Special distributions

Discrete distributions

Name	Distribution		$E(X)$	$D(X)$
Bernoulli $X \sim \mathrm{I}(p)$	$P(X=0)=1-p$ $P(X=1)=p$		p	$\sqrt{p(1-p)}$
Binomial $X \sim \mathrm{BIN}(n,p)$	$P(X=k)=\binom{n}{k}p^k(1-p)^{n-k}$	$k=0,1,\ldots,n$	np	$\sqrt{np(1-p)}$
Poisson $X \sim \mathrm{POI}(\lambda)$	$P(X=k)=\frac{\lambda^k}{k!}e^{-\lambda}$	$k=0,1,2,\ldots$	λ	$\sqrt{\lambda}$
Pessimistic geometric $X \sim \mathrm{PGEO}(p)$	$P(X=k)=p(1-p)^k$	$k=0,1,\ldots$	$\frac{1-p}{p}$	$\frac{\sqrt{1-p}}{p}$
Geometric $X \sim \mathrm{GEO}(p)$	$P(X=k)=p(1-p)^{k-1}$	$k=1,2,\ldots$	$\frac{1}{p}$	$\frac{\sqrt{1-p}}{p}$
Negative binomial $X \sim \mathrm{NBIN}(m,p)$	$P(X=k)=\binom{k-1}{m-1}p^m(1-p)^{k-m}$	$k=m,m+1,\ldots$	$\frac{m}{p}$	$\sqrt{m}\frac{\sqrt{1-p}}{p}$
Discrete uniform $X \sim \mathrm{DU}(n)$	$P(X=k)=\frac{1}{n}$	$k=1,2,\ldots,n$	$\frac{n+1}{2}$	$\sqrt{\frac{n^2-1}{12}}$
Hipergeometric $X \sim \mathrm{HGEO}(N,M,n)$ $(M<N, n\leq M,$ $n \leq N-M)$	$P(X=k)=\frac{\binom{M}{k}\binom{N-M}{n-k}}{\binom{N}{n}}$	$k=0,1,\ldots,n$	$n\frac{M}{N}$	$\frac{N-M}{N}\sqrt{\frac{nM}{N-1}}$

Continuous distributions

Name	Probability density function		$E(X)$	$D(X)$
Exponential $X \sim \mathrm{EXP}(\lambda)$	$f(x)=\lambda e^{-\lambda x}$	$x \geq 0$	$\frac{1}{\lambda}$	$\frac{1}{\lambda}$
Normal (Gaussian) $X \sim \mathrm{N}(\mu,\sigma^2)$	$f(x)=\frac{1}{\sqrt{2\pi}\sigma}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$		μ	σ
Standard normal $X \sim \mathrm{N}(0,1)$	$f(x)=\frac{1}{\sqrt{2\pi}}e^{-\frac{x^2}{2}}$		0	1
Uniform $X \sim \mathrm{U}(a,b)$	$f(x)=\frac{1}{b-a}$	$a \leq x \leq b$	$\frac{a+b}{2}$	$\frac{b-a}{\sqrt{12}}$
Beta $X \sim \mathrm{B}(a,b)$ $(a,b>0)$	$f(x)=\frac{\Gamma(a+b)}{\Gamma(a)\Gamma(b)}x^{a-1}(1-x)^{b-1}$	$0 \leq x \leq 1$	$\frac{a}{a+b}$	$\sqrt{\frac{ab}{(a+b)^2(a+b+1)}}$
Gamma $X \sim \Gamma(n,\lambda)$	$f(x)=\frac{\lambda^n x^{n-1}e^{-\lambda x}}{\Gamma(n)}$	$x \geq 0$	$\frac{n}{\lambda}$	$\frac{\sqrt{n}}{\lambda}$
Cauchy $X \sim \mathrm{C}$	$f(x)=\frac{1}{\pi}\frac{1}{1+x^2}$		not exists	not exists

$\Gamma(\alpha)=\int_0^\infty x^{\alpha-1}e^{-x}\,\mathrm{d}x \quad (\alpha>0)$

$n \in \mathbb{Z}^+ \implies \Gamma(n)=(n-1)!$