Probability Distributions Cheat Sheet

Type	Name	Notation	Parameters	Probability Density Function (p.d.f.)	Mean	Variance
Discrete	Bernoulli	$X \sim Bern(p)$	p - probability of success	$P[X=x]=p^x(1-p)^{1-x}$	$E[X]=p$	$Var[X]=p(1-p)$
	Binomial	$X \sim Bin(n,p)$	p - probability of success n - number of trials	$P[X=x]=\binom{n}{x}p^x(1-p)^{n-x}$	$E[X]=np$	$Var[X]=np(1-p)$
	Poisson	$X \sim Poiss(\lambda)$	λ - mean	$P[X=x]=\frac{\lambda^x e^{-\lambda}}{x!}$	$E[X]=\lambda$	$Var[X]=\lambda$
Continuous	Normal	$X \sim N(\mu,\sigma^2)$	μ - mean σ^2 - variance	$f(x)=\frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	$E[X]=\mu$	$Var[X]=\sigma^2$
	Standard Normal	$Z \sim N(0,1)$		$f(z)=\frac{1}{\sqrt{2\pi}}e^{-\frac{z^2}{2}}$	$E[Z]=0$	$Var[Z]=1$
	Exponential	$X \sim \exp(\lambda)$	λ - reciprocal of mean	$f(x)=\lambda e^{-\lambda x}$	$E[X]=\frac{1}{\lambda}$	$Var[X]=\frac{1}{\lambda^2}$

Results:

1) The Binomial Distribution converges to the Poisson Distribution when n is large, p is small and $np<10$. We have $\lambda=np$.

2) The Binomial Distribution converges to the Normal Distribution when n is large and p is close to 0.5. We have $\mu=np$ and $\sigma^2=np(1-p)$.

3) A Normally Distributed random variable $X \sim N(\mu,\sigma^2)$ is converted to a Standard Normally Distributed random variable $Z \sim N(0,1)$ by using the formula: $Z=\frac{X-\mu}{\sigma}$.

4) Let be $X_1, X_2, \cdots, X_n$ be independent, identically distributed random variables with mean μ and variance σ^2. The **Central Limit Theorem** states that the distribution of the sample mean is: $\bar{X}=\frac{1}{n}\sum_{i=1}^{n} X_i \sim N(\mu, \frac{\sigma^2}{n})$ given that n is sufficiently large ($n>30$). If the population size N is finite, we add the finite population correction factor and the distribution of the sample mean is: $\bar{X}=\frac{1}{n}\sum_{i=1}^{n} X_i \sim N(\mu, \frac{\sigma^2(N-n)}{n(N-1)})$.

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