



SNS COLLEGE OF TECHNOLOGY

Coimbatore – 35

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Bayes Theorem in Machine Learning



Bayes Theorem in Machine Learning



Bayesian method is used to calculate conditional probability in Machine Learning application that includes classification tasks.

Bayes theorem helps to determine the probability of an event with random knowledge. It is used to calculate the probability of occurring one event while other one already occurred. It is a best method to relate the condition probability and marginal probability.



What is Bayes Theorem?



Bayes' theorem can be derived using product rule and conditional probability of event X with known event Y:

$$P(X|Y) = \frac{P(Y|X).P(X)}{P(Y)}$$

Here, both events X and Y are independent events which means probability of outcome of both events does not depends one another.



The above equation is called as Bayes Rule or Bayes Theorem.

- $P(X|Y)$ is called as **posterior**, which we need to calculate. It is defined as updated probability after considering the evidence.
- $P(Y|X)$ is called the likelihood. It is the probability of evidence when hypothesis is true.
- $P(X)$ is called the **prior probability**, probability of hypothesis before considering the evidence
- $P(Y)$ is called marginal probability. It is defined as the probability of evidence under any consideration.

Hence, Bayes Theorem can be written as:

$$\text{posterior} = \text{likelihood} * \text{prior} / \text{evidence}$$



Principle #3a:

Use Bayes' Rule to infer unknown model variables from observed data

$$\mathbf{P(M|D)} = \frac{\mathbf{P(D|M) P(M)}}{\mathbf{P(D)}}$$

Likelihood

Prior

Posterior