

Review Session Handout #2

Chapter 3: Elasticity and Its Applications

Introduction to Microeconomics: Markets, Strategy, and Real-World Cases

Felix Muñoz-Garcia, Washington State University

Exercise R2.1. A music-streaming service raises its monthly subscription price from \$12 to \$15. As a result, the number of subscribers falls from 80 million to 72 million.

- (a) Compute the price elasticity of demand using the midpoint method.
- (b) Is demand elastic or inelastic in this price range?
- (c) Did the streaming service's total revenue rise or fall after the price increase? Verify your answer by computing total revenue before and after the change, and explain how the result is consistent with your answer in part (b).

Solution. Throughout this handout, percentage changes are rounded to one decimal place and elasticities to two decimal places.

Part (a). The midpoint method divides each change by the average of the starting and ending values. The price rises by \$3 from an average of \$13.50, a change of about 22.2 percent. The number of subscribers falls by 8 million from an average of 76 million, a change of about 10.5 percent. The price elasticity of demand is therefore about $\frac{10.5}{22.2} \approx 0.47$, reported without its minus sign.

Part (b). The elasticity, 0.47, is less than 1, so demand is inelastic in this price range (Table 3.1): the number of subscribers responds less, in percentage terms, than the price.

Part (c). Total revenue is the price multiplied by the quantity sold. Before the increase, revenue is $\$12 \times 80$ million = \$960 million a month; after it, revenue is $\$15 \times 72$ million = \$1,080 million a month. Total revenue rises by \$120 million. This matches the total revenue rule of Section 3.3: when demand is inelastic, raising the price raises total revenue, because the 22.2 percent higher price more than makes up for the 10.5 percent fewer subscribers.

Remark. Dividing by the averages makes the elasticity the same whether the price rises from \$12 to \$15 or falls from \$15 to \$12.

Exercise R2.2. A grocery store sells organic milk at \$6 per gallon (800 gallons per week) and conventional milk at \$4 per gallon (2,000 gallons per week). When the price of organic milk rises to \$7 per gallon, organic milk sales fall to 650 gallons per week and conventional milk sales rise to 2,200 gallons per week. In a different period, with both prices back at their original levels, the average monthly income of households near the store rises from \$4,000 to \$4,400, and organic milk sales rise from 800 to 930 gallons per week.

- (a) Compute the own-price elasticity of demand for organic milk using the midpoint method.
- (b) Compute the cross-price elasticity of demand for conventional milk with respect to the price of organic milk, using the midpoint method.

- (c) Based on part (b), are organic milk and conventional milk substitutes or complements?
- (d) Using the income data, compute the income elasticity of demand for organic milk with the midpoint method. Is organic milk a necessity or a luxury for these households? Is your answer consistent with the own-price elasticity from part (a)?

Solution.

Part (a). The price of organic milk rises by \$1 from an average of \$6.50, about 15.4 percent. Organic milk sales fall by 150 gallons from an average of 725, about 20.7 percent. The own-price elasticity of demand is about $\frac{20.7}{15.4} \approx 1.34$. Since 1.34 is greater than 1, demand for organic milk is elastic.

Part (b). The cross-price elasticity measures how the quantity of one good responds to a change in the price of another. Conventional milk sales rise by 200 gallons from an average of 2,100, about 9.5 percent, while the price of organic milk rises by about 15.4 percent. The cross-price elasticity is about $\frac{9.5}{15.4} \approx 0.62$.

Part (c). The cross-price elasticity is positive: a higher price for organic milk raises the quantity of conventional milk bought. The two goods are therefore substitutes. When organic milk becomes more expensive, some shoppers switch to conventional milk.

Part (d). Income rises by \$400 from an average of \$4,200, about 9.5 percent. Organic milk sales rise by 130 gallons from an average of 865, about 15.0 percent. The income elasticity of demand is about $\frac{15.0}{9.5} \approx 1.58$. It is positive, so organic milk is a normal good, and it is above 1, so organic milk is a luxury for these households: their purchases grow faster than their income (Section 3.4). This is consistent with part (a), since luxuries tend to have elastic demand (Section 3.2.3), and the own-price elasticity of 1.34 is above 1.

Remark. Two of the determinants of Section 3.2.3 point in the same direction here. Organic milk has a close substitute, conventional milk (part (c)), and it behaves as a luxury (part (d)); both features make its demand elastic.

Exercise R2.3. A city is considering a corrective tax on two-liter bottles of soda. A market study reports how buyers and bottlers respond when the price of a bottle rises from \$2.00 to \$2.40, holding everything else fixed:

Price per bottle	Quantity demanded (bottles/week)	Quantity supplied (bottles/week)
\$2.00	110,000	95,000
\$2.40	90,000	105,000

- (a) Compute the price elasticity of demand using the midpoint method, and state whether demand is elastic or inelastic.
- (b) Compute the price elasticity of supply using the midpoint method, and state whether supply is elastic or inelastic.
- (c) Using your answer to part (a), what happens to buyers' total spending on soda when the price rises from \$2.00 to \$2.40? If the tax raised the price of soda by 10 percent, by roughly what percentage would soda purchases fall, and how does this compare with cigarettes, whose demand has an elasticity of about 0.4? What does the comparison suggest about what the soda tax would accomplish?

- (d) Based on your answers to parts (a) and (b), which side of the market, buyers or bottlers, would bear the larger share of the tax? Explain.

Solution.

Part (a). The price rises by \$0.40 from an average of \$2.20, about 18.2 percent. The quantity demanded falls by 20,000 bottles from an average of 100,000, a change of 20.0 percent. The price elasticity of demand is about $\frac{20.0}{18.2} \approx 1.10$. Since 1.10 is greater than 1, demand is elastic.

Part (b). The price elasticity of supply is also a ratio of percentage changes. The quantity supplied rises by 10,000 bottles from an average of 100,000, a change of 10.0 percent, while the price rises by about 18.2 percent. The price elasticity of supply is about $\frac{10.0}{18.2} \approx 0.55$. Since 0.55 is less than 1, supply is inelastic: in this range, bottlers cannot easily expand output when the price rises.

Part (c). Total spending falls, from $\$2.00 \times 110,000 = \$220,000$ to $\$2.40 \times 90,000 = \$216,000$ a week, as the total revenue rule predicts for elastic demand. A 10 percent price increase would cut soda purchases by roughly $1.10 \times 10 = 11$ percent, against only about $0.4 \times 10 = 4$ percent for cigarettes. Following Section 3.5.2, a tax on a good with elastic demand produces a large fall in consumption, the goal of a corrective tax, but raises less revenue than a tax on a good with inelastic demand, since buyers cut back on many of the taxed bottles.

Part (d). Bottlers would bear the larger share. Supply (elasticity 0.55) is less elastic than demand (elasticity 1.10): buyers can easily switch to other drinks, while bottlers cannot easily cut back their output. Bottlers are less able to walk away, so they must absorb the larger share of the tax to keep buyers from leaving. Section 4.4.1 develops this rule.

Remark. The same elasticity of demand decides both what a corrective tax accomplishes and who bears it. Because soda buyers respond strongly to the price, the tax changes their behavior a great deal, and much of its burden falls on the less elastic side of the market, the bottlers.