Distributions

- **Bernoulli Random Variable** $X \sim B(p)$ has probability mass function

$$p_X(1) = p \quad \text{and} \quad p_X(0) = 1 - p\,, \text{ where } 0 \leq p \leq 1,$$

$$E[X] = p \quad \text{and} \quad \mathrm{var}(X) = p(1-p).$$

- **Binomial Distribution** $S_n \sim B(n, p)$, has probability mass function

$$P(S_n = k) = p_{S_n}(k) = \binom{n}{k} p^k (1-p)^{n-k} \text{ for } k = 0, 1, \ldots, n,$$

$$E[S_n] = np \quad \text{and} \quad \mathrm{var}(S_n) = np(1-p).$$

- **Geometric Distribution** $X \sim G(p)$, has probability mass function

$$p_X(k) = p(1-p)^{k-1} \text{ for } k = 1,\ 2,\ \ldots,$$

$$E[X] = \frac{1}{p} \quad \text{and} \quad \mathrm{var}(X) = \frac{1-p}{p^2}.$$

- **Poisson Distribution** $X \sim P(\lambda)$, has probability mass function

$$p_X(k) = e^{-\lambda}\frac{\lambda^k}{k!} \text{ for } k = 0,\ 1,\ 2,\ \ldots,$$

$$E[X] = \lambda \quad \text{and} \quad \mathrm{var}(X) = \lambda.$$

- **Normal Distribution** $X \sim N(\mu, \sigma)$ has density function

$$f_X(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \text{ for } -\infty < x < \infty,$$

$$E[X] = \mu \quad \text{and} \quad \mathrm{var}(X) = \sigma^2$$

- **Uniform Distribution** $X \sim U(a, b)$ has density function

$$f_X(x) = \begin{cases} \frac{1}{b-a} & \text{for } x \in (a,b) \\ 0 & \text{otherwise} \end{cases},$$

$$E[X] = \frac{a+b}{2} \quad \text{and} \quad \mathrm{var}(X) = \frac{(b-a)^2}{12}$$

- **Exponential Distribution** $X \sim \exp(\lambda)$ has density function

$$f_X(x) = \begin{cases} \lambda e^{-\lambda x} & \text{for } x \geq 0 \\ 0 & \text{otherwise} \end{cases},$$

$$E[X] = \frac{1}{\lambda} \quad \text{and} \quad \mathrm{var}(X) = \frac{1}{\lambda^2}$$