

CSE 107
Probability and Statistics for Engineers
Information for Midterm 1

Mean and Variance Formulas:

$$E[aX + b] = aE[X] + b$$

$$E[a_1X_1 + a_2X_2 + \cdots + a_nX_n] = a_1E[X_1] + a_2E[X_2] + \cdots + a_nE[X_n]$$

$$\text{Var}(aX + b) = a^2\text{Var}(X)$$

Summation Formulas:

$$\sum_{k=0}^{n-1} ar^k = a \left(\frac{1-r^n}{1-r} \right) \quad \text{for any } r \neq 1$$

$$\sum_{k=0}^{\infty} ar^k = a \left(\frac{1}{1-r} \right) \quad \text{for } -1 < r < 1$$

$$\sum_{k=1}^n k = \frac{n(n+1)}{2}$$

$$\sum_{k=1}^n k^2 = \frac{n(n+1)(2n+1)}{6}$$

$$\sum_{k=1}^n k^3 = \left(\frac{n(n+1)}{2} \right)^2$$

Discrete Random Variables:

Uniform on the interval $[a, b] = \{a, a+1, a+2, \dots, b\}$, where $a, b \in \mathbb{Z}$

$$p_X(k) = \begin{cases} \frac{1}{b-a+1} & \text{if } a \leq k \leq b \\ 0 & \text{otherwise} \end{cases}$$

$$E[X] = \frac{a+b}{2}$$

$$\text{Var}(X) = \frac{(b-a)(b-a+2)}{12}$$

Bernoulli with parameter p

$$p_X(k) = \begin{cases} p & \text{if } k = 1 \\ 1 - p & \text{if } k = 0 \end{cases}$$

$$E[X] = p$$

$$Var(X) = p(1 - p)$$

Binomial with parameters n, p

$$p_X(k) = \begin{cases} \binom{n}{k} p^k (1 - p)^{n-k} & \text{if } 0 \leq k \leq n \\ 0 & \text{otherwise} \end{cases}$$

$$E[X] = np$$

$$Var(X) = np(1 - p)$$

Geometric with parameter p

$$p_X(k) = \begin{cases} (1 - p)^{k-1} \cdot p & \text{if } k = 1, 2, 3, \dots \\ 0 & \text{otherwise} \end{cases}$$

$$E[X] = \frac{1}{p}$$

$$Var(X) = \frac{1 - p}{p^2}$$

Poisson with parameter λ

$$p_X(k) = \begin{cases} e^{-\lambda} \cdot \frac{\lambda^k}{k!} & \text{if } k = 0, 1, 2, 3, \dots \\ 0 & \text{otherwise} \end{cases}$$

$$E[X] = \lambda$$

$$Var(X) = \lambda$$