

5.7: Calculating Elasticity and Percentage Changes

Learning Objectives

- Mathematically differentiate between elastic, inelastic, and unitary elasticities of demand
- Calculate percentage changes, or growth rates
- Differentiate between the midpoint elasticity approach and the point elasticity approach in calculating elasticity

Calculating Elasticity

The formula for calculating elasticity is:

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

Let's look at the practical example mentioned earlier about cigarettes. Certain groups of cigarette smokers, such as teenage, minority, low-income, and casual smokers, are somewhat sensitive to changes in price: for every 10 percent increase in the price of a pack of cigarettes, the smoking rates drop about 7 percent. Plugging those numbers into the formula, we get

$$\text{Price Elasticity of Demand} = \frac{\text{percent change in quantity}}{\text{percent change in price}} = \frac{-7\%}{10\%} = -0.7$$

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Inelastic, Elastic, and Unitary Demand

So what does the number -0.7 tell us about the elasticity of demand? The negative sign reflects the law of demand: at a higher price, the quantity demanded for cigarettes declines. All price elasticities of demand have a negative sign, so it's easiest to think about elasticity in absolute value, ignoring the negative sign. The fact that the result is less than one is more important than the negative sign. It tells us that the size of the quantity change is less than the size of the price change (i.e. the numerator in the elasticity formula is less than the denominator). This tells us that it would take a relatively large price change in order to cause a relatively small change in quantity demanded. In other words, consumer responsiveness to a change in price is relatively small. Therefore, when the elasticity is less than 1, we say that demand is **inelastic**.

The data above indicate that the demand for cigarettes by teenagers, minority, low income and casual smokers is relatively inelastic. Addicted adult smokers, though, are even less sensitive to changes in the price—most are willing to pay whatever it takes to support their smoking habit. We can say that their demand is even more inelastic than low income or casual smokers.

Different products have different price elasticities of demand. If the absolute value of the elasticity of some product is greater than one, it means that the change in the quantity demanded is greater than the change in price. This indicates a larger reaction to price change, which we describe as **elastic**. If the elasticity is equal to one, it means that the change in the quantity demanded is exactly equal to the change in price, so the demand response is exactly proportional to the change in price. We call this **unitary elasticity**, because unitary means one.

Watch It

Watch this video carefully to understand how to solve for elasticity and to see what the numerical values for elasticity mean when applied to economic situations.

A link to an interactive elements can be found at the bottom of this page.

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Calculating Percentage Changes and Growth Rates

Before we dive deeper into solving for elasticity, let's first make sure we are comfortable calculating percentage changes, also known as a **growth rates**. The formula for computing a growth rate is straightforward:

$$\text{Percentage change} = \frac{\text{Change in quantity}}{\text{Quantity}}$$

Suppose that a job pays \$10 per hour. At some point, the individual doing the job is given a \$2-per-hour raise. The percentage change (or growth rate) in pay is

$$\frac{\$2}{\$10} = 0.20 \text{ or } 20\%$$

Now to solve for elasticity, we use the growth rate, or percentage change, of the quantity demanded as well as the percentage change in price in order to examine how these two variables are related. The price elasticity of demand is the ratio between the percentage change in the quantity demanded (Qd) and the corresponding percent change in price:

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

There are two general methods for calculating elasticities: the **point elasticity approach** and the **midpoint (or arc) elasticity approach**. Elasticity looks at the percentage change in quantity demanded divided by the percentage change in price, but *which* quantity and *which* price should be the denominator in the percentage calculation? The point approach uses the initial price and initial quantity to measure percent change. This makes the math easier, but the more accurate approach is the midpoint approach, which uses the average price and average quantity over the price and quantity change. (These are the price and quantity halfway between the initial point and the final point.) Let's compare the two approaches. Suppose the quantity demanded of a product was 100 at one point on the demand curve, and then it moved to 103 at another point. The growth rate, or percentage change in quantity demanded, would be the change in quantity demanded $\frac{(103-100)}{(103+100)}$ divided by the average of the two quantities demanded:

$$\frac{(103-100)}{(103+100)/2}$$

In other words, the growth rate:

$$\frac{(103-100)}{(103+100)/2} = \frac{3}{101.5} = 0.0296 = 2.96\% \text{ growth}$$

Note that if we used the point approach, the calculation would be:

$$\frac{(103-100)}{100} = 3\% \text{ growth}$$

This produces nearly the same result as the slightly more complicated midpoint method (3% vs. 2.96%). If you need a rough approximation, use the point method. If you need accuracy, use the midpoint method. Note: as the two points become closer together, the point elasticity becomes a closer approximation to the arc elasticity.

In this module you will often be asked to calculate the *percentage change* in the quantity. Keep in mind that this is same as the the growth rate of the quantity. As you work through the course and find other applications for calculate growth rates, you will be well prepared.

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<https://assessments.lumenlearning.co...sessments/7151>

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.

Learning Objectives

elastic demand: when the calculated elasticity of demand is greater than one, indicating a high responsiveness of quantity demanded or supplied to changes in price

elastic supply: when the calculated elasticity of either supply is greater than one, indicating a high responsiveness of quantity demanded or supplied to changes in price

inelastic demand: when the calculated elasticity of demand is less than one, indicating that a 1 percent increase in price paid by the consumer leads to less than a 1 percent change in purchases (and vice versa); this indicates a low responsiveness by consumers to price changes

inelastic supply:

[/glossary-term]

[glossary-definition]when the calculated elasticity of supply is less than one, indicating that a 1 percent increase in price paid to the firm will result in a less than 1 percent increase in production by the firm; this indicates a low responsiveness of the firm to price increases (and vice versa if prices drop) [/glossary-definition]

[glossary-term]midpoint elasticity approach: [/glossary-term][glossary-definition]Most accurate approach to solving for elasticity in which the percent changes in quantity demanded and price are measured relative to the average quantity demanded and price; the initial quantity demand is subtracted from the new quantity demanded; then divided by the average of the two quantities demanded; similarly, the initial price is subtracted from the new price, then divided by the average of the two prices [/glossary-definition]

[glossary-term]point elasticity approach: [/glossary-term][glossary-definition]approximate method for solving for elasticity in which the percent changes are measured relative to the initial quantity demanded and price; the initial quantity demanded is subtracted from the new quantity demanded, then divided by the initial quantity demanded; similarly, the initial price is subtracted from the new price, then divided by the initial price. [/glossary-definition]

[glossary-term]unitary elasticity: [/glossary-term][glossary-definition]when the calculated elasticity is equal to one indicating that a change in the price of the good or service results in a proportional change in the quantity demanded or supplied[/glossary-definition][glossary-page]

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