

DISTRIBUTION $X$	DENSITY FUNCTION $f_X(x)$	$E(X)$	$\text{Var}(X)$	PROBABILITY GENERATING FUNCTION $G_X(t)$ MOMENT GENERATING FUNCTION $M_X(t)$
uniform on $\{1, \dots, n\}$	$f(x) = \frac{1}{n}$ for $x = 1, 2, \dots, n$	$\frac{n+1}{2}$	$\frac{n^2-1}{12}$	$G_X(t) = \frac{t(t^n-1)}{n(t-1)}$ $M_X(t) = \frac{e^t(e^{nt}-1)}{n(e^t-1)}$
binomial( $n, p$ )	$f(x) = \binom{n}{x} p^x (1-p)^{n-x}$ for $x = 0, 1, \dots, n$	$np$	$np(1-p)$	$G_X(t) = (1-p+pt)^n$ $M_X(t) = (1-p+pe^t)^n$
<i>Geom</i> ( $p$ ) $0 < p < 1$	$f(x) = p(1-p)^x$ for $x = 0, 1, 2, \dots$	$\frac{1-p}{p}$	$\frac{1-p}{p^2}$	$G_X(t) = \frac{p}{1-(1-p)t}$ $M_X(t) = \frac{p}{1-(1-p)e^t}$
negative binomial <i>NB</i> ( $r, p$ )	$f(x) = \binom{r+x-1}{x} p^r (1-p)^x$ for $x = 0, 1, 2, \dots$	$r \frac{1-p}{p}$	$r \frac{1-p}{p^2}$	$G_X(t) = \left( \frac{p}{1-(1-p)t} \right)^r$ $M_X(t) = \left( \frac{p}{1-(1-p)e^t} \right)^r$
<i>Pois</i> ( $\lambda$ )	$f(x) = \frac{\lambda^x e^{-\lambda}}{x!}$ for $x = 0, 1, 2, \dots$	$\lambda$	$\lambda$	$G_X(t) = e^{\lambda(t-1)}$ $M_X(t) = e^{\lambda(e^t-1)}$
hypergeometric <i>Hyp</i> ( $n, r, k$ )	$f(x) = \frac{\binom{r}{x} \binom{n-r}{k-x}}{\binom{n}{k}}$ for $x = 0, 1, \dots, k$	$\frac{kr}{n}$	$\frac{kr}{n} \left( \frac{n-r}{n} \right) \frac{n-k}{n-1}$	not given here
$d$ -dimensional hypergeometric with parameters $n, (n_1, \dots, n_d), k$	$f(x_1, \dots, x_d) = \frac{\binom{n_1}{x_1} \binom{n_2}{x_2} \dots \binom{n_d}{x_d}}{\binom{n}{k}}$ for $x_1 + x_2 + \dots + x_d = k$	N/A	N/A	N/A
multinomial $n, (p_1, \dots, p_d)$	$f(x_1, \dots, x_d) = \frac{n!}{x_1! x_2! \dots x_d!} p_1^{x_1} p_2^{x_2} \dots p_d^{x_d}$ for $x_1 + x_2 + \dots + x_d = n$	N/A	N/A	N/A

DISTRIBUTION $X$	DENSITY FUNCTION $f_X(x)$ DISTRIBUTION FUNCTION $F_X(x)$	EXPECTED VALUE $EX$ VARIANCE $Var(X)$	MGF $M_X(t)$
uniform on $(a, b)$	$f(x) = \begin{cases} \frac{1}{b-a} & x \in (a, b) \\ 0 & \text{else} \end{cases}$ $F(x) = \begin{cases} 0 & x < a \\ \frac{x-a}{b-a} & x \in [a, b) \\ 1 & x \geq b \end{cases}$	$EX = \frac{a+b}{2}$ $Var(X) = \frac{(b-a)^2}{12}$	$M_X(t) = \frac{e^{tb} - e^{ta}}{t(b-a)}$
exponential with parameter $\lambda > 0$	$f(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$ $F(x) = \begin{cases} 1 - e^{-\lambda x} & x \geq 0 \\ 0 & x < 0 \end{cases}$	$EX = \frac{1}{\lambda}$ $Var(X) = \frac{1}{\lambda^2}$	$M_X(t) = \frac{\lambda}{\lambda - t} \text{ for } t < \lambda$
Cauchy	$f(x) = \frac{1}{\pi(1+x^2)}$ $F(x) = \frac{1}{2} + \frac{1}{\pi} \arctan x$	$EX = \infty$ $Var(X) \text{ DNE}$	$M_X(t) \text{ DNE}$
std. normal $n(0, 1)$	$f(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2}$ $F(x) = G(x)$	$EX = 0$ $Var(X) = 1$	$M_X(t) = e^{t^2/2}$
normal $n(\mu, \sigma^2)$	$f(x) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(\frac{-(x-\mu)^2}{2\sigma^2}\right)$ $F(x) = G\left(\frac{x-\mu}{\sigma}\right)$	$EX = \mu$ $Var(X) = \sigma^2$	$M_X(t) = \exp\left(\mu t + \frac{\sigma^2 t^2}{2}\right)$
gamma $\Gamma(r, \lambda)$	$f(x) = \begin{cases} \frac{\lambda^r}{\Gamma(r)} x^{r-1} e^{-\lambda x} & x > 0 \\ 0 & x \leq 0 \end{cases}$ $F_X \text{ not given here}$	$EX = \frac{r}{\lambda}$ $Var(X) = \frac{r}{\lambda^2}$	$M_X(t) = \left(\frac{\lambda}{\lambda - t}\right)^r \text{ for } t < \lambda$
$\chi^2(n) = \Gamma\left(\frac{n}{2}, \frac{1}{2}\right)$	$f(x) = \begin{cases} \frac{1}{(\sqrt{2})^n \Gamma(\frac{n}{2})} x^{\frac{n}{2}-1} e^{-\frac{1}{2}x} & x > 0 \\ 0 & x \leq 0 \end{cases}$ $F_X \text{ not given here}$	$EX = n$ $Var(X) = 2n$	$M_X(t) = \left(\frac{1}{1-2t}\right)^{\frac{n}{2}} \text{ for } t < \frac{1}{2}$
Beta $B(r_1, r_2)$	$f(x) = \begin{cases} \frac{\Gamma(r_1+r_2)}{\Gamma(r_1)\Gamma(r_2)} x^{r_1-1} (1-x)^{r_2-1} & x \in (0, 1) \\ 0 & \text{else} \end{cases}$ $F_X \text{ not given here}$	$EX = \frac{r_1}{r_1+r_2}$ $Var(X) = \frac{r_1 r_2}{(r_1+r_2)^2 (r_1+r_2+1)}$	$M_X(t) = 1 + \sum_{k=1}^{\infty} \left(\prod_{j=0}^{k-1} \frac{r_1+j}{r_1+r_2+j}\right) \frac{t^k}{k!}$
Student's $t$ -distribution (with $n$ degrees of freedom)	$f(x) = \frac{\Gamma(\frac{n+1}{2})}{\Gamma(\frac{n}{2})\sqrt{n\pi}} \left[1 + \frac{x^2}{n}\right]^{-\frac{n+1}{2}}$ $F_X \text{ not given here}$	$EX = 0$ $Var(X) \text{ DNE if } n \leq 2$ $Var(x) = \frac{n}{n-2} \text{ if } n > 2$	$\text{not given here}$
$F$ -distribution with parameters $n_1, n_2$	$f(x) = \frac{\Gamma(\frac{n_1+n_2}{2})}{\Gamma(\frac{n_1}{2})\Gamma(\frac{n_2}{2})} \left(\frac{n_1}{n_2}\right)^{\frac{n_1}{2}} x^{\frac{n_1}{2}-1} \left[1 + \frac{n_1}{n_2}x\right]^{-\frac{n_1+n_2}{2}}$ <p style="text-align: center;">(for <math>x &gt; 0</math>)</p> $F_X \text{ not given here}$	$EX \text{ DNE if } n_2 \leq 2$ $EX = \frac{n_2}{n_2-2} \text{ if } n_2 > 2$ $Var(X) \text{ DNE if } n_2 \leq 4$ $Var(X) = \frac{2n_2^2(n_1+n_2-2)}{n_1(n_2-2)^2(n_2-4)} \text{ if } n_2 > 4$	$\text{not given here}$
joint normal with mean vector $\vec{\mu}$ ; covariance matrix $\Sigma$	$f(\vec{x}) = \frac{1}{(2\pi)^{d/2} \sqrt{\det \Sigma}} \exp\left[-\frac{1}{2}(\vec{x} - \vec{\mu})^T \Sigma^{-1}(\vec{x} - \vec{\mu})\right]$	$\text{N/A}$	$\text{not given here}$