

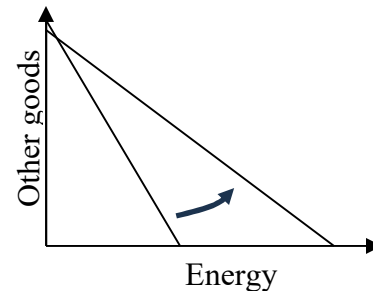
EXAMINATION #2 VERSION B
“Consumers and Demand”
September 28, 2023

INSTRUCTIONS: This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets.

I. MULTIPLE CHOICE: Circle the one best answer to each question. Use margins for scratch work. [1 pt each—10 pts total]

(1) The assumption of diminishing marginal rate of substitution implies that indifference curves

- a. slope up.
- b. slope down.
- c. get flatter as they approach the horizontal axis.
- d. get steeper as they approach the horizontal axis.
- e. none of the above.



(2) Which utility function below violates the axiom of *monotonicity* or *more is better*?

- a. $U(q_1, q_2) = -q_1^{-1} - q_2^{-1}$.
- b. $U(q_1, q_2) = 3q_1^5 q_2^4$.
- c. $U(q_1, q_2) = 3q_1 q_2$.
- d. $U(q_1, q_2) = (5q_1) / (4q_2)$.

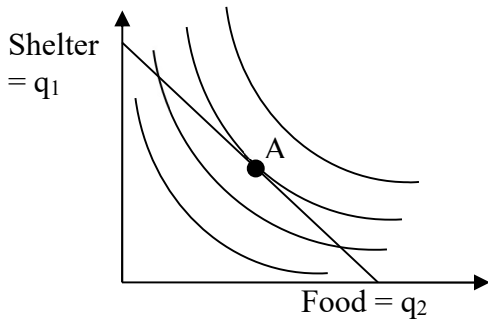
(3) In the graph below, the shift in the budget line could be caused by

- a. an increase in income.
- b. a decrease in income.
- c. an increase in the price of energy.
- d. a decrease in the price of energy.
- e. an increase in the price of other goods.
- f. a decrease in the price of other goods.

(4) If all prices and the consumer's income double, then the consumer's budget line

- a. becomes flatter.
- b. becomes steeper.
- c. shifts inward, toward the origin in parallel fashion.
- d. shifts outward, away from the origin in parallel fashion.
- e. None of the above.

The next two questions refer to the following graph of a consumer's budget line and indifference curves. Suppose the consumer is currently at bundle A for some reason.



- (5) This consumer could enjoy higher utility, without increasing total spending, by
- purchasing less food and more shelter.
 - purchasing more food and less shelter.
 - purchasing less food and less shelter.
 - any of the above.
 - none of the above.

- (6) Let MU_1 denote the marginal utility of shelter and MU_2 denote the marginal utility of food for this consumer. Let p_1 denote the price of shelter and p_2 denote the price of food. At bundle A,
- $MU_2 = MU_1$ and $p_2 = p_1$.
 - $MU_2/MU_1 = p_2/p_1$.
 - $MU_2/MU_1 < p_2/p_1$.
 - $MU_2/MU_1 > p_2/p_1$.
 - cannot be determined from information given.

(7) What is wrong with this demand function?

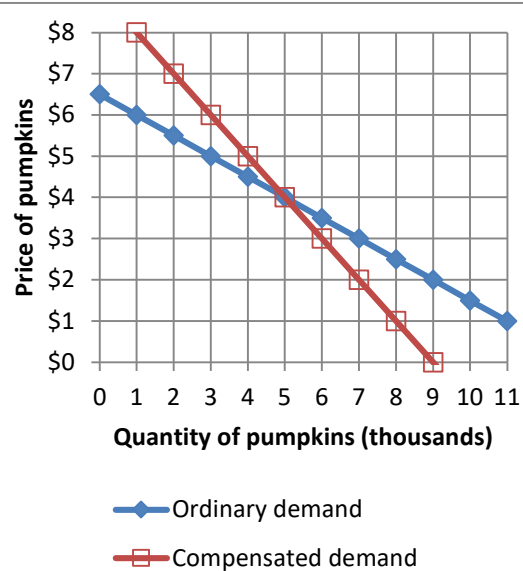
$$q_1^* = 3 I^{1.2} p_1^{-0.5} p_2^{0.1}$$

- This demand function implies that the quantity demanded can be negative even if income and prices are positive.
- This demand function implies that good 1 is a Giffen good.
- This demand function is not homogeneous of degree zero.
- This demand function implies that the price of another good influences the demand for good 1, which is impossible.

(8) Which price index tends to *underestimate* the rate of inflation, due to substitution bias?

- Laspeyres price index.
- Paasche price index.
- Fisher price index.
- All of the above.
- None of the above.

The next two questions refer to the following graph of ordinary and compensated demand curves for pumpkins.



- (9) Suppose the price of pumpkins fell from \$4 to \$2. The compensating variation in income that would leave consumers just as well off as before the price change equals
- \$2.
 - \$10 thousand.
 - \$12 thousand.
 - \$14 thousand.

- (10) Again, suppose the price of pumpkins fell from \$4 to \$2. The increase in consumer surplus equals
- \$2.
 - \$10 thousand.
 - \$12 thousand.
 - \$14 thousand.

II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Price elasticity of demand: 10 pts] Suppose the price elasticity of demand for cheese is -0.75 , and the price of cheese falls by 4 %.

- Is the demand for cheese *elastic* or *inelastic* ?
- Will the quantity demanded of cheese *increase* or *decrease*?
- By about how much?
- Will consumers' total spending on cheese *increase* or *decrease*?
- By about how much?

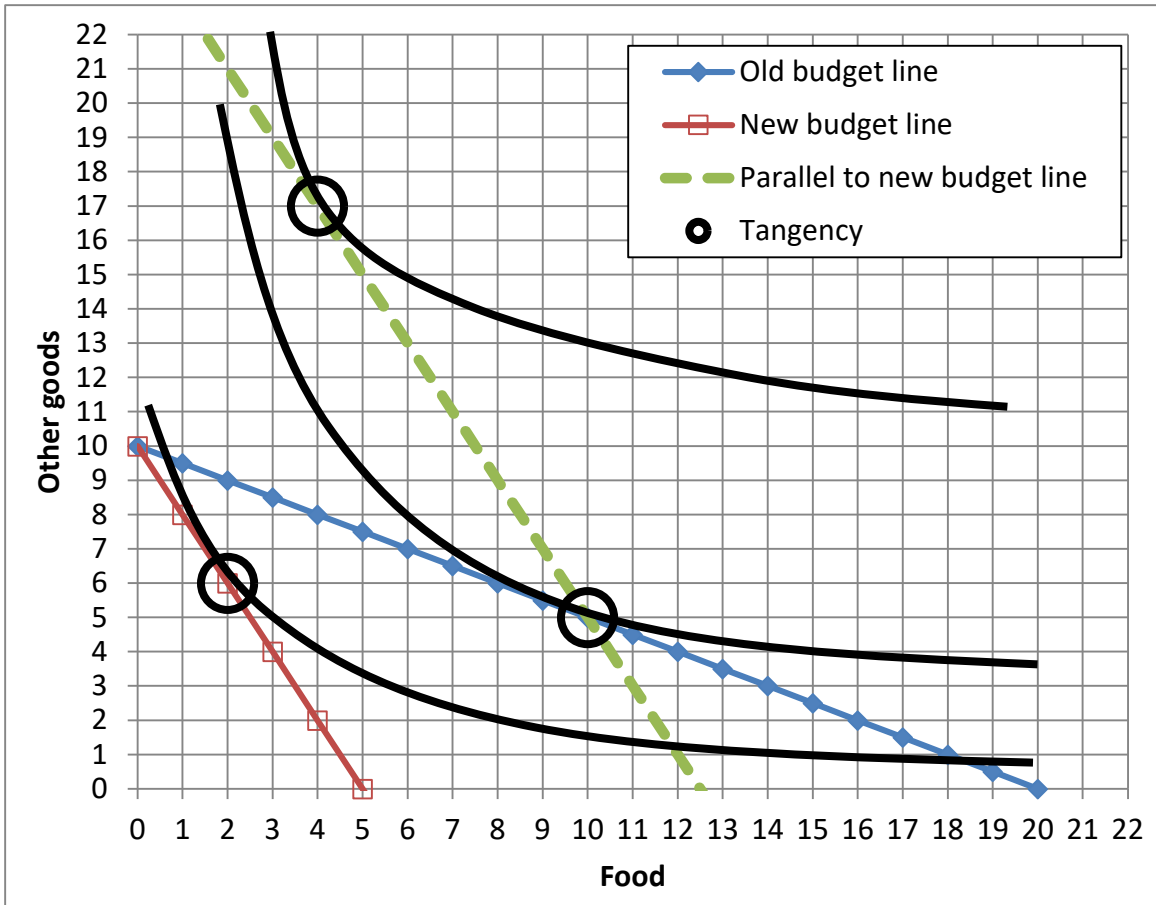
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(2) [Income elasticity of demand: 10 pts] Suppose that a consumer's income rises by 5%, and the income elasticity of demand for gasoline is 0.6.

- Does the income elasticity indicate that gasoline is an *inferior* good, a *necessary* good, or a *luxury or superior* good?
- Will the quantity demanded of gasoline *increase* or *decrease*?
- By about how much?
- Will the share of the consumer's budget devoted to gasoline *increase* or *decrease*?
- By about how much?

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(3) [Substitution and income effects: 12 pts] Consider the indifference-curve diagram below. Assume the consumer has **\$40 income**.



- What was the price of food on the old budget line?
- Given the old budget line, how much food does the consumer demand?
- What is the price of food on the new budget line?
- Given the new budget line, how much food does the consumer demand?
- Compute the change in quantity of food demanded due to the substitution effect: Δq^{sub} .
- Compute the change in quantity of food demanded due to the income effect: Δq^{inc} .

\$	
	units
\$	
	units
	units
	units

(4) [Slutsky equation: 10 pts] The Slutsky equation in elasticity form is given by

$$\varepsilon = -S \eta + \varepsilon^{\text{comp}}$$

where, as usual, ε denotes the own-price elasticity of demand, S denotes the share of total consumer spending devoted to the good (a fraction), η denotes the income elasticity of demand, and $\varepsilon^{\text{comp}}$ denotes the compensated demand elasticity. Suppose that for energy, $\varepsilon = -0.6$, $S = 0.1$, and $\eta = 0.4$.

a. Compute the compensated elasticity of demand for energy ($\varepsilon^{\text{comp}}$).

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Suppose the price of energy rises by 10%, but the consumer's income does *not* change.

b. Does the quantity demanded of energy *increase* or *decrease*?

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c. By about how much?

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Continue to assume that the price of energy rises by 10%, but now suppose the government helps the consumer by giving them a cash transfer equal to 10% of last year's spending on energy.

d. Does the quantity demanded of energy *increase* or *decrease*?

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e. By about how much?

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(5) [Cost-of-living indexes: 6 pts] Suppose we are given the following data on prices and quantities consumed of food and clothing.

	Food		Clothing	
	Price	Quantity	Price	Quantity
Old period	\$10	2 units	\$5	6 units
New period	\$10	7 units	\$10	6 units

Assume that all cost-of-living indexes equal 100 in the old period.

a. Compute the *value* of the Laspeyres cost-of-living index in the new period.

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b. Compute the *value* of the Paasche cost-of-living index in the new period.

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c. Give a *formula* for the Fisher cost-of-living index in the new period. The formula should include numbers but no variables.

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III. PROBLEMS: Please write your answers in the boxes on this question sheet. Show your work and circle your final answers.

(1) [Budgets and choice: 14 pts] A consumer has the following utility function:

$U(q_1, q_2) = (q_1 + 4) q_2$, where q_1 denotes quantity of food and q_2 denotes the quantity of other goods. The price of food is \$5 and the price of other goods is \$4. The consumer has \$100 in income to spend on these items.

- a. [4 pts] Give an equation for the consumer's budget line. The variables q_1 and q_2 should be the only unknowns.

- b. [4 pts] Find a formula for the consumer's marginal rate of substitution in consumption of other goods for food—that is, the |slope| of the consumer's indifference curve with food on the vertical axis and other goods on the horizontal axis. The variables q_1 and q_2 should be the only unknowns. Circle your final answer.

- c. [6 pts] Solve for the quantities of food (q_1^*) and other goods (q_2^*) that this consumer will choose. Circle your final answers.

(2) [Properties of individual demand functions: 12 pts] Suppose an alleged demand function is $q_1^* = (I + 2p_2)p_1^{-1} + 7$, where I denotes the consumer's income, p_1 denotes the price of good #1, and p_2 denotes the price of good #2.

- a. Is this function homogeneous of degree zero in income and prices? Justify your answer.

- b. Find the partial derivative $\partial q_1^* / \partial p_1$. Is good #1 an ordinary good or a Giffen good? Justify your answer.

- c. Find the partial derivative $\partial q_1^* / \partial I$. Is good #1 an inferior good or a normal good? Justify your answer.

- d. Find the partial derivative $\partial q_1^* / \partial p_2$. Are goods #1 and #2 substitutes, complements, or unrelated in demand? Justify your answer.

(3) [Finding individual demand functions: 12 pts] A consumer has the following utility function: $U(q_1, q_2) = q_1^3 q_2^4$, where q_1 denotes the quantity of entertainment and q_2 denotes the quantity of other goods.

- a. Find a formula for the consumer's marginal rate of substitution in consumption of other goods for entertainment—that is, the $|\text{slope}|$ of the consumer's indifference curve with entertainment on the vertical axis and other goods on the horizontal axis. The variables q_1 and q_2 should be the only unknowns. Circle your final answer.

Let p_1 denote the price of entertainment and let p_2 denote the price of other goods. Let I denote the consumer's income.

- b. Solve for the consumer's demand function for entertainment—that is, the formula showing q_1^* as a function of p_1 , p_2 , and I (but not q_2). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

- c. Solve for the consumer's demand function for other goods—that is, the formula showing q_2^* as a function of p_1 , p_2 , and I (but not q_1). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

IV. CRITICAL THINKING: Answer just *one* of the questions below (your choice). [4 pts]

(1) Alex's utility function is $U = q_1 q_2$, where q_1 denotes the quantity of food and q_2 denotes the quantity of other goods. If the price of food is $p_1 = \$3$ and the price of other goods is $p_2 = \$2$, compute the *minimum* amount of income that Alex must have to attain a target level of utility of $U = 600$ utils.

- Give the equation for Alex's target indifference curve.
- Give an equation for the tangency condition, where the slope of Alex's indifference curve equals the slope of Alex's budget line.
- Solve for Alex's optimal quantities of food q_1^* and other goods q_2^* .
- Find the amount of income Alex would need to purchase the optimal quantities.

(2) Suppose the demand function for good 1 takes the following form:

$$q_1^* = 15 p_1^\epsilon p_2^\alpha I^\eta,$$

where p_1 is the good's own price, p_2 is the price of another good, and I is the consumer's income. If the demand for good 1 is homogeneous of degree zero in all prices and income, then what must be the value of the *sum* of the exponents: $(\epsilon + \alpha + \eta)$? Justify your answer with algebra.

Circle the question you are answering and write your answer below. Full credit requires good grammar, legible writing, accurate spelling, and correct reasoning.

[end of exam]