DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE INSTRUCTED TO BEGIN

Econ 30010
Intermediate Microeconomic Theory
Midterm Exam, Fall 2009

Instructions:
1) You may use a pen or pencil, a hand-held nonprogrammable, nongraphing calculator, and a ruler or straightedge. No other materials may be at or near your desk. Books, coats, backpacks, etc... must be placed in the front or rear of the classroom.
2) Once you are instructed to begin, check that your exam has 11 numbered pages.
3) Be sure to show all of your work. **Answers without supporting calculations will receive zero credit.** You will receive credit only for the answers and supporting calculations that appear in this test booklet.
4) You have 120 minutes from the beginning of the exam period to complete this exam. No extensions will be granted.
5) The times listed below are only estimates that are intended to help you manage your time.

NAME ______Answer Key__________________________

Question 1 -	20 minutes:	_______	(25 points)
Question 2 -	10 minutes:	_______	(12 points)
Question 3 -	25 minutes:	_______	(26 points)
Question 4 -	25 minutes:	_______	(26 points)
Total -	80 minutes:	_______	(89 points)

1. Short answer questions.

a. Explain what is meant by "capital-saving technological change"?

This is a change in technology which decreases the marginal rate of substitution of capital for labor (or increases the marginal rate of substitution of labor for capital) for any capital-labor ratio. As a result, a firm is willing to use more labor and less capital holding fixed output and relative prices.

b. Write down the equations that describe a consumer's utility-maximizing bundle. Provide an economic interpretation for each equation.

Budget Line equation: $p_1q_1 + p_2q_2 = m$ - This equation describes the set of bundles that are exactly affordable.

Marginal Value equation: $MU_1(q_1,q_2)/p_1 = MU_2(q_1,q_2)/p_2$ - This equation describes those bundles for which the last dollar spent on each good increases utility equally.

c. Define the concept of "compensating variation."

The compensating variation of a price change is the change in income needed to ensure that a consumer chooses a bundle that yields the same utility she was getting before prices changed.

d. How do non-linear prices differ from linear prices?

Linear prices so not vary with the quantity a consumer purchases. Non-linear prices do.

e. Janice likes the taste of red wine and chocolate but both foods can give her migraines. Her utility function for bundles of these two items is

$$U(W,C) = -(1-W)^2 - C^{1/2}$$

where W denotes the number of glasses of red wine she drinks each day and C denotes the number of ounces of chocolate she eats each day. Over what range of values for W and C is each item a good, a bad, or a neutral product?

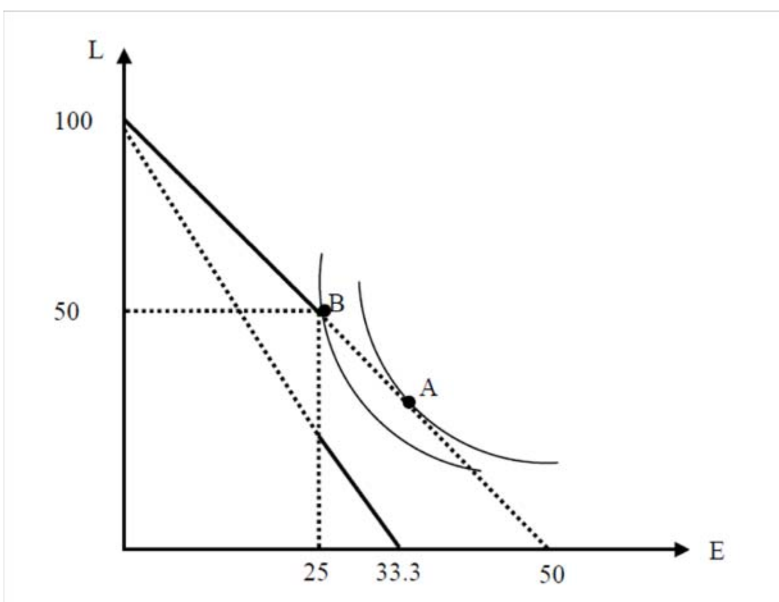
$MU_W = 2(1 - W)$ and $MU_C = -C^{-1/2}/2$

Red wine is a good for $W < 1$ since in this range MU_W is positive; it is a bad for $W > 1$ since in this range $MU_W < 0$; and it is a neutral good at $W = 1$. Since $MU_C < 0$ for all C, chocolate is always a bad.

f. During the summer Sam can stay cool by drinking lemonade and by running his air conditioner. Lemonade costs $.50/ounce and the electricity to power the air conditioner costs $1/kilowatt-hour (KwH). Sam's monthly income to spend on lemonade and electricity is $50/month.

Suppose that the local electricity provider is concerned about too many people running their air conditioners and so to avoid brownouts or blackouts, it implements the following pricing plan. For individuals who use up to 25 KwH of electricity in a month, their cost is $1/KwH. For individuals who use more than 25 KwH of electricity in a month, their cost is $1.50/KwH for all of the electricity they use.

Draw Sam's budget line given this new plan. On the same graph, draw a set of indifference curves that would be consistent with Sam using more than 25 KwH of electricity under the original prices and with Sam using exactly 25 KwH of electricity under the new plan.



2. Consider the following three pairs of conditional factor demands.

(A)	(B)	(C)
$K = (w^3/r)q^2$	$K = (2w/r)^{1/3}q^2$	$K = (r/w)q$
$L = (r^2/w)q$	$L = \left(\frac{r}{2w}\right)^{2/3} q^2$	$L = (w/r)q$

Which, if any, of the three pairs are conditional factor demands for a cost-minimizing firm? For each pair that is consistent with cost-minimizing behavior, derive the related production function. For each pair that is not consistent with cost-minimizing behavior, explain why.

(A) - Inconsistent. If both factor prices change by the same proportion, the quantity demanded of capital and labor will change. *K* and *L* should not change when relative prices are unchanged.

(C) - Inconsistent. *K* and *L* depend only on relative prices but *K* is increasing in *r* (it should be decreasing) and *L* is increasing in *w* (it should be decreasing)

(B) - Consistent - The conditional factor demands depend on factor prices only via relative prices and each conditional factor demand is decreasing in that factor's price. To recover the production function, rewrite the conditional factor demand for capital as

$$2w/r = K^3/q^6$$

and rewrite the conditional factor demand for labor as

$$2w/r = q^3/L^{3/2}.$$

Combining these two equations implies $K^3/q^6 = q^3/L^{3/2}$ or $q^9 = K^3L^{3/2}$ or $q = K^{1/3}L^{1/6}$.

Thus, the conditional factor demands in (B) were generated by a firm with the production function, $F(K,L) = K^{1/3}L^{1/6}$.

3. Ben likes pizza and burgers. His utility function for bundles of these two products is

$$U(q_z,q_b) = q_z^{1/2} + q_b^{1/2}$$

where q_z is the number of slices of pizza Ben eats each week and q_b is the number of burgers he eats each week.

a. Derive Ben's demand curves for pizza and burgers. Use the demand curves to determine if pizza and burgers are complements or substitutes.

Marginal Utilities: $MU_z = q_z^{-1/2}/2$ and $MU_b = q_b^{-1/2}/2$

Marginal Value Equation: $\dfrac{1}{2p_z q_z^{1/2}} = \dfrac{1}{2p_b q_b^{1/2}}$ or $q_z = (p_b/p_z)^2 q_b$

Budget Line Equation: $p_z q_z + p_b q_b = m$

Solve Marginal Value and Budget Line equations simultaneously to get Ben's demand curves.

$$q_b^* = \frac{m}{p_b(1 + p_b/p_z)} \text{ and } q_z^* = \frac{m}{p_z(1 + p_z/p_b)}$$

Since q_b^* is increasing in p_z and q_z^* is increasing in p_b, pizza and hamburgers are substitutes.

b. Suppose that last week the price of a slice of pizza was $2 and the price for a burger was $3 and that Ben had $30 to spend on pizza and burgers. This week the price of a burger increases to $6. Draw a graph that illustrates how to calculate the compensating variation of this price change. Then calculate the compensating variation.

Calculating the intermediate bundle:

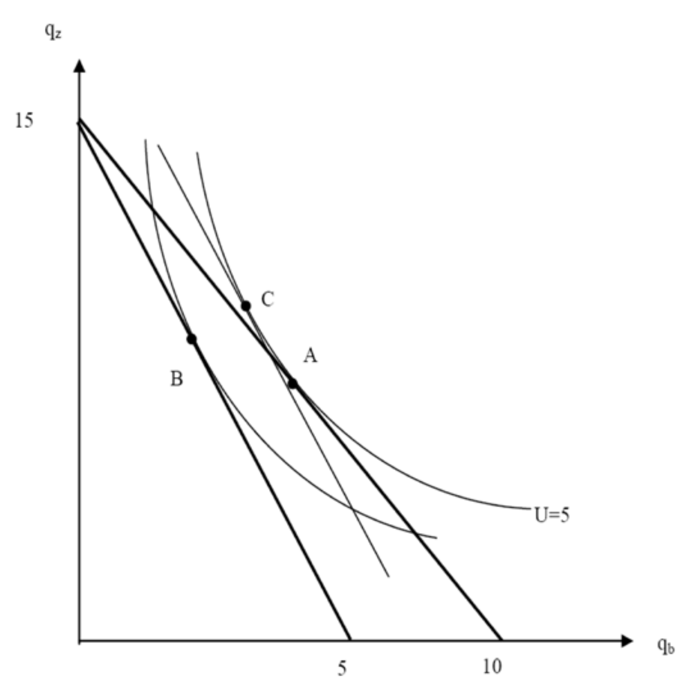
Marginal Value Equation using new prices: $q_z = 9q_b$

Utility at original prices: When p_b = $3/burger and p_z = $2/slice, $q_b^* = 4$ and $q_z^* = 9$ so $U(9,4) = 5$.

This means the intermediate bundle must satisfy $q_z^{1/2} + q_b^{1/2} = 5$

Solving the Marginal Value Equation and the equation for the 5-unit indifference curve simultaneously yields q_b = 25/16 and q_z = 225/16.

The cost of this bundle at the new prices equals (6)(25/16) + (2)(225/16) = $37.50. Thus, the CV = $37.50 - $30 = $7.50.



c. Would the equivalent variation associated with this price change be larger or smaller than the compensating variation? Why?

Smaller - The EV uses the original lower prices to place a dollar value on the change in utility. When prices are low, you need fewer dollars to replicate a change in utility than when prices are high.

d. (Bonus Question) Suppose that in addition to the price of a burger increasing to $6, the price of a slice of pizza also increases to $4. What is the compensating variation of the combined price changes? Why? What is the equivalent variation? Why?

CV = $30. Prices have doubled so relative prices are unchanged. Thus there is only an income effect and Ben will need twice as much money to afford bundle A.

EV = $15. The other way to replicate the same income effect brought about by doubling prices is to halve income.

4. A firm operates with the production function

$$F(K,S,U) = 2KSU$$

where K denotes the amount of capital, S denotes the amount of skilled labor, and U denotes the amount of unskilled labor. Let r denote the rental rate, w_s denote the wage rate for skilled labor, and w_u denote the wage rate for unskilled labor.

a. Derive the firm's conditional factor demands and its cost function. Does the firm's cost function exhibit economies or diseconomies of scale? Why?

Calculate Marginal Products: $MP_K = 2SU$, $MP_L = 2KU$, $MP_U = 2KS$

Marginal Value Equations:

$MP_K/r = MP_S/w_s$ implies $S = (r/w_s)K$

$MP_S/w_s = MP_U/w_u$ implies $U = (w_s/w_u)S = (r/w_u)K$

q-unit isoquant equation: $2KSU = q$

Solving the Marginal Value equations and the q-unit isoquant equation simultaneously implies

$K^* = (w_s w_u/(2r^2))^{1/3} q^{1/3}$, $S^* = (rw_u/(2w_s^2))^{1/3} q^{1/3}$, and $U^* = (rw_s/(2w_u^2))^{1/3} q^{1/3}$.

Then the firm's long-run total cost function is

$$TC(q) = rK^* + w_s S^* + w_u U^* = h(w,r)q^{1/3}$$

and average cost is

$$AC(q) = h(w,r)q^{-2/3}.$$

Since average cost is decreasing in q, the firm's costs exhibit economies of scale.

b. Suppose the government passes legislation that doubles the wage rate paid to unskilled workers. What happens to the amount of unskilled labor employed by the firm?

An increase in the wage paid to unskilled workers will cause the firm to substitute away from unskilled labor towards capital and/or skilled labor. In this case, the quantity demanded of unskilled labor will fall by a factor of $2^{2/3}$ or 1.59.

c. Derive the firm's short-run conditional factor demands and its short-run cost function if capital is fixed at $\bar{K}$ units. Derive the formulas for the firm's short-run average cost, short-run average variable cost, and short-run marginal cost.

Simultaneously solving the marginal value equation, $MP_s/w_s = MP_U/w_u$, and the q-unit isoquant equation, which is now $q = 2\bar{K}SU$, implies $S^* = (w_u q/(2\bar{K}w_s))^{1/2}$ and $U^* = (w_s q/(2\bar{K}w_u))^{1/2}$.

Now $STC(q) = r\bar{K} + w_s S^* + w_u U^* = r\bar{K} + (2w_s w_u q/\bar{K})^{1/2}$.

Then $SAC(q) = r\bar{K}/q + (2w_s w_u/(\bar{K}q))^{1/2}$, $AVC(q) = (2w_s w_u/(\bar{K}q))^{1/2}$, and

$SMC(q) = (1/2)(2w_s w_u/(\bar{K}q))^{1/2}$.

d. Compare the impact of a doubling of the wage rate paid to unskilled workers in the short-run to that in the long-run.

U^* does not decrease as much in the short-run because the firm is unable to substitute towards capital as it could in the long-run.

and/or

Total costs will increase more in the short-run than in the long-run because the firm cannot substitute away from unskilled labor as much as it would like in the short-run.