

# PROBABILITY

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IITH Future Wireless Communication (FWC)

Module 2

## Q-12,13.4,9

The random variable  $X$  has a probability distribution  $P(X)$  of the following form. where  $k$  is some number:

$$P(X) = \begin{cases} k, & \text{if } x=0 \\ 2k, & \text{if } x=1 \\ 3k, & \text{if } x=2 \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

- a) Determine the value of  $k$   
b) Find  $P(X < 2), P(X \leq 2), P(X \geq 2)$

### Solution

If we expand the probabilities given further more by substituting the value of  $x$  and only considering 0 to 4 hours as the probability of studying in the remaining hours is zero, we get

$x$	0	1	2
$\Pr(X = x)$	$k$	$2k$	$3k$

we also know that,

$$\sum_{k=0}^2 \Pr(X = k) = 1 \quad (2)$$

By substituting the probabilities in (??)

$$\Rightarrow k + 2k + 3k = 1 \quad (3)$$

$$\Rightarrow 6k = 1 \quad (4)$$

$$k = 0.167 \quad (5)$$

$x$	0	1	2
$\Pr(X = x)$	0.167	0.334	0.501

We know that, Cumulative Distributive Function (CDF)

$$F(x) = \Pr(X \leq x) \quad (6)$$

$x$	0	1	2
$F(X)$	0.167	0.501	1.00

And also,

$$\Pr(x < X \leq y) = F(y) - F(x) \quad (7)$$

1.  $P(X < 2)$

$$\Rightarrow \sum_{k=0}^1 \Pr(X = k) = \Pr(X \geq 2) \quad (8)$$

$$\Rightarrow \Pr(0 < X \leq 1) \quad (9)$$

$$= F(1) \quad (10)$$

$$= 0.501 \quad (11)$$

2.  $P(X \leq 2)$

$$\implies \sum_{k=0}^2 \Pr(X = k) = \Pr(X \leq 2) \quad (12)$$

$$= F(2) \quad (13)$$

$$= 1 \quad (14)$$

3.  $P(X \geq 2)$

$$\implies \Pr(1 < X \leq 2) \quad (15)$$

$$= F(2) - F(1) \quad (16)$$

$$= 1.002 - 0.501 \quad (17)$$

$$= 0.501 \quad (18)$$