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Data Analytics

Problem 1

Naive Bayes Theorem

Problem Statement:

Assume that a patient named Mary took a lab test for a certain disease and the result came back positive. The test returns a positive result in 95% of the cases in which the disease is actually present, and it returns a positive result in 6% of the cases in which the disease is not present. Furthermore, 1% of the entire population has this disease. What is the probability that Mary actually has the disease, given that the test is positive?

Given:

Let $B = (\text{Having the Disease})$

Let $A = (\text{Testing Postive})$

Probability of Mary having Disease, given testing positive ?
Therefore it's $P(B|A)$

Solution:

$$P(B) = 0.01 \quad P(\neg B) = 0.99$$

$$P(A|B) = 0.95$$

$$P(A|\neg B) = 0.06$$

Bayes Theorem

$$P(B|A) = P(A|B) \cdot P(B) / P(A)$$

To find $P(A)$

$$\begin{aligned} P(A) &= P(A \cap B) + P(A \cap \neg B) \\ &= P(B) \cdot P(A|B) + P(\neg B) \cdot P(A|\neg B) \\ &= 0.01 \cdot 0.95 + 0.99 \cdot 0.06 = 0.069 \end{aligned}$$

$$P(A) = 0.069$$

Therefore,

$$P(B|A) = 0.95 \cdot 0.01 / 0.069$$

$$P(B|A) = 0.1377$$

Therefore, the probability of Mary having the disease given that the test is positive is only approximately 13.77%.