Ecn 100 - Intermediate Microeconomics
University of California - Davis May 12, 2010
Instructor: John Parman

Midterm 2 - Solutions

You have until 1:00pm 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. Suppose that the only two goods a consumer buys are bread and butter and she always spends her full income on those two goods. If butter is a luxury good, we can say for certain that the income elasticity of bread is:
   (a) Greater than one.
   (b) Less than negative one.
   (c) Greater in magnitude than the income elasticity of butter.
   (d) Less than one.

   (d) If butter is a luxury good, when income increases by one percent spending on butter increases by more than one percent. To keep a balanced budget, this implies that if spending on bread goes up, it must do so by less than one percent.

2. Suppose that a firm uses a technology that exhibits decreasing returns to scale. Currently the firm is producing 100 units of output at a total cost of \$200. If the firm decides to cut output to 50 units by reducing all inputs by a constant proportion, the firm's new total costs will be:
   (a) Equal to \$100.
   (b) Greater than \$100.
   (c) Less than \$100.
   (d) Not enough information.

   (c) If a firm uses a decreasing returns to scale technology, doubling output from 50 to 100 would require more than doubling the inputs and therefore the costs. So the costs at 50 units of output should be less than half of the costs at 100 units of output.

3. Suppose goods X and Y are both normal goods. When the price of good Y increases, we can say for certain that:
   (a) The income effect for Y will be negative.
   (b) The substitution effect for X will be positive.

(c) The income effect for X will be negative.
(d) All of the above.

(d) The increase in the price of Y leads to a drop in effective income. Since both X and Y are normal goods, this will lead to a negative income effect for both goods. Because X became relatively cheaper, it will have a positive income effect.

4. Free disposal of inputs will typically guarantee that a production technology:
   (a) Is convex.
   (b) Exhibits constant returns to scale.
   (c) Is monotonic.
   (d) Exhibits diminishing technical rate of substitution.

   (c) If we can freely dispose of inputs, then increasing the levels of inputs should never reduce the level of output (we could always just throw away the extra input and achieve the old level of output).

5. There are two consumers for widgets. Both consumers have linear demand curves that hit a quantity of zero when the price of a widget reaches \$10. On a graph with quantity on the horizontal axis and price on the vertical axis, the slope of the first consumer's demand curve is -1 and the slope of the second consumer's demand curve is -2. The slope of the market demand curve will be:
   (a) $-\frac{1}{3}$.
   (b) -3.
   (c) $-\frac{2}{3}$.
   (d) None of the above.

   (c) When the price of a widget drops by \$2, the first consumer's demand increases by two units and the second consumer's demand increases by one unit, leading to an increase in market demand of three units. So the slope of the market demand curve is $-\frac{2}{3}$.

For problems 6 and 7, use the following information. Cheerios and milk are the only two goods you consume. Your demand for bowls of cheerios (C) and glasses of milk (M) in terms of the price of a bowl of cheerios (p_C), the price of a glass of milk (p_M) and your income income (I) are given by the following equations:

$$C = \frac{I}{p_C + 2p_M} \tag{1}$$

$$M = \frac{2I}{p_C + 2p_M} \tag{2}$$

6. When the price of cheerios decreases, the sign of the substitution effect for milk will be _____ and the sign of the income effect for milk will be _____.
   (a) Positive, positive.
   (b) Positive, negative.

(c) Negative, positive.
(d) Positive, positive.

(c) If cheerios get cheaper, milk gets relatively more expensive leading to a negative substitution effect for milk. The lower price for cheerios leads to an increase in effective income which will result in a positive income effect for milk.

7. When the price of milk increases, the magnitude of the subsitution effect for cheerios will be:
   (a) Greater than the magnitude of the income effect for cheerios.
   (b) Equal to the magnitude of the income effect for cheerios.
   (c) Less than the magnitude of the income effect for cheerios.
   (d) Not enough information.

   (c) Notice that milk and cheerios are complements (when p_M increases, the demand function for cheerios decreases). So the net change in demand for cheerios will be negative when the price of milk increases. However, the substitution effect for cheerios will be positive since milk became relatively cheaper. This tells us that the income effect must be larger in magnitude in the substitution effect to get an overall negative effect.

8. Suppose that the price of output is \$4, the price of a unit of capital is \$12, and the price of unit of labor if \$8. If labor is fixed in the short run and capital is variable, what will the marginal product of capital be for the last unit of capital used by a profit-maximizing firm? (You can assume that the short run profit-maximizing combination of inputs contains positive, finite quantities of both inputs.)
   (a) 3.
   (b) $\frac{3}{2}$.
   (c) $\frac{1}{3}$.
   (d) Not enough information.

   (a) To maximize profits, the firm will set the value of the marginal product of capital ($p \cdot MP_K$) equal to the rental rate of capital. This means choosing the level of capital that leads to a marginal product of capital equal to $\frac{r}{p}$ or $\frac{12}{4}$.

9. Using the same information as question 8, what will the marginal product of labor be for the last worker used by a profit-maximizing firm? (You can assume that the short run profit-maximizing combination of inputs contains positive, finite quantities of both inputs.)
   (a) 2.
   (b) $\frac{3}{2}$.
   (c) $\frac{1}{2}$.
   (d) Not enough information.

   (d) Labor is fixed in the short run. This means that we have no way of determining the marginal product of labor from the given prices and any decisions the firm makes in the short run.

10. Which of the following production functions does not exhibit a dimishing technical rate of substitution?

(a) $f(K, L) = KL$.
(b) $f(K, L) = K^{\frac{1}{2}}L^{\frac{1}{2}}$.
(c) $f(K, L) = K^2 + L^2$.
(d) None of the above.

(c) The marginal product of labor is $2L$ and the marginal product of capital is $2K$, giving a technical rate of substitution of $\frac{L}{K}$. This gets larger as you move down and right along an isoquant which indicates an increasing technical rate of substitution.

11. If a market has a downward sloping, linear demand curve and an upward sloping, linear supply curve, a value tax placed on consumers will definitely:
    (a) Generate tax revenue greater than the loss in producer surplus and the loss in consumer surplus combined.
    (b) Generate tax revenue greater than the deadweight loss.
    (c) Generate tax revenue less than the loss in producer suprlus and the loss in consumer surplus combined.
    (d) Generate tax revenue equal to the deadweight loss.

    (c) We know that the tax will generate a deadweight loss. This means that the drop in consumer and producer surplus will be larger than the tax revenue generated (the difference between these two quantities is the deadweight loss).

12. We would expect the price elasticity of demand for Dell laptops to be (you can assume Dell laptops are normal but not luxury goods):
    (a) Greater in magnitude than the price elasticity of demand for laptops in general.
    (b) Smaller in magnitude than the price elasticity of demand for laptops in general.
    (c) Smaller in magnitude than the price elasticity of demand for computers in general.
    (d) Greater than zero.

    (a) If we focus on Dell laptops, there are many close substitutes. An increase in the price of a Dell will lead many consumers to purchase other brands instead suggesting a large price elasticity for Dells. There are fewer close substitutes for laptops or computers in general, so the response in demand to a change in price of all laptops or all computers will be more inelastic.

13. If capital is fixed in the short run and labor is variable, the level of short run profits a firm can make:
    (a) Does not depend on the price of capital.
    (b) Does not depend on the price of labor.
    (c) Does not depend on the price of output.
    (d) None of the above.

    (d) The choice of how much labor the firm uses will depend on both the price of labor and the price of output. While the price of capital does not affect the level of labor to choose, it does affect profits by changing how much the firm has to spend on its fixed amount of capital.

14. Which of the following technologies exhibits constant returns to scale?

(a) $f(K, L) = KL$.
(b) $f(K, L) = K^{\frac{1}{2}} L^{\frac{1}{2}}$.
(c) $f(K, L) = K^{\frac{1}{2}} + L^{\frac{1}{2}}$.
(d) None of the above.

(b) Notice that $f(\lambda K, \lambda L) = \lambda^{\frac{1}{2}} L^{\frac{1}{2}} \lambda^{\frac{1}{2}} K^{\frac{1}{2}} = \lambda f(K, L)$.

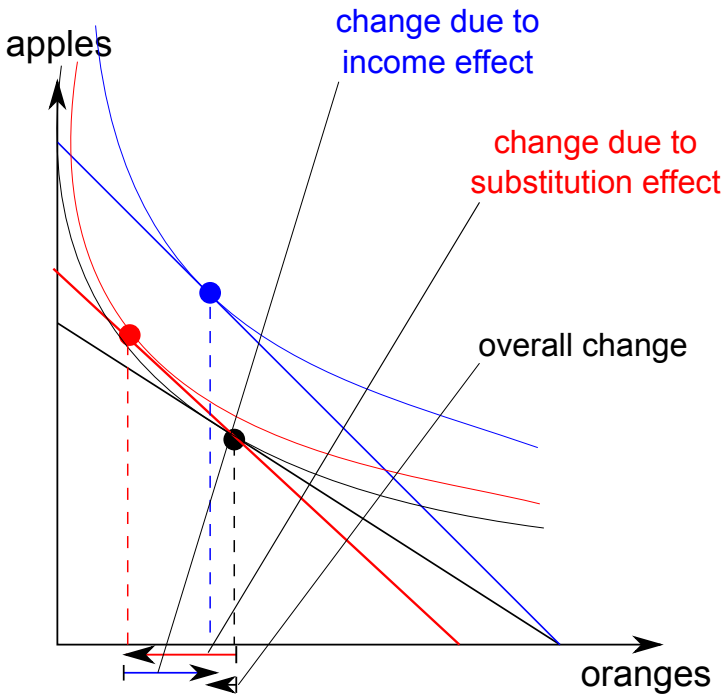
15. A store determines that customer demand for DVDs is very elastic. The store can increase revenues by:

(a) Increasing the price of DVDs.
(b) Decreasing the price of DVDS.
(c) The answer depends on the cost of producing a DVD.
(d) None of the above.

(b) If demand is very elastic, lowering the price will lead to a large increase in the quantity of DVDs sold. The percent increase in quantity will be larger than the percent decrease in price leading to an overall increase in revenues.

SECTION II: SHORT ANSWER (40 points)

1. (10 points) The graph below shows the initial budget line for a consumer who buys only apples and oranges. Apples and oranges are normal goods and they are substitutes. On the graph below, show the change in demand for oranges decomposed into the part due to the income effect and the part due to the substitution effect when the price of apples decreases. Include any relevant budget lines, indifference curves and consumption bundles.



The decrease in the price of apples rotates the budget line up (from the black budget line to the blue budget line). This will move the consumer from their original bundle (the black bundle on the graph) to a new bundle (the blue bundle) that has more apples but fewer oranges since apples and oranges are substitutes. The intermediate budget line (the red budget line) will pass through the original bundle but have the same slope as the new budget line. The intermediate bundle (the red bundle) will be located up and to the left of the original bundle since apples have gotten relatively cheaper and oranges have gotten relatively more expensive. The intermediate bundle will down and to the left of the final bundle because both apples and oranges are normal goods. The substitution effect is the change in oranges moving from the original bundle to the intermediate bundle and the income effect is the change in oranges moving from the intermediate bundle to the final bundle.

2. (15 points) Suppose that a firm uses screws (S) and nails (N) as its two inputs. One screw can always be substituted for two nails. The firm can produce output according to the following production function:

$$f(S, N) = 10S + 5N \tag{3}$$

(a) What is the marginal product of nails (MP_N)?

$$MP_N = \frac{df(S, N)}{dN} = 5$$

(b) In the short run, the number of screws a firm has is fixed at 10 but the firm can choose any number of nails it wants. The price of a unit of output is \$1, the price of a nail is \$5 and the price of a screw is \$10. Draw a graph with the number of nails used on the horizontal axis and output on the vertical axis. Show the short run production function on this graph as well as the isoprofit line that corresponds to profits of \$100. Be certain to label all slopes and intercepts with their numerical values. *Note that the prices were switched during the exam such that the price of a nail was \$10 and the price of a screw was \$5.*

In the short run, the production function is:

$$f(10, N) = 10 \cdot 10 + 5N = 100 + 5N$$

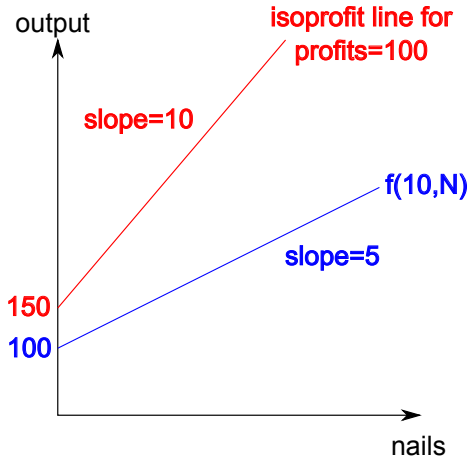
To get an equation for the isoprofit line, we can write out an equation for profits, plug in all of our prices and rearrange to get output as a function of N:

$$\pi = py - p_S S - p_N N$$

$$100 = 1 \cdot y - 5 \cdot 10 - 10 \cdot N$$

$$y = 150 + 10N$$

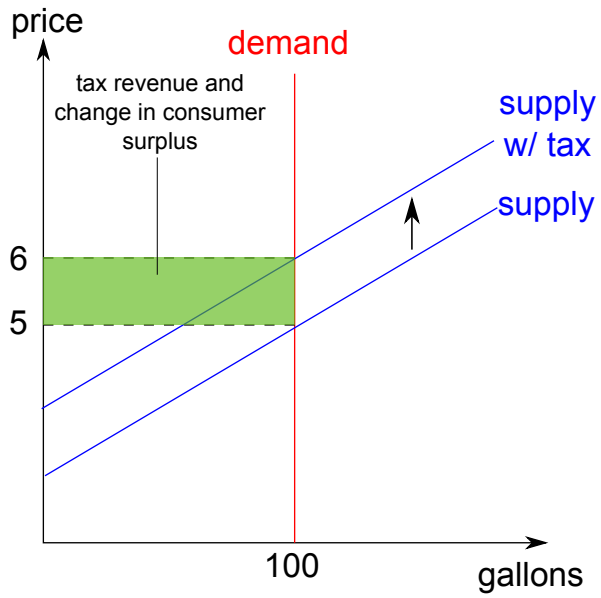
Graphing these two functions gives us:



(c) How many nails will the firm use and how many units of output will the firm produce in the short run?

Notice that the marginal product of a nail is constant and equal to 5. Given that the price of output is \$1, this means each extra nail used by the firm will generate an additional \$5 in revenue. However, each additional nail costs \$10. So the firm will not want to use any nails in the short run. The optimal number of nails will be zero and the amount of output produced by the firm will be 100 units ($f(10, 0) = 100$). We could also see this result from the graph by noting that the isoprofit lines are steeper than the production function. We can always reach a higher isoprofit line by moving down and left along the production function. This would lead us to the endpoint of the production function where output equals 100 and the number of nails equals zero.

3. (15 points) Suppose that market demand for water in Davis is perfectly inelastic. Davis residents will always consume a total of 100 gallons of water each day no matter what the price of water is. Water supply is given by an upward-sloping, linear supply curve. Currently, the equilibrium price of a gallon of water is \$5. Suppose that Davis places a \$1 per gallon tax on water suppliers. On a graph with gallons of water on the horizontal axis and price of water per gallon on the vertical axis, use appropriate supply and demand curves to show the effects of this tax. The following items should be shown on your graph and clearly labeled. If any of the items cannot be shown on the graph, include a one sentence explanation of why they cannot be graphed.
   - The original equilibrium price and quantity before the tax.
   - The new eqilibrium quantity, price paid by consumers and price received by producers after the tax.
   - The change in consumer surplus.
   - The change in producer surplus.
   - The tax revenue.



The original equilibrium price is at \$5 and the original equilibrium quantity is at 100 gallons. This point is at the intersection of the demand curve and the original supply curve. The quantity tax shifts the supply curve up by \$1, leading to a new equilibrium at 100 gallons, \$6 as the price paid by consumers and \$5 as the price received by the producers. The tax revenue is the quantity times the \$1 per unit tax, represented by the area of the green rectangle on the graph. There is no change in producer surplus since producers sell the same quantity and receive the same price as they did before the tax. The consumer surplus has gone done by \$1 per unit on all of the units consumed since consumers are paying \$1 more per unit than they had been. So the loss in consumer surplus is this \$1 per unit multiplied by the number of units. On the graph, this is the same green rectangle

as tax revenue.