Random Variables

name (parameters)	probability function	expectation	variation	description
Discrete				
Bernouli (p)	$p(1) = p$, $p(0) = 1-p$	p	$p(1-p)$	A binary indicator of the success of an experiment successful w/ prob. p.
Binomial (n,p)	$p(i) = \binom{n}{i} p^i (1-p)^{n-i}$	np	$np(1-p)$	The number of successes that occur in n trials of an experiment with success probability p.
Poisson (Λ)	$P\{X=i\} = e^{-\Lambda} \frac{\Lambda^i}{i!}$	Λ	Λ	The number of events (i) that will occur (randomly) in a time interval in which Λ events would be expected to occur. Note: $\lambda = \frac{\Lambda}{t}$, where λ = average rate of occurrence
Geometric (p)	$p(n) = (1-p)^{n-1} p$	$\frac{1}{p}$	$\frac{1-p}{p^2}$	The number of trials (n) needed to get a success, where p is the probability that any trial succeeds,
Negative Binomial (r,p)	$p(n) = \binom{n-1}{r-1} p^r (1-p)^{n-r}$	$\frac{r}{p}$	$\frac{r(1-p)}{p^2}$	The number of trials (n) needed to get r successes where p is the probability of success in any trial
Hypergeometric (n,N,m)	$p(i) = \frac{\binom{m}{i}\binom{N-m}{n-i}}{\binom{N}{n}}$	np	$\left(\frac{N-n}{N-1}\right) np(1-p)$	The number (i) of members of a subpopulation of size m chosen when a sample of size n is chosen from a population of size N.
		where $p = \frac{m}{N}$		
Continuous				
Uniform (α,β)	$f(x) = \begin{cases} \frac{1}{\beta-\alpha} & \text{if } \alpha<x<\beta \\ 0 & \text{otherwise} \end{cases}$	$\frac{\alpha+\beta}{2}$	$\frac{(\beta-\alpha)^2}{12}$	A random variable evenly distributed over an interval
Normal (μ,σ^2)	$f(x) = \frac{e^{-\frac{(x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma}$	μ	σ^2	The limiting case of the sum of a large number of largely independent random variables none of which dominates.
Exponential (λ)	$f(t) = \begin{cases} \lambda e^{-\lambda t} & \text{if } t \geq 0 \\ 0 & \text{if } t<0 \end{cases}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$	The amount of time needed for an event to occur, given that events occur at rate λ.
$\lambda(t)$	$F(t) = 1 - e^{-\int_0^t \lambda(t)dt}$; $f(t) = \lambda(t) e^{-\int_0^t \lambda(t)dt}$			
Gamma (r,λ)	$f(t) = \frac{\lambda e^{-\lambda t} (\lambda t)^{r-1}}{\Gamma(r)}$, where $\Gamma(r) = \int_0^\infty e^{-x} x^{r-1} dx = (r-1)!$	$\frac{r}{\lambda}$	$\frac{r}{\lambda^2}$	The amount of time until r events occur, if they occur at rate λ.
Beta (a,b)	$f(x) = \begin{cases} \frac{1}{B(a,b)} x^{a-1}(1-x)^{b-1} & 0<x<1 \\ 0 & \text{otherwise} \end{cases}$, where $B(a,b) = \int_0^1 x^{a-1}(1-x)^{b-1}dx = \frac{\Gamma(a)\Gamma(b)}{\Gamma(a+b)}$	$\frac{a}{a+b}$	$\frac{ab}{(a+b)^2(a+b+1)}$	The conditional success probability given that $\underline{a+b}$ trials result in a successes (stats)

Notes

① $n-i \leq N-m$
② $i \leq m$
③ $i \leq n$

$\Longleftrightarrow n-(N-m) \leq i \leq \min(n,m)$