

Assignment 4: CBSE Probability Grade 12

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Question

Exercise 13.3.13

Probability that A speaks truth is $\frac{4}{5}$. A coin is tossed. A reports that a head appears. The probability that actually there was a head is

- 1 $\frac{4}{5}$
- 2 $\frac{1}{2}$
- 3 $\frac{1}{5}$
- 4 $\frac{2}{5}$

Solution

Let random variables $X, Y \in \{0, 1\}$ denote the following events in Table (4)

Event	Description
$X=0$	A tells truth
$X=1$	A tells false
$Y=0$	head appears on coin
$Y=1$	tails appears on coin

Table 4: Description of events

Input probabilities

The following are the input probabilities as given in the question:

Probability	Value
$\Pr(X = 0)$	$4/5$
$\Pr(X = 1)$	$1/5$
$\Pr(Y = 0) \mid \Pr(X = 0)$	$1/2$
$\Pr(Y = 0) \mid \Pr(X = 1)$	$1/2$
$\Pr(X = 0) \mid \Pr(Y = 0)$?

Table 4: Input probabilities

Computation

The desired probability is given by:

$$\Pr(X = 0|Y = 0) \quad (2.0.1)$$

$$= \frac{\Pr(X = 0, Y = 0)}{\Pr(Y = 0)} \quad (2.0.2)$$

$$= \frac{\Pr(Y = 0|X = 0) \Pr(X = 0)}{\sum_{i=0}^1 \Pr(Y = 0, X = i)} \quad (2.0.3)$$

$$= \frac{\Pr(Y = 0|X = 0) \Pr(X = 0)}{\sum_{i=0}^1 \Pr(Y = 0|X = i) \Pr(X = i)} \quad (2.0.4)$$

Answer

On substituting the values from Table (4) we get:

$$\Pr(X = 0|Y = 0) = \frac{\frac{4}{5} \times \frac{1}{2}}{\frac{4}{5} \times \frac{1}{2} + \frac{1}{5} \times \frac{1}{2}} \quad (3.0.1)$$

$$= \frac{4}{5} \quad (3.0.2)$$