Statistical Distribution Reference Tables

Continuous Distributions

Distribution	PDF	CDF
Normal N(μ, σ^2)	$f(x) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$	$F(x) = \Phi\left(\frac{x-\mu}{\sigma}\right)$
Exponential Exp(λ)	$f(x) = \lambda e^{-\lambda x}$	$F(x) = 1 - e^{-\lambda x}$
Gamma Γ(α, θ)	$f(x) = \frac{1}{\Gamma(\alpha)\theta^\alpha}x^{\alpha-1}e^{-x/\theta}$	$F(x) = \frac{\gamma(\alpha, x/\theta)}{\Gamma(\alpha)}$
Lognormal LogN(μ, σ^2)	$f(x) = \frac{1}{x\sigma\sqrt{2\pi}}\exp\left(-\frac{(\ln x-\mu)^2}{2\sigma^2}\right)$	$F(x) = \Phi\left(\frac{\ln x-\mu}{\sigma}\right)$
Beta Beta(α, β)	$f(x) = \frac{1}{B(\alpha,\beta)}x^{\alpha-1}(1-x)^{\beta-1}$	$F(x) = I_x(\alpha,\beta)$
Uniform U(a, b)	$f(x) = \frac{1}{b-a}$	$F(x) = \frac{x-a}{b-a}$
Chi-Square χ^2_k	$f(x) = \frac{1}{2^{k/2}\Gamma(k/2)}x^{k/2-1}e^{-x/2}$	$F(x) = \frac{\gamma(k/2, x/2)}{\Gamma(k/2)}$
Student's t t_ν	$f(x) = \frac{\Gamma((\nu+1)/2)}{\sqrt{\nu\pi}\Gamma(\nu/2)}\left(1+\frac{x^2}{\nu}\right)^{-(\nu+1)/2}$	No closed form
Cauchy C(x_0, γ)	$f(x) = \frac{1}{\pi\gamma}\left[1+\left(\frac{x-x_0}{\gamma}\right)^2\right]^{-1}$	$F(x) = \frac{1}{\pi}\arctan\left(\frac{x-x_0}{\gamma}\right)+\frac{1}{2}$
GEV (ξ ≠ 0) $t(y) > 0$	$f(y) = \frac{1}{\sigma}t(y)^{-1/\xi-1}\exp\left(-t(y)^{-1/\xi}\right)$ where $t(y) = 1+\xi\frac{y-\mu}{\sigma}$	$F(y) = \exp\left(-t(y)^{-1/\xi}\right)$
GEV (ξ = 0, Gumbel)	$f(y) = \frac{1}{\sigma}\exp\left(-\frac{y-\mu}{\sigma}\right)\exp\left(-\exp\left(-\frac{y-\mu}{\sigma}\right)\right)$	$F(y) = \exp\left(-\exp\left(-\frac{y-\mu}{\sigma}\right)\right)$
GPD (ξ ≠ 0) $1+\xi\frac{y}{\sigma} > 0$	$f(y) = \frac{1}{\sigma}\left(1+\xi\frac{y}{\sigma}\right)^{-1/\xi-1}$	$F(y) = 1-\left(1+\xi\frac{y}{\sigma}\right)^{-1/\xi}$
GPD (ξ = 0, Exponential)	$f(y) = \frac{1}{\sigma}\exp\left(-\frac{y}{\sigma}\right)$	$F(y) = 1-\exp\left(-\frac{y}{\sigma}\right)$

Discrete Distributions

Distribution	PMF	CDF
Bernoulli Bern(p)	$P(X=x) = p^x(1-p)^{1-x}$	$F(x) = \begin{cases} 0 & x < 0 \\ 1-p & 0 \le x < 1 \\ 1 & x \ge 1 \end{cases}$

Binomial Bin(n, p)	$P(X=k)=\binom{n}{k}p^k(1-p)^{n-k}$	$F(k)=\sum_{j=0}^{k}\binom{n}{j}p^j(1-p)^{n-j}$
Poisson Pois(λ)	$P(X=k)=\frac{\lambda^k e^{-\lambda}}{k!}$	$F(k)=e^{-\lambda}\sum_{j=0}^{k}\frac{\lambda^j}{j!}$
Geometric (failures)	$P(X=k)=(1-p)^k p$	$F(k)=1-(1-p)^{k+1}$
Negative Binomial NB(r, p)	$P(X=k)=\binom{k+r-1}{k}(1-p)^k p^r$	No closed form
Discrete Uniform U{a,…,b}	$P(X=k)=\frac{1}{b-a+1}$	Piecewise linear

Support Conditions

Distribution	**Support**
Normal	$x \in \mathbb{R}$
Exponential	$x \geq 0$
Gamma	$x > 0$
Lognormal	$x > 0$
Beta	$0 < x < 1$
Uniform	$a \leq x \leq b$
Chi-Square	$x > 0$
Student's t	$x \in \mathbb{R}$
Cauchy	$x \in \mathbb{R}$
GEV ($\xi > 0$)	$y > \mu - \sigma/\xi$
GEV ($\xi < 0$)	$y < \mu - \sigma/\xi$
GEV ($\xi = 0$)	$y \in \mathbb{R}$
GPD ($\xi > 0$)	$y \in [0, \infty)$
GPD ($\xi < 0$)	$y \in [0, -\sigma/\xi]$
GPD ($\xi = 0$)	$y \geq 0$
Bernoulli	$x \in \{0,1\}$
Binomial	$k = 0,1,\dots,n$
Poisson	$k = 0,1,2,\dots$
Geometric	$k = 0,1,2,\dots$
Negative Binomial	$k = 0,1,2,\dots$
Discrete Uniform	$k \in \{a, a+1, \dots, b\}$

Notes

Parameter Notation

- μ: mean (location)
- σ^2: variance
- σ: standard deviation (scale)
- α, β: shape parameters
- λ: rate parameter
- θ: scale parameter
- k, ν: degrees of freedom
- ξ: shape parameter (extreme value distributions)

Special Functions

- $\Phi(\cdot)$: Standard normal CDF
- $\Gamma(\cdot)$: Gamma function
- $\gamma(\cdot,\cdot)$: Lower incomplete gamma function
- $B(\cdot,\cdot)$: Beta function
- $I_x(\cdot,\cdot)$: Regularized incomplete beta function