ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2025
William M. Boal

EXAMINATION 2 ANSWER KEY
"Consumers and Demand"

Version A

I. Multiple choice

(1)b . (2)d. (3)a. (4)c. (5)b. (6)b. (7)a. (8)c. (9)c. (10)b.

II. Short answer

(1) a. elastic. b. decrease. c. 6 %.
d. decrease. e. 2 %.

(2) a. necessary good. b. increase. c. 2 %.
d. decrease. e. 8 %.

(3) Note: This graph is based on Slutsky's approach to income and substitution effects, not Hicks's approach.
a. \$4. b. 10 units energy. c. \$10.
d. 3 units energy. e. -5 units energy. f. -2 units energy.

(4) a. $\varepsilon^{comp} = -1.02$. b. decrease. c. 11 % (using ε).
d. decrease e. 10.02 % (using ε^{comp}).

(5) a. Laspeyres = 140. b. Paasche = 130. c. $\sqrt{140 \times 130}$.

III. Problems

(1) [Budgets and choice]
a. Equation for budget line (income=spending): $160 = 5\ q_1 + 4\ q_2$.
b. $MRSC = MU_2/MU_1 = (q_1\text{-}8) / q_2$.
c. Solve the tangency condition [$MRSC = p_2/p_1$ or $(q_1\text{-}8) / q_2 = 4/5$] jointly with equation for budget line (see part a) to get $q_1^* = 20$, $q_2^* = 15$.

(2) [Properties of individual demand functions]
a. Homogeneity of degree zero means that if income and all prices are multiplied by the same factor, the quantity demanded never changes. Check homogeneity of the demand function by replacing I by (aI), replacing p_1 by (ap_1), and replacing p_2 by (ap_2) , where a is an arbitrary factor:

$$2\ (aI)^{1.5}\ (ap_1)^{-0.5}\ (ap_2)^{0.1}$$
$$= a^{1.5-0.5+0.1}\ \ 2\ I^{1.5}\ p_1^{-0.5}\ p_2^{0.1}$$
$$= a^{1.1}\ \ 2\ I^{1.5}\ p_1^{-0.5}\ p_2^{0.1}$$

Note that the "a" factor does *not* cancel. So multiplying income and prices by some arbitrary positive factor a changes the quantity demanded. This function is not homogeneous of degree zero in income and prices.

b. $\frac{\partial q_1^*}{\partial p_1} = 2\, I^{1.5}\, (-0.5) p_1^{-1.5}\, p_2^{0.1}$. This expression is negative, so good #1 is an ordinary good, not a Giffen good.
c. $\frac{\partial q_1^*}{\partial I} = \ 2\, (1.5) I^{0.5}\, p_1^{-0.5}\, p_2^{0.1}$. This expression is positive, so good #1 is a normal good, not an inferior good.
d. $\frac{\partial q_1^*}{\partial p_2} = \ 2\, I^{1.5}\, p_1^{-0.5}\, (0.1) p_2^{-0.9}$. This expression is positive, so goods #1 and #2 are substitutes, not complements.

(3) [Finding individual demand functions]
a. MRS = $MU_2/MU_1 = (q_1^2\, 5q_2^4) / (2\, q_1\, q_2^5) = (5q_1) / (2q_2)$.
b. Solve MRS = $(5q_1) / (2q_2) = p_2/p_1$ (the tangency condition) jointly with $I = p_1q_1 + p_2q_2$ (the budget constraint) to get $q_1^* = \frac{2I}{7\, p_1}$, and
c. $q_2^* = \frac{5I}{7\, p_2}$.
[There are many ways to solve the equations jointly. One way to begin is to cross-multiply the tangency condition to get $(5/2)\, p_1\, q_1 = p_2\, q_2$. Then substitute into the budget constraint:

$$I = p_1\, q_1 + (5/2)\, p_1\, q_1 = (7/2)\, p_1\, q_1 .$$

Then solve for q_1^* as a function of p_1 and I. Finally, substitute your expression for q_1^* into either the budget constraint or the tangency condition and solve for q_2^* as a function of p_2 and I. These particular demand functions depend on income and the own price of the good—they do not depend on the price of the other good. This always happens with Cobb-Douglas utility functions, so you would not want to use a Cobb-Douglas utility function to model substitutes and complements.]

IV. Critical thinking

(1) Demand for this good is **inelastic** because spending rises when the price increases. To compute the price elasticity of demand, recall that for small percent changes,

$$\%\ change\ spending = \%\ change\ price + \%\ change\ quantity$$

Substituting the numbers given in the problem:

$$7\% = 10\% + \%\ change\ quantity$$

So the percent change in quantity is -3%. The price elasticity of demand by definition equals percent change in quantity divided by percent change in price = -3%/10% = **-0.3.**

(2) This good must be a **luxury (or superior) good** because the spending share rises when income rises. To compute the income elasticity of demand, recall that for small percent changes,

$$\%\ change\ spending\ share = \%\ change\ quantity - \%\ change\ income$$

Substituting the numbers given in the problem:

$$2\% = \%\ change\ quantity - 5\%$$

So the percent change in quantity is 7%. The income elasticity of demand by definition equals percent change in quantity divided by percent change in income = 7%/5% = **1.4.**

Version B

I. Multiple choice

(1)c . (2)b. (3)e. (4)b. (5)d. (6)c. (7)b. (8)d. (9)c. (10)d.

II. Short answer

(1) a. inelastic. b. decrease. c. 2 %.
d. increase. e. 3 %.

(2) a. luxury or superior good. b. increase. c. 6 %.
d. increase. e. 1 %.

(3) Note: This graph is based on Slutsky's approach to income and substitution effects, not Hicks's approach.
a. \$2. b. 10 units of food. c. \$8.
d. 2 units of food. e. -6 units of food. f. -2 units of food.

(4) a. $\varepsilon^{comp} = -0.53$. b. decrease. c. 8 % (using ε).
d. decrease e. 5.3 % (using ε^{comp}).

(5) a. Laspeyres = 160. b. Paasche = 130. c. $\sqrt{160 \times 130}$.

III. Problems

(1) [Budgets and choice]
a. Equation for budget line (income=spending): $150 = 5\, q_1 + 6\, q_2$.
b. MRSC = $MU_2/MU_1 = q_1 / (q_2-5)$.
c. Solve the tangency condition [MRSC = p_2/p_1 or $q_1 / (q_2-5) = 6/5$) jointly with equation for budget line (see part a) to get $q_1^* = 12$, $q_2^* = 15$.

(2) [Properties of individual demand functions]
a. Homogeneity of degree zero means that if income and all prices are multiplied by the same factor, the quantity demanded never changes. Check homogeneity of the demand function by replacing I by (aI), replacing p_1 by (ap_1), and replacing p_2 by (ap_2), where a is an arbitrary factor:

$$\begin{aligned}&(aI - 2ap_2)(ap_1)^{-1} + 3\\ &= a\,a^{-1}\,(I - 2p_2)(p_1)^{-1} + 3\\ &= (I - 2p_2)(p_1)^{-1} + 3\end{aligned}$$

Note that the "a" factor cancels. So multiplying income and prices by some arbitrary positive factor a *does not* change the quantity demanded. The function <u>IS homogeneous of degree zero</u> in income and prices.

b. $\frac{\partial q_1^*}{\partial p_1} = (I - 2p_2)(-1)(p_1)^{-2}$. This expression is negative, so good #1 is an <u>ordinary good</u>, not a Giffen good.

c. $\frac{\partial q_1^*}{\partial I} = (p_1)^{-1}$. This expression is positive, so good #1 is a <u>normal good</u>, not an inferior good.

d. $\frac{\partial q_1^*}{\partial p_2} = -2(p_1)^{-1}$. This expression is negative, so goods #1 and #2 are complements, not substitutes.

(3) [Finding individual demand functions]

a. MRS = $MU_2/MU_1 = (4\ q_1^3\ q_2^3) / (3\ q_1^2\ q_2^4) = (4q_1) / (3q_2)$.

b. Solve MRS = $(4q_1) / (3q_2) = p_2/p_1$ (the tangency condition) jointly with $I = p_1q_1 + p_2q_2$ (the budget constraint) to get $q_1^* = \frac{3\,I}{7\,p_1}$, and

c. $q_2^* = \frac{4I}{7\,p_2}$.

[There are many ways to solve the equations jointly. One way to begin is to cross-multiply the tangency condition to get $(4/3)\ p_1\ q_1 = p_2\ q_2$. Then substitute into the budget constraint:

$$I = p_1q_1 + (4/3)\ p_1\ q_1 = (7/3)\ p_1\ q_1 .$$

Then solve for q_1^* as a function of p_1 and I. Finally, substitute your expression for q_1^* into either the budget constraint or the tangency condition and solve for q_2^* as a function of p_2 and I. These particular demand functions depend on income and the own price of the good—they do not depend on the price of the other good. This always happens with Cobb-Douglas utility functions, so you would not want to use a Cobb-Douglas utility function to model substitutes and complements.]

IV. Critical thinking

Same as Version A.

[end of answer key]