Baye's Rule

- Baye's Rule states that the probability of an event A given some evidence B is equal to the probability of B given A multiplied by the prior probability of A, divided by the prior probability of B.
- In other words, Baye's Rule allows us to update our beliefs about the probability of an event based on new information or evidence.

`One of the challenges of using Baye's Rule is estimating the prior probabilities, which can be subjective or difficult to determine in some cases.`

P(A|B) = P(B|A) * P(A) / P(B)

Where:

- P(A|B) is the probability of event A occurring given evidence B
- P(B|A) is the probability of evidence B given that event A has occurred
- P(A) is the prior probability of event A occurring
- P(B) is the prior probability of evidence B occurring

Problem

Three boxes labeled as A, B, and C, are present. Details of the boxes are:

- Box A contains 2 red and 3 black balls
- Box B contains 3 red and 1 black ball
- And box C contains 1 red ball and 4 black balls

All the three boxes are identical having an equal probability to be picked up. Therefore, what is the probability that the red ball was picked up from box A?

Solution

Let E denote the event that a red ball is picked up and A, B and C denote that the ball is picked up from their respective boxes. Therefore the conditional probability would be

P(A|E) which needs to be calculated.

The existing probabilities P(A) = P(B) = P (C) = 1 / 3, since all boxes have equal probability of getting picked.

P(E|A) = Number of red balls in box A / Total number of balls in box A = 2 / 5

Similarly, P(E|B) = 3 / 4 and P(E|C) = 1 / 5

Then evidence P(E) = P(E|A)*P(A) + P(E|B)*P(B) + P(E|C)*P(C)

= (2/5) *(1/3) + (3/4)* (1/3) + (1/5) * (1/3) = 0.45

Therefore, P(A|E) = P(E|A) *P(A) / P(E) = (2/5)* (1/3) / 0.45 = 0.296

REF: [Bayes Theorem Explained With Example - Complete Guide]

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