ECS 132 Notes

Mentioned Exampl

ALOHA Network

Bus Ridership

Preferential Attachment Matrix

Dice Problem

Formulas, Equations, Rules

Lower case letter c will repsresent a constant

Basic Rules

If events are independent:

$$P(A \ or \ B) = P(A) + P(B)$$
$$P(A \ and \ B) = P(A) \cdot P(B)$$
$$p(AandB) = P(A)P(B|A)$$
$$P(B|A) = \frac{P(A \ and \ B)}{P(A)}$$

Bayes' Rule

$$P(A|B) = \frac{P(A)P(B|A)}{P(A)P(B|A) + P(not \ A)P(B|not \ A)}$$

Expected Value

$$E(X) = \sum_{c \in A} cP(X = c)$$

$$E(U + V) = E(U) + E(V)$$

$$E(cU) = c \cdot EU$$

$$E(UV) = EU \cdot EV$$

$$E[g(X)] = \sum_{c \in A} g(c) \cdot P(X = c)$$

Variance

$$Var(U) = E[(U - EU)^2] \qquad \text{(Variance Definition)}$$

$$Var(U) = E(U^2) - (EU)^2$$

$$Var(cU) = c^2 Var(U)$$

$$Var(U + c) = Var(U)$$

$$\text{coef. of var.} = \frac{\sqrt{Var(X)}}{EX}$$

Covariance

$$Cov(U, V) = E[(U - EU)(V - EV)]$$

$$Cov(U, V) = E(UV) - EU \cdot EV$$

Distribution

The **Probability Mass Function** (pmf) of a discrete random variable V, denoted p_V, as

$$p_V(k) = P(V = k)$$

Example: Toss Coin Until First Head

$$p_N(k) = \frac{1}{2^k}, k = 1, 2, \ldots$$

Parameteric Families of pmfs

Notations

N choose M notation: $\binom{N}{M}$ This represetn how many combinations are there to choose M elements from N elemetns.

Eg:

68 students, among them, 48 cs students, choose 4 from 68 that are exactly 2 cs to other major:

$$\frac{\binom{48}{2}\binom{20}{2}}{\binom{68}{4}}$$