eBook

BASIC MATH FORMULAS

Deepak Kumar

Contents

Symbol Meaning

Symbol	Meaning
N	Set of Natural numbers
Z	Setot Integers numbers
Q	Set of Rational numbers
R	Set of Real number
C	Set of Complex numbers
$\cup$	The union of
$\cap$	Intersected with
$\subset$	ls a subset of
$\subseteq$	is a subset of or equal to
$\not\subset$	Is not a subset of
$\supset$	Is superset of
$\supseteq$	Is a superset of or equal to
$\not\supset$	is not a superset of
\	Set Difference
$\in$	Is an element of
$\notin$	Is not an element of
[a. b]	Closed interval
]a,b[	Open interval
{a, b, c}	Set of Elements
Ø or { }	Empty Set
( )	Group (do first)
+	Addition (plus, add)
–	Subtraction (minus, subtract)

÷	Division
×	Multiplication (times)
±	PIus-minus
$<$	Is less than
≤	ls less than ar equal to
$>$	ls greater than
≥	is greater than or equal to
⇔	Equivalence
⇒	Implication (implies)
=	Equality (is equal to)
≠	inequality (is not equal to)
≅	Approximately (equal to)
≡	Congruence
Σ	Summation
Π	Product
∇	Gradient
∧	And (propositional logic)
∨	Or (propositional logic)
∃	Existential quantification (there is)
∄	There is not
∀	Universal quantification (for all)
– or ¬	Negation
#	Cardinality
:	Such that
∴	Therefore

∵	Because
QED	End of proof (quod erat demonstrandum)
GCD	Greatest Common Divisor
LCM	Lowest common Multiple
√	Square Root
∛	Cube Root
!	Factorial
%	Percent
‰	Per mille
°F	Degrees Fahrenheit
°C	Degrees Celsius
α _ Α	Alpha
β–Β	beta
γ _ Γ	Gamma
δ _ Δ	Delta
ε _ Ε	Epsilon
ζ _ Ζ	Zeta
η - Η	Eta
θ _ Θ	Theta
ι - Ι	Iota
κ _ Κ	Kappa
λ - Λ	Lambda
μ - Μ	Mu
ν _ Ν	Nu
ξ_ Ξ	Xi
ο- Ο	Omicron

π _ Π	Pi
ρ _ P	Rho
σ _ Σ	Sigma
τ__ T	Tau
υ__Y	Upsilon
φ__ Φ	Phi
χ _ X	Chi
ψ _ Ψ	Psi
ω _ Ω	Omega
∠	Angle
∡	Angle Measure
°	Degrees
′	Minutes
″	Seconds
⊥	Is perpendicular to
∥	Is parallel to
sin()	Sine
cos()	Cosine
tan()	Tangent
cot()	Cotangent
$\vec{v}$	Vector
$\lVert \vec{v} \rVert$	Norm of
$\lvert x \rvert$	Absolute value (modulus)
$\bar{x}$	Mean
$\tilde{x}$	Median

$\log_a()$	Logarithm with base a
ln()	Natural Logarithm (with base e)
log()	Common Logarithm (with base 10)
$f(x)$	Function
$f'(x)$	Derivative of Function
$\int$	Integral (differential calculus)
Dom (f)	Domain of the function f
Ran (f)	Range of the function f
f^{-1}	Inverse Function
$f \circ g$	Function Composition
lim()	Limit
$x \to a$	x approaches a
∞	Infinity
π	Pi, $\pi = 3{,}14159265359...$
e	Euler's constant, $e = 2{,}7182 \ldots$
Φ	Golden Ratio, $\Phi = 1{,}6180$
i	Imaginary number, $i^2 = -1$
R(z)	The real pert of a complex number
I(z)	The imaginary part of a complex

Areas

Square

$A = l^2$

l = length of side

Rectangle

$$A = w \times h$$

w: width, *h* : height

Triangle

$$A = \frac{b \times h}{2}$$

b : base, *h* : height

Rhombus

$$A = \frac{D \times d}{2}$$

D = large diagonal, *d* : small diagonal

Trapezoid

$$A = \frac{B \times b}{2} \times h$$

B : large side, *b* : small side, *h* : height

Regular polygon

$$A = \frac{P}{2} \times a$$

P : perimeter

a : apothem

Circle

$A = \pi r^2$

$P = 2\pi r$

r : radius

P : perimeter

Cone (lateral surface)

$A = \pi r \times s$

r : radius

s :slant height

Sphere (surface area)

$A = 4 \quad r^2$

r : radius

Volumes

Cube

$V = s^3$

s : side

Parallelepiped

$V = l \times w \times h$

l : length, w : width, h : height

Regular prism

$V = b \times h$

b : base, h : height

Cylinder

V = r2 × h

r : radius, *h*eight

Cone (or pyramid)

$V = \frac{1}{3} b \times h$

h : base, h : height

Sphere

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

r : radius

Functions and Equations

Directly Proportional

$$y = kx \qquad k = \frac{y}{x}$$

Inversely Proportional

$$y = \frac{k}{x} \qquad k = yx$$

k : Constant of Proportionality

Quadratic formula

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

Concavity

$$ax^2 + bx + c = 0$$

Concave up : $a > 0$
Concave Down : $a < 0$

Discriminant

$$\Delta = b^2 - 4ac$$

Vertex of the parabola

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

Concavity

$y = a(x - h)^2 + k$

concave up : $a > 0$

concave down: $a < 0$

Vertex of the parabola $V(h, k)$

Zero-product property

$A \times B = 0 \Longleftrightarrow A = 0 \vee B = 0$

ex : $(x + 2) \times (x - 1) = 0 \Longleftrightarrow$

$x + 2 = 0 \vee x - 1 = 0 \Longleftrightarrow x = -2 \vee x = 1$

Difference of two square

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

ex : $(x - 2)(x + 2) = x^2 - 2^2 = x^2 - 4$

Perfect square trinomial

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

ex: $(2x + 3)^2 = (2x)^2\ 2.2x.3\ + 3^2 = 4x^2 + 12x + 9$

Binomial theorem

$$(x + y)^n = \sum_{k=0}^{n} {}^nC_k k^{n-k} y^k$$

Exponents

Product

$a^m \times a^n = a^{m+n}$

ex : $3^5 \times 3^2 = 3^{5+2} = 3^7$

$a^m \times b^m = (a \times b)^m$

ex: $3^5 \times 2^5 = (3 \times 2)^5 = 6^5$

Quotient

$a^m \div a^n = a^{m-n}$

ex : $3^7 \div 3^2 = 3^{7-2} = 3^5$

$a^m \div b^m = (a \div b)^m$

ex : $6^5 \div 2^5 = (6 \div 2)^5 = 3^5$

ex : $5^3 \div 2^3 = \left(\frac{5}{2}\right)^3$

Power of Power

$(a^m)^p = a^{m \times p}$

ex : $(5^2)^3 = 5^{2 \times 3} = 5^6$

Zero Exponents

$a^0 = 1$

ex : $8^0 = 1$

Negative Exponents

$a^{-n} = \left(\frac{1}{a}\right)^n$

ex : $3^{-2} = \left(\frac{1}{3}\right)^2$

ex : $\left(\frac{2}{3}\right)^{-4} = \left(\frac{3}{2}\right)^4$

Fractional Exponents

$a^{\frac{p}{q}} = \sqrt[q]{a^p}$

ex : $a^{\frac{4}{3}} = \sqrt[3]{2^4}$

Radicals

Multiplication

$\sqrt[n]{x} \times \sqrt[n]{y} = \sqrt[n]{x \times y}$

$$ex : \sqrt[3]{2} \times \sqrt[2]{5} = \sqrt[2]{2 \times 5} \Longleftrightarrow \sqrt[3]{10}$$

Division

$$\sqrt[n]{x} \div \sqrt[n]{y} = \sqrt[n]{\frac{x}{y}}$$

$$ex : \sqrt[4]{8} \div \sqrt[4]{3} = \sqrt[4]{\frac{8}{3}}$$

Addition

$$a\sqrt[n]{x} \pm b\sqrt[n]{x} = (a \pm b)\sqrt[n]{x}$$

$$ex : 4\sqrt[3]{5} - 2\sqrt[3]{5} = (4 - 2)\sqrt[3]{5} \Longleftrightarrow 2\sqrt[3]{5}$$

Exponents

$$(\sqrt[n]{x})^p = \sqrt[n]{x^p}$$

$$ex : (\sqrt{2})^3 = \sqrt{2^3} \Longleftrightarrow \sqrt{8}$$

Radicals

$$\sqrt[n]{\sqrt[p]{x}} = \sqrt[n.p]{x}$$

$$ex: \sqrt[3]{\sqrt{5}} = \sqrt[3 \times 2]{5} \Longleftrightarrow \sqrt[6]{5}$$

Exponentiation

$$\sqrt[n]{a^m} = a^{\frac{m}{n}}$$

$$ex : \sqrt[3]{4^5} = 4^{\frac{5}{3}}$$

$$(\sqrt[n]{a})^n = a$$

$$ex : (\sqrt{3})^2 = 3$$

Simplifying Radicals

$$(\sqrt[n]{a})^m = \sqrt[n]{a^m}$$

$$ex : (\sqrt{4})^5 = \sqrt{4^5}$$

Trigonometry

Trigonometry Ratios

$$\sin\alpha = \frac{opp.}{hip.}$$

opp. opposite
hip. : hypotenuse

$$\cos\alpha = \frac{adj.}{hip.}$$

adj. : adjacent, hip. : hypotenuse

$$\tan\alpha = \frac{opp.}{adj.}$$

opp. : opposite, adj.: adjacent

Fundamental identities

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

$$\tan\alpha = \frac{\sin\alpha}{\cos\alpha}$$

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

Law of sine (aka sine rule)

$$\frac{\sin A}{a} - \frac{\sin B}{b} = \frac{\sin C}{c}$$

Law of Cosines (aka cosine rule)

$$a^2 = b^2 + c^2 - 2bc\cos A$$

Heron's formula

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

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

Exact Values

$$\sin\left(\frac{\pi}{6}\right) = \frac{1}{2}$$

$$\cos\left(\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$$

$$\tan\left(\frac{\pi}{6}\right) = \frac{\sqrt{3}}{3}$$

$$\sin\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$$

$$\cos\left(\frac{\pi}{4}\right) = \frac{\sqrt{2}}{2}$$

$$\tan\left(\frac{\pi}{4}\right) = 1$$

$$\sin\left(\frac{\pi}{2}\right) = \frac{\sqrt{3}}{2}$$

$$\cos\left(\frac{\pi}{3}\right) = \frac{1}{2}$$

$$\tan\left(\frac{\pi}{6}\right) = \sqrt{3}$$

Angle Relationships

$$\sin(-\alpha) = -\sin\alpha$$
$$\cos(-\alpha) = \cos\alpha$$
$$\tan(-\alpha) = -\tan\alpha$$

$$\sin(\pi - \alpha) = \sin\alpha$$
$$\cos(\pi - \alpha) = -\cos\alpha$$
$$\tan(\pi - \alpha) = -\tan\alpha$$

$$\sin(\pi + \alpha) = -\sin\alpha$$
$$\cos(\pi + \alpha) = -\cos\alpha$$
$$\tan(\pi + \alpha) = \tan\alpha$$

$$\sin\left(\frac{\pi}{2} - \alpha\right) = \cos\alpha$$

$$\cos\left(\frac{\pi}{2} - \alpha\right) = \sin\alpha$$

$$\tan\left(\frac{\pi}{2} - \alpha\right) = \frac{1}{\tan\alpha}$$

$$\sin\left(\frac{\pi}{2} + \alpha\right) = \cos\alpha$$

$$\cos\left(\frac{\pi}{2} + \alpha\right) = -\sin\alpha$$

$$\tan\left(\frac{\pi}{2} + \alpha\right) = -\frac{1}{\tan\alpha}$$

$$\sin\left(\frac{3\pi}{2} - \alpha\right) = -\cos\alpha$$

$$\cos\left(\frac{3\pi}{2} - \alpha\right) = -\sin\alpha$$

$$\tan\left(\frac{3\pi}{2} - \alpha\right) = \frac{1}{\tan\alpha}$$

$$\sin\left(\frac{3\pi}{2} + \alpha\right) = -\cos\alpha$$

$$\cos\left(\frac{3\pi}{2} + \alpha\right) = \sin\alpha$$

$$\tan\left(\frac{3\pi}{2} + \alpha\right) = -\frac{1}{\tan\alpha}$$

Trigonometric Equations

$$\cos x = \cos \alpha \Longleftrightarrow x = \alpha + 2k\pi \vee x = -\alpha + 2k\pi, k \in Z$$

$$\tan x = \tan \alpha \Longleftrightarrow x = \alpha + k\pi, k \in Z$$

Sum Formulas

$$\sin(a + b) = \sin a \times \cos b + \sin b \times \cos a$$

$$\cos(a + b) = \cos a \times \cos b - \sin a \times \sin b$$

$$\tan(a + b) = \frac{\tan a + \tan b}{1 - \tan a \times \tan b}$$

Difference Formulas

$$\sin(a - b) = \sin a \times \cos b - \sin b \times \cos a$$

$$\cos(a - b) = \cos a \times \cos b + \sin a \times \sin b$$

$$\tan(a - b) = \frac{\tan a - \tan b}{1 + \tan a \times \tan b}$$

Double Angle Formulas

$$\sin(2a) = 2 \times \sin a \times \cos a$$

$$\cos(2a) = \cos^2 a - \sin^2 a$$

$$\tan(2a) = \frac{2 \times \tan b}{1 - \tan^2 a}$$

Geometry

Euler's Polyhedral Formula

F + V = E + 2

F : Face, V: Vertex, E : Edge

Sum of interior angles of a regular polygon

$$S_i = (n - 2) \times 180°$$

n: Number of sides

Pythagorean theorem

$$H^2 = C_1^2 + C_2^2$$

Hypotenuse :H

Leg: C_1 e C_2

Distance between two points

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

ex : $A(8, 2)$e $B(4, -1)$

$$\overline{AB} = \sqrt{(8 - 4)^2 + (2 + 1)^2} \Longleftrightarrow$$

$$\overline{AB} = \sqrt{16 + 9} \Longleftrightarrow \overline{AB} = 5$$

Midpoints

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

ex : $A(2, 6)$e $B(4, -2)$

$$M\left(\frac{2 + 4}{2}, \frac{6 + 2}{2}\right) \Longleftrightarrow M(3, 2)$$

Slope-intercept form

slop : m, Y intercept : b

$$y = mx + b$$

Vector Form

Direction vector $\vec{u}\ (u_1, u_2, u_3)$

Point (x_0, y_0, z_0)

$$(x, y, z) = (x_0, y_0, z_0) + k\,(u_1, u_2, u_3),\ k \in R$$

Cartesian Form

Direction vector $\vec{u}\ (u_1, u_2, u_3)$

Point(x_0, y_0, z_0)

$$\frac{x - x_0}{u_1} = \frac{y - y_0}{u_2} = \frac{z - z_0}{u_3}$$

Parametric Form

Direction vector $\vec{u}\ (u_1, u_2, u_3)$

Point (x_0, y_0, z_0)

$$\begin{cases} x = x_0 + Ku_1 \\ y = y_0 + Ku_2 \\ z = z_0 + Ku_2 \end{cases},\ k \in R$$

Equation of a plane

Cartesian Form

Normal vector $\vec{u}\ (n_1, n_2, n_3)$

Point (x_0, y_0, z_0)

$$n_1(x - x_0) + n_2(y - y_0) + n_3(z - z_0) = 0$$

Scalar Form

Normal vector $\vec{u}\ (n_1, n_2, n_3)$

$$n_1x + n_2y + n_3z + d = 0$$

Equation of a circle

Center(x_0, y_0) and radius r

$$(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = r^2$$

Equation of a Sphere

Center(x_0, y_0, z_0) and radius r

$$(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = r^2$$

Equation of an ellipse

Center(h, k) Axis a and b

$$\left(\frac{x - y}{a}\right)^2 + \left(\frac{y - k}{b}\right)^2 = 1$$

Logic

Conjunction

p	q	$p \wedge q$
V	V	V
V	F	F
F	V	F
F	F	F

Conjunction

p	q	$p \vee q$
V	V	V
V	F	V
F	V	V

F	F	F

Implication

p	q	p →q
V	V	V
V	F	F
F	V	V
F	F	V

Law of non contradiction

F ∧- p ⟺F

Law of the excluded middle

p ∨- p ⟺V

Double Negation

- (- p) ⟺p

Commutativity

Conjunction p ∧ p ⟺ q ∧ p

Disjunction p ∨ p ⟺ q ∨ p

Associativity

Conjunction (p ∧ p) ∧ r⟺ p ∧ (q ∧ r)

Disjunction (p ∨ q) ∨ r ⟺ p ∨ (q ∨ r)

Neutral Element

Conjunction p ∧ V⟺ p

Disjunction p ∨ F⟺ p

Absorbing Element

Conjunction $p \wedge F \Longleftrightarrow F$

Disjunction $p \vee V \Longleftrightarrow V$

Idempotence

Conjunction $p \wedge p \Longleftrightarrow p$

Disjunction $p \vee p \Longleftrightarrow p$

Distributive Property

Conjunction $p \wedge (q \vee r) \Longleftrightarrow (p \wedge q) \vee (p \wedge r)$

Disjunction $p \vee (p \wedge r) \Longleftrightarrow (p \vee p) \wedge (p \vee r)$

Properties of Implication

Transitive $(p \Rightarrow q) \wedge (q \Rightarrow r) \Rightarrow (p \Rightarrow r)$

Implication and Disjunction $(p \Rightarrow q) \Longleftrightarrow -p \vee q$

Negation $-(p \Rightarrow q) \Longleftrightarrow p \wedge -q$

Contrapositive of an implication $(p \Rightarrow q) \Longleftrightarrow (-q \Rightarrow -p)$

Properties of Equivalence

Double implication $(p \Longleftrightarrow q) \Longleftrightarrow [(q \Rightarrow q) \wedge (p \Rightarrow q)]$

Transitive $[(p \Longleftrightarrow q) \wedge (q \Longleftrightarrow r)] \Rightarrow (p \Longleftrightarrow r)$

Negation $-(p \Longleftrightarrow q) \Longleftrightarrow [(p \wedge -q) \vee (q \wedge -p)]$

De Morgan's laws

Negation of a Conjunction $-(p \wedge q) \Longleftrightarrow -p \vee -q$

Negation of a Disjunction $-(p \vee q) \Longleftrightarrow -p \vee -q$

Negation of Universal Quantifier

$-(\forall x, p(x)) \Longleftrightarrow \exists x : -p(x)$

Negation of Existential Quantifier

$\neg(\exists x : \neg p(x)) \Longleftrightarrow \forall x, \neg p(x)$

Vector

Notation

$\overrightarrow{AB} = B - A = (b_1 - a_1, b_2 - a_2)$

Magnitude

$\| \vec{u} \| = \sqrt{(u_1)^2 + (u_2)^2}$

Square of magnitude of a vector

$(\vec{u})^2 = \| \vec{u} \|^2$

Calculations

$A + \vec{u} = (a_1 + u_1, a_2 + u_2)$

$\vec{u} + \vec{v} = (u_1 + v_1, u_2 + v_2)$

$k \times \vec{u} = (k \times u_1, k \times u_2)$

The Scalar or Dot Product

$\vec{u} . \vec{v} = u_1 \times v_1 + u_2 + v_2$

$\vec{u} . \vec{v} = \| \vec{u} \| \times \| \vec{v} \| \times \cos(\vec{u} \wedge \vec{v})$

Angle between two lines

Direction vector of lines : $\vec{u}$ e $\vec{v}$

angle : α

$$\cos \alpha = \frac{|\vec{u} . \vec{v}|}{\| \vec{u} \| \times \| \vec{v} \|}$$

Statistic

Summation Rules and Properties

$$\sum_{i = p}^{n} \lambda = (n - p + 1)\lambda$$

$$\sum_{i = 1}^{n} \lambda x_i = \lambda \sum_{i = 1}^{n} x_i$$

$$\sum_{i = 1}^{n} (x_i + y_i) = \sum_{i = 1}^{n} x_i + \sum_{i = 1}^{n} y_i$$

$$\sum_{i - 1}^{n} x_i = \sum_{i - 1}^{n} x_i + \sum_{i - p + 1}^{n} x_i$$

Used Symbols

Statistical sample

$$x = (x_1, x_2, x_3, \ldots, x_n)$$

Sample Size

N

Absolute Frequency

n_i

Relative Frequency

$$f_i = \frac{n_i}{N}$$

Cumulative (Absolute) Frequency

N_i

Cumulative Relative Frequency

F_i

Ungrouped Data

$$\overline{x} = \frac{\sum_{i=1}^{k} x_i}{N}$$

Grouped Data

$$\overline{x} = \frac{\sum_{i=1}^{k} n_i\, x_i}{N}$$

$$\overline{x} = \sum_{i=1}^{k} f_i x_i$$

Median

$$\text{If N is odd Me} = x_k,\ k = \frac{N+1}{2}$$

$$\text{If N is even Me} = \frac{x_k + x_{k+1}}{2},\ k = \frac{N}{2}$$

Sum of Deviations from the mean

$$\sum_{i=1}^{k} d_i = \sum_{i=1}^{k} \left(x_i - \overline{x}\right) = 0$$

Sum of Squared Deviations from the Mean

Ungrouped Data

$$SS_x = \sum_{i=1}^{k} (x_i - \bar{x})^2$$

$$SS_x = \sum_{i=1}^{k} x_i^2 - k\bar{x}^2$$

Grouped Data

$$SS_x = \sum_{i=1}^{k} (x_i - \bar{x})^2 n_i$$

Sample Variance

$$S_x^2 = \frac{SS_x}{N - 1}$$

Sample Standard Deviation

$$S_x = \sqrt{\frac{SS_x}{N - 1}}$$

Sequences

Arithmetic sequences

Common difference $r = u_{n+1} - u_n$

Expression for the nth term $u_n = u_1 + (n - 1)r$

Monotonicity

Increasing if $r > 0$

Decreasing if $r < 0$

Sum of the first n terms $S_n = \frac{u_1 + u_n}{2} \times n$

Geometric Sequences

Common ratio $r = \frac{u_{n+1}}{u_n}$

Expression for the nth term $u_n = u_1 \times r^{n-1}$

Monotonicity

Increasing if $u_1 > 0 \wedge r > 1$

Decreasing if $u_1 < 0 \wedge r > 1$

Not Monotonic if $r < 0$

Sum of the first n terms $S_n = u_1 \times \frac{1 - r^n}{1 - r}$

Simple Interest

$FV = P \times (1 - r \times t)$

Compound Interest

$FV = P \times (1 +)^t$

Derivatives

Average rate of change between two points

Slope of the Secant Line $[a, b]$ $SSL = \frac{f(b) - f(a)}{b - a}$

Rate of change at a point

$$f'(x_0) = \lim_{x \to x_0} \frac{f(x) - f(x_0)}{x - x_0}$$

$$f'(x_0) = \lim_{h \to 0} \frac{f(x_0 + h) - f(x_0)}{h}$$

Constant

$$a' = 0$$

Multiplication by constant

$$(mx)' = m$$

Power Rule

$$(u^n)' = n \times u^{n - 1} \times u'$$

Root

$$(\sqrt[n]{u})' = \frac{u'}{n \times \sqrt[n]{u^{n - 1}}}$$

Exponential

$$(a^u)' = u' \times a^u \times \ln a$$

Exponential base

$$(e^u)' = u' \times e^u$$

Sum Rule

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

Product Rule

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

Quotient Rule

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

Chain Rule

$$(gof)' = g'(f) + f'$$

Sine

$$(\sin u)' = u' \times \cos u$$

Cosine

$$(\cos u)' = -u' \times \sin u$$

Tangent

$$(\tan u)' = \frac{u'}{\cos^2 u}$$

Logarithms

$$(\log_a u)' = \frac{u'}{u \times \ln a}$$

Natural logarithm

$$(\ln u)' = \frac{u'}{u}$$

Probability and Sets

Commutative

$$A \cup B = B \cup A$$

$$A \cap B = B \cap A$$

Associative

$$A \cup (B \cup C) = A \cup (B \cup C)$$

$$A \cap (B \cap C) = A \cap (B \cap C)$$

Neutral element

$$A \cap \varnothing = A$$

$$A \cap E = A$$

Absorbing Element

$$A \cup E = E$$

$$A \cap \varnothing = \varnothing$$

Distributive

$$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$$

$$A \cup (B \cup C) = (A \cap B) \cup (A \cap C)$$

De Morgan's laws

$$\overline{A \cap B} = \overline{A} \cup \overline{B}$$

$$\overline{A \cup B} = \overline{A} \cap \overline{B}$$

Laplace laws

$$P(A) = \frac{\text{Number of ways it can happen}}{\text{Total number of outcomes}}$$

Complement of an Event

$$P(\overline{A}) = 1 - P(A)$$

Union of Events

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Conditional Probability

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

Independent Events

$$P(A|B) = P(A)$$

$$P(A \cap B) = P(A) \times P(B)$$

Permutation

$$P_n = n! = n \times (n - 1) \times \dots \times 2 \times 1$$

Permutations without repetition

$$^{n}A'_{p} = n^{p}$$

Combination

$$^{n}C_{p} = \frac{^{n}A_{p}}{p!} = \frac{n!}{(n - p)! \times p!}$$

Probability Distribution

Average value

$$\mu = x_1p_1 + x_2p_2 + \dots + x_kp_k$$

Standard deviation

$$\sigma = \sqrt{\sum_{i = 1}^{k} p_i(x_i - \mu)^2}$$

Bionomial distribution

$$P(X = k) = {}^{n}C_{k}.p^{k}.(1 - p)^{n - k}$$

Logarithms

Definition

$$\log_a b = x \Longleftrightarrow b = a^x$$

$$\log_a 1 = 0$$

$$\log_a a = 1$$

$$\log_a a^b = b$$

Product

$$\log_a (u \times v) = \log_a u + \log_a v$$

Quotient

$$\log_a \left(\frac{u}{v}\right) = \log_a u - \log_a v$$

Exponential

$$\log_a u^v = v \times \log_a u$$

Change of Base

$$\log_a u^v = \frac{\log_b u}{\log_b a}$$

Special Limits

$$\lim_{x \to +\infty} \frac{a^x}{x^p} = +\infty \ (a, p \in R)$$

$$\lim_{x \to +\infty} \frac{\log_a x}{x} = 0 \ (a > 1, a \in R)$$

$$\lim_{x \to 0} \frac{e^{x} - 1}{x} = 1$$

$$\lim_{x \to 0} \frac{\ln (x - 1)}{x} = 1$$

$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

$$\lim_{x \to +\infty} \frac{\sin x}{x} = 0$$

$$\lim_{u_n \to +\infty} \left(1 + \frac{k}{u_n}\right)^{u_n} = e^{k}$$

$$\log\left(1 + \frac{1}{n}\right)^{n} = e \ (n \in N)$$

Integrals and primitives

Common primitives

$$\int 1 \, dx = x + c, \ c \in R$$

$$\int (u(x))^{\alpha}.u^{'}(x)dx = \frac{(u(x))^{\alpha + 1}}{\alpha + 1} + c, \ \alpha \in R \{0, -1\}, \ c \in R$$

$$\int \frac{u^{'}(x)}{u(x)} dx = \ln(|u(x)|) + c, \ c \in R$$

$$\int e^{u}(x).u^{'}(x)dx = e^{u}(x) + c, \ c \in R$$

$$\int \sin(u(x)).u^{'}(x)dx = - \cos(u(x)) + c, \ c \in R$$

$$\int \cos\ (u(x)).u'(x)dx\ = \sin\ (u(x))\ + c,\ c\ \in R$$

Linearity rules of Integration

$$\int (f(x) +\ g(x)dx \int (f(x)dx +\ \int g(x)dx$$

$$\int k.f(x)\ dx = k\int f(x)dx$$

Properties of Definite Integrals

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

$$\int_b^a f(x)dx = 0$$

$$\int_a^b f(x)dx = \int_a^c f(x)dx +\ \int_c^b f(x)dx$$

$$\int_a^b (f(x)dx + g(x))dx = \int_a^b f(x)dx +\ \int_a^b g(x)dx$$

$$\int_a^b k.f(x)dx =\ k\ \int_a^b f(x)dx$$

Barrow's rule

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

where F is primitive from *f* in the interval [*a*, *b*]

Complex Numbers

Complex Number

$$z = a + bi$$

Conjugate

$$\bar{z} = a + bi$$

Symmetry

$-z = -a - bi$

Equality

$a + bi = c + di \Longleftrightarrow a = c \wedge b = d$

Addition

$(a + bi) = (c + di) = (a + c) + (b + d)i$

Subtraction

$(a + bi) - (c + di) = (a - c) + (b - d)i$

Multiplication

$(a + bi) \times (c + di) = (ac - bd) + (ad + bc)i$

Division

$$\frac{a + bi}{c + di} = \frac{a + bi}{c + di} \times \frac{c - di}{c - di} = \frac{ac + bd}{c^2 + d^2} + \frac{bc - ad}{c^2 + d^2} i$$

Inverse

$$z^{-1} = \frac{1}{z}$$

$$z^{-1} = \frac{1}{|z|^2}.\bar{z}$$

Properties

$\bar{\bar{z}} = z$

$|z| = |\bar{z}|$

$|z|^2 = z,\bar{z}$

$$Re\ (z) = \frac{z + \bar{z}}{2}$$

$$Im\ (z) = \frac{z - \bar{z}}{2i}$$

Exponential to Algebraic form conversion

Angle

$$\arg\ (z) = \theta$$

$$\theta = \tan^{-1}\left(\frac{b}{a}\right)$$

Distance

$|z|$

$$|z| = \sqrt{a^2 + b^2}$$

Exponential form

Complex Number

$$z = |z|.e^{i\theta}$$

$$z = |z|.(\cos\theta + i\sin\theta)$$

Conjugate

$$\bar{z} = |z|.e^{i(-\theta)}$$

Symmetry

$$-z = |z|.e^{i(\theta + \pi)}$$

Multiplication

$$z_1 = |z_1|.e^{i\theta_1}$$

$$z_2 = |z_2|.e^{i\theta_2}$$

$$z_1 \times z_2 = |z_2||z_2|.e^{i(\theta_1 + \theta_2)}$$

Division

$$\frac{z_1}{z_2} = \frac{|z_1|}{|z_2|}.e^{i(\theta_1 - \theta_2)}$$

Exponentiation

$$z^n = |z|^n . e^{in\theta}$$

Radicals

$$\sqrt[n]{|z|^n.e^{i\theta}} = \sqrt[n]{|n|}.e^{i\left(\frac{\theta + 2k\pi}{n}\right)}, k \in \{0, \ldots, n - 1\}, n \in N$$

Basic math formulas