Managerial Economics

M.Com. IV Sem.
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Elasticity of Demand

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Objectives

After studying this unit, you will be able to:

- Calculate price elasticity of demand
- Explain the income elasticity of demand concept
- State how cross elasticities of demand are calculated

Introduction

Elasticity is the measure of responsiveness. It is the ratio of the percent change in one variable to the percent change in another variable. The key thing to understand is that we use elasticity when we want to see how one thing changes when we change something else. How does demand for a good change when we change its price? How does the demand for a good change when the price of a substitute good changes?

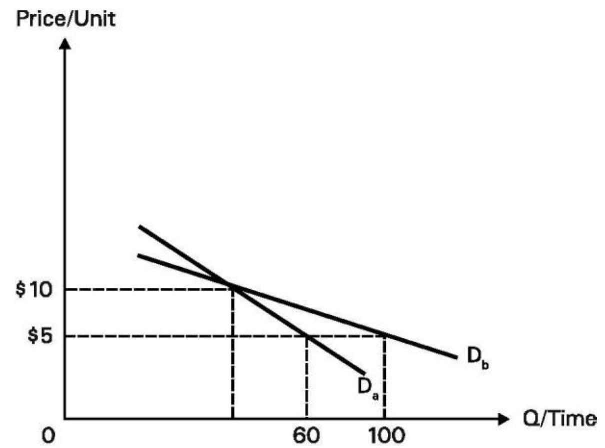
Elasticity varies among products because some products may be more essential to the consumer. A good or service is considered to be elastic if a slight change in price leads to a sharp change in the quantity demanded or supplied.

Usually these kinds of products are readily available in the market and a person may not necessarily need them in his or her daily life. For example, air conditioners, televisions, movie tickets, branded clothes etc. On the other hand, an inelastic good or service is one in which changes in price witness only modest changes in the quantity demanded or supplied, if any at all. These goods tend to be things that are more of a necessity to the consumer in his or her daily life. For example, rice, potatoes, onion, salt, medicines etc.

5.1 Concept of Elasticity

The law of demand tells us that consumers will respond to a price decline by buying more of a product. It does not, however, tell us anything about the degree of responsiveness of consumers to a price change. The contribution of the concept of elasticity lies in the fact that it not only tells us that consumer's demand responds to price changes but also the degree of responsiveness of consumers to a price change. Figure 5.1 shows two demand curves. Let D_a be the demand for cheese in Switzerland and D_b be the demand for cheese in England.

Figure 5.1



At a price of $10, the quantity demanded in both countries is 60. When the price falls from $10 to $5, the quantity of cheese demanded increases in both. However, for the same change in price, from $10 to $5, the change in quantity demanded increases more in England compared to Switzerland. In other words, for the same decrease in price in the two countries, the quantity demanded responds more in England than in Switzerland.

We would describe the above situation by saying that the demand for cheese is more elastic in England than in Switzerland. Elasticity, then, is first another word for "responsiveness".

Elasticity of demand is important primarily as an indicator of how total revenue changes when a change in price induces changes in quantity along the demand curve. The total revenues of the firm will equal the price changed times the quantity sold (TR = P x Q). Naturally, total revenues received by firms are equal to total spending by consumers. If consumers buy 50 units at $10 each, then the total revenue will be $500. By simple multiplication, total revenue can always be calculated for each point in a demand schedule or diagram.

5.1.1 Classification of Demand Curves according to their Elasticities

Depending on how the total revenue changes, when price changes we can classify all demand curves in the following five categories:

1. Perfectly inelastic demand curve
2. Inelastic demand curve
3. Unitary elastic demand curve
4. Elastic demand curve
5. Perfectly elastic demand curve

Figure 5.2 helps us to explain what these five categories imply about the relationship between changes in total revenue and changes in price. It shows three different types of demand curves each having a different implication for total revenue when price is reduced form $10 to $5.

1. In the case of demand curve D_a in Figure 5.2, when the price is $10, total revenue is $500 (10 x 50). When the price changes to $5, the quantity demanded does not respond at all and remains at 50. The total revenue when the price is $5 is $250. In other words, when price decreases, total revenue decreases as well.

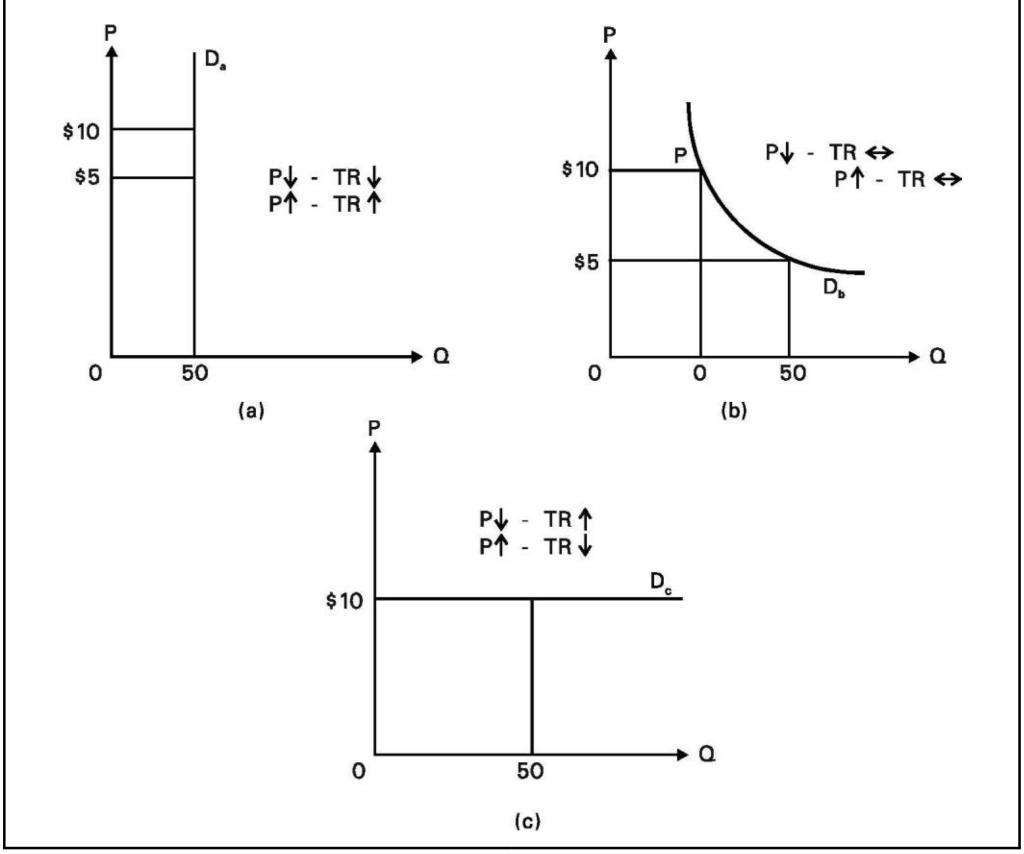
All such demand curves where quantity demanded is totally unresponsive to changes in price are called perfectly inelastic demand curves.

Further, such demand curves imply that when price decreases, the total revenue decreases and vice-versa.

Finally, all such demand curves are supposed to have an elasticity coefficient, E_d, equal to 0. Elasticity coefficient is a number describing the elasticity of the demand curve.

Life saving drugs are most likely to have demand curves which resemble perfectly inelastic demand curves. For example, a diabetic would be willing to pay almost any price to get the required amount of insulin.

Figure 5.2



2. Demand curve D_c in Figure 5.2(c) above represents another extreme case – a perfectly horizontal demand curve. When the price is $10, 50 units are being sold and the total revenue is $500. When the price falls to $5, the quantity demanded increases infinitely and so does the total revenue. On the other hand, when price rises above $10 the quantity demanded falls to Zero and total revenue also falls to zero.

Such horizontal demand curves, where quantity demanded is infinitely responsive to price changes, are called perfectly elastic demand curves.

These perfectly elastic demand curves have a property that when price decreases total revenue increases, and vice-versa.

The elasticity coefficient, E_d, is equal to infinity ($E_d = \infty$).

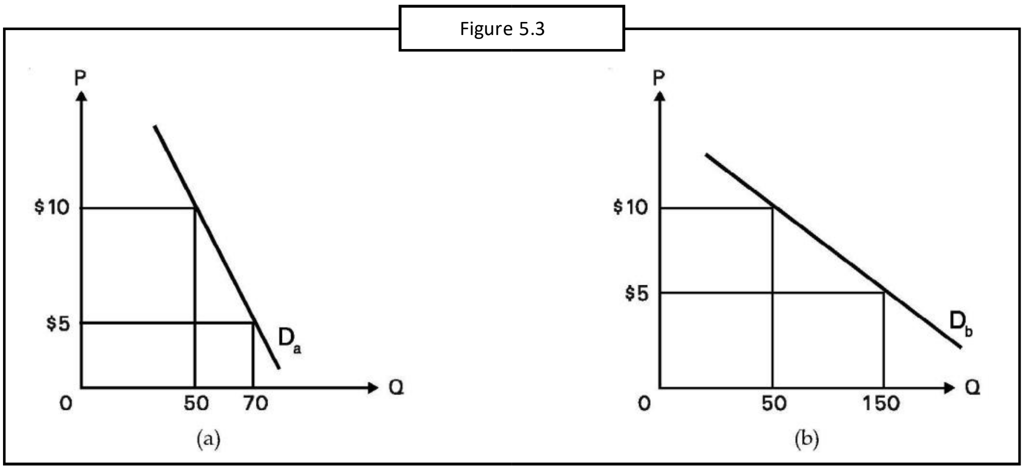
3. The demand curve D_b in Figure 5.2(b) above represents the midpoint of a spectrum where extremes are represented by the demand curves D_a and D_c.

In the case of D_b when price decreases from $10 to $5, the total revenue remains unaffected at $500, such a demand curve is said to be unitary elastic and has the property that when price increases or decreases, the total revenue remains constant. The elasticity coefficient for such demand curves is equal to one. Examples of unitary elastic demand curves occur when a person budgets a certain amount of money for, say, meat or magazines and will not deviate from that figure regardless of price. However, such cases are also unusual in that few demand curves have constant unitary elasticity.

4. Besides the three types of demand curves we have discussed there are two more types of demand curves.

Demand curves which have an elasticity coefficient between 0 and 1 are called relatively inelastic or simply inelastic. When the price falls, the quantity demanded expands but total revenue still decreases. Figure 5.3(a) shows D_a as an example of a relatively inelastic curve.

Figure 5.3



Finally, ∞ demand curve D_b in Figure 5.3(b) is an example of a relatively elastic or simply elastic demand curve. Such demand curves have an elasticity coefficient between 1 and and have the property that when price decreases total revenue increases and vice-versa.

Believe it or not, in the real world, 99.99 per cent of the demand curves are either relatively elastic or relatively inelastic.

Table 5.1 summarises the discussion we have had so far. It tells us how the firm's total revenues (and the consumer's total expenditures) for a product will change as prices are raised or lowered. As shown in the table the value of the elasticity coefficient, E_d, can be anything from zero to infinity and each value can immediately tell us the elasticity of the demand curve at the relevant price. For instance, if a demand curve has an elasticity coefficient of 0.5 at a given price, then we know that this is an inelastic demand curve at that price.

Table 5.1

Price Elasticity of Demand (E_d)		How total revenues or expenditures are affected by price changes	
E_d Value	Term for Elasticity of Demand	Price increases	Price decreases
Zero	Perfectly inelastic	Increase proportionally with price	Decrease Proportionally with price
$0 < E_d < 1$	Relatively inelastic	Increase less than proportionally with price	Decrease less than proportionally with price
$E_d = 1$	Unitary elastic	Unaffected by price changes	
$A > E_d > 1$	Relatively elastic	Decrease but less than proportionally	Increase, but less than proportionally
∞	Perfectly elastic	Total Revenue falls to zero	Increase more than proportionally

5.1.2 Numerical Measurement of Elasticity

What does it mean when we say that the elasticity of demand is 0.5? 0.4? 2.3? To answer this question we have to examine the following definition for elasticity coefficient, E_d.

$$E_d = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

One calculates these percentage changes, of course, by dividing the change in price by the original price and the consequent change in quantity demanded by the original quantity demanded. Thus we can restate our formula as:

$$E_d = \frac{\dfrac{\text{Change in quantity demanded}}{\text{Original quantity demanded}}}{\dfrac{\text{Change in price}}{\text{Original in price}}}$$

This formula can also be written as:

$$E_d = \frac{\dfrac{Q_1 - Q_0}{Q_0}}{\dfrac{P_1 - P_0}{P_0}}$$

Where P_0 = Original price,

P_1 = New price

Q_0 = Original quantity demanded

Q_1 = New quantity demanded

Sometimes we may also find this written as:

$$E_d = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}}$$

Let us answer a basic question about this formula: Why use percentages rather than absolute amounts in measuring consumer responsiveness? The answer is that if we use absolute changes, our impression of buyer responsiveness will be arbitrarily affected by the choice of units.

To illustrate, if the price of product X falls from $3 to $2 and consumers, as a result, increase their purchases from 60 to 100 pounds, we get the impression that the consumers are quite sensitive to price changes and therefore demand is elastic. After all, a price change of "one" has caused a change in the amount demanded of 'forty". But by changing the monetary units from dollars to pennies (why not?), we find that a price change of "one hundred" causes a quantity change of "forty", giving the impression of inelasticity. The use of percentage changes avoids this problem. The given price decrease is 33 per cent whether measured in terms of dollars or in terms of pennies. Thus, the use of percentages gives us the nice property that the units in which the money or goods are measured — ¾ bushels or tons of wheat, dollars or cents or rupees — do not affect elasticity.

Interpreting the Formula

Caution Demand is elastic if a given percentage change in price results in a larger percentage change in quantity demanded. For example, if a two per cent decline in price results in a 4 per cent increase in quantity demanded, demand is then said to be elastic. If a given percentage change in price is accompanied by a relatively smaller change in the quantity demanded, demand is inelastic. For example, if a 3 per cent change in price gives rise to a 1 per cent increase in the amount demanded, demand is said to be inelastic. The borderline case of unitary elasticity, which separates elastic and inelastic demands, occurs where a percentage change in price and accompanying percentage change in quantity demanded happen to be equal.

5.1.3 Computation of Elasticity Coefficients

We may use two measures of elasticity:

1. Arc elasticity, if the data is discrete and therefore incremental changes are measurable.
2. Point elasticity, if the demand function is continuous and therefore only marginal changes are calculable.

Example: Given the following data, calculate the price elasticity of demand when (a) price increases from ₹ 3.00 per unit to ₹ 4.00 per unit and (b) the price falls from ₹ 4.00 per unit to 3.00 per unit.

Px ₹ (per unit)	6	5	4	3	2	1
Qx	750	1250	2000	3250	4650	8000

$$e_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} \text{ or } \frac{dq}{dp} \times \frac{P}{Q}$$

(a) When price increases from ₹ 3 to Rs 4 per unit, P, the old price = ₹ 3 and Q, the old quantity (from the table) = 3250 units.

New Price = ₹ 4

New Quantity = 2000 units.

Δ P = New price – Old price = 4 – 3 = 1

Δ Q = New quantity – Old quantity = 2000 – 3250 = – 1250

Substituting,

$$e_P = (-) \frac{(-1250)}{1} \times \frac{3}{3250} = 1.15$$

(b) When price falls from ₹ 4 to 3 per unit,

P, the old price = ₹ 4

Q, the old quantity (from the table) = 2000

New price = ₹ 3

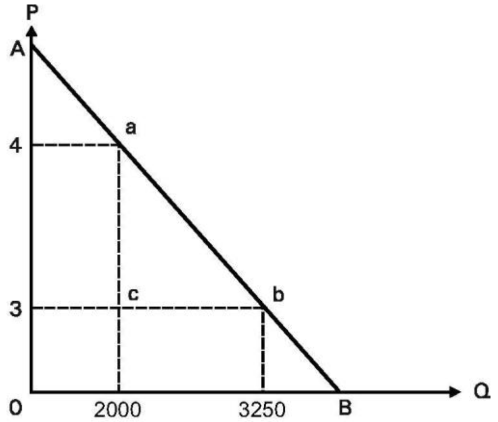
New quantity = 3250 units

Δ P = New price – Old price = 2000 – 3250 = –1250

Δ Q = 3250 – 2000 = 1250

Substituting,

$$e_p = (-)\frac{(-1250)}{1} \times \frac{4}{2000} = 2.5$$



The question is, how is it that we get different demand responses for the same range of price change? The answer is that our initial quantity demanded and price have been different. When we calculate for price fall, they are 2000 for initial quantity demanded and 4 for initial price. When we calculate it ₹for price rise they are 3250 for initial quantity demanded and 3 for initial price. Hence elasticity tends to depend on our₹ choice of the initial situation. However, demand response should be the same for the same finite stretch of the demand curve. To get rid of this dilemma created by the choice of the initial situations, we take the arithmetic mean of the two quantities Q and the mean of the two prices P. This gives us the concept of arc elasticity of demand.

$$\text{Arc elasticity} = \frac{\Delta Q}{Q_0 + Q_1} \times \frac{P_0 - P_1}{\Delta P}$$

$$\text{or, } e = \frac{\Delta Q}{\Delta P} \times \frac{P_0 + P_1}{Q_0 + Q_1}$$

Where Q_0 and Q_1 are the two quantities corresponding to the two points on the demand curve. Similarly P_0 and P_1 are the two prices.

The measurement of elasticity is done by two methods, namely, Geometrical Method and Arithmetical Method.

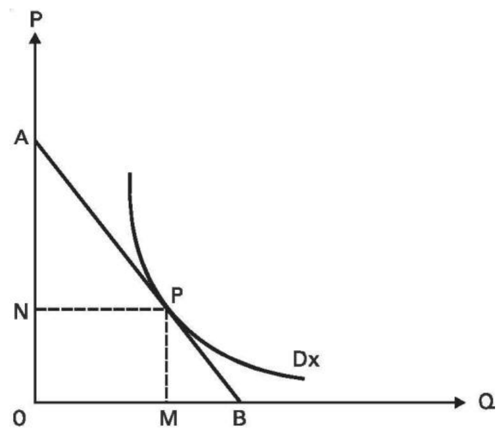
A geometrical way of measuring the elasticity at any point on a demand curve is now in order.

Consider point P on the demand curve Dx in Figure 5.4 (we have taken a non-linear demand curve). Draw a tangent line AB at point P on the demand curve. Applying point elasticity formula, it follows that the elasticity at point P is:

$$e = \frac{dQ}{dP} \times \frac{P}{Q} = \frac{\frac{dQ}{dP}}{\frac{Q}{P}}$$

$\frac{dQ}{dP}$ is the inverse of the slope of the demand curve, hence is equal to $\frac{MB}{PM}$

Figure 5.4



Price is equal to PM and quantity is equal to OM.

$$e = \frac{\frac{MB}{PM}}{\frac{OM}{PM}} = \frac{MB}{PM} \cdot \frac{PM}{OM} = \frac{MB}{OM}$$

In other words, the price elasticity of demand is measured graphically by the ratio of the two segments of the horizontal axis identified by the intersection of the tangent to the point considered with the horizontal axis and by the perpendicular from that point to the same axis.

If we now consider the similar triangles APN and PBM then AP/PM= PB/MB (from properties of similar triangles) or MB/PN = PB/AP. Hence elasticity = MB/ON can be written as equal to PB/AP, i.e., elasticity at P is also equal to PB/AP, the ratio of the lower segment of the demand curve to the upper segment.

In the same way we can show that elasticity is equal to ON/NA (taking again similar triangles and equating the ratio of sides).

Notes

Some important factors that determine the elasticity of demand are:

1. Luxury or Necessity Goods: Luxury goods tend to have an elastic demand, while necessity goods have an inelastic demand. Purchasers can stop buying the luxury goods when their prices rise.

2. Percentage of Income: Big items in a budget tend to have a more elastic demand than small items. For example consumers may be affected by a 1 per cent rise or fall in price of a flat but are insensitive to such fluctuations in pens.

3. Substitutes: Items that can be substituted easily have a more elastic demand than those that cannot.

4. Time: The demand for a product becomes more elastic the longer the time period under consideration. It takes time to decide about another product before buying it as one develops a habit of using a particular product.

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