Formulae Sheet

$$\begin{split} \bar{x} &= \frac{\sum_{i=1}^n x_i}{n} & s^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n-1} \\ P(A^c) &= 1 - P(A) & P(A \cup B) = P(A) + P(B) - P(A \cap B) \\ P(A|B) &= \frac{P(A \cap B)}{P(B)} = \frac{P(B|A)P(A)}{P(B|A)P(A) + P(B|A^c)P(A^c)} \end{split}$$

Linear combination of random variables X and Y and fixed numbers a and b:

$$E[aX+bY]=aE[X]+bE[Y] \\ Var(aX+bY)=a^2Var(X)+b^2Var(Y) \text{ if } X \text{ and } Y \text{ are independent.}$$

Discrete Random Variables

Let X be a discrete random variable with a pmf of f(x) then

$$E[X] = \sum_{x} x f(x)$$

$$Var(X) = E[(X - E[X])^2] = \sum_{x} (x - E[X])^2 f(x) = E[X^2] - (E[X])^2$$

pmf	E(X)	Var(X)
$\pi^x (1-\pi)^{1-x}$	π	$\pi(1-\pi)$
$\binom{n}{x}\pi^x(1-\pi)^{n-x}$	$n\pi$	$n\pi(1-\pi)$
$(1-\pi)^x\pi$	$\frac{1-\pi}{\pi}$	$\frac{1-\pi}{\pi^2}$
$\frac{\lambda^x}{x!}e^{-\lambda}$	λ	λ

Continuous Random Variables

Let X be a continuous random variable with a pdf of f(x) then

$$E[X] = \int_{x \in \Omega_x} x f(x) \, dx$$

$$Var(X) = E[(X - E[X])^2] = \int_{x \in \Omega_x} (x - E[X])^2 f(x) \, dx = E[X^2] - (E[X])^2$$

pdf	E(X)	Var(X)
$\lambda e^{-\lambda x}$	$\frac{1}{\lambda}$	$\frac{1}{\lambda^2}$
$\frac{1}{b-a}$	$\frac{b+a}{2}$	$\frac{(b-a)^2}{12}$