Some possibly useful formulae

- Bernoulli random variable

$$p_X(0) = 1 - p \quad \text{and} \quad p_X(1) = p$$
$$E[X] = p$$
$$\mathrm{Var}(X) = p(1-p)$$

- Binomial random variable

$$p_X(k) = \binom{n}{k} p^k (1-p)^{n-k}$$
$$E[X] = np$$
$$\mathrm{Var}(X) = np(1-p)$$

- Geometric random variable

$$p_X(k) = (1-p)^{k-1} p$$
$$E[X] = \frac{1}{p}$$
$$\mathrm{Var}(X) = \frac{1-p}{p^2}$$

- Poisson random variable

$$p_X(k) = \frac{\lambda^k}{k!} e^{-\lambda}$$
$$E[X] = \lambda$$
$$\mathrm{Var}(X) = \lambda$$

- Uniform random variable, $U(a,b)$

$$f_X(x) = \begin{cases} 0 \text{ if } x \notin [a,b] \\ \dfrac{1}{b-a} \text{ if } x \in [a,b] \end{cases}$$

$$E[X] = \frac{a+b}{2} \qquad \mathrm{Var}(X) = \frac{(b-a)^2}{12}$$

- Normal random variable, $\mathcal{N}(\mu, \sigma^2)$

$$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$

$$E[X] = \mu \qquad \mathrm{Var}(X) = \sigma^2$$

- Exponential random variable, $Exp(\lambda)$, with $\lambda > 0$

$$f_X(x) = \begin{cases} 0 \text{ if } x < 0 \\ \lambda e^{-\lambda x} \text{ if } x \geq 0 \end{cases}$$

$$E[X] = \frac{1}{\lambda} \qquad \text{Var}(X) = \frac{1}{\lambda^2}$$

- Gamma random variable, $\text{Gam}(i, \lambda)$, with $\lambda > 0$ and $i \in \mathbb{N}^*$

$$f_X(x) = \begin{cases} 0 \text{ if } x < 0 \\ \lambda \frac{(\lambda x)^{i-1} e^{-\lambda x}}{(i-1)!} \text{ if } x \geq 0 \end{cases}$$

$$E[X] = \frac{i}{\lambda} \qquad \text{Var}(X) = \frac{i}{\lambda^2}$$

- Markov's inequality

$$E[X] \geq aP(X \geq a)$$

- Chebyshev's inequality

$$P(|X - E[X]| \geq |a|) \leq \frac{1}{a^2}\text{Var}(X)$$

- Covariance

$$\text{Cov}(X,Y) = E[(X - E[X])(Y - E[Y])] = E[XY] - E[X]E[Y]$$

- Correlation coefficient

$$\rho(X,Y) = \frac{\text{Cov}(X,Y)}{\sqrt{\text{Var}(X)\text{Var}(Y)}}$$