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 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?

Table 1:

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

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

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

Table 2:

R	Event that Red marble is drawn
A	Event that marble is drawn from Box A
B	Event that marble is drawn from Box B
C	Event that marble is drawn from Box C
D	Event that marble is drawn from Box D

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

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

$P(B)$: 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

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

$P(C)$: 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

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

$P(D)$: 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

$P(R/D)$: 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

$P(R)$:Probability of getting a Red marble

$$
\begin{aligned}
&= P(A)P(R/A) + P(B)P(R/B) \\
&\quad + P(C)P(R/C) + P(D)P(R/D) \\
&= \frac{1}{4} \times \frac{1}{10} + \frac{1}{4} \times \frac{6}{10} + \frac{1}{4} \times \frac{8}{10} \\
&= \frac{1}{4}(\frac{1}{10} + \frac{6}{10} + \frac{8}{10}) \\
&= \frac{1}{4} \times \frac{3}{2}
\end{aligned}
$$

1 Part A

$P(A/R)$:probability that marble is drawn from box A given it is Red marble.By using bayes theorem

$$
\begin{aligned}
&= \frac{P(R/A).\mathrm{P(A)}}{P(R)} \\
&= \frac{\frac{1}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}} \\
&= \frac{1}{15}
\end{aligned}
$$

2 Part B

$P(B/R)$:probability that marble is drawn from box B given it is Red marble.By using bayes theorem

$$
\begin{aligned}
&= \frac{P(R/B).P(B)}{P(R)} \\
&= \frac{\frac{6}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}} \\
&= \frac{2}{5}
\end{aligned}
$$

3 part C

$P(C/R)$:probability that marble is drawn from box C given it is Red marble.By using bayes theorem

$$
\begin{aligned}
&= \frac{P(R/C).P(C)}{P(R)} \\
&= \frac{\frac{8}{10} \times \frac{1}{4}}{\frac{1}{4} \times \frac{3}{2}} \\
&= \frac{8}{15}
\end{aligned}
$$