sloping.

    (a) Since the good is normal, an increase in income will lead to an increase in demand giving an upward sloping Engel curve. Since the good is ordinary, an increase in price will lead to a decrease in demand giving a downward sloping demand curve.

22. Suppose that capital and labor are the only two inputs used by a firm. The marginal product of capital is constant and equal to 2. The marginal product of labor is constant and equal to 4. The firm:
    (a) Will use only capital if the price of capital is less than twice the price of labor.
    (b) Will use only capital if the price of capital is more than twice the price of labor.
    (c) Will use only capital if the price of capital is less than half the price of labor.
    (d) Will always use positive quantities of both capital and labor.

    (c) Capital is half as productive as labor so the firm will only be willing to pay half as much for a unit of capital as it would for a unit of labor.

23. If a monopolist uses a two-part tariff in a market where the demand curve is downward sloping:
    (a) Consumer surplus will be larger than if the monopolist just charged a single price per unit without a fixed fee.
    (b) The quantity sold will be smaller than if the monopolist just charged a single price per unit without a fixed fee.
    (c) Producer surplus will be smaller than if the monopolist just charged a single price per unit without a fixed fee.

(d) The price charged per unit will be lower than the price charged per unit without a fixed fee.

(d) With a two-part tariff, the monopolist will increase the quantity sold and decrease the price per unit but then charge a fee equal to the consumer surplus under this new combination of price and quantity.

24. Suppose a person consumes only cake and ice cream. A doubling of the prices of cake and ice cream will:
    (a) Change the slope of the budget line and reduce the set of affordable bundles.
    (b) Change the slope of the budget line and increase the set of affordable bundles.
    (c) Reduce the set of affordable bundles but keep the slope of the budget line the same as before.
    (d) Increase the set of affordable budnels but keep the slope of the budget line the same as before.

    (c) The slope of the budget line is just the ratio of the prices. Since both prices double, the ratio will not change. However, since the goods have gotten more expensive the set of affordable bundles will be smaller.

25. A monopoly will be most likely to exist:
    (a) When demand is large relative to the minimum efficient scale.
    (b) When demand is small relative to the minimum efficient scale.
    (c) When there are no barriers to entry.
    (d) When products are very homogeneous.

    (b) Monopolies are more likely when demand is small relative to the minimum efficient scale of the firm or when there are severe barriers into the industry.

SECTION II: SHORT ANSWER (40 points)

1. (14 points) There are ten firms producing bicycles (B). The firms are identical with each firm having the following cost function:

$$C(B) = \frac{1}{3}B^4 - \frac{3}{2}B^3 + 9B \tag{1}$$

The market for bicycles is competitive (firms are all price takers) with demand for bicycles given by:

$$D(p) = 90 - 2p \tag{2}$$

(a) At what price will firms shut down?

Firms will shut down when price drops below the minimum of the average variable cost curve. Notice that in this case, there is no difference between the average variable cost curve and the average cost curve since there are no fixed costs. To find the minimum of the average variable cost curve, we can set marginal cost equal to average variable cost:

$$MC(B) = AVC(B)$$

$$\frac{4}{3}B^3 - \frac{9}{2}B^2 + 9 = \frac{1}{3}B^3 - \frac{3}{2}B^2 + 9$$

$$B^3 = 3B^2$$

$$B = 3$$

$$MC(3) = \frac{4}{3}3^3 - \frac{9}{2}3^2 + 9$$

$$MC(3) = 4.5$$

So the firm will shut down when the price drops below \$4.5.

(b) Derive the *short run* industry supply function. *(Note that this was changed to ask for the short run inverse supply function for a single firm.)*

The short run supply curve is just the marginal cost curve above the shutdown price (\$4.5). So to get the inverse supply curve, we simply set price equal to the marginal cost function:

$$p(B) = MC(B)$$

$$p(B) = \frac{4}{3}B^3 - \frac{9}{2}B^2 + 9 \text{ for } B \geq 3$$

(c) Find the equilibrium price, quantity (for the market, not an individual firm) and number of firms in the *long run.*

Profits for an individual firm must be zero in the long run. This tells us that the long run equilibrium price will be the \$4.5 found in part (a). Plugging this price into the demand function gives us the equilibrium quantity:

$$D(4.5) = 90 - 2 \cdot 4.5$$

$$D(4.5) = 81$$

We also know from part (a) that at the breakeven price, each firm produces 3 units. Given this information and the equilibrium quantity, we can solve for the equilibrium number of firms:

$$n = \frac{81}{3} = 27$$

2. (14 points) There is a single firm producing tables (T). The firm has fixed costs equal to \$100 and the firm's total costs increase by \$10 for each additional table they produce. The inverse demand curve for tables is given by:

$$p(T) = 200 - T \tag{3}$$

   (a) Write down an equation giving total costs for the firm as a function of T, the number of tables produced.

   We know that the fixed cost term in the function will just be \$100. For the variable costs, each unit costs \$10, so the total variable costs will be 10 times the number of units. Combining the fixed and variable costs gives us the following total cost function:

$$C(T) = 10T + 100$$

   (b) How many tables will the firm produce and what will firm profits be?

   The firm will choose its quantity by setting marginal revenue equal to marginal cost. Marginal costs are simply \$10. To find marginal revenue, we can write down a function for total revenue and take a derivative with respect to the number of tables:

$$R(T) = p(T) \cdot T$$
$$R(T) = (200 - T) \cdot T$$
$$R(T) = 200T - T^2$$
$$MR(T) = \frac{dR(T)}{dT} = 200 - 2T$$

   Setting marginal revenue equal to marginal cost gives us:

$$MR(T) = MC(T)$$
$$200 - 2T = 10$$
$$T = 95$$

   Plugging in a quantity of 95 into the demand function gives us a price of \$105. Profits will be:

$$\pi(T) = R(T) - C(T)$$
$$\pi(T) = 200T - T^2 - 10T - 100$$
$$\pi(95) = 200 \cdot 95 - 95^2 - 10 \cdot 95 - 100$$
$$\pi(95) = 8925$$

   (c) What is the socially efficient quantity of tables?

   The socially efficient quantity will be where the marginal cost curve intersects the demand curve:

$$p(T) = MC(T)$$
$$200 - T = 10$$
$$T = 190$$

   Notice that the socially efficient quantity is larger than the monopoly quantity.

(d) Calculate the deadweight loss generated by the firm acting as a monopolist.

The deadweight loss will be the area under the demand curve above the marginal cost curve between the monopoly quantity and the efficient quantity. The height of this triangle is the distance between the demand curve and the marginal cost curve at the monopoly quantity $(105 - 10)$. The width of this triangle is the difference between the monopoly quantity and efficient quantity $(190 - 95)$. So the deadweight loss is:

$$DWL = \frac{1}{2}(105 - 10)(190 - 95)$$

$$DWL = \frac{1}{2}95^2$$

$$DWL = 4512.5$$

3. (12 points) Suppose that a firm uses only capital and labor as inputs. The firm's production function is given by:

$$f(K, L) = K^{\frac{1}{2}} L^{\frac{1}{2}} \tag{4}$$

The price of a unit of capital is \$4 and the wage is \$1. The price of a unit of output is \$10.

(a) Derive expressions for the marginal product of labor and the marginal product of capital.

$$MPL = \frac{df(K, L)}{dL} = \frac{1}{2} K^{\frac{1}{2}} L^{-\frac{1}{2}}$$

$$MPK = \frac{df(K, L)}{dK} = \frac{1}{2} K^{-\frac{1}{2}} L^{\frac{1}{2}}$$

(b) Derive expressions for the optimal amount of labor as a function of output ($L(y)$) and the optimal amount of capital as a function of output ($K(y)$). Your expressions should contain only y and constants.

The firm will choose the levels of the inputs such that the ratio of the marginal products is equal to the ratio of the prices of the inputs:

$$\frac{MPL}{MPK} = \frac{w}{r}$$

$$\frac{\frac{1}{2} K^{\frac{1}{2}} L^{-\frac{1}{2}}}{\frac{1}{2} K^{-\frac{1}{2}} L^{\frac{1}{2}}} = \frac{w}{r}$$

$$\frac{K}{L} = \frac{w}{r}$$

$$K = \frac{w}{r} L$$

We also know that the inputs must produce the desired level of output y:

$$y = K^{\frac{1}{2}} L^{\frac{1}{2}}$$

Plugging the previous expression for K into this equation gives us:

$$y = \left(\frac{w}{r} L\right)^{\frac{1}{2}} L^{\frac{1}{2}}$$

$$y = \left(\frac{w}{r}\right)^{\frac{1}{2}} L$$

$$L = \left(\frac{r}{w}\right)^{\frac{1}{2}} y$$

Plugging this back into our expression relating K to L gives:

$$K = \frac{w}{r} \left(\frac{r}{w}\right)^{\frac{1}{2}} y$$

$$K = \left(\frac{w}{r}\right)^{\frac{1}{2}} y$$

We can plug in the values of r and w to get the final expressions for $K(y)$ and $L(y)$:

$$L(y) = 2y$$

$$K(y) = \frac{1}{2}y$$

(c) Find an expression for total costs as a function of output ($C(y)$).

$$C(y) = rK(y) + wL(y)$$

$$C(y) = 4 \cdot \frac{1}{2}y + 1 \cdot 2y$$

$$C(y) = 4y$$