AI1103 - Assignment 1

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PROBLEM

2.12. In a school, there are 1000 students, out of which 430 are girls. It is known that out of 430, 10 percent of girls study in class XII. What is the probability that a student chosen randomly studies in Class XII given that the chosen student is a girl ?

SOLUTION

Total number of girls are 430 out of 1000 students
Total number of girls in Class XII : 10 % of total girls

$$= \frac{10 * 430}{100} \tag{1}$$

$$= 43 \tag{2}$$

Let X $\in \{0, 1\}$ be the random variable such that 1 represents girl, 0 represents boy.

$$P(X = 1) = \frac{430}{1000} \tag{3}$$

Let Y $\in \{0, 1\}$ be the random variable such that 1 represents chosen student is in Class XII, 0 represents chosen student is not in Class XII.

$$P(Y = 1) = \frac{1}{2} \tag{4}$$

$$P(Y = 0) = \frac{1}{2} \tag{5}$$

Now,
Chosen student is a girl in Class XII

$$P(Y = 1|X = 1) = \frac{43}{1000} \tag{6}$$

Chosen student is a girl not in Class XII

$$P(X = 1|Y = 0) = \frac{387}{1000} \tag{7}$$

$$= \frac{P(X = 1|Y = 1) \cdot P(Y = 1)}{\sum_{i=0}^{1} P(X = 1|Y = i) \cdot P(Y = i)} \tag{8}$$

$$= \frac{P(X = 1|Y = 1) \cdot P(Y = 1)}{P(X = 1|Y = 0)P(Y = 0)+P(X = 1|Y = 1)P(Y = 1)} \tag{9}$$

$$= \frac{0.043 \cdot (\frac{1}{2})}{0.387 \cdot (\frac{1}{2}) + 0.043 \cdot (\frac{1}{2})} \tag{10}$$

$$= \frac{0.043}{0.43} \tag{11}$$

$$= \frac{1}{10} \tag{12}$$

Hence, the probability that a student chosen randomly studies in Class XII given that the chosen student is a girl is 0.1.