Assignment 3–probability and Random Variable

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problem statement: Suppose we have four box A,B,C and D containing coloured marbles as given below: one of the box has

Table 1:

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

been selected at random and a single marble is drawn from it.If the marble is red.What is the probability that it was drawn from box A?Box B?Box C?

Solution: Here we are having 4 boxes with 10 balls each.There is a equal likelihood of selecting four boxes

$X \in (0, 1, 2, 3)$ where 0 represents Box A,1 represents Box B,2 represents Box C,3 represents Box D

$Y \in (0, 1, 2)$ where 0 represents Red marble,1 represents White marble,2 represents Black marble

Suppose P(X=0): probability that Box A is selected $= \frac{1}{4}$

We are having 1 red balls in box A,so probability of getting the red ball from box A is given by

P(Y=0/X=0): probability that Red marble is selected given it is from Box A $= \frac{1}{10}$

P(X=1): probability that Box B is selected $= \frac{1}{4}$

We are having 6 red balls in box B,so probability of getting the red ball from box B is given by

P(Y=0/X=1): probability that Red marble is selected from Box B $= \frac{6}{10}$

P(X=2): probability that Box C is selected $= \frac{1}{4}$

We are having 8 red balls in box C,so probability of getting the red ball from box C is given by

P(Y=0/X=2): probability that Red marble is selected from Box C $= \frac{8}{10}$

P(X=3): probability that Box D is selected $= \frac{1}{4}$.

We are having 0 red balls in box D,so probability of getting the red ball from box D is given by

P(X=0/Y=3): probability that Red marble is selected from Box D $= 0$

Since red balls are in all the three boxes.The probability that selected ball is red is given by

P(Y=0):Probability of getting a Red marble

$$= \text{P(X=0)P(Y=0/X=0)+P(X=1)}$$
$$\text{P(Y=0/X=1)} + \text{P(X=2)P(Y=0/X=2)}$$
$$+ \text{P(X=3)P(Y=0/X=3)}$$
$$= \frac{1}{4} \times \frac{1}{10} + \frac{1}{4} \times \frac{6}{10} + \frac{1}{4} \times \frac{8}{10}$$
$$= \frac{1}{4}(\frac{1}{10} + \frac{6}{10} + \frac{8}{10})$$
$$= \frac{1}{4} \times \frac{3}{2}$$

bayes theorem

$$= \frac{\text{P(Y=0/X=1).P(X=1)}}{\text{P(Y=0)}}$$
$$= \frac{\frac{6}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}}$$
$$= \frac{2}{5}$$

3   part C

P(X=2/Y=0):probability that marble is drawn from box C given it is Red marble.By using bayes theorem

1   Part A

P(X=0/Y=0):probability that marble is drawn from box A given it is Red marble.By using bayes theorem

$$= \frac{\text{P(Y=0/X=0).P(X=0)}}{\text{P(Y=0)}}$$
$$= \frac{\frac{1}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}}$$
$$= \frac{1}{15}$$

$$= \frac{\text{P(Y=0/X=2).P(X=2)}}{\text{P(Y=0)}}$$
$$= \frac{\frac{8}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}}$$
$$= \frac{8}{15}$$

2   Part B

P(X=1/Y=0):probability that marble is drawn from box B given it is Red marble.By using