

# AI1110: Assignment-1

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**12.13.6.16 Question:** Bag I contains 3 red and 4 black balls and Bag II contains 4 red and 5 black balls. One ball is transferred from Bag I to Bag II and then a ball is drawn from Bag II. The ball so drawn is found to be red in colour. Find the probability that the transferred ball is black.

**Answer:**  $(\frac{16}{31})$

**Solution:**

Let  $\Pr(X, Y)$  be the Random variable for the events of drawing balls from bags.

$$X = \begin{cases} 1, & \text{if ball is being drawn from Bag I} \\ 2, & \text{if ball is being drawn from Bag II} \end{cases} \quad (1)$$

$$Y = \begin{cases} 1, & \text{if ball drawn is Red} \\ 2, & \text{if ball drawn is Black} \end{cases} \quad (2)$$

$$\Pr(X = 1, Y = 1) = \frac{\text{No. of Red balls}}{\text{Total Balls}} = \frac{3}{7} \quad (3)$$

$$\Pr(X = 1, Y = 2) = \frac{\text{No. of Black balls}}{\text{Total Balls}} = \frac{4}{7} \quad (4)$$

$$\Pr(X = 2, Y = 1) = \Pr(X = 1, Y = 1) \times \frac{5}{10} + \Pr(X = 1, Y = 2) \times \frac{4}{10} \quad (5)$$

$$\Pr(X = 2, Y = 1) = \frac{15}{70} + \frac{16}{70} \quad (6)$$

$$\Pr(X = 2, Y = 1) = \frac{31}{70} \quad (7)$$

By total probability law, we know,

$$\Pr(X = 2, Y = 2) = 1 - \Pr(X = 2, Y = 1) \quad (8)$$

$$\Pr(X = 2, Y = 2) = \frac{39}{70} \quad (9)$$

Red ball from Bag I:	$\Pr(X = 1, Y = 1) = \frac{3}{7}$
Black ball from Bag I:	$\Pr(X = 1, Y = 2) = \frac{4}{7}$
Red ball from Bag II:	$\Pr(X = 2, Y = 1) = \frac{31}{70}$
Black ball from Bag II:	$\Pr(X = 2, Y = 2) = \frac{39}{70}$

(10)

TABLE I  
FINAL PROBABILITIES OF THE EVENTS.

By Bayes Theorem,

$$\Pr(E_i|A) = \frac{\Pr(E_i) \Pr(A|E_i)}{\sum_{k=1}^{k=n} \Pr(E_k) \Pr(A|E_k)} \quad (11)$$

$$\Pr(B|E) = \frac{\Pr((X = 2, Y = 1)|(X = 1, Y = 1)) \Pr(X = 1, Y = 1)}{\Pr(X = 2, Y = 1|X = 1, Y = 1) \Pr(X = 1, Y = 1) + \Pr(X = 2, Y = 1|X = 1, Y = 2) \Pr(X = 1, Y = 2)} \quad (12)$$

where  $\Pr(B|E)$  is the conditional probability of transferred ball being Black, known that the final ball drawn is Red which is our desired final answer.

$$\Pr(X = 1|Y = 2) = \frac{\frac{4}{10} \times \frac{4}{7}}{\frac{4}{10} \times \frac{4}{7} + \frac{5}{10} \times \frac{3}{7}} \quad (13)$$

$$\Pr(X = 1|Y = 2) = \frac{16}{31} \quad (14)$$