10%

(No att) → 80%

me
1 shresh
2 arnav
3 karan
5.
6.

2 Ass → coding (real life qn. Python/R)

← Proj → 6 people → last 2 week

absolute : 4 : 95

2 Quiz

mid / End → in class
↳ everything.

wed : 2 → 3 } office hours
friday : TBA }

Rev :-

Random Exp :

toss a coin

Random Variable.
discrete

$X : \Omega \to R$

X : # of heads

	1	0
$P(X=x)$:	1/2	1/2

throw a die.

X : # on die

$P(\cancel{X}=x)$	1	2	3	4	5	6
	1/6	-	-	-	-	1/6

Pmf

$P(X_i = x_i) \geq 0$

$\Sigma P(X_i = x_i) = 1$

continuous RV :

PDF : $f_x(x) \geq 0$, $\int f_X(x)\, dx = 1$

CDF : $F_X(x) = P(X \leq x)$

$$F_X(x) = \int_{-\infty}^{x} f_X(u)\, du$$

multiple RV :

$RE_1 \quad \Omega = \{H,T\}$ $\qquad$ $RE_2 \quad \Omega = \{H,T\}$

X_1 : # of H $\qquad$ X_2 = # of H.

$\underset{\sim}{X} = (X_1, X_2)$: Joint RV : vector of RV (2-D RV)

$P(\underset{\sim}{X} = \underset{\sim}{x}) = P(X_1 = x_1, X_2 = x_2) \geq 0$

$\underset{\underset{\sim}{x} = \Omega}{\Sigma} P(\underset{\sim}{X} = \underset{\sim}{x}) = 1$

we make n-D RV

$\underset{\sim}{X} = (X_1 \cdots X_n) \to$ n dim vector.

A_1 & A_2 are ind.

$$P(A_1 \cap A_2) = P(A_1)P(A_2)$$

$P(\underset{\sim}{X} = \underset{\sim}{x})$: Joint pmf.

$$P(\underset{\sim}{X} = \underset{\sim}{x}) = P(X_1 = x_1, X_2 = x_2 \cdots X_n = x_n)$$
$$= \prod_{i=1}^{n} P(X_i = x_i)$$

if all $X_i \sim$ Bernoulli$(p) \to$ identically distributed RV.

$$P(X_1 = 1, \cdots X_n = 1) = p^{x}$$

if $n=3$, $X_1 \sim Ber(p)$, $X_2 \sim Binom(N, p)$, $X_3 \sim Poisson(\lambda)$

$$P(X_1 = x_1, X_2 = x_2, X_3 = x_3) = \prod P(X_i = x_i)$$

not identical

IIDs (Independent & Identical Distributions).

CDF. $F_{\underset{\sim}{X}}(x) = P(\underset{\sim}{X} \le \underset{\sim}{x}) = P(X_1 \le x_1, X_2 \le x_2 \cdots X_n \le x_n)$

$= \prod_{i=1}^{n} P(X_i \le x_i)$ if X_is are independent

$= \prod_{i=1}^{n} F_{X_i}(x_i)$

$\hookrightarrow$ marginal CDFs.

if X_i are identically distribution.
easy to mult.

$\underset{\sim}{X} = (X_1 \cdots X_n)$

$P(X_i = x_i)$ = marginal pmf

$F_{X_i}(x_i)$ = " CDF

$\underset{\sim}{X} = (X_1 - \cdots - X_n)$ $\quad P(X_i = x_i)$ & $F_{X_i}(x_i)$ as PMF & CDF

X_i's are independent.

i) $F_{\underset{\sim}{X}}(\underset{\sim}{x})$ $\quad$ ii) $P_{\underset{\sim}{X}}(\underset{\sim}{x})$ $\Big\}$ → simply multiply.

$\underset{\sim}{X} = (X_1 \cdots X_n)$, we are given $F_{\underset{\sim}{X}}(\underset{\sim}{x})$ find $F_{X_i}(x_i)$

$$\boxed{F_{\underset{\sim}{X}}(\infty, \infty, \infty, x_i, \infty \cdots \infty) = F_{X_i}(x_i)}$$

$F_{X_1}(x_1) = P(X_1 \le x_1, -\infty < X_2 < \infty)$ | $P(X_1 < x_1, 0 < X_2 < \infty)$

$= \int_{-\infty}^{x_1} \int_{-\infty}^{\infty} f_{\underset{\sim}{x}}(\underset{\sim}{x})\, dx$ | $= \sum_{u=0}^{x_1} \sum_{v=0}^{\infty} P(X_1 = u, X_2 = v)$

finding 2 out of n

$$F_{X_1 X_2}(x_1, x_2) = P(X_1 < x_1, X_2 < x_2, 0 < X_3 < \infty \cdots 0 < X_n < \infty)$$

$$= \sum_{u_1 = 0}^{x_1} \sum_{u_2 = 0}^{x_2} \sum_{u_3 = 0}^{\infty} \cdots \sum_{u_n = 0}^{\infty} \left(P(X_1 = u_1, X_2 = u_2 \cdots X_n = u_n) \right)$$

$X_1 \perp\!\!\!\perp X_2$: X_1, X_2 independent.

$X_1 X_2 X_3$: independent : pairwise independent. $\quad X_1 \perp\!\!\!\perp X_2$, mutual indep.

$X_1 \perp\!\!\!\perp X_3 \quad P(X_1 X_2 X_3)$

$X_2 \perp\!\!\!\perp X_3 \quad = P(X_1) P(X_2) P(X_3)$

$X_1 \cdots X_n$ for pairs

triplets & mutual independence.

quadruplets

⋮

n