#### 1

# Assignment7

## CS20Btech11035 -NYALAPOGULA MANASWINI

## Download python code from

https://github.com/N-Manaswini23/assignment7/ tree/main/python%20codes

### Download latex code from

https://github.com/N-Manaswini23/assignment7/blob/main/assignment7.tex

## CSIR UGC NET EXAM(Dec 2016) Q-49

There are two boxes. Box-1 contains 2 red balls and 4 green balls. Box-2 contains 4 red balls and 2 green balls. A box is selected at random and a ball is chosen randomly from the selected box. If the ball turns out to be red, what is the probability that Box-1 had been selected?

#### **SOLUTION**

Box-1 has 2 red balls and 4 green balls. Box-2 has 4 red balls and 2 green balls. Let  $B \in \{1, 2\}$  represent a random variable where 1 represents selecting box-1 and 2 represents selecting box-2.

Event	definition	value
Pr(B=1)	Probability of selecting	$\frac{1}{2}$
	Box-1	_
Pr(B=2)	Probability of selecting	$\frac{1}{2}$
	Box-2	_
$\Pr\left(R=1 B=1\right)$	Probability of drawing	$\frac{1}{3}$
	red ball from Box-1	
$\Pr(G=1 B=1)$	Probability of drawing	$\frac{2}{3}$
	green ball from Box-1	
$\Pr\left(R=1 B=2\right)$	Probability of drawing	$\frac{2}{3}$
	red ball from Box-2	
$\Pr\left(G=1 B=2\right)$	Probability of drawing	$\frac{1}{3}$
	green ball from Box-2	

TABLE 0: Table 1

From Baye's theorem

$$Pr(R = 1) = Pr(R = 1|B = 1) \times Pr(B = 1)$$
  
+  $Pr(R = 1|B = 2) \times Pr(B = 2)$  (0.0.1)

Substiting values from table (0) in (0.0.1)

$$\Pr(R=1) = \frac{1}{2} \tag{0.0.2}$$

$$Pr((R = 1)(B = 1)) = Pr(R = 1|B = 1)$$

$$\times \Pr\left(B = 1\right) \tag{0.0.3}$$

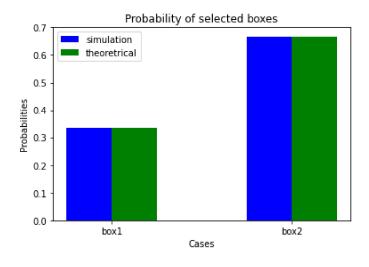
$$=\frac{1}{6}\tag{0.0.4}$$

We need to find Pr(B = 1|R = 1)

$$\Pr(B = 1|R = 1) = \frac{\Pr((R = 1)(B = 1))}{\Pr(R = 1)} \quad (0.0.5)$$

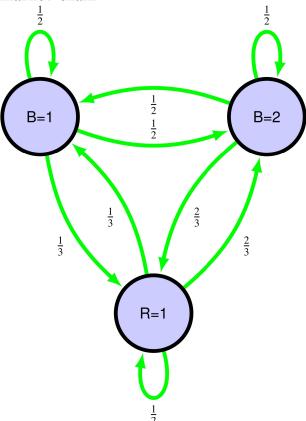
$$=\frac{1}{3}$$
 (0.0.6)

 $\therefore$  The desired probability that box-1 is selected  $=\frac{1}{3}$ 



## SOLUTION USING MARKOV CHAIN

## markov chain



Let us represent the above markov chain diagram in a transition matrix P.

Let states  $\{1, 2, 3\}$  correspond to events  $\{B = 1, B = 2, R = 1\}$  respectively.

The value of  $P_{ij}$  is equal to probability of transition from state i to state j

$$P = \begin{bmatrix} \frac{1}{2} & \frac{1}{2} & \frac{1}{3} \\ \frac{1}{2} & \frac{1}{2} & \frac{2}{3} \\ \frac{1}{3} & \frac{2}{3} & \frac{1}{2} \end{bmatrix}$$
 (0.0.7)

We need to find Pr(B = 1|R = 1)

$$Pr(B = 1|R = 1) = P_{31}$$
 (0.0.8)

$$\therefore \Pr(B = 1|R = 1) = \frac{1}{3}$$
 (0.0.9)

