Chapter 8
Elasticity of Demand

SOLUTIONS TO EXERCISES

Exercise 8.1. Market research revealed that the market demand function for home exercise equipment is

\[ Q = 2400 - 2P - 15P_v, \]

where \( P \) is the price of exercise equipment and \( P_v \) is the price of exercise videos. The current price of exercise equipment is 300 and the current price of exercise videos is 20.

a. Given these prices, calculate the own-price elasticity of demand for exercise equipment.

**Solution:** One way to solve this problem is to plug in \( P_v = 20 \) to obtain the demand curve, which is linear, and then use our formula \( E = P/(\bar{P} - P) \) for the elasticity of a linear demand curve at price \( P \). Plugging in \( P_v = 20 \) yields \( Q = 2100 - 2P \). The choke price is \( \bar{P} = 1050 \). Elasticity when \( P = 300 \) is \( 300/(1050 - 300) = 0.4 \).

b. Are exercise videos and exercise equipment complements or substitutes?

**Solution:** Videos and equipment are complements, because a higher price for videos makes demand for equipment go down.

c. Suppose the price of exercise videos increases to 40. Does the own-price elasticity of demand increase or decrease?

**Solution:** If instead \( P_v = 40 \), the demand curve is \( Q = 1800 - 2P \) and the choke price is 900. Hence, elasticity when \( P = 300 \) is \( 300/(900 - 300) = 0.5 \). Demand has become more elastic.

Exercise 8.2. Calculate the price elasticity at current prices in the following examples. If you do not have enough information, say so.

a. The firm’s demand curve is \( Q = 2000 - 5P \), and the firm’s output is 500.

**Solution:** When output is 500, the price is \( P = 300 \). The choke price of this demand curve is 400. Therefore, using the formula \( E = P/(\bar{P} - P) \) for the elasticity of a linear demand curve, we have \( E = 300/(400 - 300) = 3 \).

b. The firm’s demand curve is \( Q = 5P^{-1.55} \); the firm’s price and output are unobserved.

**Solution:** This is a constant elasticity demand curve. The elasticity is 1.55 at any price.

Exercise 8.3. Table E8.1 shows actual data about the prices of Model T touring cars in different years and the sales volumes at those prices.
Table E8.1

<table>
<thead>
<tr>
<th>Year</th>
<th>Retail price</th>
<th>Sales volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1908</td>
<td>850</td>
<td>5,986</td>
</tr>
<tr>
<td>1909</td>
<td>950</td>
<td>12,292</td>
</tr>
<tr>
<td>1910</td>
<td>780</td>
<td>19,293</td>
</tr>
<tr>
<td>1911</td>
<td>690</td>
<td>40,402</td>
</tr>
<tr>
<td>1912</td>
<td>600</td>
<td>78,611</td>
</tr>
<tr>
<td>1913</td>
<td>550</td>
<td>182,809</td>
</tr>
<tr>
<td>1914</td>
<td>490</td>
<td>260,720</td>
</tr>
<tr>
<td>1915</td>
<td>440</td>
<td>355,276</td>
</tr>
<tr>
<td>1916</td>
<td>360</td>
<td>577,036</td>
</tr>
</tbody>
</table>

**a.** Assuming that these data represent points on a fixed demand curve, calculate the arc elasticity of demand by comparing the data (i) for the years 1910 and 1911 and (ii) for the years 1915 and 1916.

**Solution:**

(i) From 1910 to 1911, arc elasticity is

\[
\frac{40,402 - 19,293}{(19,293 + 40,402)/2} \div \frac{690 - 780}{(780 + 690)/2} = 5.78.
\]

(ii) From 1915 to 1916, arc elasticity is

\[
\frac{577,036 - 355,276}{(577,036 + 355,276)/2} \div \frac{360 - 440}{(440 + 360)/2} = 2.38.
\]

**b.** Give two reasons why we might not want to consider these data to be points on a fixed demand curve.

**Solution:**

1. Demand depends not only on the price of the Model T, but also on the prices of other goods, on income, and on consumer tastes. These may have changed between 1908 and 1916. In particular, demand for the recently introduced automobile depended on the infrastructure of roads and gas stations that were being developed.

2. The good is a durable good; hence demand depends not only on the current price but also on the expected future prices and on past prices. This is particularly important in this market because the Model T had been introduced recently and stocks had not built up to their steady-state levels.

**Commentary** A suitable answer could consist of two reasonably different examples of what I grouped into the first reason.