

5.8: Calculating Price Elasticities Using the Midpoint Formula

Learning Objectives

- Calculate price elasticity using the midpoint method
- Differentiate between slope and elasticity



Figure 1. Just how elastic is it?

We have defined price elasticity of demand as the responsiveness of the quantity demanded to a change in the price. We also explained that price elasticity is defined as the percent change in quantity demanded divided by the percent change in price. In this section, you will get some practice computing the price elasticity of demand using the midpoint method.

The Midpoint Method

To calculate elasticity, we will use the average percentage change in both quantity and price. This is called the **midpoint method for elasticity** and is represented by the following equations:

$$\text{percent change in quantity} = \frac{Q_2 - Q_1}{(Q_2 + Q_1) \div 2} \times 100$$

$$\text{percent change in price} = \frac{P_2 - P_1}{(P_2 + P_1) \div 2} \times 100$$

The advantage of the midpoint method is that one obtains the same elasticity between two price points whether there is a price increase or decrease. This is because the formula uses the same base for both cases.

Exercise: Calculating the Price Elasticity of Demand

Let's calculate the elasticity from points B to A and from points G to H, shown in Figure 2, below.

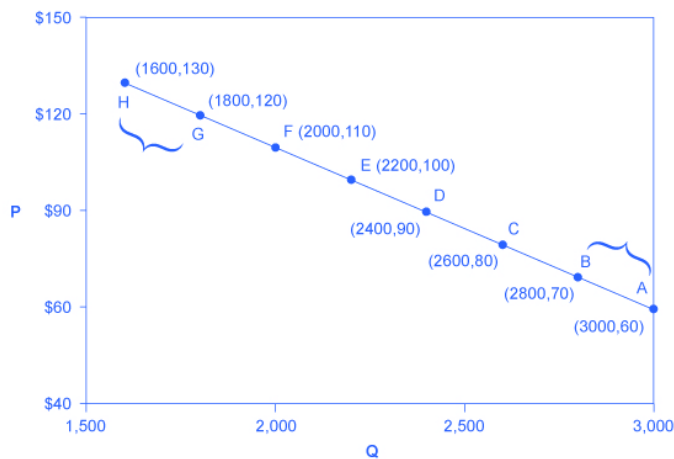


Figure 2. Calculating the Price Elasticity of Demand. The price elasticity of demand is calculated as the percentage change in quantity divided by the percentage change in price.

Elasticity from Point B to Point A

Step 1. We know that $\text{Price Elasticity of Demand} = \frac{\text{percent change in quantity}}{\text{percent change in price}}$

Step 2. From the midpoint formula we know that

$$\text{percent change in quantity} = \frac{Q_2 - Q_1}{(Q_2 + Q_1) \div 2} \times 100$$

$$\text{percent change in price} = \frac{P_2 - P_1}{(P_2 + P_1) \div 2} \times 100$$

Step 3. We can use the values provided in the figure (as price decreases from \$70 at point B to \$60 at point A) in each equation:

$$\text{percent change in quantity} = \frac{3,000 - 2,800}{(3,000 + 2,800) \div 2} \times 100 = \frac{200}{2,900} \times 100 = 6.9$$

$$\text{percent change in price} = \frac{60 - 70}{(60 + 70) \div 2} \times 100 = \frac{-10}{65} \times 100 = -15.4$$

Step 4. Then, those values can be used to determine the price elasticity of demand:

$$\text{Price Elasticity of Demand} = \frac{6.9 \text{ percent}}{-15.4 \text{ percent}} = -0.45$$

The elasticity of demand between these two points is 0.45, which is an amount smaller than 1. That means that the demand in this interval is inelastic.

Remember: price elasticities of demand are *always* negative, since price and quantity demanded always move in opposite directions (on the demand curve). As you'll recall, according to the law of demand, price and quantity demanded are inversely related. By convention, we always talk about elasticities as positive numbers, however. So, mathematically, we take the absolute value of the result. For example, -0.45 would be interpreted as 0.45.

This means that, along the demand curve between points B and A, if the price changes by 1%, the quantity demanded will change by 0.45%. A change in the price will result in a smaller percentage change in the quantity demanded. For example, a 10% *increase* in the price will result in only a 4.5% *decrease* in quantity demanded. A 10% *decrease* in the price will result in only a 4.5% *increase* in the quantity demanded.

Note also that a larger (negative) number means demand is **more elastic**, so that if price elasticity of demand were -0.75, the quantity demanded would change by a greater percentage than when the elasticity was -0.45.

Exercise: Elasticity Of Demand from Point G to Point H

Calculate the price elasticity of demand using the data in Figure 2 for an increase in price from G to H. Does the elasticity increase or decrease as we move up the demand curve?

Step 1. We know that $\text{Price Elasticity of Demand} = \frac{\text{percent change in quantity}}{\text{percent change in price}}$

Step 2. From the midpoint formula we know that

$$\text{percent change in quantity} = \frac{Q_2 - Q_1}{(Q_2 + Q_1) \div 2} \times 100$$

$$\text{percent change in price} = \frac{P_2 - P_1}{(P_2 + P_1) \div 2} \times 100$$

Step 3. We can use the values provided in the figure in each equation:

$$\text{percent change in quantity} = \frac{1,600 - 1,800}{(1,600 + 1,800) \div 2} \times 100 = \frac{-200}{1,700} \times 100 = -11.76$$

$$\text{percent change in price} = \frac{130 - 120}{(130 + 120) \div 2} \times 100 = \frac{10}{125} \times 100 = 8.0$$

Step 4. Then, those values can be used to determine the price elasticity of demand:

$$\text{Price Elasticity of Demand} = \frac{\text{percent change in quantity}}{\text{percent change in price}} = \frac{-11.76}{8} = -1.47$$

The elasticity of demand from G to H is 1.47. The magnitude of the elasticity has increased (in absolute value) as we moved up along the demand curve from points A to B. Recall that the elasticity between those two points is 0.45. Demand is inelastic between points A and B and elastic between points G and H. This shows us that price elasticity of demand changes at different points along a *straight-line demand curve*.

Let's pause and think about why the elasticity is different over different parts of the demand curve. When price elasticity of demand is greater (as between points G and H), it means that there is a larger impact on demand as price changes. That is, when the price is higher, buyers are more sensitive to additional price increases. Logically, that makes sense.

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Elasticity Is Not Slope

It's a common mistake to confuse the slope of either the supply or demand curve with its elasticity. The slope is the rate of change in units along the curve, or the rise/run (change in y over the change in x). For example, in Figure 2 above, for each point shown on

the demand curve, price drops by \$10 and the number of units demanded increases by 200. So the slope is $-10/200$ along the entire demand curve, and it doesn't change. The price elasticity, however, changes along the curve. Elasticity between points B and A was 0.45 and increased to 1.47 between points G and H. Elasticity is the *percentage* change—which is a different calculation from the slope, and it has a different meaning.

When we are at the upper end of a demand curve, where price is high and the quantity demanded is low, a small change in the quantity demanded—even by, say, one unit—is pretty big in percentage terms. A change in price of, say, a dollar, is going to be much less important in percentage terms than it will be at the bottom of the demand curve. Likewise, at the bottom of the demand curve, that one unit change when the quantity demanded is high will be small as a percentage. So, at one end of the demand curve, where we have a large percentage change in quantity demanded over a small percentage change in price, the elasticity value will be high—demand will be relatively elastic. Even with the same change in the price and the same change in the quantity demanded, at the other end of the demand curve the quantity is much higher, and the price is much lower, so the percentage change in quantity demanded is smaller and the percentage change in price is much higher. See Figure 3, below:

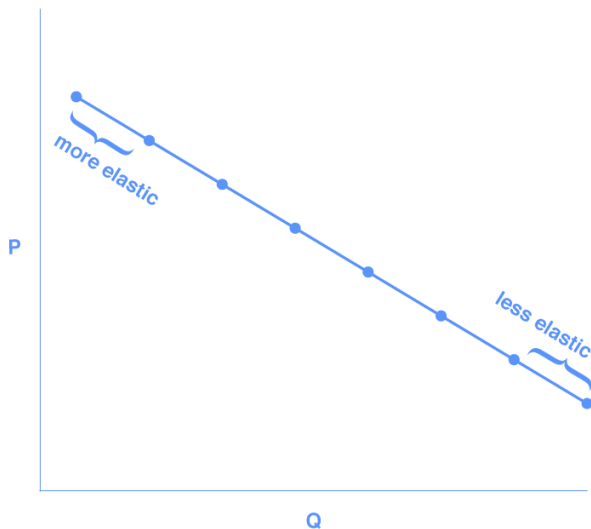


Figure 3. Elasticity changes along the demand curve.

At the bottom of the curve we have a small numerator over a large denominator, so the elasticity measure will be much lower, or inelastic. As we move along the demand curve, the values for quantity and price go up or down, depending on which way we are moving, so the percentages for, say, a \$1 difference in price or a one-unit difference in quantity, will change as well, which means the ratios of those percentages will change, too.

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Try It

These next questions allow you to get as much practice as you need, as you can click the link at the top of the questions (“Try another version of these questions”) to get a new version of the questions. Practice until you feel comfortable with this concept.

[ohm_question]152002-152003-152000[/ohm_question]

Learning Objectives

[glossary-page][glossary-term]elasticity: [/glossary-term]
[glossary-definition]an economics concept that measures responsiveness of one variable to changes in another variable[/glossary-definition]**[glossary-term]midpoint method:** [/glossary-term]**[glossary-definition]**measures the average elasticity over some part of the demand (or supply) curve[/glossary-definition]**[glossary-term]more elastic:** [/glossary-term]**[glossary-definition]**the calculated elasticity is greater in absolute value, meaning the quantity response is greater to the same change in price[/glossary-definition]/[glossary-page]

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