ML estimate

The Rayleigh probability density function is defined as:

\[ p(x|\theta) = 2\theta x \exp(-x^2\theta) \]  

(1)

with \( \theta > 0 \). What is the maximum likelihood estimate for the parameter \( \theta \) of this distribution? Given a sample \( D \) of \( n \) independent and identically distributed training examples \( x_0 \ldots x_n \) drawn from this distribution, the likelihood of \( \theta \) with respect to \( D \) is:

\[ p(D|\theta) = \prod_{k=1}^{n} p(x_k|\theta). \]  

(2)

Remember that maximizing the log likelihood also maximizes the likelihood.

Bayes classifier

In this exercise the goal is to use the Bayes classifier to learn to predict US congressman party affiliation (Democrat/Republican) from the votes on a number of issues. More details about this dataset are available here. The data is divided into the training set and the test set.

1. Use the Bayes classifier:

\[ \hat{y} = \arg \max_y P(x|y)P(y) \]

2. Compute MLE estimate of class distributions \( P(y) \), i.e. use relative counts from training data

3. Make the so called Naive Bayes assumption to compute \( P(x|y) \), i.e. assume that features in \( x \) are independent:

\[ P(x|y) = \prod_{j=1}^{D} P(x_j|y) \]

where \( D \) is the number of features. Now you can use relative counts from training data to estimate \( p(x_j|y) \) for each feature and class label.

4. Apply the model to training and test data, and report the error rates for both cases

Please include both a brief description of your results and the code you used to compute them.

Please send your solutions by Wednesday Dec 1 to gchrupala@lsv.uni-saarland.de

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