Notable distributions

Discrete

Name	Probability mass function (p.m.f.)	Range	Expectation	Standard deviation
Bernoulli (indicator variable) $X \sim I(p)$	$P(X=1) = p$) $P(X=0) = 1-p$		p	$\sqrt{p \cdot (1-p)}$
Binomial (sampling with replacement) $X \sim B_n(p)$	$P(X=k) = \binom{n}{k} \cdot p^k (1-p)^{n-k}$,	k = 0, 1, 2, …, n	np	$\sqrt{np \cdot (1-p)}$
Geometric (first success) $X \sim G(p)$	$P(X=k) = p \cdot (1-p)^{k-1}$,	k = 1, 2, …	$\frac{1}{p}$	$\frac{\sqrt{1-p}}{p}$
Negative binomial or Pascal (mth success) $X \sim Nb_m(p)$	$P(X=k) = \binom{k-1}{m-1} \cdot p^m (1-p)^{k-m}$,	k = m, m+1, …	$\frac{m}{p}$	$\sqrt{m} \cdot \frac{\sqrt{1-p}}{p}$
Hypergeometric (sampling without replacement) $X \sim Hg(N, M, n)$ $M<N,\ n \le \min\{M, N-M\}$	$P(X=k) = \frac{\binom{M}{k}\binom{N-M}{n-k}}{\binom{N}{n}}$,	k = 0, 1, 2, …, n	$n\frac{M}{N}$	$\sqrt{n\frac{M}{N}\left(1-\frac{M}{N}\right)\left(1-\frac{M-1}{N-1}\right)}$
Poisson $X \sim P(\lambda)$	$P(X=k) = \frac{\lambda^k}{k!} \cdot e^{-\lambda}$,	k = 0, 1, 2, …	λ	$\sqrt{\lambda}$
{1, 2, …, n} **Uniform** $X \sim E(1, 2, \dots, n)$	$P(X=k) = \frac{1}{n}$,	k = 1, 2, …, n	$\frac{n+1}{2}$	$\frac{\sqrt{n^2-1}}{2\sqrt{3}}$

Absolutely continuous

Name	Probability density function (p.d.f.)	Cumulative distribution function	Expectation	Standard deviation
[a,b] Uniform $X \sim U[a,b]$	$f(x) = \frac{1}{b-a}$, a≤x≤b	$F(x) = \frac{x-a}{b-a}$, a≤x≤b	$\frac{a+b}{2}$	$\frac{b-a}{2\sqrt{3}}$
Exponential $X \sim Exp(\lambda)$	$f(x) = \lambda e^{-\lambda x}$, x>0	$F(x) = 1 - e^{-\lambda x}$, x>0	$\frac{1}{\lambda}$	$\frac{1}{\lambda}$
Cauchy $X \sim C(\vartheta, \sigma),\ \sigma > 0$	$f(x) = \frac{1}{\pi\sigma}\frac{1}{1+(\frac{x-\vartheta}{\sigma})^2}$	$F(x) = \frac{1}{2} + \frac{1}{\pi} arctg \frac{x-\vartheta}{\sigma}$	*Does not exist*	*Does not exist*
Gamma $\Gamma_\alpha(\lambda), \alpha, \lambda > 0$	$f(x) = \frac{\lambda^n x^{n-1} e^{-\lambda x}}{\Gamma(\alpha)}$ x>0	$F(x) = \frac{\lambda^n}{(n-1)!} \cdot \int_0^x t^{n-1} e^{-\lambda t} dt$ x>0	$\frac{\alpha}{\lambda}$	$\frac{\sqrt{\alpha}}{\lambda}$
Gauss – Normal $X \sim N(\mu, \sigma^2)$	$f(x) = \frac{1}{\sqrt{2\pi}\sigma} \cdot e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	$F(x) = \int_{-\infty}^x f(t) dt$	μ	σ
Standard normal $X \sim N(0, 1)$	$\varphi(x) = \frac{1}{\sqrt{2\pi}} \cdot e^{-\frac{x^2}{2}}$	$\Phi(x) =$ *see quantile table!*	*0*	*1*
Pareto $X \sim P(\alpha, \beta)$ $\alpha>0, \beta>0$	$f(x) = \beta\alpha^\beta / x^{\beta+1}$ If x≥α	$F(x) = \int_\alpha^x f(t) dt$	$\frac{\alpha\beta}{\beta-1}$ β>1	$\sqrt{\frac{\alpha^2\beta}{(\beta-1)(\beta-2)}}$ β>2
Beta $X \sim B(a, b)$ a>0, b>0	$f(x) = \frac{1}{B(a,b)} \cdot x^{a-1}(1-x)^{b-1}$, $0 \le x \le 1$	$F(x) = \int_0^x f(t) dt$	$\frac{a}{a+b}$	$\sqrt{\frac{ab}{(a+b)^2(a+b+1)}}$
$\chi^2(n)$ $\equiv \Gamma_{\frac{n}{2}}\left(\frac{1}{2}\right)$ $X = \sum_{i=1}^n X_i^2$ $X_1 \dots X_n \sim N(0, 1)$ i.i.d.	$f(x) = x^{\frac{n}{2}-1} \cdot \frac{e^{-\frac{x}{2}}}{2^{\frac{n}{2}}\Gamma\left(\frac{n}{2}\right)}$	$F(x) = \int_0^x f(t) dt,\ x > 0$	n	$\sqrt{2n}$
Student t $X = \frac{Y}{\sqrt{Z/n}} \sim t(n)$ $Y \sim N(0, 1)$ $Z \sim \chi^2(n)$ indep.	$f(x) = \frac{1}{\sqrt{\pi \cdot n}} \frac{\Gamma\left(\frac{n+1}{2}\right)}{\Gamma\left(\frac{n}{2}\right)} \left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}}$		0 , if $n \ge 2$	$\sqrt{\frac{n}{n-2}}$, if $n \ge 3$
Fisher F $X = \frac{Y/n}{Z/m} \sim F(n, m)$ $Y \sim \chi^2(n)$ $Z \sim \chi^2(m)$ indep.	$f(x) = \frac{n\Gamma\left(\frac{n+m}{2}\right)\left(\frac{n}{m}x\right)^{\frac{n}{2}-1}}{m\Gamma\left(\frac{n}{2}\right)\Gamma\left(\frac{m}{2}\right)\left(1+\frac{n}{m}x\right)^{\frac{n+m}{2}}}$, $x > 0$		$\frac{m}{m-2}$ If m>2	$\sqrt{\frac{2m^2(m+n-2)}{n(m-2)^2(m-4)}}$ m>4

$$\Gamma(\alpha) = \int_0^\infty x^{\alpha-1} e^{-x} dx,\ \alpha > 0; \quad \Gamma(n) = (n-1)!, \quad B(a,b) = \frac{\Gamma(a) \cdot \Gamma(b)}{\Gamma(a+b)} \cdot$$