

Microeconomics, Module 4: "Consumers in the Marketplace"

Practice Problems

(The attached PDF file has better formatting.)

Exercise 4.1: Price Elasticity of Demand

The price of a good is \$100, and the quantity demanded is 5,000. The *price elasticity of demand* is -1.50 . If the price changes to \$101, what is the new quantity demanded?

Solution 4.1: The percentage change in the price is $\$101 / \$100 = +1\%$. The percentage change in the quantity demanded is $-1.50 \times 1\% = -1.5\%$. The change in the quantity demanded is $5,000 \times (-1.5\%) = -75$. The new quantity demanded is $5,000 - 75 = 4,925$.

Exercise 4.2: Income Elasticity of Demand

A consumer's income is \$50,000, and the quantity demanded of a good is 5,000. The *income elasticity of demand* is $+0.50$. If the consumer's income changes to \$51,000, what is the new quantity demanded?

Solution 4.2: The percentage change in the consumer's income is $\$51,000 / \$50,000 = +2\%$. The percentage change in the quantity demanded is $+0.50 \times 2\% = +1.0\%$. The change in the quantity demanded is $5,000 \times 1.0\% = 50$. The new quantity demanded is $5,000 + 50 = 5,050$.

Exercise 4.3: Income Elasticity of Demand

What is the income elasticity of demand for a new car? Assume there is no inflation from 20X7 to 20X8 and all other items are held constant, such as the consumer's assets and the prices of all goods.

	<u>20X7</u>	<u>20X8</u>
● Income	\$30,000	\$40,000
● Price	\$15,000	\$15,000
● Quantity	1,000	1,200

Solution 4.3:

The income elasticity of demand is the percentage change in quantity demanded divided by the percentage change in the consumer's income:

- Percentage change in quantity demanded = $(1,200 - 1,000) / 1,000 = 20\%$
- Percentage change in the consumer's income = $(40,000 - 30,000) / 30,000 = 33.3\%$

The income elasticity of demand = $20.0\% / 33.3\% = 60\% = 0.600$.

Question 4.4: Normal Goods

Suppose that new homes are a normal good, with an upward sloping Engel curve. The price of new homes is \$500,000. If the price of new homes changes to \$600,000, what are the income and substitution effects on the quantity demanded of new homes?

- A. substitution effect \Rightarrow quantity increases; income effect \Rightarrow quantity increases
- B. substitution effect \Rightarrow quantity increases; income effect \Rightarrow quantity decreases
- C. substitution effect \Rightarrow quantity decreases; income effect \Rightarrow quantity increases

- D. substitution effect \Rightarrow quantity decreases; income effect \Rightarrow quantity decreases
- E. substitution effect \Rightarrow quantity increases; income effect \Rightarrow quantity may increase or decrease

Answer 4.4: D

The substitution effect always causes a decrease in the quantity demanded when the price increases. The income effect depends on the type of good. For a normal good, when the consumer's income (or wealth) increases, the quantity demanded increases. In this problem, the home purchaser's income (wealth) *decreases*, since the new home costs more and leaves the consumer with less money, so the quantity demanded *decreases*.

Question: Why don't we normally analyze the income effects when discussing price changes?

Answer: Unless the good is a major purchase, such as a new home or a new car, the income effect is too small to be material.

Question 4.5: Income Elasticity of Demand

The Engel curve for good X shows that the consumer buys 20 units when income is 50 and 21 units when income is 55. The income elasticity of demand between income of 50 and 55 is

- A. -1
- B. $-\frac{1}{2}$
- C. $\frac{1}{2}$
- D. 1
- E. 2

Answer 4.5: C

- $\Delta Q/Q = (21 - 20)/20 = 5\%$.
- $\Delta \text{Inc}/\text{Inc} = (55 - 50)/50 = 10\%$.

$$\Delta Q/Q \div \Delta \text{Inc}/\text{Inc} = 5\% / 10\% = \frac{1}{2}$$

Question 4.6: Income Elasticity of Demand

Suppose the Engel curve for wine is $Q = k \times \ln(Y + 5)$, where Y is the consumer's income in thousands of dollars and k is a constant. What is the income elasticity of demand if the consumer's income is \$20,000?

- A. +1
- B. $+\frac{1}{2}$
- C. $+\frac{1}{4}$
- D. $-\frac{1}{2}$
- E. $-\frac{1}{4}$

Answer 4.6: C

The income elasticity of demand is $\partial Q/\partial Y \times Y/Q =$

$$[k / (Y + 5)] \times [Y / (k \times \ln(Y + 5))] = Y / [(Y + 5) \times \ln(Y + 5)].$$

At $Y = 20$, this is $20 / [25 \ln(25)] = 0.249 \approx \frac{1}{4}$.

Question 4.7: Price Elasticity of Demand

Suppose the demand curve is linear. If the price elasticity of demand is -1 at a price of 100, what is the price elasticity of demand at a price of 150?

- A. $-\frac{1}{2}$
- B. -1
- C. $-1\frac{1}{2}$
- D. -2
- E. -3

Answer 4.7: E

If $Q = \alpha - \beta P$, $\eta = \partial Q / \partial P \times (P/Q) = -\beta P / (\alpha - \beta P)$. At $P = 100$, $\eta = -1$, so

$$-1 = -100\beta / (\alpha - 100\beta) \Rightarrow \alpha = 200\beta$$

At $P = 150$, $\eta = -150\beta / (200\beta - 150\beta) = -3$.

Question 4.8: Price Elasticity of Demand

Suppose the demand curve is linear. If the price elasticity of demand is -1 at a price of 100, what is the price elasticity of demand at a price of 50?

- A. $-\frac{1}{3}$
- B. $-\frac{1}{2}$
- C. -1
- D. -2
- E. -3

Answer 4.8: A

If $Q = \alpha - \beta P$, $\eta = \partial Q / \partial P \times (P/Q) = -\beta P / (\alpha - \beta P)$. At $P = 100$, $\eta = -1$, so

$$-1 = -100\beta / (\alpha - 100\beta) \Rightarrow \alpha = 200\beta$$

At $P = 50$, $\eta = -50\beta / (200\beta - 50\beta) = -\frac{1}{3}$.

Question 4.9: Price Elasticity of Demand

Suppose the price elasticity of demand is -2 . If the price falls from \$10,000 to \$9,500, then

- A. The quantity demanded increases by 2%.
- B. The quantity demanded increases by 5%.
- C. The quantity demanded increases by 10%.
- D. The quantity demanded increases by 500 units.
- E. The quantity demanded increases by 1,000 units.

Answer 4.9: C

The change in price is -5% , so the change in quantity is $-5\% \times -2 = +10\%$.

Question 4.10: Price Elasticity of Demand

The price elasticity of demand η is -1 at $P = \$100$, and the demand curve is linear. At $P = \$110$, which of the following is true?

- A. $\eta > -1$
- B. $\eta = -1$
- C. $\eta < -1$
- D. $\eta > -1$ for normal goods and $\eta < -1$ for inferior goods
- E. $\eta < -1$ for normal goods and $\eta > -1$ for inferior goods

Answer 4.10: C

The price elasticity of demand is $\partial Q/\partial P \times P/Q$. For a linear demand curve, $\partial Q/\partial P$ is constant. As P increases, P/Q increases, so the *absolute value* of the elasticity increases. The price elasticity is negative; when the absolute value increases, the value decreases.

Normal and inferior goods relate to income elasticity of demand, not to price elasticity of demand. For all goods, quantity demanded declines when price increases.

Question 4.11: Elasticities

Which of the following is most likely to be a positive number?

- A. The price elasticity of demand for generic cigarettes
- B. The price elasticity of demand for brand-name cigarettes
- C. The income elasticity of demand for generic cigarettes
- D. The cross elasticity of demand between generic cigarettes and disposable lighters
- E. The cross elasticity of demand between generic cigarettes and brand-name cigarettes

Answer 4.11: E

Items A and B: The price elasticity of demand is negative.

Item C: The income elasticity of demand for low quality items is positive for poor people and negative for others.

Item D: Cigarettes and lighters are complements. If the price of cigarettes rises, consumers need fewer lighters, so the cross elasticity of demand is negative.

Item E: Generic cigarettes and brand-name cigarettes are substitutes. If the price of one rises, consumers buy more of the other.

Question 4.12: Price Elasticity of Demand

Suppose consumers demand 400 million packs of cigarettes weekly at the current price, and the price elasticity of demand for cigarettes is $-\frac{1}{2}$. A 3% increase in the price of cigarettes would reduce the quantity demanded to

- A. 399.5 million packs weekly
- B. 398.5 million packs weekly
- C. 399.0 million packs weekly
- D. 398.0 million packs weekly
- E. 394.0 million packs weekly

Answer 4.12: E

The percentage change in the quantity demanded is $+3\% \times -\frac{1}{2} = -1.5\%$. The new quantity demanded is $400 - 400 \times 1.5\% = 394$.

Question: A large price elasticity of demand is indicative of competitive markets. The market for cigarettes is extremely competitive; why is the elasticity so small?

Answer: The price elasticity of demand is large for any particular brand of cigarettes, at least over the long-term. It is small for cigarettes in total. Consumers will switch brands based on relative prices, but they don't give up smoking because the price of cigarettes have increased.

Question 4.13: Constant Price Elasticity of Demand

Suppose the demand curve is $P \times Q = k$, where k is a constant. What is the price elasticity of demand for this good?

- A. $+1/4$
- B. $-1/4$
- C. -1
- D. $-1/16$
- E. $+1/16$

Answer 4.13: C

We write $Q = k / P \Rightarrow \partial Q / \partial P = -k/P^2$. The elasticity η is

$$\eta = -k/P^2 \times (P/Q) = -k/P^2 \times (P/(k/P)) = -1.$$

This demand curve has constant elasticity for all values of P .

Question: Does a constant price elasticity of demand make sense?

Answer: Suppose $P = \$100$, $Q = 100$, and the price elasticity of demand is constant at -1 .

- If P declines by 10% to $\$90$, Q increases by 10% to 110.
- If P declines by another 10% to $\$81$, Q increases by another 10% to 121.

We compare the value per unit in each range.

- Between Q of 100 and 110, the average value to the consumer is $\$1$ per unit.
- Between Q of 110 and 121, the average value to the consumer is $\$9 / 11 = \0.818 per unit.

Constant price elasticity of demand is not impossible, since it does show decreasing marginal utility. But the decrease is slow; we generally expect a faster decrease.

Question 4.14: Gas Taxes

Suppose the government imposes a 100% tax surcharge on gasoline, which causes all drivers who are able to use public transportation. What is the effect of the tax surcharge on the price elasticity of demand for gasoline?

- A. Demand becomes less price-elastic.
- B. Demand becomes more price-elastic.
- C. Demand becomes more price-elastic at sufficiently low prices and less price-elastic at sufficiently high prices.

- D. Demand becomes less price-elastic at sufficiently low prices and more price-elastic at sufficiently high prices.
- E. The price elasticity of demand does not change.

Answer 4.14: A

Question: For a linear demand curve, demand is more price elastic as the price increases. From the decreasing marginal utility of goods, this is generally true; what is different here?

Answer: The gas surcharge eliminates drivers who are more price conscious (whose demand is more price elastic), leaving the drivers whose demand is less price elastic.

Question: Can one see this phenomenon in actuarial work?

Answer: Consider life insurance mortality rates. Let us suppose that 100 healthy people and 100 less healthy people are born each year. Of this cohort, 1% of the healthy people and 2% of the unhealthy people die each year.

The mortality rates for both healthy and unhealthy people are constant. The mortality rate for the total population is a weighted average of the rates for healthy and unhealthy people. The first year, the weights are 50%-50%, so the overall mortality rate is 1.5%. Each year, more of the population consists of healthy persons (the unhealthy people die more rapidly), so the weighted average mortality rate declines.

Question: Does this occur if mortality rates increase for both healthy and unhealthy persons?

Answer: The phenomenon still occurs, though it is offset by the increasing mortality rates. This phenomenon is one of the bases of life insurance mortality table construction. In the *Price Theory* textbook, Landsburg shows how firms separate consumers into groups with different price elasticities of demand to maximize profits.

Question: It is not legal in the U.S. to charge consumers different prices for the same good. How can a firm separate its consumers into different groups?

Answer: We explain in the module on price discrimination.

Question 4.15: Income Elasticity

Which is the most likely pattern for the income elasticity of demand?

- A. Increasing over all income levels
- B. Decreasing over all income levels
- C. Constant over all income levels
- D. Increasing for low income, and decreasing for high income
- E. Decreasing for low income, and increasing for high income

Answer 4.15: B

Consider the income elasticity of demand for coarse bread, which is cheap but filling, and it is bought mostly by poor people. Suppose each loaf of coarse bread costs \$1.

If Jacob's income is \$10 a week, he buys two loaves of bread, and if his income is \$20 a week, he buys four loaves of bread; the income elasticity of demand is 100%. At \$10 a week, Jacob is hungry much of the time, and he spends additional income on more bread.

If his income rises to \$30 a week, Jacob buys 5 loaves, by which time he is sated. Now the income elasticity of demand is $25\% / 50\% = 50\%$.

If his income rises to \$40 a week, Jacob still buys 5 loaves; he wants no more coarse bread. The income elasticity of demand is 0%.

If his income rises to \$50 a week, Jacob buys one loaf of white bread and 4 loaves of coarse bread. The income elasticity of demand is $-20\% / 25\% = -80\%$.

Question: This seems correct for low quality products, like coarse bread. What about high quality products, like mutton or steak? The poor person has no money to afford any meat, so the income elasticity of demand is zero for a poor person. As income rises, the consumer begins to buy meat, so the income elasticity of demand rises.

Answer: If the consumer buys nothing, the income elasticity of demand is not defined; it is not zero. When the consumer begins to buy the product, the income elasticity of demand is infinite. The income elasticity of demand declines from $+\infty$ to $-\infty$.

Question: The Engel curve is upward sloping and then downward sloping for most goods. Doesn't this indicate first rising and then declining income elasticity of demand?

Answer: The income elasticity of demand is related to the slope of the Engel curve, not its value. The value first increases and then decreases, but the slope decreases. (We use percentage changes, so the word slope is not actually correct.)