



Quadratic formula

QUADRATIC FORMULA

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

for $ax^2 + bx + c = 0$ with $a \neq 0$

STANDARD FORM (QUADRATIC EQUATION FORMAT)

$$ax^2 + bx + c = 0, \quad a \neq 0$$

DISCRIMINANT FORMULA

$$D = b^2 - 4ac$$

$D > 0$: two real roots, $D = 0$: equal roots, $D < 0$: no real roots

SUM OF ROOTS

$$\alpha + \beta = -\frac{b}{a}$$

PRODUCT OF ROOTS

$$\alpha\beta = \frac{c}{a}$$

EQUATION FROM ITS ROOTS

$$x^2 - (\alpha + \beta)x + \alpha\beta = 0$$

VERTEX OF THE PARABOLA

$$\left(-\frac{b}{2a}, -\frac{D}{4a}\right)$$

axis of symmetry is the line $x = -b/2a$

VALUE OF I

$$i = \sqrt{-1}, \quad i^2 = -1$$

used when $D < 0$

Distance and midpoint

DISTANCE FORMULA (TWO POINTS)

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Also called the Euclidean distance formula

DISTANCE FROM THE ORIGIN

$$OP = \sqrt{x^2 + y^2}$$

DISTANCE FORMULA WITH THREE COORDINATES

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

MIDPOINT FORMULA

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

SECTION FORMULA (INTERNAL, RATIO M:N)

$$P = \left(\frac{mx_2 + nx_1}{m + n}, \frac{my_2 + ny_1}{m + n}\right)$$

SECTION FORMULA (EXTERNAL, RATIO M:N)

$$P = \left(\frac{mx_2 - nx_1}{m - n}, \frac{my_2 - ny_1}{m - n}\right)$$

SLOPE FORMULA

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \tan \theta$$

TWO POINT SLOPE FORM OF A LINE

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1} (x - x_1)$$

AREA OF A TRIANGLE FROM COORDINATES

$$\Delta = \frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$$

CENTROID OF A TRIANGLE

$$G = \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$$

POINT TO LINE DISTANCE FORMULA

$$p = \frac{|ax_0 + by_0 + c|}{\sqrt{a^2 + b^2}}$$

distance of (x_0, y_0) from the line $ax + by + c = 0$

Trigonometry

SIN COS TAN FORMULA

$$\sin \theta = \frac{P}{H}, \cos \theta = \frac{B}{H}, \tan \theta = \frac{P}{B}$$

P perpendicular, B base, H hypotenuse

PYTHAGOREAN IDENTITY

$$\sin^2 \theta + \cos^2 \theta = 1$$

SIN(A + B) FORMULA

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

COS(A + B) FORMULA

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

SIN 2X FORMULA

$$\sin 2x = 2 \sin x \cos x = \frac{2 \tan x}{1 + \tan^2 x}$$

COS 2X FORMULA

$$\cos 2x = \cos^2 x - \sin^2 x = 2 \cos^2 x - 1 = 1 - 2 \sin^2 x$$

same as the cos 2 theta formula with x written as θ

TAN 2X FORMULA

$$\tan 2x = \frac{2 \tan x}{1 - \tan^2 x}$$

SIN 3X FORMULA

$$\sin 3x = 3 \sin x - 4 \sin^3 x$$

COS 3X FORMULA

$$\cos 3x = 4 \cos^3 x - 3 \cos x$$

TAN 3X FORMULA

$$\tan 3x = \frac{3 \tan x - \tan^3 x}{1 - 3 \tan^2 x}$$

SIN A SIN B FORMULA

$$2 \sin A \sin B = \cos(A - B) - \cos(A + B)$$

SUM TO PRODUCT (SINES)

$$\sin C + \sin D = 2 \sin \frac{C + D}{2} \cos \frac{C - D}{2}$$

Algebra identities

(A+B)² FORMULA, A PLUS B WHOLE SQUARE

$$(a + b)^2 = a^2 + 2ab + b^2$$

(A-B)² FORMULA, A MINUS B WHOLE SQUARE

$$(a - b)^2 = a^2 - 2ab + b^2$$

A²-B² FORMULA

$$a^2 - b^2 = (a + b)(a - b)$$

A²+B² FORMULA

$$a^2 + b^2 = (a + b)^2 - 2ab = (a - b)^2 + 2ab$$

(A+B)³ FORMULA, A PLUS B WHOLE CUBE

$$(a + b)^3 = a^3 + b^3 + 3ab(a + b)$$

(A-B)³ FORMULA, A MINUS B WHOLE CUBE

$$(a - b)^3 = a^3 - b^3 - 3ab(a - b)$$

A³+B³ FORMULA

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

A³-B³ FORMULA

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

(A+B+C)² FORMULA

$$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$$

A³+B³+C³-3ABC FORMULA

$$a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$$

LAWS OF EXPONENTS

$$a^m a^n = a^{m+n}, \quad (a^m)^n = a^{mn}$$

a > 0, or m and n whole numbers

LAWS OF LOGARITHMS

$$\log(mn) = \log m + \log n$$

m, n > 0; same base on both sides

Heron's formula

HERON'S FORMULA

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

a, b, c are the three sides

SEMI-PERIMETER

$$s = \frac{a + b + c}{2}$$

half the perimeter of the triangle

EQUILATERAL TRIANGLE (SIDE A)

$$A = \frac{\sqrt{3}}{4} a^2$$

EXPANDED FORM (NO S)

$$A = \frac{1}{4} \sqrt{(a+b+c)(-a+b+c)(a-b+c)(a+b-c)}$$

QUADRILATERAL WITH DIAGONAL

Area = area of the two triangles formed by a diagonal, each found by Heron's formula.

ISOSCELES TRIANGLE (EQUAL SIDES A, BASE B)

$$A = \frac{b}{4} \sqrt{4a^2 - b^2}$$

TRIANGLE INEQUALITY CHECK

Each side must be less than the sum of the other two, so $s - a$, $s - b$ and $s - c$ are all positive.

Volume and surface area

CUBE (SIDE A)

$$V = a^3, \text{ TSA} = 6a^2, \text{ LSA} = 4a^2$$

CUBOID

$$V = lbh, \text{ TSA} = 2(lb + bh + hl)$$

CYLINDER

$$V = \pi r^2 h, \text{ CSA} = 2\pi r h, \text{ TSA} = 2\pi r(r + h)$$

r is the base radius, h the height

CONE

$$V = \frac{1}{3} \pi r^2 h, \text{ CSA} = \pi r l$$

slant height $l = \sqrt{r^2 + h^2}$

SPHERE

$$V = \frac{4}{3} \pi r^3, S = 4\pi r^2$$

HEMISPHERE

$$V = \frac{2}{3} \pi r^3, \text{ CSA} = 2\pi r^2, \text{ TSA} = 3\pi r^2$$

PYRAMID

$$V = \frac{1}{3} \times \text{base area} \times h$$

PRISM

$$V = \text{base area} \times h, \text{ LSA} = \text{base perimeter} \times h$$

FRUSTUM OF A CONE

$$V = \frac{1}{3} \pi h (R^2 + r^2 + Rr)$$

R and r are the radii of the two ends, h the height

LITRES

$$1 \text{ L} = 1000 \text{ cm}^3, 1 \text{ m}^3 = 1000 \text{ L}$$

Perimeter

PERIMETER OF TRIANGLE

$$P = a + b + c$$

PERIMETER OF SQUARE

$$P = 4a$$

PERIMETER OF RECTANGLE

$$P = 2(l + b)$$

l is the length, b the breadth

CIRCUMFERENCE OF CIRCLE

$$C = 2\pi r = \pi d$$

PERIMETER OF SEMICIRCLE

$$P = \pi r + 2r = r(\pi + 2)$$

ARC LENGTH

$$L = \frac{\theta}{360^\circ} \times 2\pi r$$

θ in degrees

PERIMETER OF SECTOR

$$P = 2r + \frac{\theta}{360^\circ} \times 2\pi r$$

REGULAR POLYGON

$$P = n \times a$$

n sides, each of length a

RHOMBUS AND PARALLELOGRAM

$$P_{\text{rhombus}} = 4a, \quad P_{\text{parallelogram}} = 2(a + b)$$

a and b are the two different side lengths

SEMI-PERIMETER OF TRIANGLE

$$s = \frac{a + b + c}{2}$$

Area formulas

AREA OF A CIRCLE (RADIUS) $A = \pi r^2$	AREA OF A CIRCLE (DIAMETER) $A = \frac{\pi d^2}{4}$ d = 2r
AREA OF A TRIANGLE $A = \frac{1}{2} \times b \times h$ b is the base, h the perpendicular height	TRIANGLE WITH 3 SIDES (HERON) $A = \sqrt{s(s-a)(s-b)(s-c)}, s = \frac{a+b+c}{2}$
EQUILATERAL TRIANGLE $A = \frac{\sqrt{3}}{4} a^2$	SQUARE AND RECTANGLE $A_{\text{square}} = a^2, \quad A_{\text{rect}} = l \times b$
PARALLELOGRAM $A = b \times h$	RHOMBUS $A = \frac{1}{2} d_1 d_2$ d1 and d2 are the diagonals
TRAPEZIUM (TRAPEZOID) $A = \frac{1}{2} (a + b) h$ a and b are the parallel sides, h the distance between them	ELLIPSE $A = \pi ab$ a and b are the semi-axes
SECTOR OF ANGLE THETA $A = \frac{\theta}{360^\circ} \times \pi r^2$ θ in degrees	SEMICIRCLE $A = \frac{1}{2} \pi r^2$

Interest formulas

COMPOUND INTEREST FORMULA (AMOUNT) $A = P \left(1 + \frac{R}{100} \right)^n$	COMPOUND INTEREST $CI = A - P = P \left[\left(1 + \frac{R}{100} \right)^n - 1 \right]$
SIMPLE INTEREST FORMULA $SI = \frac{P \times R \times T}{100}$ Amount under simple interest is P + SI	COMPOUNDED HALF-YEARLY $A = P \left(1 + \frac{R}{200} \right)^{2n}$
COMPOUNDED QUARTERLY $A = P \left(1 + \frac{R}{400} \right)^{4n}$	COMPOUNDED MONTHLY $A = P \left(1 + \frac{R}{1200} \right)^{12n}$
GENERAL FORM (K TIMES A YEAR) $A = P \left(1 + \frac{r}{k} \right)^{kn}$ r as a decimal, so 8% is 0.08	RATE OF INTEREST FORMULA (COMPOUND) $R = 100 \left[\left(\frac{A}{P} \right)^{1/n} - 1 \right]$
RATE OF INTEREST FORMULA (SIMPLE) $R = \frac{100 \times SI}{P \times T}$	DIFFERENT RATES EACH YEAR $A = P \left(1 + \frac{R_1}{100} \right) \left(1 + \frac{R_2}{100} \right) \left(1 + \frac{R_3}{100} \right)$

CI MINUS SI FOR 2 YEARS

$$CI - SI = P \left(\frac{R}{100} \right)^2$$

DEPRECIATION

$$V = P \left(1 - \frac{R}{100} \right)^n$$

Percentage

PERCENTAGE FORMULA

$$\text{Percentage} = \frac{\text{Part}}{\text{Whole}} \times 100$$

PERCENT OF A NUMBER

$$x\% \text{ of } N = \frac{x}{100} \times N$$

PERCENTAGE CHANGE FORMULA

$$\% \text{ change} = \frac{\text{New} - \text{Old}}{\text{Old}} \times 100$$

Positive answer is an increase, negative is a decrease

PERCENTAGE INCREASE FORMULA

$$\% \text{ increase} = \frac{\text{Increase}}{\text{Original}} \times 100$$

PROFIT PERCENTAGE

$$\text{Profit}\% = \frac{SP - CP}{CP} \times 100$$

LOSS PERCENTAGE FORMULA

$$\text{Loss}\% = \frac{CP - SP}{CP} \times 100$$

DISCOUNT PERCENTAGE FORMULA

$$\text{Discount}\% = \frac{MP - SP}{MP} \times 100$$

PERCENTAGE ERROR FORMULA

$$\% \text{ error} = \frac{|\text{Measured} - \text{True}|}{\text{True}} \times 100$$

SUCCESSIVE PERCENTAGE CHANGE

$$\text{Net}\% = a + b + \frac{ab}{100}$$

use a negative sign for a decrease

PERCENTILE FORMULA

$$\text{Percentile} = \frac{\text{Values below}}{\text{Total values}} \times 100$$

प्रतिशत निकालने का फॉर्मूला

$$\text{प्रतिशत} = (\text{भाग} \div \text{कुल}) \times 100$$

percentage nikalne ka formula in Hindi

Standard deviation

POPULATION STANDARD DEVIATION

$$\sigma = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}}$$

n is the number of values; for a whole population the mean is often written μ

SAMPLE STANDARD DEVIATION

$$s = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n - 1}}$$

use when the data is a sample from a larger group

VARIANCE FORMULA

$$\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n}$$

variance is the square of SD

SHORTCUT FORM

$$\sigma^2 = \frac{\sum x_i^2}{n} - \bar{x}^2$$

GROUPED DATA (DIRECT)

$$\sigma = \sqrt{\frac{\sum f_i x_i^2}{N} - \left(\frac{\sum f_i x_i}{N} \right)^2}$$

$$N = \sum f_i$$

STEP DEVIATION METHOD

$$\sigma = h \sqrt{\frac{\sum f_i u_i^2}{N} - \left(\frac{\sum f_i u_i}{N} \right)^2}$$

$$u_i = \frac{x_i - A}{h}$$

MEAN DEVIATION FORMULA

$$\text{M.D.}(\bar{x}) = \frac{\sum |x_i - \bar{x}|}{n}$$

QUARTILE DEVIATION FORMULA

$$\text{Q.D.} = \frac{Q_3 - Q_1}{2}$$

COEFFICIENT OF VARIATION

$$\text{C.V.} = \frac{\sigma}{\bar{x}} \times 100$$

COVARIANCE FORMULA

$$\text{cov}(x, y) = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n}$$

Mean, median, mode

MEAN FORMULA

$$\bar{x} = \frac{\sum x_i}{n}$$

sum of observations divided by their number

MEDIAN FORMULA (N ODD)

$$\text{Median} = \left(\frac{n+1}{2} \right)^{\text{th}} \text{ value}$$

MEDIAN FORMULA (N EVEN)

$$\text{Median} = \frac{\left(\frac{n}{2} \right)^{\text{th}} + \left(\frac{n}{2} + 1 \right)^{\text{th}} \text{ value}}{2}$$

MEDIAN FOR GROUPED DATA

$$\text{Median} = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

l lower limit of median class, n total frequency, cf cumulative frequency before it, f its frequency, h class width

MODE FORMULA (GROUPED)

$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

f₁ modal class frequency, f₀ and f₂ the classes before and after, l its lower limit, h class width

MEAN, GROUPED (DIRECT)

$$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

MEAN, STEP DEVIATION

$$\bar{x} = a + h \cdot \frac{\sum f_i u_i}{\sum f_i}$$

$$u_i = \frac{x_i - a}{h}$$

EMPIRICAL RELATION

$$\text{Mode} \approx 3 \text{ Median} - 2 \text{ Mean}$$

approximate, for moderately skewed data

GEOMETRIC MEAN FORMULA

$$\text{GM} = \sqrt[n]{x_1 x_2 \cdots x_n}$$

HARMONIC MEAN FORMULA

$$\text{HM} = \frac{n}{\sum \frac{1}{x_i}}$$

Integration

POWER RULE

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

RECIPROCAL

$$\int \frac{1}{x} dx = \log |x| + C$$

EXPONENTIAL

$$\int e^x dx = e^x + C, \quad \int a^x dx = \frac{a^x}{\log a} + C$$

log is the natural log, to base e; a > 0, a ≠ 1

SIN AND COS

$$\int \sin x dx = -\cos x + C, \quad \int \cos x dx = \sin x + C$$

SEC SQUARED

$$\int \sec^2 x dx = \tan x + C$$

INTEGRATION BY PARTS FORMULA

$$\int u v dx = u \int v dx - \int (u' \int v dx) dx$$

u' = du/dx; choose u by ILATE

1 OVER X SQUARED PLUS A SQUARED

$$\int \frac{dx}{x^2 + a^2} = \frac{1}{a} \tan^{-1} \frac{x}{a} + C$$

1 OVER ROOT OF A SQUARED MINUS X SQUARED

$$\int \frac{dx}{\sqrt{a^2 - x^2}} = \sin^{-1} \frac{x}{a} + C$$

ROOT OF A SQUARED MINUS X SQUARED

$$\int \sqrt{a^2 - x^2} dx = \frac{x}{2} \sqrt{a^2 - x^2} + \frac{a^2}{2} \sin^{-1} \frac{x}{a} + C$$

FUNDAMENTAL THEOREM

$$\int_a^b f(x) dx = F(b) - F(a)$$

F is any antiderivative of f

Differentiation

POWER RULE

$$\frac{d}{dx} (x^n) = nx^{n-1}$$

works for any real n (take x > 0 when n is a fraction)

CONSTANT

$$\frac{d}{dx} (k) = 0$$

PRODUCT RULE

$$(uv)' = u'v + uv'$$

QUOTIENT RULE

$$\left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$$

CHAIN RULE

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

DERIVATIVE OF SIN X

$$\frac{d}{dx} (\sin x) = \cos x$$

DERIVATIVE OF COS X

$$\frac{d}{dx} (\cos x) = -\sin x$$

DERIVATIVE OF TAN X

$$\frac{d}{dx} (\tan x) = \sec^2 x$$

DERIVATIVE OF E TO THE X

$$\frac{d}{dx} (e^x) = e^x$$

DERIVATIVE OF LOG X

$$\frac{d}{dx} (\log x) = \frac{1}{x}$$

natural log, x > 0

DERIVATIVE OF INVERSE SINE

$$\frac{d}{dx} (\sin^{-1} x) = \frac{1}{\sqrt{1-x^2}}$$

FIRST PRINCIPLES

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

Worked examples, practice questions and free calculators: quadraticformula.info/maths-formulas/