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Naive Bayes for Probabilistic Classifier

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1 INTRODUCTION

In this assignment we have implemented Naive Bayes algorithm for predicting the result.This is based on the Bayes theorem.The Bayes theorem describes the probability of occurrence of an event related to any condition.It relates the happening of an event ,given some pre-conditions to probability of the pre-condition given that event occurred. So it is based on conditional probability.Conditional probability is likelihood of an outcome occurring, based on a previous outcome having occurred in similar circumstances. Bayes' theorem provides a way to revise existing predictions or theories (update probabilities) given new or additional evidence.

Statement of Bayes Theorem:
Let $E_1, E_2, \ldots, E_n$ be a set of events associated with a sample space S, where all the events $E_1, E_2, \ldots, E_n$ have nonzero probability of occurrence and they form a partition of S. Let A be any event associated with S, then according to Bayes theorem

$$P(\frac{E_i}{A}) = \frac{P(\frac{A}{E_i})P(E_i)}{\sum_{i=1}^{n} P(\frac{A}{E_i})P(E_i)}$$

Naive Bayes Approach:
Here we are given a data set of 10 features and 3 classes.We calculate prior probability of classes and conditional probability of features in order to calculate posterior probability.Prior probability is the probability of an event occurring before new data is collected. In other words, it represents the best rational assessment of the probability of a particular outcome

based on current knowledge before an experiment is performed.Posterior probability is the revised probability of an event occurring after taking into consideration the new information. Posterior probability is calculated by updating the prior probability using Bayes' theorem. In statistical terms, the posterior probability is the probability of event A occurring given that event B has occurred.
Now,when ever new data come with some given conditions then the model calculate the probability of that event and assign a class to it.

2 Estimated Parameters

2.1 Prior Probabilities

Our result is as follows:

	Class 0	Class 1	class 2
Probability	0.333	0.333	0.333

2.2 Guassian class

In it we calculate likelihood of the event. We calculate the mean and variance of the data for the same.

$$G(x,\sigma) = \frac{1}{\sigma\sqrt{2\pi}} \exp \frac{-x^2}{2\sigma^2}$$

Our result is as follows:

	Class 0	Class 1	class 2
mean for X1 Variance X1	2.0209 9.05	0.202 25.16	8.02 35.66
mean for X2 Variance X2	3.9067 78.42	0.856 230.03	-0.02 4.00

2.3 Bernoulli class

Our result is as follows:

	Class 0	Class 1	class 2
Probability for X3	0.2	0.59	0.9
Probability for X4	0.1	0.8	0.19

2.4 Laplace class

$$L(x|\mu,\beta) = \frac{1}{2\beta}\exp^{\frac{-|x-\mu|}{\beta}}$$

Our result is as follows:

	Class0	Class1	class2
μ for X5 β for X5	0.081 0.1.983	0.387 0.98	0.798 3
μ for X6 β for X6	0.870 5.977	0.352 06	0.211 3.08

2.5 Exponential class

$$F(x,\lambda) = \lambda\exp^{-\lambda * x} \qquad ; x >= 0$$
$$= 0 \qquad ; x < 0$$

Our result is as follows:

	Class0	Class1	class2
λ for X7	5.934	8.954	26.84
λ for X8	1.807	23.94	44.06

2.6 Multinominal class

Our result is as follows:

		Class 0	Class 1	class 2
Probability for X9	P0 P1 P2 P3	0.2022 0.2032 0.2042 0.1967	0.0977 0.1984 0.4047 0.1583	0.2052 0.0.2997 0.1029 0.3417
Probability for X10	P0 P1 P2 P3 P4 P5 P6 P7	0.1213 0.1236 0.1257 0.1277 0.127 0.1271 0.1241 0.1235	0.1009 0.0506 0.0508 0.1998 0.1524 0.1487 0.2003 0.0965	0.1972 0.0481 .0483 0.1054 0.1552 0.153 0.098 0.1948

3 RESULT

3.1 ACCURACY

Our accuracy on valid data set is **89.37%**

3.2 F1 SCORE

	Class0	Class1	class2
Validation F1 Score	0.436801	0.43175	0.471571