

Elasticity: An Introduction

In many circumstances, it is not enough for an economist, policymaker, firm or consumer to simply know the direction in which a variable will be moving. For example, if I am a producer, the law of demand tells me that if I increase the price of my good, the quantity demanded by consumers will decrease. The law of demand doesn't tell me what will happen to my total revenue (the price of the good times the number of units sold), however. Whether total revenue increases or decreases depends on how responsive the quantity demanded is to the price change. Will it decrease a little? A lot? Throughout the discipline of economics, in fact, the responsiveness of one variable to changes in another variable is an important piece of information. In general, *elasticity* is a measurement of how responsive one variable is to a change in another variable — that is, how elastic one variable is given a change in the other, *ceteris paribus* (that is, holding all other variables constant).

Because elasticity measures responsiveness, changes in the variables are measured relative to some base or starting point. Consider the following elasticity measurements:

The price elasticity of demand, ϵ_d :

$$\epsilon_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$$

The income elasticity of demand, ϵ_d :

$$\epsilon_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in income}}$$

The price elasticity of supply, ϵ_s :

$$\epsilon_s = \frac{\text{percentage change in quantity supplied}}{\text{percentage change in price}}$$

The wage elasticity of labor supply, ϵ_{ls} :

$$\epsilon_{ls} = \frac{\text{percentage change in quantity of labor supplied}}{\text{percentage change in wage}}$$

Part A

Extra-Credit Problems

1. Now, suppose that your economics teacher currently allows you to earn extra credit by submitting answers to the end-of-the-chapter questions in your textbook. The number of questions you're willing to submit depends on the amount of extra credit for each question. How responsive you are to a change in the extra-credit points the teacher gives can be represented as an *elasticity*. Write the formula for the elasticity of extra-credit problems submitted:

$$\epsilon_{ps} = \underline{\hspace{4cm}}$$

2. Now, consider that your teacher's goal is to get you to submit twice as many questions: a 100-percent increase. Underline the correct answer in parentheses.
 - (A) If the number of chapter-end questions you submit *is* very responsive to a change in extra-credit points, then a given increase in extra credit elicits a large increase in questions submitted. In this case, your teacher will need to increase the extra-credit points by (*more than / less than / exactly*) 100 percent.
 - (B) If the number of chapter-end questions you submit *is not* very responsive to a change in extra-credit points, then a given increase in extra credit elicits a small increase in questions submitted. In this case, your teacher will need to increase the extra-credit points by (*more than / less than / exactly*) 100 percent.

Part B**The Price Elasticity of Demand**

It's easy to imagine that there are many applications for the elasticity concept. Here we will concentrate on the price elasticity of demand for goods and services. For convenience, the measure is repeated here:

$$\epsilon_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$$

Note the following points:

- Price elasticity of demand is always measured *along* a demand curve. When measuring the responsiveness of quantity demanded to a change in price, all other variables must be held constant.
- The price elasticity of demand is typically reported as a positive number, even though the calculation itself is negative; price and quantity demanded move in opposite directions.
- Along a linear demand curve, there are price ranges over which demand is elastic, unit elastic and inelastic.



Figure 17.1

Relationship Between Changes in Quantity Demanded and Price

Percentage change in quantity demanded	>	percentage change in price	> 1	Elastic
Percentage change in quantity demanded	=	percentage change in price	= 1	Unit elastic
Percentage change in quantity demanded	<	percentage change in price	< 1	Inelastic

Part C

Calculating the Arc Elasticity Coefficient

The arc elasticity calculation method is obtained when the midpoint or average price and quantity are used in the calculation. This is reflected in the formula below.

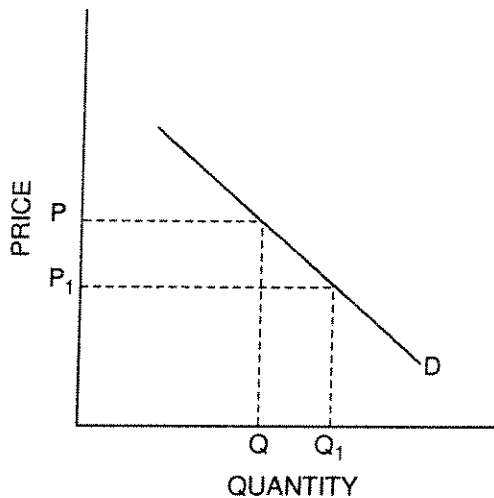
$$\epsilon_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}} = \frac{\frac{Q - Q_1}{(Q + Q_1) / 2}}{\frac{P - P_1}{(P + P_1) / 2}} = \frac{\frac{\Delta Q}{(Q + Q_1) / 2}}{\frac{\Delta P}{(P + P_1) / 2}}$$

If we have the consumer's or market demand curves, we can precisely calculate the elasticity value, or coefficient. Suppose that price is increased (decreased) from P to P_1 and so quantity demanded decreases (increases) from Q to Q_1 .



Figure 17.2

Calculating the Arc Elasticity Coefficient



By making all numbers positive, we've in effect taken the absolute values of these changes, and so the elasticity coefficient will be positive. Note that we have used the average of the two prices and the two quantities. We have done this so that the elasticity measured will be the same whether we are moving from Q to Q_1 or the other way around.

Part D

Coffee Problems

Suppose Moonbucks, a national coffee-house franchise, finally moves into the little town of Middle-ofnowhere. Moonbucks is the only supplier of coffee in town and faces the following demand schedule each week. Write the correct answer on the answer blanks, or underline the correct answer in parentheses.



Figure 17.3
Cups of Coffee Demanded per Week

Price (per cup)	Quantity Demanded
\$6	80
5	100
4	120
3	140
2	160
1	180
0	200

3. What is the arc price elasticity of demand when the price changes from \$1 to \$2? _____

$$\epsilon_d = \frac{\frac{\Delta Q}{(Q + Q_1) / 2}}{\frac{\Delta P}{(P + P_1) / 2}} = \frac{\quad}{\quad} = \quad$$

So, over this range of prices, demand is (*elastic / unit elastic / inelastic*).

4. What is the arc price elasticity of demand when the price changes from \$5 to \$6? _____

$$\epsilon_d = \frac{\frac{\Delta Q}{(Q + Q_1) / 2}}{\frac{\Delta P}{(P + P_1) / 2}} = \frac{\quad}{\quad} = \quad$$

So, over this range of prices, demand is (*elastic / unit elastic / inelastic*).

Note: Because the relationship between quantity demanded and price is inverse, price elasticity of demand would always be negative. Economists believe using negative numbers is confusing when referring to “large” or “small” elasticities of demand. Therefore, they use absolute or positive numbers, changing the sign on the negative numbers.

Part E

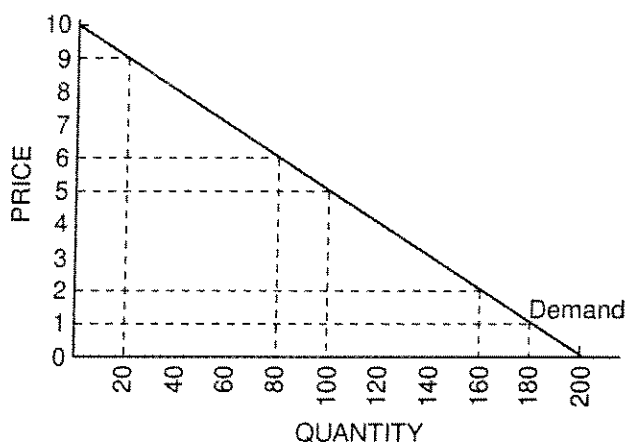
Now, consider Figure 17.4, which graphs the demand schedule given in Figure 17.3.

Recall the slope of a line is measured by the rise over the run: slope = rise / run = $\Delta P / \Delta Q$.



Figure 17.4

Elasticity of Demand for Coffee



5. Using your calculations of ΔP and ΔQ from Question 3, calculate the slope of the demand curve.

6. Using your calculations of ΔP and ΔQ from Question 4, calculate the slope of the demand curve.

7. The law of demand tells us that an increase in price results in a decrease in the quantity demanded. Questions 5 and 6 remind us that the slope of a straight line is *constant everywhere along the line*. Along this demand curve, a change in price of \$1 generates a change in quantity demanded of 20 cups of coffee a week.

You've now shown mathematically that while the slope of the demand curve is related to elasticity, the two concepts are not the same thing. Briefly discuss the relationship between where you are along the demand curve and the elasticity of demand. How does this tie into the notion of *responsiveness*?