

DEMAND AND THE DEMAND CURVE

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Introduction The demand curve (normally drawn as a straight line!) represents graphically the relationship between the price of a product and the quantity of that product which is demanded. Typically the curve slopes down reflecting the fact that a reduction in price will result in an increase in the quantity consumed. An understanding of the relationship between movements in price and movements in quantity demanded underpins pricing and revenue generation strategies.

Figure 1: Demand for Mars Bars in Cranfield University Shop

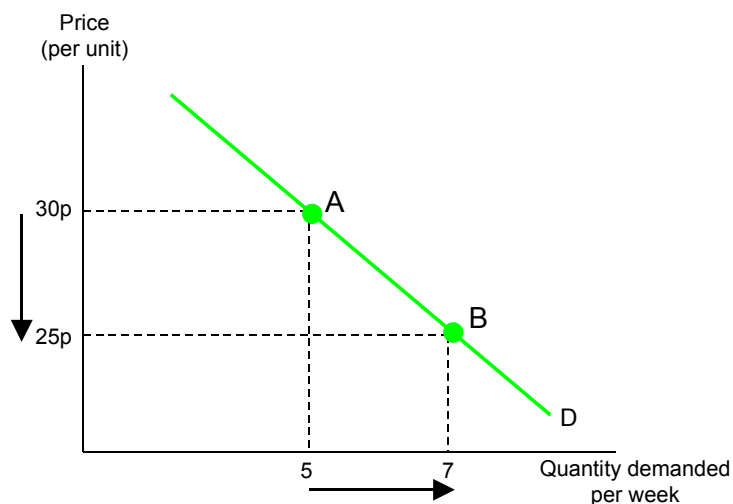
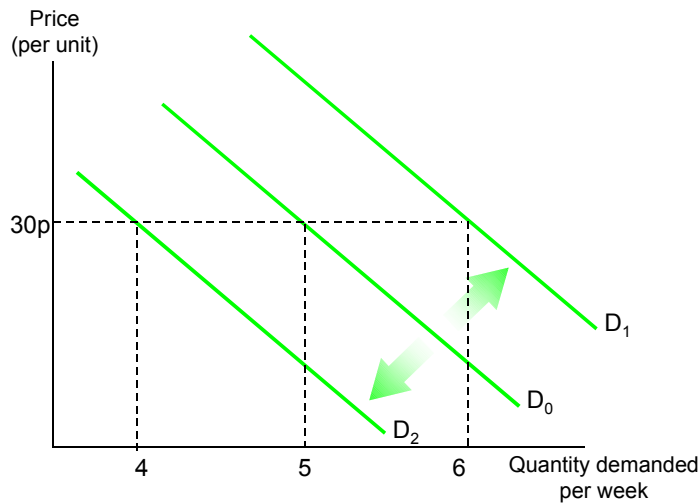


Figure 1 is a typical **demand curve**; as the unit price of the chocolate bar falls from 30p to 25p, the quantity consumed increases from say 5 units to 7 units per week.

Consumption has moved along the demand curve from A to B. The demand curve is fixed in the price–quantity space on the assumption that all other factors which may influence the demand for Mars Bars – eg, the consumer’s income, advertising, the pricing of alternatives – remain constant. This is the **ceteris paribus** assumption. Should any of these other **demand** factors alter, then the *ceteris paribus* assumption is relaxed, and the whole demand curve will shift, see Figure 2.

Figure 2: A Change in Demand

A 'shift' in the demand curve from D_0 to D_1 represents an increase in demand, while a movement from D_0 to D_2 is associated with a reduction in demand. Note that a shift in demand from D_0 to D_1 results in more of the product being demanded at each and every price, for example at a price of 30p per unit quantity demanded increases from 5 to 6 units.

What movement in

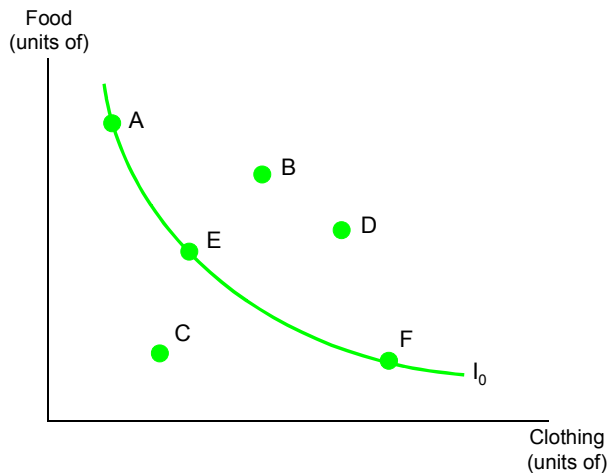
- (i) advertising spend;
- (ii) consumer's income;
- (iii) population;

would cause the demand curve to shift

- (a) D_0 to D_1 ;
- (b) D_0 to D_2 ?

Theory of Consumer Behaviour

The market demand curve shown in Figure 1 is underpinned by a theory of consumer behaviour. Initially the theory asks you to consider how a consumer would rank 'baskets' or 'bundles' of consumption opportunities. In order to simplify the analysis we confine our attention to a basket containing just two goods (food, clothing). If we assume that all units of food are identical as are all units of clothing, then the theory provides a method of ranking the various baskets containing different quantities of food and clothing. Consider Figure 3.

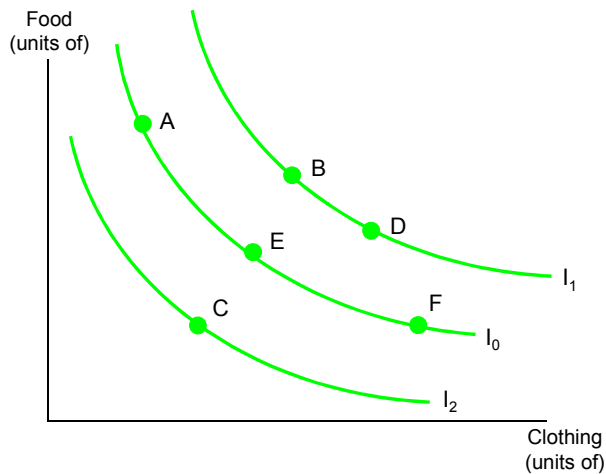
Figure 3: An Indifference Curve

In order to determine preference here we employ the concept of an **indifference curve** (see Figure 3). An indifference curve joins all bundles of food and clothing that yield an identical level of utility. The schedule I_0 is an indifference curve and hence all baskets on I_0 (A, E, F) represent combinations of clothing and food which give the consumer the same level of **utility**/satisfaction. Consider what happens as we move from point A to E. As utility must be held constant along the indifference curve it must be the case that in moving from A to E the **marginal utility** (MU) gained, due to increased consumption of clothing, must exactly equal the MU given up, due to decreased consumption of food. MU declines as consumption of a product rises, hence at point A the MU of food is lower than at point E and *vice versa* for clothing. As bundles B and D lie above the indifference curve both bundles are preferred to A, E and F.

Why are indifference curves shaped as they are ie, convex to the origin?
(Hint: think about marginal utility)

Baskets B and D deliver higher levels of utility than any basket on I_0 , basket C delivers lower levels of utility than any point on I_0 . By placing points C, D and B on their indifference curves we can create a **preference map**. Any point on I_1 is preferred to any point on I_0 and any point on I_0 is preferred to any point on I_2 . Utility and indifference curves underpin the economic theory of consumer behaviour.

Figure 4: An Indifference Map

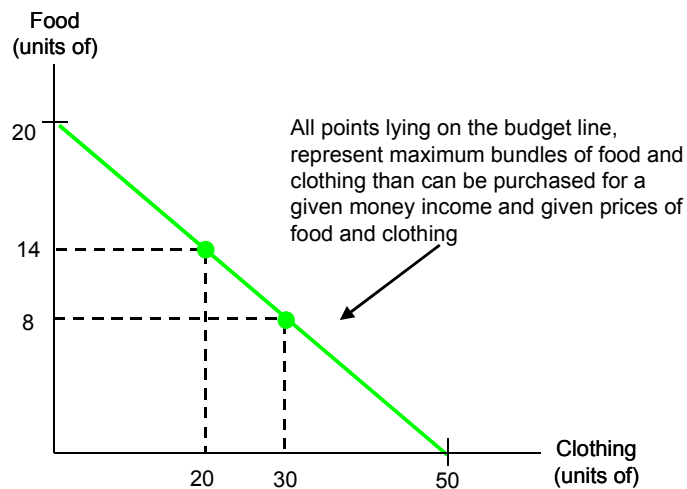


Income Constraint and the Budget Line

Having mapped consumers' preferences between alternative baskets of goods we now need to introduce a **budget constraint**, which will ultimately be used in conjunction with the indifference map to determine the basket of goods which maximises the individual consumer's total utility. In order to construct a **budget line** we need three bits of information:

1. How much income the consumer has (say £100);
2. How much food costs per unit (say £5);
3. How much clothing costs per unit (say £2).

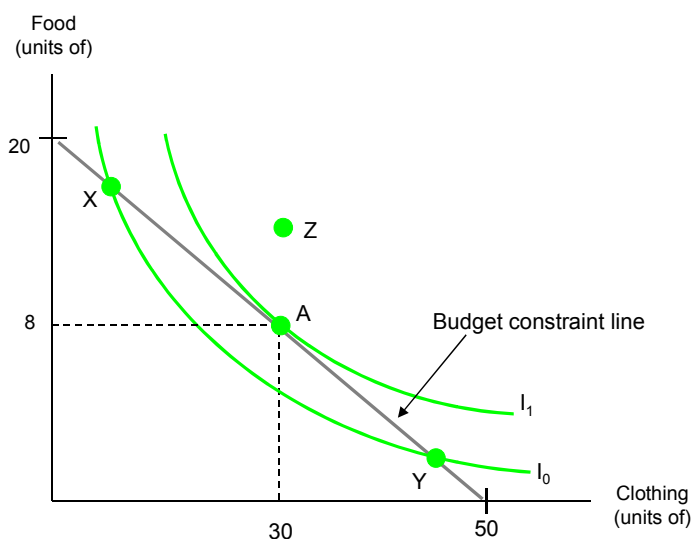
Given this information we can construct the budget line. With an income of £100 the consumer can purchase all bundles of food and clothing lying on the budget line. Simply if all of the consumer's £100 income were spent on food they could purchase 20 units. Conversely, if all of the consumer's £100 income were spent on clothing they could purchase 50 units at £2 per unit. The budget line shows all the combinations of food and clothing which could be purchased if all of the consumer's income of £100 were spent. From the consumer's perspective income places a constraint on what can be purchased.

Figure 5: The Budget Constraint

What would happen to the budget line, in figure 5, if the price of clothing fell to £1 per unit?

Maximising Consumer Satisfaction

By combining the indifference map and the budget line we can identify the basket of food and clothing which maximises consumer satisfaction given the income they have to spend and the price of food and clothing. This is represented by point A in Figure 6.

Figure 6: Consumer Equilibrium

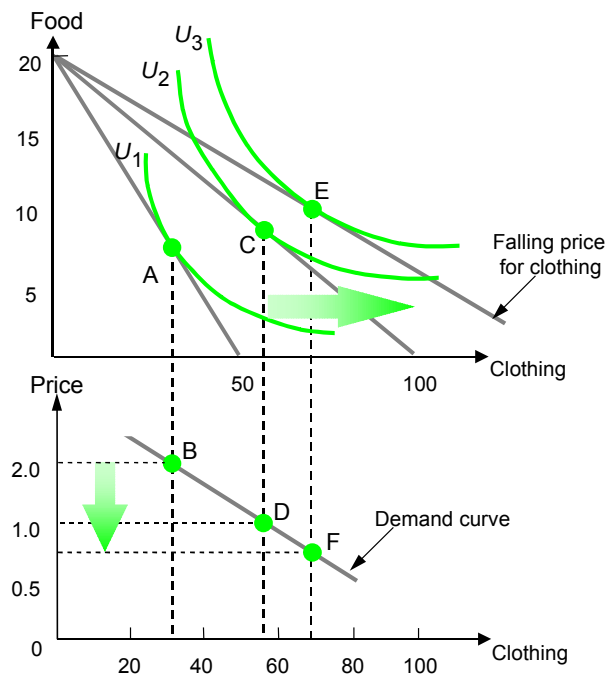
- Why is utility maximised at A and not X or Y?
- Why is utility not maximised at point Z in this example?

Deriving the Demand Curve

So what!! The above analysis promised to explain the slope of the demand curve, so here goes. Consider the budget line. As the price of clothing falls (**money income** and the price of food held constant) the budget line will move as shown in the upper half of Figure 7. That is, *ceteris paribus* increasing amounts of clothing can be purchased.

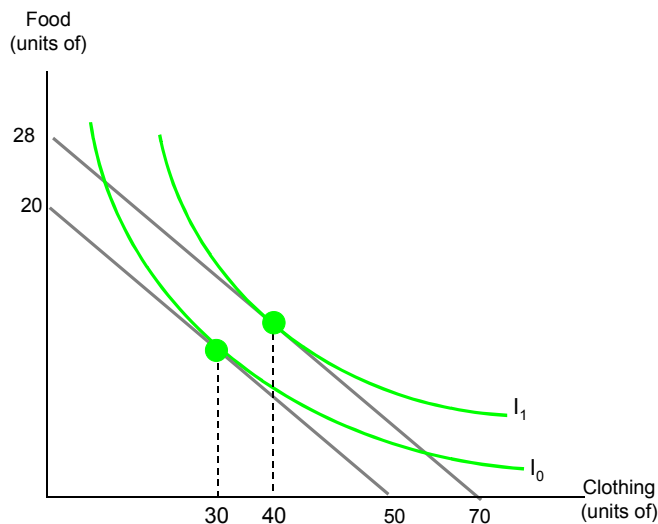
Consider Figure 7. We can see that as the price of clothing falls, the consumer is able to move onto higher indifference curves and hence the consumption of clothing increases to bundles represented by points A, C and E. We can translate these bundles into the price–quantity space shown in the lower half of the figure. For example, at a unit price of £2 some 30 units of clothing are purchased – point B. If the price of clothing falls to £1 consumption rises to 55 units – point D – and if the price falls to £0.75 consumption rises further to 70 units – point F. If we join points B, D and F we have the individual's demand curve for clothing.

Figure 7: Deriving the Demand Curve



Income and Demand What will happen to demand if consumers' income increases when the price of the goods they consume remains constant? First consider the budget line. An increase in income from £100 to £140 with the price of food and clothing held constant would cause the budget line to shift out to the right – more of both goods could be purchased as shown in figure 8. The move from A to B represents an increase in consumption of clothing despite the relative price of food and clothing remaining unchanged. As we saw in figure 2, this is equivalent to a rightward shift in the demand curve. But note, given the consumer's indifference map, consumption of food also rises in response to a rise in money income.

Figure 8: Income and Demand



Substitutes and Complements

Movements along the demand curve show the impact on consumption of change in price when the prices of other goods and services remain unchanged. It follows that changes in the prices of other goods and services will influence the position of the demand curve. In practice there are two important categories of goods or services that have a significant influence on demand for a product. These two categories are:

- Complementary goods are goods where the consumption of one good increase the consumption of the other good. For example, a fall in the price of video players might be expected to increase the demand for video players.

- Substitute goods; where the increase in the consumption of one product leads to a fall in demand for another. For example, a fall in the price of butter is likely to be accompanied by a fall in demand for margarine.

Questions for Discussion

In terms of Figure 2, starting with the D_0 demand curve:

- Does D_1 or D_2 represent the effect of a fall in the price of a substitute product?
- Does D_1 or D_2 represent the effect of a rise in the price of a complementary good.

The Market Demand Curve

So far we have confined ourselves to deriving an individual's demand curve. In practice it is the **market demand curve** that is of interest to business. The market demand curve is the sum of all the individual demand curves of those people who enter the market. It follows that if their individual demand curves slope downwards so too will the market demand curve. If there is an overall rise in the incomes of those people in the market then the market demand curve will shift to the right. Similarly, the market demand curve will shift to the left or right depending on changes in the prices of substitute and complementary products. There is however one additional influence on the market demand; namely, the number of people who enter the market. Hence if the firm can attract more people into its market – by say advertising – then the demand curve will shift to the right. At the level of the market demand curve the rise in consumption as the price is lowered will reflect additional purchasers joining the market as well as existing customers purchasing an increased volume.

We can represent market demand with the following equation:

$$(1) \quad Q_x = f(P_x, P_s, P_c, Y, T, N)$$

where Q_x is the quantity of product x demanded by the market and this is a function of the product's price (P_x), the prices of substitute and complementary goods (P_s and P_c), the average levels of incomes (Y), the preferences or tastes of consumers (T) and the number of people in the market (N)

Price Elasticity of Demand

For a business the level of market demand is critical to the generation of revenue. Total revenue (TR) is the product of the quantity sold (Q) and price (P):

$$(2) \quad TR = PQ$$

An increase in the quantity sold – ΔQ , where Δ represents change – arising from a rise in demand will always increase total revenue:

$$(3) \quad TR + \Delta TR = PQ + P\Delta Q$$

However, the impact of an increase in price, ΔP on the revenue is more complicated. As we have seen, there is an inverse relationship between price and quantity sold. A rise in price will reduce sales and the issues for an individual business is how responsive sales are to a change in price. This responsiveness is measured by the **price elasticity of demand**.

We are interested in this relationship because it will allow us to evaluate how a pricing strategy will impact on revenue flow. Price elasticity of demand is measured with the elasticity coefficient e_p which takes a value between 0 and ∞ . For the non-mathematicians ∞ (infinity) can be interpreted as a very big number and e_p is calculated as:

$$(4) \quad e_p = (-1) \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}$$

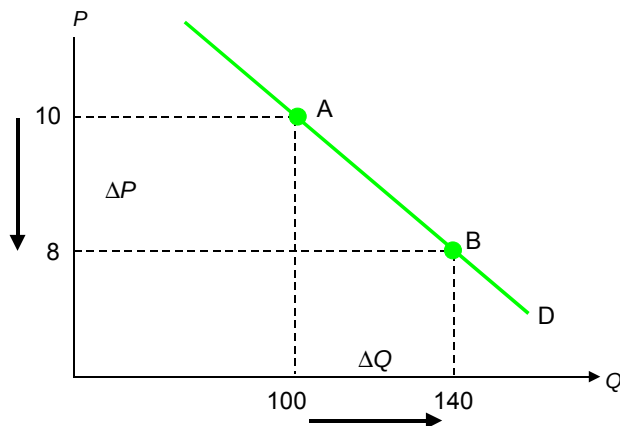
The (-1) has no economic significance and its role is to convert the negative relationship between ΔP and ΔQ into a positive number. Equation (3) can be rewritten as:

$$(5) \quad e_p = \frac{\Delta Q}{Q} \bigg/ \frac{\Delta P}{P}$$

where Q and P are the original quantity and price respectively. Equation (5) can then be rearranged to give:

$$(6) \quad e_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

Please note that since the gradient of the straight line demand curve is $\Delta Q/\Delta P$, the gradient of the demand curve does not measure price elasticity of demand.

Figure 9: Price Elasticity of Demand

Consider Figure 9. On the basis of equation (5) we can translate the changes shown into an elasticity coefficient:

$$e_p = \frac{20}{1} \cdot \frac{10}{100} = 2$$

An elasticity coefficient of 2 says that whatever the percentage reduction (rise) in price the percentage change as quantity consumed rises (or falls) by twice the percentage. Hence, a ten per cent reduction in price has caused a twenty per cent increase in the quantity sold. In this example, a price cut has increased revenue. This is not always the case. The value of e_p can fall into 3 categories.

$1 > e_p > 0$ Demand is inelastic
 $e_p = 1$ Demand is unit elastic
 $\infty > e_p > 1$ Demand is elastic

The following table shows the implications of these demand elasticities for a firm's revenue following a price change:

e_p	Price movement	Total Revenue
$1 > e_p \geq 0$	$P \uparrow$	$TR \uparrow$
	$P \downarrow$	$TR \downarrow$
$e_p = 1$	$P \uparrow$	Total revenue constant in both cases
	$P \downarrow$	
$\infty > e_p > 1$	$P \uparrow$	$TR \downarrow$
	$P \downarrow$	$TR \uparrow$

In order to illustrate the relationships in the above table consider again Figure 9. We note from our calculation that price elasticity of demand $e_p = 2$, ie, demand is elastic.

At point A, total revenue = $10p \times 100 = £10$

At point B, total revenue = $8p \times 140 = £11.20$

Hence $e_p = 2$, price is reduced and total revenue has increased. The value of e_p is therefore critical to a firm's pricing strategy.

Income Elasticity of Demand

The foregoing deals with the concept of the responsiveness of sales to a price change. But elasticity can be applied to any factor that influences demand. For example, another important elasticity is the **income elasticity of demand**. This concept measures the responsiveness of quantity demanded to changes in income:

$$e_y = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$$

At the level of the market, income will measure the average income of those in the market. As economies grow, so do consumers' incomes and the value of e_y will allow a firm to assess the 'organic growth' potential of its products.

Key points arising from this paper.

Questions for Team Discussion

We have discussed how the value of price elasticity of demand can be calculated at any point in time. How can firms influence the value of e_p for their products, and why might they wish to do so?