Notation

Mathematical Symbols

Symbol	Usage	Interpretation
$\{\ \}$	$\{A, B, \ldots\}$	A set consisting of elements $A, B, \ldots$
$\emptyset$		Empty set
Ω		Entire sample space, universe
$[\ ]$	$[a, b]$	An interval usually on the real line $a, b \in \mathbb{R}$
$\vert$	$\{A \mid C(A)\}$	Elements of A, which satisfy condition $C(A)$
$:$	$\{A : C(A)\}$	Elements of A, which satisfy condition $C(A)$
$\doteq$	$a \doteq b$	Definition
$\circ$	$T_2 \circ T_1(\cdot)$	Composition, sequential operation on $(\cdot)$
$*$	$f(t) * g(t)$	Convolution $\big(f * g\big)(t) \doteq \int_{-\infty}^{\infty} f(\tau)\, g(t - \tau) \mathrm{d}\tau$
$\star$	$f(t) \star g(t)$	Cross-correlation $\big(f \star g\big)(t) \doteq \int_{-\infty}^{\infty} f^*(\tau)\, g(t + \tau) \mathrm{d}\tau$
$\xrightarrow{\mathrm{d}}$	$\lim_{n\to\infty} \langle f(\mathcal{X}_n)\rangle \xrightarrow{\mathrm{d}} \langle f(\mathcal{X})\rangle$	Convergence in distribution
$\times$	$\mathbf{x} \times \mathbf{y}$	Cross product used for vectors in 3D space
$\times$	$\mathbf{e}_1 \times \ldots \times \mathbf{e}_n$	Cartesian product used for n-dimensional space
$\otimes$	$\mathcal{B}_1 \otimes \mathcal{B}_2$	Kronecker product of two Borel algebras
$\bigotimes_{k=1}^{n}$	$\mathcal{B}_1 \otimes \ldots \otimes \mathcal{B}_n$	Kronecker product used for n Borel algebras
log		Logarithm in general and logarithm to base 10
ln		Natural logarithm or logarithm to base e
ld		Logarithm to base 2

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Intervals	Symbols	Definitions	
Closed intervals	$[a, b]$	$[a, b]$	$= \{x \in \mathbb{R} : a \leq x \leq b\}$
Open intervals	$]a, b[$	$]a, b[$	$= \{x \in \mathbb{R} : a < x < b\}$
Left-hand half-open intervals	$]a, b]$	$]a, b]$	$= \{x \in \mathbb{R} : a < x \leq b\}$
Right-hand half-open intervals	$[a, b[$	$[a, b[$	$= \{x \in \mathbb{R} : a \leq x < b\}$

Number Systems and Function Spaces

Natural numbers	$\mathbb{N}$	$\{0, 1, 2, 3, \ldots\}$
	$\mathbb{N}_{>0}$	$\{1, 2, 3, \ldots\}$
Integers	$\mathbb{Z}$	$\{\ldots, -3, -2, -1, 0, 1, 2, 3, \cdots\}$
	$\mathbb{Z}_{>0} = \mathbb{N}_{>0}$	$\{1, 2, 3, \ldots\}$
	$\mathbb{Z}_{\geq 0} = \mathbb{N}$	$\{0, 1, 2, 3, \ldots\}$
	$\mathbb{Z}_{<0}$	$\{-1, -2, -3, \ldots\}$
	$\mathbb{Z}_{\leq 0}$	$\{0, -1, -2, -3, \ldots\}$
Rational numbers	$\mathbb{Q}$	$\left\{\frac{m}{n} \mid (m, n) \in \mathbb{Z} \wedge n \neq 0\right\}$
Real numbers	$\mathbb{R}$	$\left\{x \mid x \text{ is rational or irrational}\right\}$
Complex numbers	$\mathbb{C}$	$\left\{z = a + b\mathrm{i} \mid (a, b) \in \mathbb{R}\,,\ \mathrm{i} = \sqrt{-1}\right\}$

Functions	$\mathcal{C}(a, b)$	Continuous on the interval $[a, b]$
	$\mathcal{C}^{-1}$	Curves including discontinuities
	$\mathcal{C}^0$	Continuous curves
	$\mathcal{C}^1$	Continuous first derivatives
	$\mathcal{C}^n$	Continuous first through n th derivatives

Variables	Symbols	Functions
Discrete variables	$i, j, k, (l), n, m, \ldots, T$	$f_k\,,\ P_k(t)\,,\ \ldots$
Continuous variables	$x, y, z, \ldots, r, s, t$	$f(x)\,,\ P(x, t)\,,\ \ldots$
Random variables	$\mathcal{A}, \mathcal{B}, \ldots, \mathcal{X}, \mathcal{Y}, \mathcal{Z}$	
discrete	$(\mathcal{X}, \mathcal{Y}, \mathcal{Z}, \ldots) \in \mathbb{N}$	$f(\mathcal{N}) = f_n\,, \ldots$
continuous	$(\mathcal{X}, \mathcal{Y}, \mathcal{Z}, \ldots) \in \mathbb{R}$	$f(\mathcal{X}) = f(x)\,, \ldots$

Vectors and Matrices

$\mathbf{a}$	(a_x, a_y, a_z)	Vector in 3D space
$\mathbf{a}$	$(a_1, a_2, \ldots, a_n)$	Vector in nD space
$\mathbf{e}_k$	$(0, \ldots, 1, \ldots, 0)$	Unit vector in the direction of the kth coordinate
A	$(a_{ij};\ i = 1, \ldots, n;$ $j = 1, \ldots, m)$	$n \times m$ rectangular matrix with n rows and m columns
A	$(a_{ij};\ i, j = 1, \ldots, n)$	$n \times n$ square matrix

Some Common Distributions

Symbol	Notation	Name
π	$\pi(\alpha)$	Poisson distribution
B	$B(n, p)$	Binomial distribution
$\mathcal{N}$	$\mathcal{N}(\mu, \sigma^2)$	Normal distribution
φ	$\mathcal{N}(0, 1)$	Standardized normal distribution
$\mathcal{U}$	$\mathcal{U}(\Omega)$	Uniform distribution over sample space Ω

Some Special Functions	Symbols	Expressions
Gamma function	$\Gamma(x)$	$(x-1)!$
Beta function	$B(x, y)$	$\int_0^1 t^{x-1}(1-t)^{y-1}\,\mathrm{d}t$
Pochhammer symbols		
Rising	$x^{(n)}$	$x(x+1)\cdots(x+n-1) = \frac{\Gamma(x+n)}{\Gamma(x)}$
Falling	$(x)_n$	$x(x-1)\cdots(x-n+1) = \frac{\Gamma(x+1)}{\Gamma(x-n+1)}$

Frequently Used Transforms

Fourier transform: $\mathcal{F}\big(f(x)\big)(k) = \tilde{f}(k) = \frac{1}{\sqrt{2\pi}} \int\limits_{-\infty}^{\infty} f(x)\, e^{\imath\, \mathrm{k\,x}}\, \mathrm{d}x$

Laplace transform: $\mathcal{L}\big(f(t)\big)(s) = \hat{f}(s) = \int\limits_{0}^{\infty} e^{-st} f(t)\ \mathrm{d}t$

Fourier-Laplace transform:

$\mathcal{LF}\big(f(x,t)\big)(k,s) = \hat{\tilde{f}}(k,s) = \frac{1}{\sqrt{2\pi}} \int\limits_{0}^{\infty} \int\limits_{-\infty}^{\infty} e^{-st}\, e^{\imath\, \mathrm{k\,x}} f(x,t)\, \mathrm{d}x\ \mathrm{d}t$

Dimensions	Symbols	Arbitrary Unit	Common unit
Temperature	T	[T]	Degree Kelvin: 1 °K
Time, cont.	t	[t]	Second: 1 s
discrete	T	[T]	Generation: 1 generation
Length	l	[l]	meter: 1 m = 100 cm = 1000 mm
Volume	V	[V]	liter: 1 l = 1 dm^3 = 0.001 m^3
Mass	m	[m]	gram: 1 g = 1000 mg = 1×10^{-6} μg
Number density	N/V	[N]	1 particle per liter
Mole	mol	[mol]	mole: 1 mol = N_{L} particles
Concentration	mol/V	[M]	1 molar = 1 mol per liter

Chemical Species	Variables	Random variables
Specific entities: **A**, **B**, ... ,	$a = [\mathbf{A}]$, $b = [\mathbf{B}]$, ... ,	$\mathcal{X}_{\mathbf{A}}$, $\mathcal{X}_{\mathbf{B}}$, ... ,
Unspecific entities: A, B, ...,	$a = [\mathsf{A}]$, $b = [\mathsf{B}]$, ...,	$\mathcal{X}_{\mathsf{A}}$, $\mathcal{X}_{\mathsf{B}}$, ... ,
$\mathsf{X}_1, \mathsf{X}_2$, ...,	$x_1 = [\mathsf{X}_1]$, $x_2 = [\mathsf{X}_2]$, ...,	$\mathcal{X}_{\mathsf{X}_1}$, $\mathcal{X}_{\mathsf{X}_2}$, ... ,
Autocatalysts: X, Y, ...,	$x = [\mathsf{X}]$, $y = [\mathsf{Y}]$, ...,	$\mathcal{X}_{\mathsf{X}}$, $\mathcal{X}_{\mathsf{Y}}$, ... ,
Individual molecules: A, B, ...		

Kinetics	Symbol	Usage
Rate function:	$v_\mu(\mathbf{x}) = \gamma_\mu h_\mu(\mathbf{x})$	Deterministic reaction $\mathbf{R}_\mu$
	$\chi_\mu(\mathbf{n}) = \gamma_\mu h_\mu(\mathbf{n})$	Stochastic reaction $\mathbf{R}_\mu$
Rate parameter:	γ_μ	Reaction $\mathbf{R}_\mu$
	k_μ, l_μ	Deterministic reaction $\mathbf{R}_\mu$
	κ_μ, λ_μ	Stochastic reaction $\mathbf{R}_\mu$
Stoichiometric factor:	$h_\mu(\mathbf{x}) = \prod_{j=1}^{M} x_j^{\nu_{j\mu}}$	Deterministic reaction $\mathbf{R}_\mu$
	$h_\mu(\mathbf{n}) = \prod_{j=1}^{M} (n_j)_{\nu_{j\mu}}$	Stochastic reaction $\mathbf{R}_\mu$
Extent of reaction:	$\boldsymbol{\xi}_\mu(\mathbf{x}) = \frac{\mathbf{x}-\bar{\mathbf{x}}}{\nu'_\mu - \nu_\mu}$	Deterministic reaction $\mathbf{R}_\mu$

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