Formula Sheet

Counting Formulas: $n!$ $\quad \dfrac{n!}{(n-k)!}$ $\quad \binom{n}{k} = \dfrac{n!}{(n-k)!k!}$

$$
\begin{aligned}
P(A^c) &= 1 - P(A) \\
P(B) &= P(B \cap A) + P(B \cap A') \\
P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\
P(A \cup B \cup C) &= P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C) \\
A' \cap B' &= (A \cup B)'
\end{aligned}
$$

Law of total prob: $P(S) = P(S|A)P(A) + P(S|B)P(B) + P(S|C)P(C)$

Discrete Distributions

	pmf	CDF	$E(X)$	$V(X)$
Binomial (n, p)	$\binom{n}{x} p^x (1-p)^{n-x}$	$B(x; n, p)$	np	$np(1-p)$
Negative Binomial (r, p)	$\binom{r+x-1}{x} (1-p)^x p^r$	$NB(x; r, p)$	$\frac{r(1-p)}{p}$	$\frac{r(1-p)}{p^2}$
Hypergeometric (n, m, N)	$\frac{\binom{m}{x}\binom{N-m}{n-x}}{\binom{N}{n}}$	$HG(x; n, m, N)$	$n\frac{m}{N}$	$n(\frac{m}{N})(1-\frac{m}{N})\frac{N-n}{N-1}$
Poisson (λ)	$\frac{e^{-\lambda}\lambda^x}{x!}$	$POI(x; \lambda)$	λ	λ

Continuos Distributions

	domain	f(x)	CDF	$E(X)$	$V(X)$
Normal (μ, σ^2)	$(-\infty, \infty)$	$\frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{x-\mu}{2\sigma^2}}$	$\Phi(\frac{x-\mu}{\sigma})$	μ	σ^2
Uniform (a, b)	$[a, b]$	$\frac{1}{b-a}$	$\frac{x-a}{b-a}$	$\frac{b+a}{2}$	$\frac{(b-a)^2}{12}$
Exponential (λ)	$[0, \infty)$	$\lambda e^{-\lambda x}$	$1 - e^{-\lambda x}$	$1/\lambda$	$1/\lambda^2$
Gamma (α, β)	$[0, \infty)$	$\frac{1}{\beta^\alpha \Gamma(\alpha)} x^{\alpha-1} e^{-x/\beta}$	$\text{Gam}(x; \alpha, \beta)$	$\alpha\beta$	$\alpha\beta^2$

$$
\begin{aligned}
& & & (\text{if } X_i \sim \text{Exp}(\lambda)) \\
\text{CDF of } \max(X_1, \ldots, X_n) &= [F(x)]^n & &= [1 - e^{-\lambda x}]^n \\
\text{CDF of } \min(X_1, \ldots, X_n) &= 1 - [1 - F(x)]^n & &= 1 - e^{-n\lambda x}
\end{aligned}
$$