

How can Bayes' Theorem be applied in R?

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Bayes' Theorem is a fundamental concept in probability theory that allows for the calculation of conditional probabilities. In R, Bayes' Theorem can be applied through the use of various statistical packages and functions. These tools allow for the analysis of data and the calculation of probabilities based on prior knowledge and observed evidence. This enables users to make more informed decisions and predictions based on data analysis. Bayes' Theorem can be applied in R for a variety of applications, such as machine learning, data mining, and predictive modeling. By incorporating Bayes' Theorem into statistical analysis in R, users can gain a deeper understanding of their data and make more accurate predictions.

Apply Bayes' Theorem in R

Bayes' Theorem states the following for any two events A and B:

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

where:

P(A|B): The probability of event A, given event B has occurred.
P(B|A): The probability of event B, given event A has occurred.
P(A): The probability of event A.
P(B): The probability of event B.

For example, suppose the probability of the weather being cloudy is 40%. Also suppose the probability of rain on a given day is 20% and that the probability of clouds on a rainy day is 85%.

If it's cloudy outside on a given day, what is the

probability that it will rain that day?

Solution:

$$P(\text{cloudy}) = 0.40 \quad P(\text{rain}) = 0.20 \quad P(\text{cloudy} \mid \text{rain}) = 0.85$$

Thus, we can calculate:

$$P(\text{rain} \mid \text{cloudy}) = P(\text{rain}) * P(\text{cloudy} \mid \text{rain}) / P(\text{cloudy})$$
$$P(\text{rain} \mid \text{cloudy}) = 0.20 * 0.85 / 0.40$$
$$P(\text{rain} \mid \text{cloudy}) = 0.425$$

If it's cloudy outside on a given day, the probability that it will rain that day is 42.5%.

We can create the following simple function to apply Bayes' Theorem in R:

```
bayesTheorem <- function(pA, pB, pBA) {  
  pAB <- pA * pBA / pB  
  return(pAB)  
}
```

The following example shows how to use this function in practice.

Example : Bayes' Theorem in R

Suppose we know the following probabilities:

$$P(\text{rain}) = 0.20 \quad P(\text{cloudy}) = 0.40 \quad P(\text{cloudy} \mid \text{rain}) = 0.85$$

#define function for Bayes' Theorem

```
bayesTheorem <- function(pA, pB, pBA) {  
  pAB <- pA * pBA / pB  
  return(pAB)  
}
```

#define probabilities

```
pRain <- 0.2  
pCloudy <- 0.4  
pCloudyRain <- .85  
#use  
function to calculate conditional probability  
bayesTheorem(pRain, pCloudy, pCloudyRain)
```

0.425

This tells us that if it's cloudy outside on a given day, the probability that it will rain that day is 0.425 or 42.5%.

This matches the value that we calculated earlier by hand.

Additional Resources

The following tutorials explain how to calculate other probabilities in R:

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