

Lab Program-8

Implement Bayes' Theorem for the following problem statement: In XYZ University, admissions for the departments IT, CSE, AIML are 75%, 85%, and 90% respectively in the previous year. In the total of their output 5, 3, 2 percent are slow learner's students. A student is taken at random from the department and is found to be slow learners. What are the probabilities that it was from the department IT, CSE, AIML?

To solve this problem using Bayes' Theorem, let's define the events:

- IT : The student is from the IT department.
- CSE : The student is from the CSE department.
- $AIML$: The student is from the AIML department.
- SL : The student is a slow learner.

Given data:

- $P(IT) = 0.75$
- $P(CSE) = 0.85$
- $P(AIML) = 0.90$
- $P(SL|IT) = 0.05$
- $P(SL|CSE) = 0.03$
- $P(SL|AIML) = 0.02$

We need to find $P(IT|SL)$, $P(CSE|SL)$, and $P(AIML|SL)$.

Bayes' Theorem states:

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

So, for each department:

1. Probability that the student is from IT given they are a slow learner:

$$P(IT|SL) = \frac{P(SL|IT) \cdot P(IT)}{P(SL)}$$

2. Probability that the student is from CSE given they are a slow learner:

$$P(CSE|SL) = \frac{P(SL|CSE) \cdot P(CSE)}{P(SL)}$$

3. Probability that the student is from AIML given they are a slow learner:

$$P(AIML|SL) = \frac{P(SL|AIML) \cdot P(AIML)}{P(SL)}$$

First, we need to calculate $P(SL)$ (the total probability of a student being a slow learner). This is done using the law of total probability:

$$P(SL) = P(SL|IT) \cdot P(IT) + P(SL|CSE) \cdot P(CSE) + P(SL|AIML) \cdot P(AIML)$$

Substitute the given values:

$$P(SL) = (0.05 \cdot 0.75) + (0.03 \cdot 0.85) + (0.02 \cdot 0.90)$$

$$P(SL) = 0.0375 + 0.0255 + 0.018$$

$$P(SL) = 0.081$$

Now, we can calculate each conditional probability:

1. $P(IT|SL)$:

$$P(IT|SL) = \frac{0.05 \cdot 0.75}{0.081}$$

$$P(IT|SL) = \frac{0.0375}{0.081}$$

$$P(IT|SL) \approx 0.463$$

2. $P(CSE|SL)$:

$$P(CSE|SL) = \frac{0.03 \cdot 0.85}{0.081}$$

$$P(CSE|SL) = \frac{0.0255}{0.081}$$

$$P(CSE|SL) \approx 0.315$$

3. $P(AIML|SL)$:

$$P(AIML|SL) = \frac{0.02 \cdot 0.90}{0.081}$$

$$P(AIML|SL) = \frac{0.018}{0.081}$$

$$P(AIML|SL) \approx 0.222$$

So, the probabilities that the slow learner is from IT, CSE, and AIML departments are approximately 46.3%, 31.5%, and 22.2%, respectively.