Chapter 2: Theory of Consumer Behaviour

Exercises — Exercises

Q1 What do you mean by the budget set of a consumer?

The budget set is the collection of all bundles of goods that a consumer can buy with her income at the prevailing market prices. With income M and prices p1 and p2, a bundle (x1, x2) belongs to the budget set if its cost does not exceed her income, that is, $p_1x_1 + p_2x_2 \leq M$. This inequality is called the budget constraint. Bundles that cost exactly M lie on the budget line, and bundles that cost less than M lie below it. Bundles costing more than M lie outside the budget set because the consumer cannot afford them.

Q2 What is budget line?

The budget line is the set of all bundles that cost the consumer exactly her entire income. Its equation is $p_1x_1 + p_2x_2 = M$, where p1 and p2 are the prices of the two goods, x1 and x2 are their quantities, and M is income. It can be written as $x_2 = M/p_2 - (p_1/p_2)x_1$. It is a straight line with horizontal intercept M/p1, vertical intercept M/p2 and slope $-p_1/p_2$. Points below the line cost less than M, and points above it are unaffordable.

Q3 Explain why the budget line is downward sloping.

A point on the budget line is a bundle that uses up the consumer's entire income. If she wants one more unit of good 1, she must pay p1 more for it. Her income is fixed, so she must cut spending on good 2 by the same amount, which means giving up p_1/p_2 units of good 2. More of one good can therefore be had only by having less of the other. For two points (x1, x2) and $(x_1 + \Delta x_1, x_2 + \Delta x_2)$ on the line, $p_1\Delta x_1 + p_2\Delta x_2 = 0$. So $\Delta x_2/\Delta x_1 = -p_1/p_2$, which is negative. Hence the budget line slopes downward.

Q4 A consumer wants to consume two goods. The prices of the two goods are Rs 4 and Rs 5 respectively. The consumer's income is Rs 20. (i) Write down the equation of the budget line. (ii) How much of good 1 can the consumer consume if she spends her entire income on that good? (iii) How much of good 2 can she consume if she spends her entire income on that good? (iv) What is the slope of the budget line?

SOLUTION

Given: p1 = Rs 4, p2 = Rs 5, M = Rs 20.
(i) Budget line: $p_1x_1 + p_2x_2 = M$, so $4x_1 + 5x_2 = 20$.
(ii) All income on good 1 ($x_2 = 0$): $x_1 = M/p_1 = 20/4 = 5$ units.
(iii) All income on good 2 ($x_1 = 0$): $x_2 = M/p_2 = 20/5 = 4$ units.
(iv) Slope = $-p_1/p_2 = -4/5 = -0.8$. Check: vertical intercept ÷ horizontal intercept = $-4/5$.
Results: (i) $4x_1 + 5x_2 = 20$; (ii) 5 units of good 1; (iii) 4 units of good 2; (iv) slope = $-4/5 = -0.8$

Q5 How does the budget line change if the consumer's income increases to Rs 40 but the prices remain unchanged?

SOLUTION

Original line: $4x_1 + 5x_2 = 20$ (intercepts 5 and 4, slope $-4/5$).
New income $M' = 40$, prices unchanged: $4x_1 + 5x_2 = 40$.
Horizontal intercept = 40/4 = 10 (earlier 5).
Vertical intercept = 40/5 = 8 (earlier 4).
Slope = $-p_1/p_2 = -4/5$, the same as before, because prices have not changed.
Both intercepts double and the slope stays the same: the budget line shifts parallel and outward, and the budget set expands.

Q6 How does the budget line change if the price of good 2 decreases by a rupee but the price of good 1 and the consumer's income remain unchanged?

SOLUTION

Original line: $4x_1 + 5x_2 = 20$.
New price of good 2 = 5 − 1 = Rs 4. New line: $4x_1 + 4x_2 = 20$, that is, $x_1 + x_2 = 5$.
Horizontal intercept = 20/4 = 5, unchanged (p_1 and M are unchanged).
Vertical intercept = 20/4 = 5 (earlier 4), so it rises.
Absolute slope = $p_1/p_2 = 4/4 = 1$ (earlier 4/5 = 0.8), so it increases.
The budget line pivots outward around the horizontal intercept: the vertical intercept rises from 4 to 5 and the line becomes steeper. The budget set expands.

Q7 What happens to the budget set if both the prices as well as the income double?

SOLUTION

Original budget line: $p_1x_1 + p_2x_2 = M$.
After doubling everything: $(2p_1)x_1 + (2p_2)x_2 = 2M$.
Dividing both sides by 2 gives $p_1x_1 + p_2x_2 = M$, the original line.
Intercepts: $2M/2p_1 = M/p_1$ and $2M/2p_2 = M/p_2$, unchanged. Slope: $-2p_1/2p_2 = -p_1/p_2$, unchanged.
The budget line and the budget set remain exactly the same.

Q8 Suppose a consumer can afford to buy 6 units of good 1 and 8 units of good 2 if she spends her entire income. The prices of the two goods are Rs 6 and Rs 8 respectively. How much is the consumer's income?

SOLUTION

The bundle (6, 8) costs her entire income, so $M = p_1x_1 + p_2x_2$.
$M = 6 \times 6 + 8 \times 8 = 36 + 64$.
M = Rs 100

Q9 Suppose a consumer wants to consume two goods which are available only in integer units. The two goods are equally priced at Rs 10 and the consumer's income is Rs 40. (i) Write down all the bundles that are available to the consumer. (ii) Among the bundles that are available to the consumer, identify those which cost her exactly Rs 40.

SOLUTION

Budget constraint: $10x1 + 10x2 \leq 40$, that is, $x1 + x2 \leq 4$, with x1 and x2 whole numbers.
(i) Available bundles (15 in all):
x1 = 0: (0,0), (0,1), (0,2), (0,3), (0,4)
x1 = 1: (1,0), (1,1), (1,2), (1,3)
x1 = 2: (2,0), (2,1), (2,2)
x1 = 3: (3,0), (3,1)
x1 = 4: (4,0)
(ii) Bundles costing exactly Rs 40 satisfy $x1 + x2 = 4$: (0,4), (1,3), (2,2), (3,1), (4,0).
Check: each costs $10 \times 4 =$ Rs 40. All other available bundles cost less than Rs 40.

Q10 What do you mean by 'monotonic preferences'?

Preferences are monotonic when, between any two bundles, the consumer prefers the bundle that has more of at least one good and no less of the other. Take bundles (x1, x2) and (y1, y2). If $x1 \geq y1$ and $x2 \geq y2$, with a strict inequality for at least one good, she prefers (x1, x2). In simple terms, more of a good is always better, or at least not worse. Monotonicity implies that indifference curves slope downward and that bundles on higher indifference curves are preferred.

Q11 If a consumer has monotonic preferences, can she be indifferent between the bundles (10, 8) and (8, 6)?

No. The bundle (10, 8) has more of good 1 ($10 > 8$) and more of good 2 ($8 > 6$) than (8, 6). With monotonic preferences, a bundle having more of at least one good and no less of the other is strictly preferred. She therefore prefers (10, 8) to (8, 6) and cannot be indifferent between them.

Q12 Suppose a consumer's preferences are monotonic. What can you say about her preference ranking over the bundles (10, 10), (10, 9) and (9, 9)?

(10, 10) has the same amount of good 1 as (10, 9) and more of good 2, so (10, 10) is preferred to (10, 9). (10, 9) has more of good 1 than (9, 9) and the same amount of good 2, so (10, 9) is preferred to (9, 9). The ranking is therefore $(10, 10) \succ (10, 9) \succ (9, 9)$. Consequently (10, 10) is also preferred to (9, 9), which has less of both goods.

Q13 Suppose your friend is indifferent to the bundles (5, 6) and (6, 6). Are the preferences of your friend monotonic?

No. The bundle (6, 6) has more of good 1 than (5, 6) and the same amount of good 2. If preferences were monotonic, your friend would strictly prefer (6, 6) to (5, 6). Because she is indifferent between them, her preferences do not satisfy monotonicity.

Q14 Suppose there are two consumers in the market for a good and their demand functions are as follows: d1(p) = 20 − p for any price less than or equal to 20, and d1(p) = 0 at any price greater than 20. d2(p) = 30 − 2p for any price less than or equal to 15, and d2(p) = 0 at any price greater than 15. Find out the market demand function.

SOLUTION

Market demand at each price = d1(p) + d2(p).
Case 1: p ≤ 15. Both consumers demand the good: (20 − p) + (30 − 2p) = 50 − 3p.
Case 2: 15 < p ≤ 20. Consumer 2 demands 0, so market demand = 20 − p.
Case 3: p > 20. Both demand 0, so market demand = 0.
Market demand: D(p) = 50 − 3p for 0 ≤ p ≤ 15; D(p) = 20 − p for 15 < p ≤ 20; D(p) = 0 for p > 20.
Check at p = 15: 50 − 45 = 5 = 20 − 15 + 0, so the two pieces agree.

Q15 Suppose there are 20 consumers for a good and they have identical demand functions: d(p) = 10 − 3p for any price less than or equal to 10/3 and d(p) = 0 at any price greater than 10/3. What is the market demand function?

SOLUTION

All 20 consumers are identical, so market demand = 20 × d(p).
For p ≤ 10/3: D(p) = 20 × (10 − 3p) = 200 − 60p.
For p > 10/3: D(p) = 20 × 0 = 0.
Market demand: D(p) = 200 − 60p for p ≤ 10/3; D(p) = 0 for p > 10/3.
Check at p = 10/3: 200 − 60 × (10/3) = 200 − 200 = 0.

Q16 Consider a market where there are just two consumers and suppose their demands for the good are given as follows (price p: d1, d2): 1: 9, 24; 2: 8, 20; 3: 7, 18; 4: 6, 16; 5: 5, 14; 6: 4, 12. Calculate the market demand for the good.

SOLUTION

Market demand at each price = d1 + d2.
p = 1: 9 + 24 = 33
p = 2: 8 + 20 = 28
p = 3: 7 + 18 = 25
p = 4: 6 + 16 = 22
p = 5: 5 + 14 = 19

p = 6: 4 + 12 = 16

Market demand at prices 1, 2, 3, 4, 5, 6 is 33, 28, 25, 22, 19, 16 units respectively.

Q17 What do you mean by a normal good?

A normal good is one whose quantity demanded rises when the consumer's income rises and falls when her income falls. Demand for a normal good thus moves in the same direction as income. Most goods are of this type, for example branded clothes, fruits and good-quality food. When income increases, the demand curve for a normal good shifts rightward, and when income decreases it shifts leftward.

Q18 What do you mean by an 'inferior good'? Give some examples.

An inferior good is one whose demand moves in the opposite direction to the consumer's income. As income rises, demand for the good falls, and as income falls, demand for it rises. Examples are low-quality food items such as coarse cereals. As the consumer's income increases, she switches to better-quality items and reduces consumption of the coarse variety. A good may be normal at low incomes and inferior beyond a certain income level. For an inferior good, the demand curve shifts leftward when income increases.

Q19 What do you mean by substitutes? Give examples of two goods which are substitutes of each other.

Substitutes are goods that can be used in place of each other, so they are not consumed together. Tea and coffee are an example. If the price of coffee rises, consumers shift to tea and the demand for tea increases; if the price of coffee falls, the demand for tea falls. The demand for a good thus moves in the same direction as the price of its substitute. A rise in the price of a substitute shifts the demand curve for the good rightward.

Q20 What do you mean by complements? Give examples of two goods which are complements of each other.

Complements are goods that are consumed together. Tea and sugar, shoes and socks, and pen and ink are examples. If the price of sugar rises, the demand for tea is likely to fall; if the price of sugar falls, the demand for tea is likely to rise. The demand for a good thus moves in the opposite direction to the price of its complement. A rise in the price of a complementary good shifts the demand curve for the good leftward.

Q21 Explain price elasticity of demand.

Price elasticity of demand measures how responsive the demand for a good is to a change in its price. It is the percentage change in demand divided by the percentage change in price: eD = (ΔQ/Q × 100) ÷ (ΔP/P × 100) = (ΔQ/ΔP) × (P/Q). It is negative because demand and price are inversely related, but we usually refer to its absolute value. If |eD| > 1, demand is elastic (typical of luxuries). If |eD| < 1, demand is inelastic (typical of necessities). If |eD| = 1, demand is unitary elastic. It is a pure number, independent of units. Availability of close substitutes raises elasticity.

Q22 Consider the demand for a good. At price Rs 4, the demand for the good is 25 units. Suppose price of the good increases to Rs 5, and as a result, the demand for the good falls to 20 units. Calculate the price elasticity.

SOLUTION

P1 = 4, Q1 = 25; P2 = 5, Q2 = 20.
ΔQ = 20 − 25 = −5, so % change in quantity = (−5/25) × 100 = −20%.
ΔP = 5 − 4 = 1, so % change in price = (1/4) × 100 = 25%.
eD = % change in quantity ÷ % change in price = −20 / 25 = −0.8.
Price elasticity of demand = −0.8 (absolute value 0.8 < 1, so demand is inelastic).

Q23 Consider the demand curve D(p) = 10 − 3p. What is the elasticity at price 5/3?

SOLUTION

D(p) = 10 − 3p, so ΔQ/ΔP = −3.
At p = 5/3: Q = 10 − 3 × (5/3) = 10 − 5 = 5.
eD = (ΔQ/ΔP) × (P/Q) = −3 × (5/3) / 5.
−3 × (5/3) = −5, and −5 / 5 = −1.
Elasticity at p = 5/3 is −1 (absolute value 1, unitary elastic).

Q24 Suppose the price elasticity of demand for a good is −0.2. If there is a 5% increase in the price of the good, by what percentage will the demand for the good go down?

SOLUTION

eD = % change in demand ÷ % change in price.
−0.2 = % change in demand ÷ 5.
% change in demand = −0.2 × 5 = −1%.
Demand will go down by 1%.

Q25 Suppose the price elasticity of demand for a good is −0.2. How will the expenditure on the good be affected if there is a 10% increase in the price of the good?

SOLUTION

|eD| = 0.2 < 1, so demand is price inelastic.
% change in demand = eD × % change in price = −0.2 × 10 = −2%.
Price rises by 10% and quantity falls by only 2%, so the percentage fall in quantity is less than the percentage rise in price.
Approximate change in expenditure = +10% − 2% = about +8% (exact: 1.10 × 0.98 = 1.078, a rise of 7.8%).
Expenditure on the good will increase, by about 8%, moving in the same direction as the price.

Q26 Suppose there was a 4% decrease in the price of a good, and as a result, the expenditure on the good increased by 2%. What can you say about the elasticity of demand?

SOLUTION

Expenditure = price × quantity. Price falls 4%, so new price = 0.96 times the old price.
Expenditure rises 2%, so 0.96 × (new quantity / old quantity) = 1.02.
New quantity / old quantity = 1.02 / 0.96 = 1.0625, so quantity rises by about 6.25%.
eD = 6.25 / (−4) ≈ −1.56, so |eD| > 1 (approximately −1.5 using the rough 6% rise).
Expenditure moved in the opposite direction to the price, which happens only when demand is price elastic.
Demand is elastic: |eD| > 1 (about 1.56).