Summary of discrete distributions

Distribution	Parameters	$P(x)$	$E[X]$	$\mathrm{Var}[X]$	$M_X(t)$
Uniform	$N > 0$, Integer	$\frac{1}{N},\ x = 1, \dots, N$	$\frac{N+1}{2}$	$\frac{N^2-1}{12}$	$\frac{e^t\ (e^{Nt}-1)}{N(e^t-1)}$
Binomial	$n > 0$, $0 < p < 1$	$\binom{n}{x} p^x\ (1-p)^{n-x}$ $x = 0, 1, 2, \dots, n$	np	$np(1-p)$	$(1-p+pe^t)^n$
Poisson	$\lambda > 0$	$\frac{e^{-\lambda}\lambda^x}{x!}$ $x = 0, 1, 2, \dots$	λ	λ	$e^{\lambda(e^t-1)}$
Geometric	$0 < p < 1$	$(1-p)^x p$ $x = 0, 1, 2, \dots$	$\frac{1-p}{p}$	$\frac{1-p}{p^2}$	$\frac{p}{1-(1-p)e^t}$
Negative Binomial	$r > 0$, $0 < p < 1$	$\binom{r+x-1}{x} p^r\ (1-p)^x$ $x = 0, 1, 2, \dots$	$\frac{r(1-p)}{p}$	$\frac{r(1-p)}{p^2}$	$\left[\frac{p}{1-(1-p)e^t}\right]^r$
Hypergeometric	$N > 0, 0 \le r \le N$ $1 \le n \le N$, integers	$\frac{\binom{N-r}{n-x}\binom{r}{x}}{\binom{N}{n}}$ $x \le \min(n, r)$	$\frac{nr}{N}$	$\frac{nr}{N}\frac{N-r}{N}\frac{N-n}{N-1}$	$\sum_{x=0}^{n} \frac{\binom{r}{x}\binom{N-r}{n-x}}{\binom{N}{n}}\ e^{xt}$
Multinomial	$n, p_1, \dots, p_k$, $0 < p_i < 1$	$\frac{n!}{x_1!x_2!\dots x_k!}\ p_1^{x_1} \dots p_k^{x_k}$, $x_1 + x_2 + \dots + x_k = n$	$E[X_i] =$ np_i	$\mathrm{Var}[X] =$ $np_i(1-p_i)$	

Summary of continuous distributions

Distribution	Parameters	$f(x)$	$E[X]$	$\mathrm{Var}[X]$	$M_X(t)$
Uniform	$a < b$	$\frac{1}{b-a},\ a \le x \le b$	$\frac{b-a}{2}$	$\frac{(b-a)^2}{12}$	$\frac{e^{bt}-e^{at}}{(b-a)t}$
Normal	μ(any number), $\sigma^2 > 0$	$\frac{1}{\sigma\sqrt{2\pi}}\ e^{-\frac{1}{2}(\frac{x-\mu}{\sigma})^2},\ \ -\infty < x < \infty$	μ	σ^2	$e^{\mu t+\frac{1}{2}\sigma^2 t^2}$
Exponential	$\frac{1}{\lambda} = \theta > 0$	$\frac{1}{\theta}\ e^{-\frac{x}{\theta}},\ x > 0$	θ	θ^2	$\frac{1}{1-\theta t}$
Gamma	$k > 0,\ \theta > 0$	$\frac{1}{\Gamma(k)\ \theta^k}\ x^{k-1}\ e^{-\frac{x}{\theta}},\ \ x > 0$	$k\ \theta$	$k\ \theta^2$	$\left(\frac{1}{1-\theta t}\right)^k$
Chi-Square	k deg. of freedom.	$\frac{1}{\Gamma(\frac{k}{2})\ 2^{\frac{k}{2}}}\ x^{\frac{k}{2}-1}\ e^{-\frac{x}{2}},\ \ x > 0$	k	$2k$	$\left(\frac{1}{1-2t}\right)^{\frac{k}{2}}$
Pareto	$k > 0,\ \theta > 0$	$\frac{k}{\theta}\left(\frac{\theta}{x}\right)^{k+1},\ \ k > 2,\ x \ge\ \theta > 0$	$\frac{k\theta}{k-1}$	$\frac{k\ \theta^2}{(k-2)(k-1)^2}$	
Lognormal	μ(any number), $\sigma^2 > 0$	$\frac{1}{y\sigma\sqrt{2\pi}}\ e^{-\frac{1}{2}(\frac{\ln y-\mu}{\sigma})^2},\ \ y > 0$	$e^{\mu+\frac{1}{2}\sigma^2}$	$(e^{\sigma^2}-1)e^{2\mu+\sigma^2}$	
Weibull	$k > 0,\ \lambda > 0$	$k\lambda x^{k-1}e^{-\lambda x^k},\ \ x > 0$	$\frac{\Gamma(1+\frac{1}{k})}{\lambda^{\frac{1}{k}}}$	$\frac{\Gamma(1+\frac{2}{k})\Gamma(1+\frac{2}{k})^2}{\lambda^{\frac{2}{k}}}$	
Beta	$a > 0,\ b > 0$	$\frac{(a+b+1)!}{(a-1)!\ (b-1)!}\ x^{a-1}\ (1-x)^{b-1}$, $0 < x < 1$	$\frac{a}{a+b}$	$\frac{ab}{(a+b)^2(a+b+1)}$	

1. If X and Y are independent χ^2 distributions with n_1 and n_2 degrees of freedom, then $X + Y$ has χ^2 distribution with $n_1 + n_2$ degrees of freedom.

2. If $X_1, X_2, \dots,\ X_n$ is a random sample from a normal distribution $N(\mu, \sigma^2)$, then $Z = \sum_{i=1}^{n} \frac{(X_i - \mu)^2}{\sigma^2}$ is $\chi^2(n)$.

3. If $X_1, X_2, \dots,\ X_n$ is a random sample from a normal distribution $N(\mu, \sigma^2)$, then $Z = \sum_{i=1}^{n} \frac{(X_i - \bar{\mathrm{X}})^2}{\sigma^2}$ is $\chi^2(n-1)$.

4. If $X \sim N(0,1)$, then $X^2 \sim \chi^2(1)$.

$$
\begin{aligned}
\Gamma(n) &= \int_{-\infty}^{\infty} x^{n-1}\ e^{-x}\ dx \\
\Gamma(n) &= (n-1)\Gamma(n-1) = (n-1)!, \qquad \Gamma\left(\frac{1}{2}\right) = \sqrt{\pi} \\
\beta(a,b) &= \int_{0}^{1} x^{a-1}\ (1-x)^{b-1}\ dx \\
&= \frac{\Gamma(a).\Gamma(b)}{\Gamma(a+b)} = \frac{(a-1)!.(b-1)!}{(a+b+1)!}
\end{aligned}
$$