

Assignment 2

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Question 10: Bag A contains 4 white balls and 3 black balls, while Bag B contains 3 white balls and 5 black balls. Two balls are drawn from Bag A and placed in Bag B. Then, what is the probability of drawing a white ball from Bag B?

Solution: Let $X = \{0, 1\}$ be a random variable representing the bags and let $Y = \{0, 1\}$ be a random variable represent the colour of the ball. Let $Z = \{0, 1, 2\}$ be a random variable representing the colour combinations of two balls.

See Tables (I) and (II) for the input probabilities. The

Event	Description
$X = 0$	Ball is drawn from bag A
$X = 1$	Ball is drawn from bag B
$Y = 0$	Colour of the ball is white
$Y = 1$	Colour of the ball is black
$Z = 0$	Both balls drawn are white
$Z = 1$	Both balls drawn are black
$Z = 2$	One ball is black and other is white

TABLE I

Probability	Value
$\Pr(Z = 0 X = 0)$	$\frac{{}^4C_2}{{}^7C_2} = \frac{2}{7}$
$\Pr(Z = 1 X = 0)$	$\frac{{}^3C_2}{{}^7C_2} = \frac{1}{7}$
$\Pr(Z = 2 X = 0)$	$\frac{{}^4C_1 \times {}^3C_1}{{}^7C_2} = \frac{4}{7}$
$\Pr(Y = 0 Z = 0, X = 1)$	$\frac{5}{10}$
$\Pr(Y = 0 Z = 1, X = 1)$	$\frac{3}{10}$
$\Pr(Y = 0 Z = 2, X = 1)$	$\frac{4}{10}$
$\Pr(Y = 0 X = 1)$?

TABLE II

desired probability is then obtained from Table (II) as

$$\begin{aligned} \Pr(Y = 0|X = 1) &= \sum_{i=0}^2 \Pr(Y = 0|Z = i, X = 1) \\ &\quad \times \Pr(Z = i, X = 0) \end{aligned} \quad (1)$$

$$= \frac{5}{10} \times \frac{2}{7} + \frac{3}{10} \times \frac{1}{7} + \frac{4}{10} \times \frac{4}{7} \quad (2)$$

$$= \frac{1}{7} + \frac{3}{70} + \frac{16}{70} \quad (3)$$

$$= \frac{29}{70} \quad (4)$$

Hence, the probability of drawing a white ball from bag B is $\frac{29}{70}$.