Elasticity

**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?

Using the demand equation, we can get \( Q_d = 30 \) when \( P = $15 \), and \( Q_d = 20 \) when \( P = $30 \)

\[
E_D = \left| \frac{(20 - 30)/30}{30 - 15/15} \right| = 1/3
\]

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

Arc-elasticity = \[
\frac{(20 - 30)/(20 + 30)/(30 - 15)/(30 + 15)}\] = 3/5

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?

We can use this formula

\[
E_D = \frac{1}{|\text{slope}|} \times \frac{P}{Q}
\]

Using the demand equation, we can get \( Q_d = 30 \) when \( P = $15 \).

\[
E_D = \frac{1}{|-1.5|} \times \frac{15}{30} = 1/3
\]

So \( E_D = 1/3 < 1 \). Then the demand is inelastic. Therefore, when the price goes up, the total revenue increases.

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?

Using the demand equation, we can get \( P = $45 \), when \( Q_d = 10 \).

\[
E_D = \frac{1}{|-1.5|} \times \frac{45}{10} = 1/3
\]

So \( E_D = 3 > 1 \). Then the demand is elastic. When the price goes up, the total revenue decreases.

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

The unit elastic point occurs at the midpoint of the demand curve if the demand curve is linear and intersects both the y-axis and x-axis.

When we draw the demand curve, the y-intercept is 60, and the x-intercept is 40. Therefore, the midpoint of the demand curve is (20, 30), which is the unit-elastic point. The answer is \( P = $30 \).

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?

At the midpoint which is the unit elastic point, the total revenue will be maximized. Therefore, \( P = $30 \), and Total Revenue = \( $30 \times 20 = $600 \).
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?

The cross-price elasticity of demand is defined as the percentage change in the quantity demanded of good A divided by the percentage change in the price of good B. Thus, the percentage change in the quantity demanded of doughnuts must be -15%. Since the cross-price elasticity of demand is negative, then doughnuts and coffee are complements.

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?

The income elasticity of demand for doughnuts is equal to the percentage change in the quantity demanded of doughnuts divided by the percentage change in income. Since a recession is a slowdown in total production in the economy and therefore is typically accompanied by higher rates of unemployment, we should anticipate that income will fall.

Since the income elasticity of demand is positive, doughnuts are a normal good. Thus, the demand for doughnuts at every price will also fall: the demand curve for doughnuts will shift to the left holding everything else constant.

Nominal and Real Prices

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?

Since the base year is 1910, first we compute the CPI at the base year.

Using 1910 as the base year, the CPI in 1910 = \[\frac{\text{Price of Market Basket in 1910}}{\text{Price of Market Basket in 1910}}\times100\]

Using 1910 as the base year, the CPI in 2010 = \[\frac{\text{Price of Market Basket in 2010}}{\text{Price of Market Basket in 1910}}\times100\]
<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal Price</th>
<th>CPI Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>$50</td>
<td>(50/50) x 100 = 100</td>
</tr>
<tr>
<td>2010</td>
<td>$400</td>
<td>(400/50) x 100 = 800</td>
</tr>
<tr>
<td>Percent change</td>
<td>(800-100)/100 x 100% = 700%</td>
<td></td>
</tr>
</tbody>
</table>

Notice that nominal prices and real prices are the same in the base year.

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

Using 1910 as the base year, the CPI in 2010 is 800, then

the real price of gas in 2010 = (Nominal price of gas in 2010 / CPI in 2010) x 100
                               = (400/800) x 100
                               = $0.5.

Hence a. is TRUE.

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

Since the base year is 1910. Then the real price of gas and nominal price of gas in 1910 are the same.

Percent change in the real price of gas from 1910 to 2010
= [(Real price of gas in 2010 – Real price of gas in 1910) / Real price of gas in 1910] x 100%
  = [(0.50 - 0.25) / 0.25] x 100% = 100%

Hence b. is TRUE.

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

Since the base year is 1910. Then the real price of haircuts and nominal price of haircuts in 1910 are the same.

Using 1910 as the base year, the CPI in 2010 is 800, then

the real price of haircuts in 2010 = (Nominal price of haircuts in 2010 / CPI in 2010) x 100
                                    = (20/800) x 100
                                    = $2.5

Thus, the real price of haircuts in 2010 is equal to the real price of haircuts in 1910
Hence c. is TRUE.

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

The real price of haircuts didn’t increase.
Hence d. is FALSE

As an exercise calculate again by yourselves all the entries of this table
<table>
<thead>
<tr>
<th>Year</th>
<th>Price of Market Basket</th>
<th>CPI (Base year = 2010)</th>
<th>Real Wage per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>$50</td>
<td>(50/400)x100 = 12.5</td>
<td>(0.5/12.5)x100 = $4</td>
</tr>
<tr>
<td>2010</td>
<td>$400</td>
<td>(400/400)x100 = 100</td>
<td>(8/100)x100 = $8</td>
</tr>
<tr>
<td>Percent change</td>
<td>[(100-12.5)/12.5]x100% = 700%</td>
<td>[(8-4)/4]x100% = 100%</td>
<td></td>
</tr>
</tbody>
</table>

Notice that the percentage change is the same even though we use different years as a base year.

Using 2010 as the base year, the CPI in 1910 is 12.5 (see table). Then

the real wage per hour in 1910 = (Nominal wage per hour in 1910/ CPI in 1910)x100
= (0.5/12.5)x100
= $4.

In the base year nominal and real prices are the same. Then the real wage per hour in 2010 = $8
Hence, the real wage increased by $4.00 between 1910 and 2010.