MATH VAULT

Mathematical Symbols

A comprehensive collection of symbols used in mathematics — categorized by function, subject and type into tables along with each symbol's usage and meaning.

The language and vocabulary of mathematics contain a large amount of **symbols** — some being more technical than others. Like letters in the alphabet, they can be used to form words, phrases and sentences that would constitute a larger part of the mathematical lexicon.

$$x \longrightarrow x+1 \longrightarrow (x+1)^2 \longrightarrow (x+1)^2 \geq 0$$
$$\longrightarrow \forall x \in \mathbb{R}[(x+1)^2 \geq 0]$$

A math symbol can be used for different **purposes** from one mathematical subfield to another (e.g., $\sim$ as logical negation and similarity of triangle), just as multiple symbols can be used to delineate the same concept or relation (e.g., $\times$ and $\cdot$ in multiplication).

A basic understanding about mathematical terminology is essential to a solid foundation in higher mathematics. To that end, the following is a compilation of some of the most well-adapted, **commonly-used symbols** in mathematics.

Moreover, these symbols are further categorized by their **function** into tables. More comprehensive lists of symbols — as categorized by **subject** and **type** — can be also found in the relevant pages below (or in the navigational panel).

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Constants

In mathematics, constants are symbols that are used to refer to **non-varying objects**. These can include key numbers, key mathematical sets, key mathematical infinities and other key mathematical objects (such as the identity matrix I).

Mathematical constants often take form of an **alphabet letter** — or a derivative of it. In some occasions, a constant might be regarded as a variable in the larger context. The following tables feature some of the most commonly-used constants, along with their name, meaning and usage.

Key Mathematical Numbers

Symbol Name	Explanation	Example
0 (**Zero**)	Additive identity of common numbers	$3+0=3$
1 (**One**)	Multiplicative identity of common numbers	$5 \times 1 = 5$
$\sqrt{2}$ (**Square root of** 2)	Positive number whose square is 2. Approximately 1.41421.	$(\sqrt{2}+1)^2 = 3+2\sqrt{2}$
e (**Euler's number**)	Base of the natural logarithm. Limit of the sequence $(1+\frac{1}{n})^n$. Approximately 2.71828.	$\ln(e^2) = 2$

Symbol Name	Explanation	Example
π (**Pi**, Archimedes' constant)	Ratio of a circle's circumference to its diameter. Half-circumference of a unit circle. Approximately 3.14159.	$\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \cdots$
φ (**Phi**, golden ratio)	Ratio between a larger number a and a smaller number b when $\frac{a+b}{a} = \frac{a}{b}$. Positive solution to the equation $x^2 - x - 1 = 0$.	$\varphi = \frac{1+\sqrt{5}}{2} \approx 1.61803$
i (**Imaginary unit**)	The principal root of -1. Foundational component of a complex number.	$(1+i)^2 = 2i$

Key Mathematical Sets

For a more comprehensive list, see **key mathematical sets in algebra**.

Symbol Name	Explanation	Example
$\varnothing$ (**Empty set**)	Set with no element	$\lvert\varnothing\rvert = 0$
$\mathbb{N}$ (**N**)	Set of natural numbers	$\forall x, y \in \mathbb{N}$, $x + y \in \mathbb{N}$
$\mathbb{Z}$ (**Z**)	Set of integers (Z stands for zahlen, number in German)	$\mathbb{N} \subseteq \mathbb{Z}$
$\mathbb{Z}_+$ (**Z-plus**)	Set of positive integers	$3 \in \mathbb{Z}_+$
$\mathbb{Q}$ (**Q**)	Set of rational numbers (Q stands for quotient)	$\sqrt{2} \notin \mathbb{Q}$
$\mathbb{R}$ (**R**)	Set of real numbers	$\forall x \in \mathbb{R}, x^2 \geq 0$
$\mathbb{R}_+$ (**R-plus**)	Set of positive real numbers	$\forall x, y \in \mathbb{R}_+, xy \in \mathbb{R}_+$

Symbol Name	Explanation	Example
$\mathbb{C}$ (C)	Set of complex numbers	$\exists z \in \mathbb{C}\,(z^2 + 1 = 0)$
$\mathbb{Z}_n$ (Z-n)	Set of integers modulo n	In the world of $\mathbb{Z}_2$, $1 + 1 = 0$.
$\mathbb{R}^3$ (R-three)	Three-dimensional Euclidean space	$(5, 1, 2) \in \mathbb{R}^3$

Key Mathematical Infinities

In mathematics, many different types of **infinity** exist. These include the purely notational use of the lemniscate symbol (∞), and the use of the following symbols in the context of cardinal/ordinal infinities:

Symbol Name	Explanation	Example
$\aleph_0$ (Aleph-naught)	Cardinality of the set of natural numbers	$\aleph_0 + 5 = \aleph_0$
$\mathfrak{c}$ (Continuum)	Cardinality of the set of real numbers	$\mathfrak{c} = 2^{\aleph_0}$
ω (Omega)	Smallest infinite ordinal number	$\forall n \in \mathbb{N}, n < \omega$

For a more comprehensive list, see **cardinality-related symbols**.

Other Key Mathematical Objects

Symbol Name	Explanation	Example
$\mathbf{0}$ (Zero)	Zero vector of a vector space	$\forall \mathbf{v} \in V$, $\mathbf{v} + \mathbf{0} = \mathbf{v}$
e (E)	Identity element of a group	$e \circ e = e$
I (I)	Identity matrix	$AI = IA = A$

Symbol Name	Explanation	Example
C (**C**)	Constant of integration	$\int 1 \, \mathrm{d}x = x + C$
$\top$ (**Tautology**)	A sentence in formal logic which is unconditionally true	For each proposition P, $P \land \top \equiv P$.
$\bot$ (**Contradiction**)	A sentence in formal logic which is unconditionally false	For each proposition P, $P \land \neg P \equiv \bot$.
Z (**Z**)	Standard normal distribution	$Z \sim N(0,1)$

Variables

A mathematical variable is a symbol that functions as a placeholder for **varying expressions** or **quantities**. The same variable can be used on a repeated basis to refer to the same thing — or *quantified* to form sentences that have a more definite meaning:

$$x, y \longrightarrow x + e^x = y \longrightarrow \exists y \in \mathbb{R} \, (x + e^x = y)$$
$$\longrightarrow \forall x \in \mathbb{R} \, \exists y \in \mathbb{R} \, (x + e^x = y)$$

In some cases, variables can be thought of as **constants** in narrower contexts (e.g., as parameters), while in other cases, variables are used in conjunction with **subscripts** to make up for the lack of letters (e.g., x_3).

While variables in mathematics are often used to represent **numbers**, they can also be used to represent other objects such as vectors, functions and matrices. The following tables document some of the most common conventions for variables — along with the context where they are adopted and used.

Variables for Numbers

Symbol(s)	Used For	Example
m, n, p, q	**Integers** and **natural numbers**	If mn is odd, then both m and n are odd.
a, b, c	**Coefficients** of functions and equations	A line of the form $ax + by = 0$ passes through the origin.
x, y, z	**Unknowns** in functions and equations	If $2x + 5 = 3$, then $x = -1$.
Δ	**Discriminant**	$\Delta = b^2 – 4ac$ for quadratic polynomials
i, j, k	**Index variables** in summations and products	$\sum_{i=1}^{10} i = 55$
t	**Time**	At $t = 5$, the velocity is $v(5) = 32$.
z	**Complex numbers**	$z\bar{z} = \lvert z \rvert^2$

Variables in Geometry

For more symbols in geometry and trigonometry, see **geometry and trigonometry symbols**.

Symbol(s)	Used For	Example
P, Q, R, S	**Vertices**	$\overline{PQ} \perp \overline{QR}$
ℓ	**Lines**	$\ell_1 \parallel \ell_2$
$\alpha, \beta, \gamma, \theta$	**Angles**	$\alpha + \beta + \theta = 180°$

Variables in Calculus

For a more comprehensive list, see **constants and variables in calculus**.

Symbol(s)	Used For	Example
$f(x), g(x,y), h(z)$	**Functions**	$f(2) = g(3,1) + 5$
a_n, b_n, c_n	**Sequences**	$a_n = \dfrac{3}{n+2}$
$h, \Delta x$	**Limiting variables** in derivatives	$\lim_{h \to 0} \dfrac{e^h - e^0}{h} = 1$
δ, ε	**Small quantities** in proofs involving limits	For all $\varepsilon > 0$, there is a $\delta > 0$ such that $\|x\| < \delta$ implies $\|2x\| < \varepsilon$.
$F(x), G(x)$	**Antiderivatives**	$F(x)' = f(x)$

Variables in Linear Algebra

For a more comprehensive list, see **variables in algebra**.

Symbol(s)	Used For	Example
$\mathbf{u}, \mathbf{v}, \mathbf{w}$	**Vectors**	$3\mathbf{u} + 4\mathbf{v} = \mathbf{w}$
A, B, C	**Matrices**	$AX = B$
λ	**Eigenvalues**	$A\mathbf{v} = \lambda\mathbf{v}$

Variables in Set Theory and Logic

For more comprehensive lists on the topics, see **variables in logic** and **variables in set theory**.

Symbol(s)	Used For	Example
A, B, C	**Sets**	$A \subseteq B \cup C$
a, b, c	**Elements**	$a \in A$
P, Q, R	**Propositions**	$P \vee \neg P \equiv \top$

Variables in Probability and Statistics

For a more comprehensive list, see variables in probability and statistics.

Symbol(s)	Used For	Example
X, Y, Z	Random variables	$E(X+Y) = E(X)+E(Y)$
μ	Population means	$H_0 : \mu = 5$
σ	Population standard deviations	$\sigma_1 = \sigma_2$
s	Sample standard deviations	$s \neq \sigma$
n	Sample sizes	If $n \geq 30$, use the normal distribution.
ρ	Population correlations	$H_a : \rho < 0$
r	Sample correlations	If $r = 0.75$, then $r^2 = 0.5625$.
π	Population proportions	$\pi = 0.5$
p	Sample proportions	$p = \frac{X}{n}$

Delimiters

Similar to punctuation marks in English, delimiters are a set of symbols which indicate the **boundaries** between independent mathematical expressions. They are often used to specify the scope for which an operation or rule would apply, and can occur both as an isolate symbol or as a pair of opposite-looking symbols.

In many scenarios, delimiters are used primarily for **grouping purposes.** The following table features some of the most commonly-used delimiters, along with their function and usage.

Symbol(s)	Function	Example
$.$	Decimal separator	25.9703
$:$	Ratio indicator	$1:4:9 = 3:12:27$
$,$	Object separator	$(3, 5, 12)$
$(), [], \{\}$	Order-of-operation indicators	$(a+b) \times c$
$(), []$	Interval indicators	$3 \notin (3, 4]$, $4 \in (3, 4]$.
$(), []$	Vector/matrix builder	$\begin{pmatrix} 1 & 4 \\ 3 & 6 \end{pmatrix}$
$\{\}$	Set builder	$\{\pi, e, i\}$
$\vert, :$	"Such that" markers	$\{x \in \mathbb{R} \mid x^2 - 2 = 0\}$
$\vert\vert, \Vert\Vert$	Norm-related operators	$\Vert(3, 4)\Vert = 5$
$\{$	Piecewise-function marker	$f(x) = \begin{cases} 1 & x \geq 0 \\ 0 & x < 0 \end{cases}$
$\langle\rangle$	Inner product operator	$\langle ka, b\rangle = k\langle a, b\rangle$
$\lceil\rceil$	Ceiling operator	$\lceil 2.476 \rceil = 3$
$\lfloor\rfloor$	Floor operator	$\lfloor \pi \rfloor = 3$

Operators

An operator is a symbol used to denote an operation — a function which takes one or multiple objects to another similar object. Most of the operators are unary and binary in nature (i.e., taking one and two inputs to their intended target, respectively), with the most common ones being the arithmetic operators (e.g., $+$).

Much like the case in English, operators allow one to expand the **lexicon** of mathematics where only finitely many symbols exist. The following tables feature some of the most commonly-used operators in mathematics — along with their usage and intended meaning.

Common Operators

Symbol(s)	Explanation	Example
$x+y$	**Sum** of x and y	$2a+3a=5a$
$x-y$	**Difference** of x and y	$11-5=6$
$-x$	**Additive inverse** of x	$-3+3=0$
$x \times y, x \cdot y$, xy	**Product** of x and y	$(m+1)n=mn+n$
$\frac{1}{x}, x^{-1}$	**Multiplicative inverse**/reciprocal of x	$\frac{1}{9} \times 9 = 9 \times \frac{1}{9} = 1$
$x \div y, x/y$	**Quotient** of x over y	$152 \div 3 = 50.\overline{6}$
$\frac{x}{y}$	**Fraction** (x over y)	$\frac{53+5}{6} = \frac{53}{6} + \frac{5}{6}$
x^y	x raised to the **power** of y	$3^4=81$
$x \pm y$	x **plus and minus** y	$\frac{-b \pm \sqrt{\Delta}}{2a}$
$\sqrt{x}$	**Positive square root** of x	$\sqrt{2} \approx 1.414$
$\|x\|$	**Absolute value** of x	$\|x-3\| < 5$
$x\%$	x **percent**	$x\% \doteq \frac{x}{100}$

Function-related Operators

For a more comprehensive list, see **function-related symbols**.

Symbol	Explanation	Example
$\operatorname{dom}(f)$	**Domain** of function f	If $g(x) = \ln x$, then $\operatorname{dom}(g) = \mathbb{R}_+$.
$\operatorname{ran}(f)$	**Range** of function f	If $h(y) = \sin y$, then it follows that $\operatorname{ran}(h) = [-1, 1]$.
$f(x)$	**Image** of element x under function f	$g(5) = g(4) + 3$
$f(X)$	**Image** of set X under function f	$f(A \cap B) \subseteq f(A) \cap f(B)$
$f \circ g$	**Composite function** (f of g)	If $g(3) = 5$ and $f(5) = 8$, then $(f \circ g)(3) = 8$.

Elementary Functions

For a more comprehensive list, see **key functions in algebra**.

Symbol(s)	Explanation	Example
$k_n x^n + \cdots + k_0 x^0$	**Polynomial** with coefficients $k_0, \ldots, k_n$	Polynomial $x^3 + 2x^2 + 3$ has a root in $(-3, -2)$.
e^x, $\exp x$	**Natural exponential function**	$e^{x+y} = e^x \cdot e^y$
b^x	**Exponential function** with base b	$2^x > x^2$ for large x.
$\ln x$	**Natural logarithmic function**	$\ln(x^2) = 2 \ln x$
$\log x$	**Logarithm function** of base 10 (or base e)	$\log 10000 = 4$
$\log_b x$	**Logarithm function** of base b	$\log_2 x = \dfrac{\ln x}{\ln 2}$
$\sin x$	**Sine function**	$\sin \pi = 0$

Symbol(s)	Explanation	Example
$\cos x$	**Cosine function**	$\cos\frac{\pi}{4} = \frac{\sqrt{2}}{2}$
$\tan x$	**Tangent function**	$\tan x = \frac{\sin x}{\cos x}$

Algebra-related Operators

For a more comprehensive list, see operators in algebra.

Symbol(s)	Explanation	Example
$\gcd(x, y)$	**Greatest common factor** of x and y	$\gcd(35, 14) = 7$
$\lfloor x \rfloor$	**Floor** of x (largest integer smaller or equal to x)	$\lfloor 3.6 \rfloor = 3$
$\lceil x \rceil$	**Ceiling** of x (smallest integer larger or equal to x)	$\lceil \pi \rceil = 4$
$\min(A)$	**Minimum** of set A	If $\min(A) = 3$, then $\min(A + 5) = 8$.
$\max(A)$	**Maximum** of set A	$\max(A \cup B) \geq \max(A$
$x \bmod y$	**Remainder** of x under modulus y	$36 \bmod 5 = 1$
$\sum_{i=m}^{n} a_i$	**Sum** of a_i (where i runs from m to n)	$\sum_{i=1}^{5} i^2 = 55$
$\prod_{i=m}^{n} a_i$	**Product** of a_i (where i runs from m to n)	$\prod_{i=1}^{n} i = n!$
$[a]$	**Equivalence class** of element a	$[a] \doteq \{x \mid xRa\}$

Symbol(s)	Explanation	Example
$\deg f$	**Degree** of polynomial f	$\deg(2x^2 + 3x + 5) = 2$
$\overline{z}$	**Conjugate** of complex number z	$\overline{5 - 8i} = 5 + 8i$
$\|z\|$	**Absolute value** of complex number z	$\|e^{\pi i}\| = 1$
$\arg(z)$	**Arguments** of complex number z	$\arg(1 + i) = \frac{\pi}{4} + 2\pi n$

Geometry-related Operators

For more symbols in geometry and trigonometry, see **geometry and trigonometry symbols**.

Symbol(s)	Explanation	Example
$\angle ABC$	**Angle** formed by vertices A, B and C	$\angle ABC = \angle CBA$
$\measuredangle ABC$, $m\angle ABC$	**Measure** of angle formed by vertices A, B and C	$\measuredangle ABC = \measuredangle A'B'C'$
$\overleftrightarrow{AB}$	**Infinite line** formed by points A and B	$\overleftrightarrow{AB} = \overleftrightarrow{BA}$
$\overline{AB}$	**Line segment** between points A and B	If $B \neq B'$, then $\overline{AB} \neq \overline{AB'}$.
$\overrightarrow{AB}$	**Ray** from point A to point B	$\overrightarrow{AB} \cong \overrightarrow{CD}$
$\|AB\|$	**Distance** between point A and point B	$\|AB\| < \|A'B'\|$
$\triangle ABC$	**Triangle** formed by vertices A, B and C	$\triangle ABC \cong \triangle A'B'C'$

Symbol(s)	Explanation	Example
$\square ABCD$	**Quadrilateral** formed by vertices A, B, C and D	$\square ABCD = \square DCBA$

Logic-related Operators

For a more comprehensive list, see **operators in logic**.

Symbol	Explanation	Example
$\neg P$	**Negation** (not P)	$\neg(1=2)$
$P \wedge Q$	**Conjunction** (P and Q)	$P \wedge Q \equiv Q \wedge P$
$P \vee Q$	**Disjunction** (P or Q)	$\pi^e \in \mathbb{Q} \vee \pi^e \notin \mathbb{Q}$
$P \to Q$	**Conditional** (if P, then Q)	$P \to Q \equiv (\neg P \vee Q)$
$P \leftrightarrow Q$	**Biconditional** (P if and only if Q)	$P \leftrightarrow Q \implies P \to Q$
$\forall \mathbf{x} P(\mathbf{x})$	**Universal statement** (for all $\mathbf{x}$, $P(\mathbf{x})$)	$\forall y \in \mathbb{N}, y+1 \in \mathbb{N}$
$\exists \mathbf{x} P(\mathbf{x})$	**Existential statement** (there exists $\mathbf{x}$ such that $P(\mathbf{x})$)	$\exists z\,(z^2 = -\pi)$

Set-related Operators

For a more comprehensive list, see **operators in set theory**.

Symbol	Explanation	Example
$\overline{A}, A^c$	**Complement** of set A	$\overline{\overline{A}} = A$
$A \cap B$	**Intersection** of sets A and B	$\{2,5\} \cap \{1,3\} = \varnothing$
$A \cup B$	**Union** of sets A and B	$\mathbb{Z} \cup \mathbb{N} = \mathbb{Z}$

Symbol	Explanation	Example
A/B, $A - B$	**Difference** of sets A and B	In general, $A - B \neq B - A$.
$A \times B$	**Cartesian product** of sets A and B	$(11, -35) \in \mathbb{N} \times \mathbb{Z}$
$\mathcal{P}(A)$	**Power set** of set A	$\mathcal{P}(\varnothing) = \{\varnothing\}$
$\|A\|$	**Cardinality** of set A	$\|\mathbb{N}\| = \aleph_0$

Vector-related Operators

For a more comprehensive list, see **operators in linear algebra**.

Symbol	Explanation	Example
$\\|\mathbf{v}\\|$	**Norm** of vector $\mathbf{v}$	$\\|(3,4)\\| = 5$
$\mathbf{u} \cdot \mathbf{v}$	**Dot product** of vectors $\mathbf{u}$ and $\mathbf{v}$	$\mathbf{u} \cdot \mathbf{u} = \\|\mathbf{u}\\|^2$
$\mathbf{u} \times \mathbf{v}$	**Cross product** of vectors $\mathbf{u}$ and $\mathbf{v}$	$\mathbf{u} \times \mathbf{u} = \mathbf{0}$
$\operatorname{proj}_{\mathbf{v}} \mathbf{u}$	**Projection** of vector $\mathbf{u}$ onto vector $\mathbf{v}$	$\operatorname{proj}_{(0,1)}(5,4) = (0,4)$
$\operatorname{span}(S)$	**Span** of set of vectors S	$\operatorname{span}(\{\mathbf{i},\mathbf{j}\}) = \mathbb{R}^2$
$\dim(V)$	**Dimension** of vector space V	$\dim(\mathbb{R}^3) = 3$

Matrix-related Operators

For a more comprehensive list, see **operators in linear algebra**.

Symbol(s)	Explanation	Example
$A+B$	**Sum** of matrices A and B	$A+X=B$
$A-B$	**Difference** of matrices A and B	In general, $A-B \neq B-A$.
$-A$	**Additive inverse** of matrix A	$B+(-B)=0$
kA	**Scalar product** of matrix A and number k	$(-1)A=-A$
AB	**Product** of matrices A and B	$AI=IA=A$
A^T	**Transpose** of matrix A	$I^T=I$
A^{-1}	**Multiplicative inverse** of matrix A	$(AB)^{-1}=B^{-1}A^{-1}$
$\operatorname{tr}(A)$	**Trace** of square matrix A	$\operatorname{tr}(A^T)=\operatorname{tr}(A)$
$\det(A)$, $\lvert A \rvert$	**Determinant** of square matrix A	$\left\lvert \begin{pmatrix} 1 & 4 \\ 3 & 2 \end{pmatrix} \right\rvert = 2-12=$

Probability-related Operators

For a more comprehensive list, see **operators in probability and statistics**.

Symbol(s)	Explanation	Exampe
$n!$	**Factorial** of n	$4!=4\cdot 3\cdot 2\cdot 1$
nPr	**Permutation** (n permute r)	$5P3=5\cdot 4\cdot 3$
nCr, $\binom{n}{r}$	**Combination** (n choose r)	$\binom{5}{2}=\binom{5}{3}$

Symbol(s)	Explanation	Exampe
$P(E)$	**Probability** of event E	$P(A \cup B \cup C) = 0.\overline{3}$
$P(A \mid B)$	**Conditional probability** of event A given event B	$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$
$E(X)$	**Expected value** of random variable X	$E(X+Y) = E(X) + E(Y)$
$V(X)$	**Variance** of random variable X	$V(5X) = 25V(X)$

Statistics-related Operators

For a more comprehensive list, see **statistical operators**.

Symbol	Explanation	Example
$\overline{X}$	**Sample mean** of data set X	$\overline{3X} = 3\overline{X}$
s^2	**Sample variance**	$s^2 = \frac{\sum(X - \overline{X})^2}{n-1}$
σ^2	**Population variance**	$\sigma^2 = \frac{\sum(X - \mu)^2}{n}$

Key Probability Functions and Distributions

For a more comprehensive list, see **probability-distribution-related operators**.

Symbol(s)	Explanation	Example
$\mathrm{Bin}(n,p)$	**Binomial distribution** with n trials and probability of success p	If X stands for the number of heads in 10 coin tosses, then $X \sim \mathrm{Bin}(10, 0.5)$.
$\mathrm{Geo}(p)$	**Geometric distribution** with probability of success p	If $Y \sim \mathrm{Geo}(1/5)$, then $E(Y) = 5$.

Symbol(s)	Explanation	Example
$U(a,b)$	**Continuous uniform distribution** from a to b	If $X \sim U(3,7)$, then $V(X) = \dfrac{(7-3)^2}{12}$.
$N(\mu, \sigma^2)$	**Normal distribution** with mean μ and variance σ^2	If $X \sim N(3, 5^2)$, then $\frac{X-3}{5} \sim Z$.
z_α	**Positive Z-score** associated with significance level α	$z_{0.05} \approx 1.645$
$t_{\alpha,\nu}$	**Positive t-score** associated with significance level α and degree of freedom ν	$t_{0.05,1000} \approx z_{0.05}$
$\chi^2_{\alpha,\nu}$	**Chi-squared score** associated with significance level α and degree of freedom ν	$\chi^2_{0.05,30} \approx 43.77$
F_{α,ν_1,ν_2}	**F-score** associated with significance level α and degrees of freedom ν_1 and ν_2	$F_{0.05,20,20} \approx 2.1242$

Calculus-related Operators

For a more comprehensive list, see **calculus and analysis symbols**.

Symbol(s)	Explanation	Example
$\lim\limits_{n\to\infty} a_n$	**Limit of sequence** a_n	$\lim\limits_{n\to\infty} \dfrac{n+3}{2n} = \dfrac{1}{2}$
$\lim\limits_{x\to c} f(x)$	**Limit of function** f as x tends to c	$\lim\limits_{x\to 3} \dfrac{\pi \sin x}{2} = \dfrac{\pi}{2} \lim\limits_{x\to 3}$ si

Symbol(s)	Explanation	Example
$\sup(A)$	**Supremum** (least upper bound) of set A	$\sup([-3,5)) = 5$
$\inf(A)$	**Infimum** (greatest lower bound) of set A	If $B = \left\{\frac{1}{1}, \frac{1}{2}, \dots\right\}$, then $\inf(B) = 0$.
$f', f'', f''', f^{(n)}$	First, second, third and nth **derivative** of function f	$(\sin x)''' = -\cos(x)$
$\int_a^b f(x)\,\mathrm{d}x$	**Definite integral** of function f from a to b	$\int_0^1 \frac{1}{1+x^2}\,\mathrm{d}x = \frac{\pi}{4}$
$\int f(x)\,\mathrm{d}x$	**Indefinite integral** of function f	$\int \ln x\,\mathrm{d}x = x\ln x - x$
f_x	**Partial derivative** of multivariate function f with respect to x	If $f(x,y) = x^2y^3$, then $f_x(x,y) = 2xy^3$.

Relational Symbols

Relational symbols are used to express **mathematical relations** between multiple objects. Many relational symbols are binary in nature, in that they take two objects as inputs and turn them into complete, meaningful sentences (as in the case of the inequality symbol $<$).

Since relational symbols form the building blocks of **mathematical sentences**, they are of foundational importance in mathematics. The following tables document some of the most commonly-used relational symbols — along with their usage and meaning.

Equality-based Relational Symbols

Symbol(s)	Explanation	Example
$x = y$	x and y are **equal**	$3x - x = 2x$

Symbol(s)	Explanation	Example
$x \neq y$	x and y are **non-equal**	$2 \neq 3$
$x \approx y$	x and y are **approximately equal**	$\pi \approx 3.1416$
$x \sim y$, xRy	x is **related to** y (as defined by the relation R)	xRy if and only if $\|x\| = \|y\|$.
$x \equiv y$	x is **equivalent**/congruent to y	$2 \equiv 101$ in mod 33
$f \propto g$	Function f is **proportional** to function g	$V \propto r^3$

Comparison-based Relational Symbols

For a more comprehensive list, see **comparison-based relational symbols in algebra**.

Symbol	Explanation	Example
$x < y$	x is **less than** y	$\sin(x) < 3$
$x > y$	x is **greater than** y	$\pi > e$
$x \leq y$	x is **less than or equal to** y	$n! \leq n^n$
$x \geq y$	x is **greater than or equal to** y	$x^2 \geq 0$

Number-related Relational Symbols

Symbol	Explanation	Example
$m \mid n$	Integer m **divides** integer n	$101 \mid 1111$
$m \perp n$	Integers m and n are **coprime**	$31 \perp 97$

Geometry-related Relational Symbols

For more symbols in geometry and trigonometry, see **geometry and trigonometry symbols**.

Symbol	Explanation	Example
$\ell_1 \parallel \ell_2$	Lines ℓ_1 and ℓ_2 are **parallel**	$\overline{PQ} \parallel \overline{RS}$
$\ell_1 \perp \ell_2$	Lines ℓ_1 and ℓ_2 are **perpendicular**	$\overrightarrow{AB} \perp \overrightarrow{BC}$
$F \sim F'$	Figure F is **similar** to figure F'	$\triangle ABC \sim \triangle DEF$
$F \cong F'$	Figure F is **congruent** to figure F'	$\square ABCD \cong \square PQRS$

Set-related Relational Symbols

For a more comprehensive list, see **relational symbols in set theory**.

Symbol	Explanation	Example
$a \in A$	Element a is a **member** of set A	$\frac{2}{3} \in \mathbb{R}$
$a \notin A$	Element a is **not a member** of set A	$\pi \notin \mathbb{Q}$
$A \subseteq B$	Set A is a **subset** of set B	$A \cap B \subseteq A$
$A = B$	Set A is **equal** to set B	If $A = B$, then $A \subseteq B$.

Logic-related Relational Symbols

For a more comprehensive list, see **relational symbols in logic**.

Symbol	Explanation	Example
$P \implies Q$	Sentence P **implies** sentence Q	x is even $\implies$ 2 divides x
$P \impliedby Q$	Sentence P is **implied by** sentence Q	$x = 3 \impliedby 3x + 2 = 11$
$P \iff Q$, $P \equiv Q$	Sentence P **if and only if** sentence Q	$x \neq y \iff (x - y)^2 > 0$

Symbol	Explanation	Example
$P \therefore Q$	P, therefore Q	$i \in \mathbb{C} \therefore \exists z \, (z \in \mathbb{C})$
$P \because Q$	P, because Q	$x = \frac{\pi}{2} \because \sin x = 1$ and $\cos x = 0$

Probability-related Relational Symbols

For a more comprehensive list, see **relational symbols in probability and statistics**.

Symbol	Explanation	Example
$A \perp B$	Events A and B are **independent**	Since $A \perp B$, we have that $P(A \cap B) = P(A)P(B$
$X \sim F$	Random variable X follows **distribution** F	$Y \sim \text{Bin}(30, 0.4)$

Calculus-related Relational Symbols

For a more comprehensive list, see **relational symbols in asymptotic analysis**.

Symbol	Explanation	Example
$f(x) \sim g(x)$	Function f is **asymptotically equal** to function g	$\pi(x) \sim \frac{x}{\ln x}$
$f(x) \in O(g(x))$	Function f is in the **big-O** of g (f "grows at most as fast" as g)	$2x^2 + 3x + 3 \in O(x^2)$

Notational Symbols

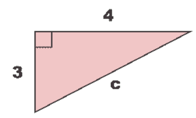
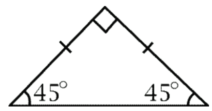
A notational symbol is a **convention** or **shorthand** whose role is different from that of a constant, variable, delimiter, operator or relational symbol. It often simply delineates the notational system being used, and might even refer to concepts that have little bearing to any definite mathematical object (e.g., ∞).

Common Notational Symbols

Symbol(s)	Explanation	Example
$\ldots, \cdots$	**Horizontal ellipsis symbols** to indicate a definite, unlisted pattern	$1^2 + 2^2 + \cdots + n^2$
$\vdots, \ddots$	**Vertical ellipsis symbols** to indicate a definite, unlisted pattern	$\begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{pmatrix}$
$f \colon A \to B$, $A \xrightarrow{f} B$	**Function** f with domain A and codomain B	A function $g : \mathbb{N} \to \mathbb{R}$ can be thought of as a sequence.
$x \mapsto f(x)$	**Function rule** mapping element x to $f(x)$	The function $x \mapsto x^2$ is increasing in the interval $[0, \infty)$.
$Q.E.D.$, $\square$, $\blacksquare$	**End-of-the-proof symbol**	Thus the result is established as desired. $\blacksquare$
$Q.E.A.$, ⨳ , ※	**Contradiction symbol**	Multiplying both sides of the equation yields that $1 = 2$. ※

Notational Symbols in Geometry and Trigonometry

For more symbols in geometry and trigonometry, see **geometry and trigonometry symbols**.

Symbol	Explanation	Example
$\circ$	**Degree symbol**	$\cos(90^\circ) = 0$
$'$	**Arcminute symbol**	$35' = \dfrac{35}{60}$ degrees
$''$	**Arcsecond symbol**	$20'' = \left(\dfrac{20}{60}\right)'$
rad	**Radian**	$\pi\,\mathrm{rad} = 180^\circ$
grad	**Gradian**	$100\,\mathrm{grad} = 90^\circ$
∟	**Right angle**	
$-, =, \equiv$	**Equal angle/length**	

Notational Symbols in Calculus

For more symbols in calculus, see **calculus and analysis symbols**.

Symbol	Explanation	Example
$+\infty$	**Positive infinity**	$\left(\dfrac{n^2+1}{n}\right) \to +\infty$
$-\infty$	**Negative infinity**	$\lim\limits_{x\to-\infty} e^x = 0$
$\Delta\mathbf{x}$	**Change** in variable $\mathbf{x}$	$m = \dfrac{\Delta y}{\Delta x}$
$\mathrm{d}\mathbf{x}$	**Differential** of variable $\mathbf{x}$	$\mathrm{d}y = f'(x)\,\mathrm{d}x$
$\partial\mathbf{x}$	**Partial differential** of variable $\mathbf{x}$	$\dfrac{\partial f}{\partial x}\,\mathrm{d}x$

Symbol	Explanation	Example
$\mathrm{d}\mathbf{f}$	Total differential of multivariate function $\mathbf{f}$	$\mathrm{d}g(x,y) = \frac{\partial g}{\partial x}\,\mathrm{d}x + \frac{\partial g}{\partial y}$

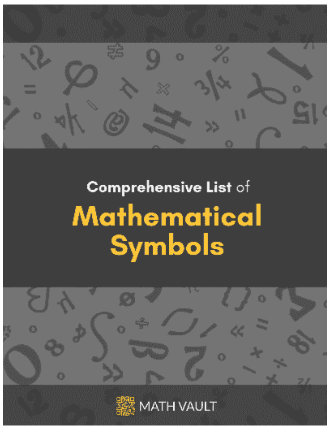
Notational Symbols in Probability and Statistics

For a more comprehensive list, see **notational symbols in probability and statistics**.

Symbol	Explanation	Example
i.i.d.	Independent and identically distributed	Given n i.i.d. random variables $X_1, \ldots, X_n$, $V(X_1 + \cdots + X_n) = V(X_1) + \cdots + V(X_n)$.
H_0	Null hypothesis	$H_0 : \mu = 23$
H_a	Alternative hypothesis	$H_a : \sigma_1^2 \neq \sigma_2^2$

For lists of symbols categorized by **type** and **subject**, refer to the relevant pages below for more.

- Arithmetic and Common Math Symbols
- Geometry and Trigonometry Symbols
- Logic Symbols
- Set Theory Symbols
- Greek, Hebrew, Latin-based Symbols
- Algebra Symbols
- Probability and Statistics Symbols
- Calculus and Analysis Symbols



Prefer the PDF version instead?

Get the master summary of mathematical symbols in **eBook form** — along with each symbol's usage and LaTeX code.

Yes. That'd be useful.

Additional Resources

- **Ultimate LaTeX Reference Guide**: A definitive reference guide for users of LaTeX
- **Definitive Guide to Learning Higher Mathematics**: A 10-principle framework for tackling higher mathematical learning, thinking and problem solving
- **10 Commandments of Higher Mathematical Learning**: An illustrated web guide on 10 scalable rules for learning higher mathematics
- **Definitive Glossary of Higher Mathematical Jargon**: A tour around higher mathematics in 100 terms

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Arithmetic and Common Math Symbols

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March 12, 2020 at 6:41 AM

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January 21, 2022 at 4:56 PM

Hi Deri. Yes it is!

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STudentBoi

April 30, 2024 at 2:58 AM

Im a highschool student that is preparing for more advanced math when I grad, this is very useful. Kudos to the ones behind this.

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April 30, 2024 at 1:31 PM

Hi STudentBoi. Glad you like it!

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