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**Study material for 23/03/2020 – 29/03/2020**

 **Bayes’ Theorem**

Suppose that A1, A2… An are mutually exclusive events whose union is the sample space S, i.e one of the events must occur. Then if A is any event, we have the following important theorem:

P(Ak|A)=$\frac{P\left(Ak\right)\*P(A|Ak)}{\sum\_{j=1}^{n}P\left(Aj\right)\*P(A|Aj)}$

This enables us to find the probability of the various events A1, A2… An. that can cause A to occur.

**Question 1**. Bag 1 contains 3 red and 4 black balls while another bag 2 contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and is found to be red. Find the probability that it is drawn from bag 2.

**Solution.** Bag 1 = {3R,4B}

 Bag 2 = {5R,6B}

 Let E1 be the event of choosing bag 1, and E2 be the event choosing bag 2 and A be the event of drawing a red ball.then, P(E1) = P(E2)= (1/2).

 P(A|E1) =P(drawing a red ball from the bag1)=(3/7).

P(A|E2) =P(drawing a red ball from the bag2)=(5/11).

Now, the probability of drawing a ball from bag 2, being given that it is a red,i.e P(E2 |A) =$\frac{P\left(E2\right)\*P(A|E2) }{P\left(E1\right)P\left(E1\right)+ P(E2)P(A|E1)}$

 = $\frac{\frac{1}{2}\*\frac{5}{11}}{\frac{1}{2}\*\frac{3}{7}+\frac{1}{2}\*\frac{5}{11}}$ =(35/68).

**Questions for Practice**.

Q1. A man is known to speak truth 3 out of 4 times. He throws a dice and reports that it is a six. Find the probability that it is actually a six.

Q2. Box I contains 3 blue and 2 red marbles while another box II contains 2 blue and 5 red marbles. One marble is drawn at random from one of the boxes and is found to be red. Find the probability that it is drawn from bag I.

Q3.Each of three identical jewelry boxes has two drawers. In each drawer of the first box there is a gold watch. In each drawer of the second box there is a silver watch. In one drawer of the third box there is a gold watch while in the other there is a silver watch. If we select a box at random , open one of the drawers and find it to contain a silver watch, what is the probability that the other drawer has gold watch?

Q4.Urn I has 2 white and 3 black balls ;Urn II, 4 white and 1 black; and Urn III, 3white and 4 black. An Urn is select at random and a ball is drawn at random is found to be white. Find the probability that Urn I is selected.

Reference.

Probability and Statistics –Murray R. Spiegel