The Gamma Function

$$\Gamma(\alpha) = \int_0^\infty x^{\alpha-1} e^{-x} dx$$

The Beta Function

$$B(\alpha, \beta) = \int_0^1 x^{\alpha-1}(1-x)^{\beta-1} dx = \frac{\Gamma(\alpha)\Gamma(\beta)}{\Gamma(\alpha+\beta)}$$

Some Important Discrete Probability Distributions

Distribution	Probability Function	Mean	Variance
Binomial(n, p)	$p(x) = \binom{n}{x} p^x (1-p)^{n-x}$ for $x = 0, 1, 2, \ldots, n$	np	$np(1-p)$
Bernoulli(p)	same as Binomial$(1, p)$		
Poisson(λ)	$p(x) = \frac{\lambda^x e^{-\lambda}}{x!}$ for $x = 0, 1, 2, \ldots$	λ	λ
Geometric(p)	$p(x) = p(1-p)^x$ for $x = 0, 1, 2, \ldots$	$\frac{1-p}{p}$	$\frac{1-p}{p^2}$

Some Important Continuous Probability Distributions

Distribution	Density Function	Mean	Variance
Uniform(a, b)	$f(x) = \frac{1}{b-a}$ for $a < x < b$	$\frac{b+a}{2}$	$\frac{(b-a)^2}{12}$
Normal(μ, σ^2)	$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-(x-\mu)^2/2\sigma^2}$ for $x \in \mathbb{R}$	μ	σ^2
Standard Normal	same as Normal$(0, 1)$		
Exponential(λ)	$f(x) = \lambda e^{-\lambda x}$ for $x > 0$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
Gamma(α, λ)	$f(x) = \frac{\lambda^\alpha}{\Gamma(\alpha)} x^{\alpha-1} e^{-\lambda x}$ for $x > 0$	$\frac{\alpha}{\lambda}$	$\frac{\alpha}{\lambda^2}$
Beta(α, β)	$f(x) = \frac{\Gamma(\alpha+\beta)}{\Gamma(\alpha)\Gamma(\beta)} x^{\alpha-1}(1-x)^{\beta-1}$ for $0 < x < 1$	$\frac{\alpha}{\alpha+\beta}$	$\frac{\alpha\beta}{(\alpha+\beta)^2(\alpha+\beta+1)}$
Chi-square(n)	same as Gamma $\left(\frac{n}{2}, \frac{1}{2}\right)$		