Common Random Variables:

- $X \sim \textsf{Binomial}(n,p)$: $0 \le p \le 1, n \in \{1,2,\ldots\}$

$$\begin{aligned} p_X(k) &= \binom{n}{k} p^k (1-p)^{n-k} & k \in \{0,1,\ldots,n\} \\ E[X] &= np \\ Var[X] &= np(1-p) \\ M_X(t) &= (pe^t + 1 - p)^n \end{aligned}$$

- $X \sim \textsf{Geometric}(p)$: $0 \le p \le 1$

$$\begin{aligned} p_X(k) &= p(1-p)^{k-1} & k \in \{1,2,\ldots\} \\ E[X] &= \frac{1}{p} \\ Var[X] &= \frac{1-p}{p^2} \\ M_X(t) &= \frac{pe^t}{1-(1-p)e^t} \end{aligned}$$

- $X \sim \textsf{Poisson}(\lambda)$: $\lambda > 0$

$$\begin{aligned} p_X(k) &= \frac{\lambda^k}{k!} e^{-\lambda} & k \in \{0,1,2,\ldots\} \\ E[X] &= \lambda \\ Var[X] &= \lambda \\ M_X(t) &= \exp\big(\lambda(e^t - 1)\big) \end{aligned}$$

- $X \sim U(a,b)$: $b > a$

$$f_X(x) = \begin{cases} \frac{1}{b-a} & a < x < b \\ 0 & \text{else} \end{cases}$$
$$E[X] = \frac{a+b}{2}$$
$$Var[X] = \frac{(b-a)^2}{12}$$
$$M_X(t) = \frac{e^{tb} - e^{ta}}{t(b-a)}$$

- $X \sim \text{Exp}(\lambda)$: $\lambda > 0$

$$f_X(x) = \begin{cases} \lambda e^{-\lambda x} & x \geq 0 \\ 0 & \text{else} \end{cases}$$
$$E[X] = \frac{1}{\lambda}$$
$$Var[X] = \frac{1}{\lambda^2}$$
$$M_X(t) = \frac{\lambda}{\lambda - t}$$

- $X \sim \mathcal{N}(\mu, \sigma)$: $\sigma > 0$

$$f_X(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$
$$E[X] = \mu$$
$$Var[X] = \sigma^2$$
$$M_X(t) = \exp\left(\mu t + \frac{\sigma^2 t^2}{2}\right)$$