ECE 313: Lecture 18
Review Chapters 1 & 2
Cumulative distribution function (CDF)

$(\Omega, \mathcal{F}, P)$

$\Omega = \{\omega : \omega - \text{outcome}\}$

$\mathcal{F} = \{A : A \subset \Omega - \text{event}\}$

P : prob

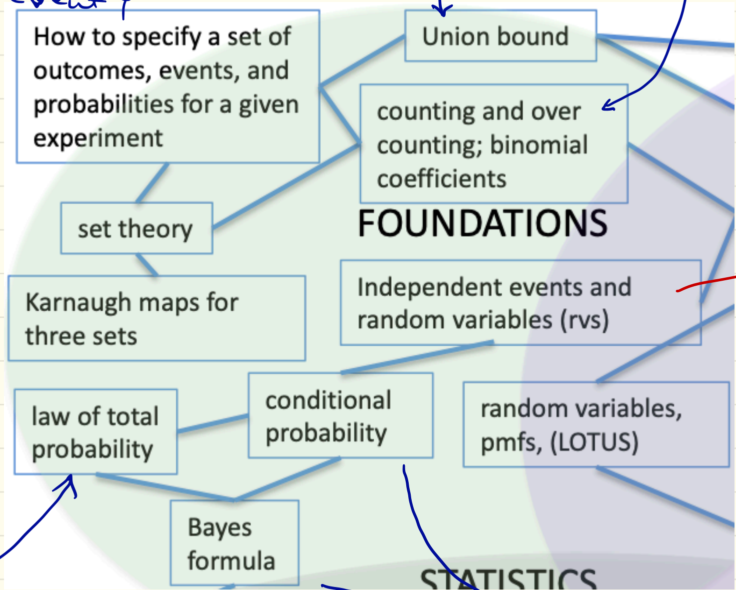
* $P(A \cup B) = P(A) + P(B)$ if A & B disjoint

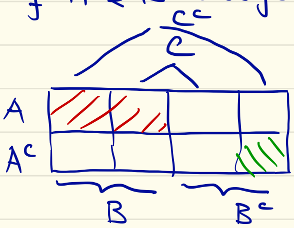
$P(A \cup B) = P(A) + P(B) - P(AB) \le P(A) + P(B)$

If all ω in Ω are equally probable

$$P(A) = \frac{|A|}{|\Omega|}$$

$$\binom{n}{k} = \#\text{ of subsets of } k \text{ items from } n = \frac{n\cdot(n-1)\dots(n-k+1)}{k(k-1)\dots 1}$$





AB $\qquad$ $A^cB^cC^c$

Ind.

$P(AB) = P(A)P(B)$

$P(X=m, Y=n) = P(X=m)\,P(Y=n)$

$\Omega \xrightarrow{\text{partion}} E_1, E_2, \dots$

$$P(A) = P(AE_1) + P(AE_2) + \dots$$
$$= P(E_1)\,P(A|E_1) + P(E_2)\,P(A|E_2) + \dots$$

$$P(AB) = P(A)\cdot P(B|A)$$

$$P(E_i|A) = \frac{P(E_i)P(A|E_i)}{\quad}$$

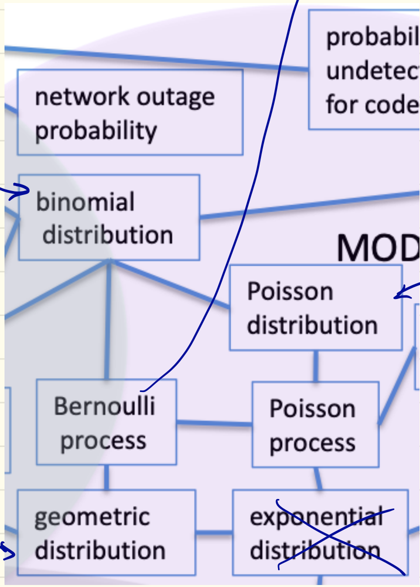
$X \sim \text{Binom}(n, p)$

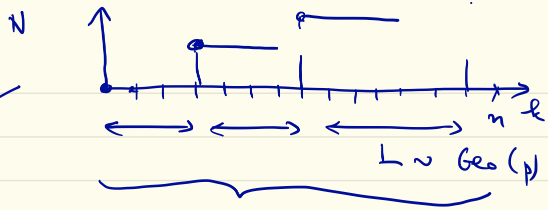
$p_X(k) = P\{X = k\}$

$= \binom{n}{k} p^k (1-p)^{n-k}$

$E[X] = np$

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





$N \sim \text{Binom}(n, p)$

$X \sim \text{Poi}(\lambda)$

$p_X(k) = \frac{e^{-\lambda} \lambda^k}{k!}$

$E[X] = \lambda$

$Var[X] = \lambda$

$X \sim \text{Geom}(p)$

$p_X(k) = (1-p)^{k-1} p$

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

$Var[X] = \frac{1-p}{p^2}$

X : nonnegative rv

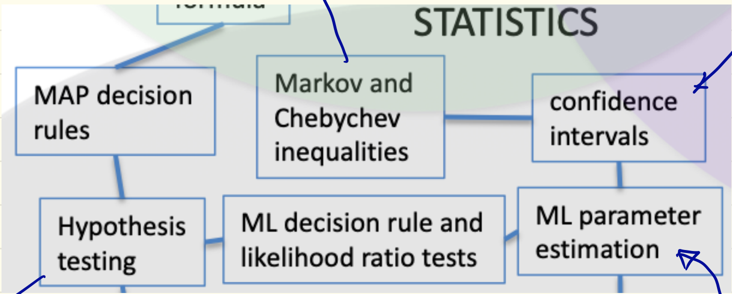
$$P(X \ge t) \le \frac{E[X]}{t}$$

$$P(|X - E[X]| \ge t) \le \frac{Var[X]}{t^2}$$

$$X \sim Binom(n, p)$$

$$\hat{p} = \frac{X}{n}$$

$$P\left(|p - \hat{p}| \le \frac{a}{2\sqrt{n}}\right) \ge 1 - \frac{1}{a^2}$$



	X: 1	2	3	...
H_1	...	...	$p(X=3 \mid H_1)$	
H_0				

$\Lambda(k)$ $\qquad \frac{1}{0}$

$$X \sim P_\theta$$

$$P(\underset{\text{given}}{X = k} \mid P_\theta) = func(\theta)$$

ML $\max_\theta$

$G_1, G_2, \dots, G_6, A_1, \dots, A_4$

A basketball team is composed of 10 players, 6 of which are considered to be "very good", and 4 "average". At any given time on a basketball game, only 5 players are in the field. Let's assume that we decide on the 5 players at the beginning of the game, and that they play the whole game. Let's denote the selected 5 players as the *playing team*. We say that the *playing team* is good if at least 3 out of the 5 players are "very good". Find the probability that a *playing team* is good.

$$|\Omega| = \binom{10}{5}$$

$$|E| = \underbrace{\binom{6}{3}}_{\text{good}} \underbrace{\binom{4}{2}}_{\text{average}} + \binom{6}{4}\binom{4}{1} + \binom{6}{5}\binom{4}{0}$$

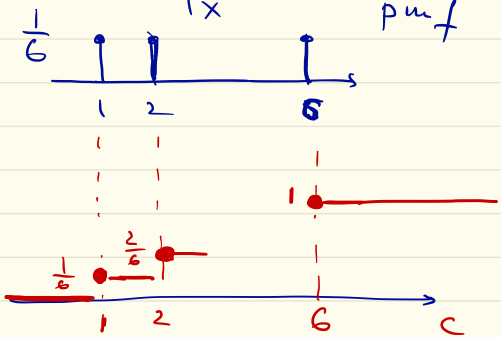
$$P(E) = \frac{|E|}{|\Omega|}$$

X : r.v.

$$P\{X \le c\} \overset{def}{=} F_X(c) \quad \left(\text{Cummulative Distn Func.}\right)$$

p_X pmf

Ex : X :



F_X

$$F_X(c) = \sum_{k \le c} p_X(k)$$

$$F_X(c) = \begin{cases} 0 & c < 1 \\ \frac{1}{6} & 1 \le c < 2 \\ \frac{2}{6} & 2 \le c < 3 \\ \vdots & \\ 1 & c \ge 6 \end{cases}$$