CS70 - Final Cheat Sheet

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Distributions Review

Uniform $(U[1, \cdots, n]); m = 1, \ldots, n$

- $\Pr[X = m] = \frac{1}{n}$
- $E[X] = \frac{n+1}{2}$
- $\text{Var}[X] = \frac{1}{12}(b-a)^2$

Binomial $(B(n,p)); m = 0, \ldots, n$

- $\Pr[X = m] = \binom{n}{m} p^m (1-p)^{n-m}$
- $E[X] = np$
- $\text{Var}[X] = np(1-p)$

Bernoulli $(B(p)); m = 0, \ldots, n$

- $\Pr[X = m] = p^m (1-p)^{n-1}$
- $E[X] = p$
- $\text{Var}[X] = p(1-p)$

Geometric $(G(p)); n = 1, 2, \ldots$

- $\Pr[X = n] = (1-p)^{n-1} p$
- $E[X] = \frac{1}{p}$
- $\text{Var}[X] = \frac{1-p}{p^2}$

Poisson $(P(\lambda)); n \geq 0$

- $\Pr[X = n] = \frac{\lambda^n}{n!} e^{-\lambda}$
- $E[X] = \lambda$
- $\text{Var}[X] = \lambda$

Indicator $X = 1$ **or** 0

- $\Pr[X = 1] = p$, $\Pr[X = 0] = (1-p)$
- $E[X] = p$
- $\text{Var}[X] = p(1-p)$

Continuous RVs

Memoryless Expo
Let X =Expo(λ). Then, for $s, t > 0$

$$\Pr[X > t + s | X > s] = \Pr[X > t] \tag{1}$$

Scaling Expo
Let X =Expo(λ) and $Y = aX$ for some $a > 0$

$$\Pr[Y > t] = \text{Expo}(\lambda/a) \tag{2}$$

$$a \times \text{Expo}(\lambda) = \text{Expo}(\lambda/a) \tag{3}$$

Scaling Uniform
Let $X = U[0, 1]$ and $Y = a + bX$ where $b > 0$

$$\Pr[Y \in (y, y + \delta)] = \frac{1}{b}\delta, \text{ for } a < y < a + b \tag{4}$$

$$f_Y(y) = \frac{1}{b} \text{ for } a < y < a + b \implies Y = U[a, a + b] \tag{5}$$

Scaling PDF
Let $f_X(x)$ be the pdf of X and $Y = a + bX$ where $b > 0$

$$\Pr[Y \in (y, y + \delta)] = f_X(\frac{y - a}{b})\frac{\delta}{b} \tag{6}$$

$$f_Y(y) = \frac{1}{b} f_X(\frac{y - a}{b}) \tag{7}$$