Elasticity

Price elasticity of demand is a measure used in economics to show the responsiveness, or elasticity, of the quantity demanded of a good or service to a change in its price. Due to the inverse relationship between price and quantity demanded, economists often refer to price elasticity of demand as a positive value (i.e., in absolute value terms).

1. Point Elasticity Formula: 

   \[ e_p = \frac{\% \Delta Q}{\% \Delta P} = \frac{Q_1 - Q_0}{Q_0} \cdot \frac{P_0 - P_1}{P_1} \]

   If we know the equation of the linear demand curve, the point elasticity formula is given by

   \[ e_p = \frac{\% \Delta Q}{\% \Delta P} = \frac{1}{\text{slope}} \times \frac{P}{Q} \]

2. Arc Elasticity Formula (= Mid-Point method): 

   \[ e_p = \frac{\% \Delta Q}{\% \Delta P} = \frac{\frac{Q_2 - Q_1}{2}}{\frac{P_2 - P_1}{2}} \]

Exercise 1: Consider the market for bicycles. The demand is given by \( P = -1.5Q_d + 60. \)

a) Suppose that the price changes from $15 to $30. Using the standard percentage change formula (Point method), what is the price elasticity of demand?

b) Suppose that the price changes from $15 to $30. Using the midpoint method, what is the price elasticity of demand?

c) When \( P = 15, \) what is the price elasticity of demand using the point method? Is it elastic or inelastic? At \( P = 15, \) if the price goes up, does the total revenue increase, decrease, or stay the same?

d) When \( Q_d = 10, \) what is the price elasticity of demand using the point method? Is it elastic or inelastic? At \( Q_d = 10, \) if the price goes up, does the total revenue increase, decrease, or stay the same?

e) At what price is the price elasticity of demand, using the point method, equal to 1?

f) Suppose you are a producer of bicycles. To maximize total revenue, at what price should you sell bicycles? How much is the maximized total revenue?

Income elasticity of demand is the ratio of the percentage change in quantity demanded to the percentage change in income. If the income elasticity of demand is negative, then good A is an inferior good. When the income elasticity is positive, good A is a normal good. Income Elasticity of Demand:

\[ e_I = \frac{\% \text{ change in quantity of good } A \text{ demanded}}{\% \text{ change in income}} = \frac{\Delta Q}{\Delta Y} \]

Cross-price elasticity of demand is the ratio of the percentage change in quantity demanded of good X to the percentage change in price of good Y. When this measure is positive goods X and Y are
substitutes. When this measure is negative goods X and Y are complements. Cross-Price Elasticity of Demand:

$$
\varepsilon_{XY} = \frac{\% \text{ change in quantity of } X \text{ demanded}}{\% \text{ change in price of good } Y} = \frac{\Delta Q_X}{\% \Delta P_X} \cdot \frac{\% \Delta P_Y}{P_Y}
$$

Exercise 2:

a) The cross-price elasticity of demand for doughnuts and coffee is equal to -1.5. So, what is the relationship between doughnuts and coffee? (Complements / Substitutes) Suppose that the price of coffee increases by 10%. What is the percentage change in the quantity demanded of doughnuts?

b) The income elasticity of demand for doughnuts is equal to 1.2, you read in the newspaper that the economy has entered a recession and you are interested in how this recession will affect your doughnut business. Holding everything else constant, what do you anticipate will happen to the demand for doughnuts? Are doughnuts a normal good given this information?

Nominal and Real Prices

<table>
<thead>
<tr>
<th>Real Price</th>
<th>Nominal Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflation adjusted</td>
<td>Unadjusted for inflation</td>
</tr>
<tr>
<td>Purchasing power</td>
<td>Money price</td>
</tr>
<tr>
<td>Relative price</td>
<td>Price tag</td>
</tr>
<tr>
<td>Constant dollar</td>
<td>Current dollar</td>
</tr>
</tbody>
</table>

The real price and nominal price are related by the following equation:

$$
\text{Real Price} = \frac{\text{Nominal Price}}{\text{CPI}} \times \text{[Scale factor]}
$$

The scale factor is equal to the Consumer Price Index (CPI) or another price index in the base year, usually equal to 100. The CPI for a particular year using a specific base year is given by

$$
\text{CPI in a particular year} = \frac{\text{Price of Market Basket in a particular year}}{\text{Price of Market Basket in the base year}} \times \text{[Scale factor]}
$$

Exercise 3 (Third Midterm Spring 2011): Suppose you want to compare the prices and wages in 2010 with what they were back in 1910. You collect the following data:

<table>
<thead>
<tr>
<th>Year</th>
<th>Price of Market Basket</th>
<th>Nominal Price of Gas</th>
<th>Nominal Price of Haircuts</th>
<th>Nominal Wage per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>$50</td>
<td>$0.25</td>
<td>$2.50</td>
<td>$0.50</td>
</tr>
<tr>
<td>2010</td>
<td>$400</td>
<td>$4.00</td>
<td>$20.00</td>
<td>$8.00</td>
</tr>
</tbody>
</table>

Using 1910 as the base year, which of the following statements about the real price of gas and the real price of haircuts in 2010 is FALSE?

a. The real price of gas in 2010 is $0.5.

b. The percent change in the real price of gas from 1910 to 2010 was 100%

c. The real price of haircuts in 2010 is the same as it was in 1910.

d. The real price increase of haircuts from 1910 to 2010 was $2.50 (in 1910 dollars).

What was the change in the real wage between 1910 and 2010 in terms of 2010 dollars?