ASSIGNMENT 1

Ganesh Bombatkar - CS20BTECH11016

Download all python codes from

https://github.com/Ganesh−RB/AI1003prob_and_randomvariables/Assignment1/codes

and latex-tikz codes from

https://github.com/Ganesh−RB/AI1003prob_and_randomvariables/Assignment1

1 Problem

Suppose we have four boxes A,B,C and D containing coloured marbles as given below:

Box	Red	White	Black
A	1	6	3
B	6	2	2
C	8	1	1
D	0	6	4

One of the box has been selected at random and a single marble has been drawn from it. If the marble is red, what is the probability that it was drawn from box A?,box B?, box C?

2 Solution

Let $X \in$ {A,B,C,D} represents the box and $Y \in$ {0,1,2} represents marbles, 0 representing Red, 1 representing White. Then,

$$\Pr(X=A)=\Pr(X=B)=\Pr(X=C)=\Pr(X=D)=\frac{1}{4} \tag{2.0.1}$$

$$\Pr(Y=0|X=A)=\frac{1}{10} \tag{2.0.2}$$

$$\Pr(Y=0|X=B)=\frac{3}{5} \tag{2.0.3}$$

$$\Pr(Y=0|X=C)=\frac{4}{5} \tag{2.0.4}$$

$$\Pr(Y=0|X=D)=0 \tag{2.0.5}$$

Now

$$\Pr(Y=0)=\sum_k \Pr(Y=0,X=k)$$
$$=\sum_k \Pr(Y=0|X=k)\times\Pr(X=k)=\frac{3}{8} \tag{2.0.6}$$

Then,
For probability of drawn red marble was from box A

$$\Pr(X=A|Y=0)=\frac{\Pr(X=A,Y=0)}{\Pr(Y=0)}$$
$$=\frac{\Pr(Y=0|X=A)\times\Pr(X=A)}{\Pr(Y=0)}$$
$$=\frac{\frac{1}{10}\times\frac{1}{4}}{\frac{3}{8}}=\frac{1}{15}=0.06667 \tag{2.0.7}$$

Similarly , For box B

$$\Pr(X=B|Y=0)=\frac{\Pr(Y=0|X=B)\times\Pr(X=B)}{\Pr(Y=0)}$$
$$=\frac{\frac{3}{5}\times\frac{1}{4}}{\frac{3}{8}}=\frac{2}{5}=0.4 \tag{2.0.8}$$

Similarly , for box D

$$\Pr(X=C|Y=0)=\frac{\Pr(Y=0|X=C)\times\Pr(X=C)}{\Pr(Y=0)}$$
$$=\frac{\frac{4}{5}\times\frac{1}{4}}{\frac{3}{8}}=\frac{8}{15}=0.53333 \tag{2.0.9}$$