

Class 11 Economics: Statistics and Microeconomics

Formulas

Statistics for Economics and Introductory Microeconomics (NCERT) · CBSE syllabus 2026-27 · NCERT textbooks (Reprint 2026-27)

How to use this sheet. The CBSE 2026-27 Class 11 Economics paper has two parts: **Statistics for Economics** (Part A) and **Introductory Microeconomics** (Part B). This sheet collects every formula from both NCERT books. Chapters without formulas are left out. Chapter numbers match each NCERT book. The amber box marked ★ **Syllabus only** covers a topic the 2026-27 syllabus lists but the current NCERT reprint does not print. It uses the standard method. Grey boxes marked ◇ **Not in 2026-27 syllabus** are in the NCERT books but not in the current syllabus. They are kept for reference.

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S3 Organisation of Data

FREQUENCY DISTRIBUTION

- Class mark (mid-point) = $\frac{\text{Upper class limit} + \text{Lower class limit}}{2}$
- Class interval (width) = Upper class limit – Lower class limit
- Range = Largest value – Smallest value

INCLUSIVE TO EXCLUSIVE (ADJUSTED LIMITS)

- Adjustment = $\frac{\text{Lower limit of next class} - \text{Upper limit of this class}}{2}$
(usually 0.5)
- Adjusted lower limit = lower limit – adjustment;
adjusted upper limit = upper limit + adjustment
- Adjusted class mark = $\frac{\text{Adjusted upper limit} + \text{Adjusted lower limit}}{2}$

S5 Measures of Central Tendency

ARITHMETIC MEAN

Method	Individual series	Discrete / continuous (use mid-points m)
Direct	$\bar{X} = \frac{\sum X}{N}$	$\bar{X} = \frac{\sum fX}{\sum f}$ or $\frac{\sum fm}{\sum f}$
Assumed mean ($d = X - A$)	$\bar{X} = A + \frac{\sum d}{N}$	$\bar{X} = A + \frac{\sum fd}{\sum f}$
Step deviation ($d' = \frac{X-A}{c}$)	$\bar{X} = A + \frac{\sum d'}{N} \times c$	$\bar{X} = A + \frac{\sum fd'}{\sum f} \times c$

- Sum of deviations from the mean is zero: $\sum(X - \bar{X}) = 0$
- Weighted mean:

$$\bar{X}_w = \frac{\sum WX}{\sum W} = \frac{W_1X_1 + W_2X_2 + \dots}{W_1 + W_2 + \dots}$$



MEDIAN

- Individual and discrete series: Median = size of the $\left(\frac{N+1}{2}\right)^{\text{th}}$ item (arrange in order; use cumulative frequency for discrete)
- Continuous series: median class holds the $\left(\frac{N}{2}\right)^{\text{th}}$ item

$$\text{Median} = L + \frac{\frac{N}{2} - c.f.}{f} \times h$$
- L lower limit of median class, $c.f.$ cumulative frequency of the class **before** it, f its frequency, h its width

MODE

- Most frequent value; data can be unimodal, bimodal or multimodal
- Continuous series (modal class = highest frequency):

$$\text{Mode} = L + \frac{D_1}{D_1 + D_2} \times h$$
- $D_1 = f_{\text{modal}} - f_{\text{before}}$, $D_2 = f_{\text{modal}} - f_{\text{after}}$ (ignore signs); classes must be equal and exclusive
- Median always lies between mean and mode: Mean > Median > Mode, or Mean < Median < Mode

◇ **QUARTILES AND PERCENTILES**

- Q_1 = size of $\left(\frac{N+1}{4}\right)^{\text{th}}$ item; Q_3 = size of $\left(\frac{3(N+1)}{4}\right)^{\text{th}}$ item
- Percentiles split data into 100 equal parts; the 50th percentile is the median

S6 Correlation**KARL PEARSON'S COEFFICIENT (PRODUCT MOMENT)**

With deviations $x = X - \bar{X}$, $y = Y - \bar{Y}$:

$$\text{Cov}(X, Y) = \frac{\sum xy}{N}, \quad r = \frac{\sum xy}{N\sigma_x\sigma_y} = \frac{\sum(X - \bar{X})(Y - \bar{Y})}{\sqrt{\sum(X - \bar{X})^2} \sqrt{\sum(Y - \bar{Y})^2}}$$

Direct (actual values):

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{N\sum X^2 - (\sum X)^2} \sqrt{N\sum Y^2 - (\sum Y)^2}}$$

Step deviation: put $U = \frac{X-A}{B}$, $V = \frac{Y-C}{D}$ and compute r from U, V ; $r_{UV} = r_{XY}$ because r is unaffected by change of origin and scale.

PROPERTIES OF R

- $-1 \leq r \leq 1$; a value outside this range means a calculation error
- No unit; unaffected by change of origin and scale
- $r = +1$ or -1 : perfect correlation; $r = 0$: no **linear** relation (variables may still be related non-linearly)
- Correlation shows covariation, not causation

SPEARMAN'S RANK CORRELATION

- Ranks not repeated:

$$r_s = 1 - \frac{6\sum D^2}{n(n^2 - 1)} = 1 - \frac{6\sum D^2}{n^3 - n}$$

- Ranks repeated (each tie of m items gets the average rank):

$$r_s = 1 - \frac{6 \left[\sum D^2 + \frac{m_1^3 - m_1}{12} + \frac{m_2^3 - m_2}{12} + \dots \right]}{n(n^2 - 1)}$$

- D = difference between the two ranks of an item; $\sum D = 0$ is a check



S7 Index Numbers

SIMPLE AGGREGATIVE PRICE INDEX

- $$P_{01} = \frac{\sum P_1}{\sum P_0} \times 100$$
- P_1 current period price, P_0 base period price; base year index = 100
- Index 138.5 means prices rose 38.5% over the base period
- Unweighted: every item counts equally, whatever its importance.

INFLATION AND USES OF CPI

- Inflation rate = $\frac{X_t - X_{t-1}}{X_{t-1}} \times 100$
(X = WPI or CPI for periods t and $t-1$)
- Purchasing power of money = $\frac{1}{\text{Cost of living index}}$
- Real wage = $\frac{\text{Money wage}}{\text{Cost of living index}} \times 100$
- Types: WPI (wholesale prices), CPI (retail, cost of living), IIP (industrial production)

◇ WEIGHTED AND AVERAGING-OF-RELATIVES METHODS

- Laspeyres (base quantities): $P_{01} = \frac{\sum P_1 q_0}{\sum P_0 q_0} \times 100$; Paasche (current quantities): $P_{01} = \frac{\sum P_1 q_1}{\sum P_0 q_1} \times 100$
- Simple average of price relatives: $P_{01} = \frac{1}{n} \sum \frac{P_1}{P_0} \times 100$; weighted: $P_{01} = \frac{\sum W \left(\frac{P_1}{P_0} \times 100 \right)}{\sum W}$
- CPI by the weighted relatives method: $\text{CPI} = \frac{\sum WR}{\sum W}$, $R = \frac{P_1}{P_0} \times 100$

M1 Introduction (Microeconomics)

PRODUCTION POSSIBILITY FRONTIER AND OPPORTUNITY COST

- PPF: all combinations of two goods an economy can produce with given resources and technology, using them fully and efficiently
- Opportunity cost of one more unit of a good = amount of the other good given up:

$$\text{Marginal opportunity cost} = \frac{\text{Units of Y given up}}{\text{Extra units of X gained}} = \left| \frac{\Delta Y}{\Delta X} \right|$$

- Point inside the PPF: resources unemployed or used wastefully. Outward shift: more resources or better technology
- Central problems: what, how and for whom to produce. Positive economics = what is; normative = what ought to be

M2 Theory of Consumer Behaviour

UTILITY

- $MU_n = TU_n - TU_{n-1}$, $TU_n = MU_1 + MU_2 + \dots + MU_n$
- Law of diminishing marginal utility: each extra unit adds less utility
- TU is maximum when $MU = 0$; TU falls when MU is negative

★ CONSUMER'S EQUILIBRIUM BY MARGINAL UTILITY

- One good: $\frac{MU_x}{P_x} = MU_m$ (marginal utility of a rupee); buy until MU (in rupees) = P_x

- Two goods:

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = MU_m$$

and MU falls as consumption rises



BUDGET SET AND BUDGET LINE

- Budget set: $p_1x_1 + p_2x_2 \leq M$; budget line: $p_1x_1 + p_2x_2 = M$
- $x_2 = \frac{M}{p_2} - \frac{p_1}{p_2}x_1$
- Intercepts $\frac{M}{p_1}$ (horizontal) and $\frac{M}{p_2}$ (vertical); slope = $-\frac{p_1}{p_2}$
- Income change: parallel shift. Price change of one good: the line rotates about the other intercept

INDIFFERENCE CURVES AND EQUILIBRIUM

- $MRS = \left| \frac{\Delta x_2}{\Delta x_1} \right|$
(amount of good 2 given up for one more unit of good 1); diminishing MRS makes the IC convex
- Optimum: budget line tangent to the highest IC:
 $MRS = \frac{p_1}{p_2}$
- ICs slope down, never intersect; a higher IC gives higher utility (monotonic preferences)

DEMAND

- Demand function $q = d(p)$; linear: $d(p) = a - bp$ for $0 \leq p \leq \frac{a}{b}$
- Market demand = horizontal sum of individual demands
- Change in own price: movement along the curve. Change in income, prices of related goods, tastes: shift of the curve
- Normal good: demand rises with income; inferior: falls.
Substitutes: $p_y \uparrow \Rightarrow d_x \uparrow$; complements: $p_y \uparrow \Rightarrow d_x \downarrow$

PRICE ELASTICITY OF DEMAND

- Percentage method:

$$e_D = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}} = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

- % change in quantity = $\frac{Q_2 - Q_1}{Q_1} \times 100$; e_D is negative (law of demand), so compare $|e_D|$
- $|e_D| > 1$ elastic; $= 1$ unitary; < 1 inelastic; 0 perfectly inelastic (vertical curve); ∞ perfectly elastic (horizontal)

Total expenditure method ($E = p \times q$)	Price falls	Price rises
Elastic $ e_D > 1$	Expenditure rises	Expenditure falls
Unitary $ e_D = 1$	Unchanged	Unchanged
Inelastic $ e_D < 1$	Expenditure falls	Expenditure rises

Factors: availability of close substitutes (more elastic), necessity vs luxury (necessities inelastic, luxuries elastic).

◇ GEOMETRIC METHOD ON A STRAIGHT-LINE DEMAND CURVE

- For $q = a - bp$: $e_D = -b\frac{p}{q}$; at a point, $|e_D| = \frac{\text{lower segment}}{\text{upper segment}}$
- $e_D = 0$ at the quantity axis, $|e_D| = 1$ at the midpoint, ∞ at the price axis
- Rectangular hyperbola $pq = \text{constant}$: $|e_D| = 1$ everywhere



M3 Production and Costs

PRODUCT OF LABOUR (SHORT RUN, CAPITAL FIXED)

- Production function $q = f(L, K)$
- $AP_L = \frac{TP_L}{L}$, $MP_L = \frac{\Delta TP}{\Delta L} = TP_L - TP_{L-1}$
- $TP = \Sigma MP$. MP rises then falls (law of variable proportions / diminishing marginal product)
- $MP > AP$: AP rising; $MP = AP$: AP at maximum; $MP < AP$: AP falling. TP maximum when $MP = 0$

SHORT-RUN COSTS

- $TC = TFC + TVC$
- $AFC = \frac{TFC}{q}$, $AVC = \frac{TVC}{q}$, $SAC = \frac{TC}{q} = AVC + AFC$
- $SMC = \frac{\Delta TC}{\Delta q} = TC_q - TC_{q-1}$
(= change in TVC, since TFC is fixed); $TVC = \Sigma SMC$
- AFC falls continuously (rectangular hyperbola); AVC, SAC and SMC are U-shaped
- SMC cuts AVC and SAC at their minimum points; min AVC comes before min SAC

◇ RETURNS TO SCALE AND LONG-RUN COSTS

- Constant returns: $f(tx_1, tx_2) = t f(x_1, x_2)$; increasing: $> t f$; decreasing: $< t f$
- Cobb-Douglas $q = x_1^\alpha x_2^\beta$: CRS if $\alpha + \beta = 1$, IRS if > 1 , DRS if < 1
- $LRAC = \frac{TC}{q}$, $LRMC = TC_q - TC_{q-1}$; isoquants join input combinations giving the same output

M4 The Theory of the Firm under Perfect Competition

REVENUE

- $TR = p \times q$, $AR = \frac{TR}{q} = p$, $MR = \frac{\Delta TR}{\Delta q}$
- Perfect competition (price taker): $MR = AR = p$; TR is a straight line through the origin with slope p
- Features: many buyers and sellers, homogeneous product, free entry and exit, perfect information

PRODUCER'S EQUILIBRIUM (PROFIT MAXIMISATION)

- Profit $\pi = TR - TC$
- Condition 1: $MR = MC$, i.e. $p = MC$
- Condition 2: MC is non-decreasing (rising) at that output
- Condition 3 (short run): $p \geq AVC$, otherwise shut down

SUPPLY CURVE OF A FIRM

- Short-run supply curve: rising part of SMC at and above min AVC; zero output below it
- **Shut-down point** (short run): $p = \min AVC$
- **Break-even point** (normal profit, zero economic profit): $p = \min AC$
- Shifts: technological progress (right), rise in input prices (left), unit tax (left)
- Market supply = horizontal sum of firms' supplies

PRICE ELASTICITY OF SUPPLY

- $e_S = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$
- e_S is positive; vertical supply curve: $e_S = 0$
- Straight-line supply curve through the origin: $e_S = 1$; cutting the price axis: $e_S > 1$; cutting the quantity axis: $e_S < 1$.

◇ LONG RUN

- Long-run conditions: $p = LRMC$, LRMC non-decreasing, $p \geq LRAC$; long-run supply curve = rising LRMC above min LRAC



M5 Market Equilibrium

EQUILIBRIUM (FIXED NUMBER OF FIRMS)

- $q^D(p^*) = q^S(p^*)$
- Excess demand $ED(p) = q^D - q^S > 0$ below p^* (price rises); excess supply $ES(p) = q^S - q^D > 0$ above p^* (price falls)
- Example: $q^D = 200 - p$, $q^S = 120 + p$ gives $p^* = 40$, $q^* = 160$

SHIFTS IN DEMAND AND SUPPLY

Change	p^*	q^*
Demand rises (shifts right)	↑	↑
Demand falls	↓	↓
Supply rises (shifts right)	↓	↑
Supply falls	↑	↓
Both rise	?	↑
Demand rises, supply falls	↑	?

"?" depends on which shift is bigger.

PRICE CEILING AND PRICE FLOOR

- **Price ceiling:** maximum price set **below** equilibrium (e.g. wheat, rice, kerosene) $\Rightarrow$ excess demand, rationing (ration shops), possible black market
- **Price floor:** minimum price set **above** equilibrium (e.g. minimum support price, minimum wage) $\Rightarrow$ excess supply; government buys the surplus (buffer stocks)

◇ FREE ENTRY AND EXIT; LABOUR MARKET

- Free entry and exit: $p_0 = \min AC$; number of firms $n_0 = \frac{q^D(p_0)}{q_{0f}}$ (market quantity / one firm's supply)
- Labour demand: firm hires until $w = VMP_L = p \times MP_L$ ($MRP_L = MR \times MP_L$)

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