Assignment 13

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https://github.com/ka−raja−babu/Matrix−Theory/tree/main/Assignment13

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1 Question No. 2.9

A laboratory blood test is 99% effective in detecting a certain disease when it is in fact,present. However,the test also yields a false positive result for 0.5% of the healthy person tested (i.e. if a healthy person is tested, then,with probability 0.005, the test will imply he has the disease). If 0.1 percent of the population actually has the disease, what is the probability that a person has the disease given that his test result is positive?

2 Solution

Let the input variables $X \in \{0,1\}$ and $Y \in \{0,1\}$ be defined according to the table 2.1 .

Input Variable	Value	Description
X	0	Absence of disease in test
	1	Presence of disease in test
Y	0	Absence of disease in reality
	1	Presence of disease in reality

TABLE 2.1: Input Variables

Given data of the question is presented in the table 2.2 .

S.No.	Expression	Value
1.	$\Pr(X=1\|Y=1)$	$\frac{99}{100}$
2.	$\Pr(X=1\|Y=0)$	$\frac{0.5}{100}=\frac{1}{200}$
3.	Pr(Y=1)	$\frac{0.1}{100}=\frac{1}{1000}$
4.	Pr(Y=0)	$\frac{99.9}{100}=\frac{999}{1000}$

TABLE 2.2: Given Data

Hence,probability that a person has the disease given that his test result is positive ,is given by

$$\Pr(Y=1|X=1)=\frac{\Pr(X=1|Y=1)\Pr(Y=1)}{\sum_{i=0}^{1}\Pr(X=1|Y=i)\Pr(Y=i)} \tag{2.0.1}$$

$$=\frac{\frac{99}{100}\times\frac{1}{1000}}{\frac{1}{200}\times\frac{999}{1000}+\frac{99}{100}\times\frac{1}{1000}} \tag{2.0.2}$$

$$=\frac{22}{133} \tag{2.0.3}$$