§1 Discrete Random Variables

Random Variable	Values	$P[X=i]$	$E[X]$	$\mathrm{Var}(X)$
Bernoulli(p) (Indicator)	$0,1$	$P[X=1]=p$ $P[X=0]=1-p$	p	$p(1-p)$
Bin(n,p)	$0,1,\dots,n$	$\binom{n}{i}p^i(1-p)^{n-i}$	np	$np(1-p)$
Hypergeometric(N,B,n)	$0,1,\dots,n$	$\frac{\binom{B}{i}\binom{N-B}{n-i}}{\binom{N}{n}}$	$n\frac{B}{N}$	$n\frac{B}{N}(1-\frac{B}{N})(\frac{N-n}{N-1})$
Uniform$\{1,\dots,n\}$	$1,2,\dots,n$	$\frac{1}{n}$	$\frac{n+1}{2}$	$\frac{n^2-1}{12}$
Geometric(p)	$1,2,3,\dots$	$(1-p)^{i-1}p$	$\frac{1}{p}$	$\frac{1-p}{p^2}$
Poisson(λ)	$0,1,2,\dots$	$\frac{\lambda^i}{i!}e^{-\lambda}$	λ	λ

§2 Continuous Random Variables

Random Variable	Values	p.d.f., $f_X(x)$	c.d.f., $P[X\le x]$	$E[X]$	$\mathrm{Var}(X)$
Uniform$[0,\ell]$	$[0,\ell]$	$\frac{1}{\ell}$	$\frac{x}{\ell}$	$\frac{\ell}{2}$	$\frac{\ell^2}{12}$
Exp(λ)	$[0,\infty)$	$\lambda e^{-\lambda x}$	$1-e^{-\lambda x}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
$\mathcal{N}(\mu,\sigma^2)$ (Gaussian)	$(-\infty,\infty)$	$\frac{1}{\sqrt{2\pi\sigma^2}}e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	$\Phi\left(\frac{x-\mu}{\sigma}\right)$	μ	σ^2

§3 Concentration Inequalities

Theorem (Markov's Inequality)

For nonnegative finite mean random variable X,

$$P[X\ge c]\le\frac{E[X]}{c}\qquad\forall c>0$$

Theorem (Chebyshev's Inequality)

For finite mean random variable X,

$$P[|X-E[X]|\ge c]\le\frac{\mathrm{Var}(X)}{c^2}\qquad\forall c>0$$

Theorem (Weak Law of Large Numbers)

For i.i.d. random variables $X_1,X_2,\dots$ with common expectation $E[X_i]=\mu\ \forall i$,

$$P\left[\left|\frac{1}{n}(X_1+X_2+\cdots+X_n)-\mu\right|<\varepsilon\right]\to 1\qquad\text{as } n\to\infty\qquad\forall\varepsilon>0$$