Table of mathematical symbols

This table contains the most commonly used mathematical symbols (in our course). During the tutorial session devoted to this course, we will work on some of these symbols. This reminder should be kept, as we will need it for future teaching.

Sym.	Pronunciation	Meaning	Example
		Part I: *Set Logic & Trigonometry*	
$\neg$	negation	Not	$\neg P$ means "not P"
$\wedge$	conjunction	And	$P \wedge Q$ means "P and Q"
$\vee$	disjunction	Or	$P \vee Q$ means "P or Q"
$\forall$	for all	For each	$\forall x\, P(x)$ means "for all x, $P(x)$"
$\exists$	there exists	There is at least one	$\exists x\, P(x)$ means "there exists at least one x such that $P(x)$"
$\subseteq$	subset of	Set inclusion	$A \subseteq B$ means "the set A is a subset of the set B"
$\subset$	strictly subset of	Strict inclusion	$A \subset B$ means "the set A is strictly included in the set B"
$\supseteq$	superset of	Superset (inverse of $\subseteq$)	$A \supseteq B$ means "the set A is a superset of the set B"
$\supset$	strictly superset of	Strict superset (inverse of $\subset$)	$A \supset B$ means "the set A is strictly a superset of the set B"
$\cup$	union	Set union	$A \cup B$ is the set containing all elements of A or B
$\cap$	intersection	Set intersection	$A \cap B$ is the set containing elements common to A and B
$\setminus$	set difference	Set difference	$A \setminus B$ is the set of elements in A that are not in B
$\emptyset$	empty set	Empty set	$\emptyset$ is the set containing no elements
$\subseteqq$	subset (variant)	Subset (variant)	$A \subseteqq B$ means "the set A is included in the set B"
$\cong$	congruence	Equivalence	$A \cong B$ means "the set A is equivalent to the set B"
$\sim$	similar	Similarity	$A \sim B$ means "the set A is similar to the set B"
$\subsetneq$	strictly subset of (variant)	Strict inclusion (variant)	$A \subsetneq B$ means "the set A is strictly included in the set B"
$\sqsubseteq$	partial subset	Partial inclusion	$A \sqsubseteq B$ means "the set A is partially included in the set B"
$\sqsupseteq$	partially contains	Partially contains	$A \sqsupseteq B$ means "the set A partially contains the set B"
$\not\subseteq$	not a subset of	Non-inclusion	$A \not\subseteq B$ means "the set A is not a subset of the set B"
$\not\subset$	not strictly a subset of	Non-strict inclusion	$A \not\subset B$ means "the set A is not strictly a subset of the set B"
$\not\supseteq$	does not contain	Non-contains	$A \not\supseteq B$ means "the set A does not contain the set B"
$\not\supset$	does not strictly contain	Non-strictly contains	$A \not\supset B$ means "the set A does not strictly contain the set B"
$\not\sqsubseteq$	not partially included	Non-partial inclusion	$A \not\sqsubseteq B$ means "the set A is not partially included in the set B"

$\not\sqsupseteq$	does not partially contain	Non-partially contains	$A \not\sqsupseteq B$ means "the set A does not partially contain the set B"
$\notin$	not an element of	Non-membership	$x \notin A$ means "the element x is not a member of the set A"
$\ni$	member of (inverse of $\in$)	Membership	$x \ni A$ means "the element x is a member of the set A"
$\rightarrowtail$	injective arrow	Injective function	$f : A \rightarrowtail B$ means that f is an injection from A to B
$\twoheadrightarrow$	surjective arrow	Surjective function	$f : A \twoheadrightarrow B$ means that f is a surjection from A to B
$\mapsto$	maps to arrow	Mapping	$f : x \mapsto f(x)$ means that f maps x to $f(x)$
$\circ$	function composition	Function composition	$(g \circ f)(x) = g(f(x))$ for functions $f : A \to B$ and $g : B \to C$
$\equiv$	equivalence	Equivalence	$x \equiv y$ means "x is equivalent to y"
$\Rightarrow$	implies	Implication	$A \Rightarrow B$ means "if A then B"
$\Leftarrow$	is implied by	Implication (reverse)	$A \Leftarrow B$ means "if B then A"
$\Leftrightarrow$	logical equivalence	Logical equivalence	$A \Leftrightarrow B$ means "A if and only if B"
$\vdash$	provable	Provable	$\vdash A$ means "A is provable"
$\models$	satisfies	Satisfies	$\models A$ means "A is satisfied"
$\bot$	contradiction	Contradiction	$\bot$ represents a contradiction
$\top$	tautology	Tautology	$\top$ represents a tautology
$\oplus$	exclusive or	Exclusive or (XOR)	$A \oplus B$ means "A or B, but not both"
$\neg$	not	Negation	$\neg A$ means "not A"
$\wedge$	logical and	Logical conjunction	$A \wedge B$ means "A and B"
$\vee$	logical or	Logical disjunction	$A \vee B$ means "A or B"
$\mathbb{N}$	set of natural numbers	Set of natural numbers	$\mathbb{N} = \{0, 1, 2, \ldots\}$
$\mathbb{Z}$	set of integers	Set of integers	$\mathbb{Z} = \{\ldots, -2, -1, 0, 1, 2, \ldots\}$
$\mathbb{Q}$	set of rational numbers	Set of rational numbers	$\mathbb{Q} = \{\frac{a}{b} \mid a \in \mathbb{Z}, b \in \mathbb{Z} \setminus \{0\}\}$
$\mathbb{R}$	set of real numbers	Set of real numbers	$\mathbb{R}$ is the set of real numbers
$\mathbb{C}$	set of complex numbers	Set of complex numbers	$\mathbb{C}$ is the set of complex numbers
$\mathbb{Z}_+$	set of positive integers	Set of positive integers	$\mathbb{Z}_+ = \{1, 2, 3, \ldots\}$
$\mathbb{Z}_-$	set of negative integers	Set of negative integers	$\mathbb{Z}_- = \{\ldots, -3, -2, -1\}$
$\mathbb{Z}_{\geq 0}$	set of non-negative integers	Set of non-negative integers	$\mathbb{Z}_{\geq 0} = \{0, 1, 2, \ldots\}$
$\mathbb{Z}_{\leq 0}$	set of non-positive integers	Set of non-positive integers	$\mathbb{Z}_{\leq 0} = \{\ldots, -2, -1, 0\}$
$\mathbb{N}^*$	set of non-zero natural numbers	Set of non-zero natural numbers	$\mathbb{N}^* = \{1, 2, 3, \ldots\}$
$\mathbb{R}^+$	set of positive real numbers	Set of positive real numbers	$\mathbb{R}^+ = \{x \in \mathbb{R} \mid x > 0\}$
$\mathbb{R}^-$	set of negative real numbers	Set of negative real numbers	$\mathbb{R}^- = \{x \in \mathbb{R} \mid x < 0\}$
$\mathbb{R}_{\geq 0}$	set of non-negative real numbers	Set of non-negative real numbers	$\mathbb{R}_{\geq 0} = \{x \in \mathbb{R} \mid x \geq 0\}$
$\mathbb{R}_{\leq 0}$	set of non-positive real numbers	Set of non-positive real numbers	$\mathbb{R}_{\leq 0} = \{x \in \mathbb{R} \mid x \leq 0\}$
$\mathbb{C}^*$	set of non-zero complex numbers	Set of non-zero complex numbers	$\mathbb{C}^* = \mathbb{C} \setminus \{0\}$
$\mathbb{P}$	set of prime numbers	Set of prime numbers	$\mathbb{P} = \{2, 3, 5, 7, 11, \ldots\}$
$\mathbb{F}_p$	finite field of cardinality p	Finite field of cardinality p	$\mathbb{F}_p = \mathbb{Z}/p\mathbb{Z}$ for a prime number p
x^y	x to the power of y	Exponentiation	$2^3 = 8$
$\log_b x$	logarithm base b of x	Logarithm	$\log_{10} 100 = 2$

$\frac{d}{dx}f(x)$	derivative of f(x) with respect to x	Derivative	$\frac{d}{dx}(x^2) = 2x$
$\int_a^b f(x)\,dx$	integral from a to b of f(x) with respect to x	Integral	$\int_0^1 x^2\,dx = \frac{1}{3}$
$\sum_{i=1}^n a_i$	sum of a_i from i=1 to n	Summation	$\sum_{i=1}^3 i^2 = 1+4+9 = 14$
∞	infinitely large	Symbol indicating the infinitely large	∞
Δ	change	Symbol representing a change or a difference	Δx
∂	difference	Symbol representing a partial difference	∂x
∇	grad	Symbol for the gradient operator	∇f
$\oint$	encircle	Integration around a closed loop	$\oint_C f(x,y)\,ds$
$\prod$	product	Product of a sequence of numbers	$\prod_{i=1}^n a_i$
$\sum$	total	Sum of a sequence of numbers	$\sum_{i=1}^n a_i$
$\parallel$	parallel	Parallel	$AB \parallel CD$ means "segment AB is parallel to segment CD"
$\perp$	perpendicular	Perpendicular	$AB \perp CD$ means "segment AB is perpendicular to segment CD"
$\angle$	angle	Angle	$\angle ABC$ represents the angle formed by segments AB and BC
$\triangle$	triangle	Triangle	$\triangle ABC$ represents the triangle formed by points A, B, and C
$\square$	square	Square	$\square ABCD$ represents the square with vertices A, B, C, and D
Part II: *Combinatorial Analysis*			
$n!$	n factorial	Product of integers from 1 to n	$5! = 5\times4\times3\times2\times1 = 120$
$\binom{n}{k}$	combination of n choose k	Number of ways to choose k objects from n without order	$\binom{5}{2} = \frac{5!}{2!(5-2)!} = 10$
$P(n,k)$	permutation of n choose k	Number of ways to choose k objects from n with order	$P(5,2) = \frac{5!}{(5-2)!} = 20$
$A(n)$	Bell number	Number of partitions of a set of n elements	$A(3) = 5$
$S(n,k)$	Stirling number of the second kind	Number of ways to partition a set of n elements into k non-empty subsets	$S(4,2) = 7$
$C(n,k)$	Catalan number	Number of paths of length 2n without crossing a given diagonal	$C(3) = \frac{1}{3+1}\binom{6}{3} = 5$
$\pi(n)$	prime number	Number of prime numbers less than or equal to n	$\pi(10) = 4$
$\lfloor x \rfloor$	floor function	Greatest integer less than or equal to x	$\lfloor 2.7 \rfloor = 2$
$\lceil x \rceil$	ceiling function	Smallest integer greater than or equal to x	$\lceil 2.3 \rceil = 3$
H_n	harmonic number	Sum of the reciprocals of the first n integers	$H_3 = 1 + \frac{1}{2} + \frac{1}{3} \approx 1.833$
$B(n)$	Bell number	Number of ways to partition a set of n elements	$B(3) = 5$
F_n	Fibonacci number	n-th Fibonacci number	$F_5 = 5$
ϕ	golden ratio	Ratio of the golden number	$\phi = \frac{1+\sqrt{5}}{2} \approx 1.618$
$\gcd(a,b)$	greatest common divisor	Greatest common divisor of a and b	$\gcd(8,12) = 4$

$lcm(a,b)$	least common multiple	Least common multiple of a and b	$lcm(4,6) = 12$

Part III: *Probability Calculus*			
Ω	sample space	Set of all possible outcomes of a random experiment	$\Omega = \{1,2,3,4,5,6\}$ for a six-sided die
E	event	Subset of the sample space Ω	$E = \{2,4,6\}$ (event "rolling an even number")
$P(E)$	probability	Probability of event E	$P(E) = \frac{\text{number of favorable outcomes for } E}{\text{total number of outcomes in } \Omega}$
$P(A \cap B)$	intersection probability	Probability that both events A and B occur simultaneously	$P(A \cap B)$
$P(A \cup B)$	union probability	Probability that at least one of the events A or B occurs	$P(A \cup B)$
$P(A\|B)$	conditional probability	Probability of A given that B is true	$P(A\|B)$
$P(\bar{A})$	complementary probability	Probability that event A does not occur	$P(\bar{A}) = 1 - P(A)$
$E_1 \perp E_2$	independent events	Events E_1 and E_2 are independent	$P(E_1 \cap E_2) = P(E_1) \cdot P(E_2)$
X	random variable	Function that assigns a real number to each outcome in Ω	$X(\text{face of the die}) = \text{value of the face}$
$\mathbb{E}[X]$	expected value	Expected average value of the random variable X	$\mathbb{E}[X] = \sum_{x \in \Omega} x \cdot P(X = x)$
$\mathbb{V}(X)$	variance	Measure of the dispersion of X around its expected value	$\mathbb{V}(X) = \mathbb{E}[(X - \mathbb{E}[X])^2]$
σ_X	standard deviation	Measure of the dispersion of X around its expected value	$\sigma_X = \sqrt{\mathbb{V}(X)}$
$\mathbb{C}(X,Y)$	covariance	Measure of the correlation between two random variables X and Y	$\mathbb{C}(X,Y) = \mathbb{E}[(X - \mathbb{E}[X])(Y - \mathbb{E}[Y])]$
$\rho_{X,Y}$	correlation coefficient	Measure of the normalized correlation between two random variables X and Y	$\rho_{X,Y} = \frac{\mathbb{C}(X,Y)}{\sigma_X \sigma_Y}$
$\hat{\theta}$	estimator of θ	Estimate of θ based on observed data	$\hat{\mu} = \frac{1}{n}\sum_{i=1}^{n} X_i$
$\widehat{\sigma}^2$	variance estimator	Estimate of the variance based on observed data	$\widehat{\sigma}^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2$
$\widehat{p}$	estimated proportion	Estimate of the proportion based on observed data	$\widehat{p} = \frac{\text{number of successes}}{\text{total number of trials}}$
$\bar{X}$	empirical mean	Mean of the observed data	$\bar{X} = \frac{1}{n}\sum_{i=1}^{n} X_i$