Assignment 1

Dontha Aarthi - CS20BTECH11015

Download all python codes from

https://github.com/Dontha-Aarthi/AI1103-Assignment-1/blob/main/Assignment1/code-assignment1.py

and latex-tikz codes from

https://github.com/Dontha-Aarthi/AI1103-Assignment-1/blob/main/Assignment1/main.tex

1 Problem

Question 2.1:
Bag I contains 3 red and 4 black balls and Bag II contains 4 red and 5 black balls. One ball is transferred from Bag I to Bag II and then a ball is drawn from Bag II. The ball so drawn is found to be red in colour. Find the probability that the transferred ball is black.

2 Solution

Let X $\in \{0,1\}$ represent the bags and Y $\in \{0,1\}$ where 0 denotes black and 1 denotes red.

Bags(X)	n(Y=0)	n(Y=1)
0	4	3
1	5	4

$$Pr(Y=0,X=0)=\frac{4}{7} \tag{2.0.1}$$

$$Pr(Y=1,X=0)=\frac{3}{7} \tag{2.0.2}$$

There are 2 states, S={0,1}
S=0 after transferring black ball.
S=1 after transferring red ball.

1) **Transferring a black ball**.

Probability of transferring a black ball from bag 1 to bag 2 is:

$$Pr(Y=0,X=0)=Pr(S=0)=\frac{4}{7} \tag{2.0.3}$$

Let T be the event of drawing a red ball from bag 2 after transferring a random ball from bag 1 to bag 2.
Now, after transferring black ball to bag 2, the probability of picking a red ball from bag 2 is:

$$Pr(T|S=0)=\frac{4}{10}=\frac{2}{5} \tag{2.0.4}$$

2) **Transferring a red ball.**

Probability of transferring a red ball from bag 1 to bag 2 is

$$Pr(Y=1,X=0)=Pr(S=1)=\frac{3}{7} \tag{2.0.5}$$

Now, after transferring red ball to bag 2, the probability of picking a red ball from bag 2 is:

$$Pr(T|S=1)=\frac{5}{10}=\frac{1}{2} \tag{2.0.6}$$

Now, we have to find probability of black ball being transferred from bag 1 to bag 2 if a red ball is being drawn from bag 2.

Using Baye's theorem,

$$Pr(S=0|T)=\frac{Pr(S=0,T)}{Pr(T)} \tag{2.0.7}$$

$$Pr(S=0|T)=\frac{Pr(S=0)Pr(T|S=0)}{Pr(S=0)Pr(T|S=0)+Pr(S=1)Pr(T|S=1)}$$

On substituting the values, we get

$$Pr(S=0|T)=\frac{\frac{4}{7}\cdot\frac{2}{5}}{\frac{4}{7}\cdot\frac{2}{5}+\frac{3}{7}\cdot\frac{1}{2}}$$

$$\implies Pr(S=0|T)=\frac{\frac{8}{35}}{\frac{8}{35}+\frac{3}{14}}$$

$$\implies Pr(S=0|T)=\frac{16}{31}$$