

Assignment 1

AI1110 : Probability and Random Variables

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Question:12.13.3.2: A bag contains 4 red and 4 black balls, another bag contains 2 red and 6 black balls. One of the two bags is selected at random and a ball is drawn from the bag which is found to be red. Find the probability that the ball is drawn from the first bag.

Solution:

TABLE I
RANDOM VARIABLE DECLARATION

Random Variable	Value of the random variable	Event
B	0	selecting first bag
	1	selecting second bag
R	0	choosing white ball from the bag
	1	choosing red ball from the bag

Given,

$$\Pr(R = 1|B = 0) = \frac{4}{8} = \frac{1}{2} \quad (1)$$

$$\Pr(R = 1|B = 1) = \frac{2}{8} = \frac{1}{4} \quad (2)$$

$$\Pr(B = 0) = \frac{1}{2} \quad (3)$$

$$\Pr(B = 1) = \frac{1}{2} \quad (4)$$

$\Pr(B = 0|R = 1)$ = probability of choosing bag 1 given that the ball is red

From Bayer's theorem,

$$\Pr(B = 0|R = 1) = \frac{\Pr(R = 1|B = 0) \Pr(B = 0)}{\Pr(R = 1|B = 0) \Pr(B = 0) + \Pr(R = 1|B = 1) \Pr(B = 1)} \quad (5)$$

$$= \frac{\frac{1}{2} \times \frac{1}{2}}{\frac{1}{2} \times \frac{1}{2} + \frac{1}{4} \times \frac{1}{2}} \quad (6)$$

$$= \frac{\frac{1}{4}}{\frac{1}{4} + \frac{1}{8}} \quad (7)$$

$$= \frac{2}{3} \quad (8)$$

Hence,

$$\Pr(B = 1|R = 1) = \frac{2}{3}$$

The probability that the ball is drawn from the first bag is $\frac{2}{3}$.