NAIVE BAYES
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18 August 2023

1 Introduction

Mulnomial naive bayes classifier and gaussian naive bayes classifier are commonly used versions of naive byes.Naive bayes is a probabilistic model ,usually used for classification problems ,that uses bayes theorem . it is naive as it assumes independence betweeen the features , that is the occurence of one feature is independent of the occurence of other features.

2 Multinomial Naive Bayes

To understand naive bayes , we should understand conditional probability and baye's rule given by equation(1) and equation(2)

$$P(A/B) = \frac{P(A \bigcap B)}{P(B)} \tag{1}$$

$$P(A/B) = \frac{P(B/A) \times P(A)}{P(B)} \tag{2}$$

for this classifier we use multiple features and extend the baye's rule assuming independence amongst the features, which is given by the equation (3).

$$P(Y = C/X1, X2, X3..) = \frac{P(Y = C) \prod_{i=1}^{n} P(X_i/Y)}{\prod_{i=1}^{n} P(X_i)} \tag{3}$$

As the denominator is constant, it can be ignored. thus the improved rule is given by equation (6).

$$P(C/X1, X2, X3..) = P(C) \prod_{i=1}^{n} P(X_i/C) \tag{4}$$

2.1 Assumptions

1) All features are independent of each other.
2) All features have equal weightage, i.e all of the feature are considered for the final result.

3 Gaussian Naive Bayes

In Gaussian naive byes , the distribution of every feature is considered to be normal distribution. The pdf of the distribution is given by equation (5), which is for a condition $Y = y$,

$$f(X_i/Y = y) = \frac{1}{\sqrt{2\pi\sigma_y^2}} e^{\frac{-(x_i - \mu_y)^2}{2\sigma_y^2}} \tag{5}$$

for various outputs, we calculate the log sums of the input features and the least sum will be used for decision making.

$$P(C/X1, X2, X3..) = P(C) \sum_{i=1}^{n} log(f(X_i/C)) \tag{6}$$

We can use cross validation and determine the importance of the feature variables. the log sum is used to remove underflow.