Assignment2

CS20Btech11035 -NYALAPOGULA MANASWINI

Download python code from

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https://github.com/N−Manaswini23/Assignment−2/
    blob/main/assignment2%20(2).py
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GATE QUESTION 63

Let the random variable X have the distribution function:

$$F(x) = \begin{cases} 0 & x < 0 \\ \frac{x}{2} & 0 \le x < 1 \\ \frac{3}{5} & 1 \le x < 2 \\ \frac{1}{2} + \frac{x}{8} & 2 \le x < 3 \\ 1 & x \ge 3 \end{cases} \tag{0.0.1}$$

Then $P(2 \le X \le 4)$ is equal to

SOLUTION

The given function is cumulative didtribution function(cdf) but not probability density function ,because integration over given intervals exceeds 1.
Let X be a binomial random variable.
Cumulative distribution function F(x) is given in (0.0.1)
We know that

$$F_X(r) = \Pr(X \le r) \tag{0.0.2}$$

S.No	x(range)	F(x)
1	$x < 0$	0
2	$0 \le x < 1$	$\frac{x}{2}$
3	$1 \le x < 2$	$\frac{3}{5}$
4	$2 \le x < 3$	$\frac{1}{2} + \frac{x}{8}$
5	$3 \le$ x	1

TABLE 0: This is table 1

We need to find $P(2 \le X < 4)$,we know that

$$P(a \le X < b) = P(0 \le X < b) - P(0 \le X < a) \tag{0.0.3}$$

$$= \sum_{k=0}^{b} P(X = k) - \sum_{k=0}^{a} P(X = k) \tag{0.0.4}$$

$$= F(b) - F(a) \tag{0.0.5}$$

$$\therefore P(2 \le X < 4) = F(4) - F(2) \tag{0.0.6}$$

According to piecewise function given in the question:
$4 > 3$.

$$\therefore F(4) = 1 \tag{0.0.7}$$

$$F(2) = \frac{3}{5} \tag{0.0.8}$$

This is because if we take $\frac{1}{2} + \frac{x}{8}$ then $X = 2$ will not included (we get value $P(2 < X < 4)$).
Substituting (0.0.8) and (0.0.7) in (0.0.6)

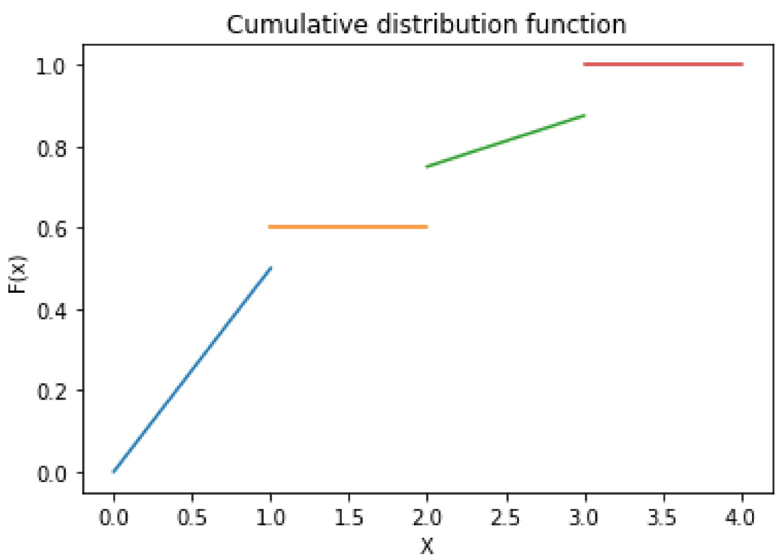
$$P(2 \le X < 4) = F(4) - F(2) \tag{0.0.9}$$

$$= 1 - \frac{3}{5} \tag{0.0.10}$$

$$= \frac{2}{5} \tag{0.0.11}$$

$$\therefore P(2 \le X < 4) = \frac{2}{5} \tag{0.0.12}$$

(0.0.13)


Cumulative distribution function
F(x)
X
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0