Data Mining, CSCI 347, Fall 2019
Naïve Bayes, Sept. 11

Naïve Bayes assumes that all attributes predicting the class are independent and contributing equally. While this is rarely the case, the decoupling of the class conditional feature distributions means that each distribution can be independently estimated as a one dimension distribution. This makes calculations very fast.

This assumption is true is a dataset with only one attribute (feature) predicting the class.

1. Consider a dataset with the following number of records.

   t – total # of records
   n - # records with class = 'X'
   t-n - # records with class something other than 'X'

   a - # records with evidence = 'A'
   t-a - # records with evidence something other than 'Al

   e - # records with evidence = 'A' and class = 'X'
   a-e - # records with evidence = 'A' and with class something other than 'X'

   a. What is the value of Pr[class='X' | evidence='A'] using the variables above?

      Pr[class='X' | evidence='A'] = e/a

   b. Use Bayes formula, and the variables above, to give a formula of Pr[class='X' | evidence='A'].

      $$Pr[class='X' \mid evidence='A'] = \frac{Pr[evidence='A' \mid class='X] * Pr[class='X']}{Pr[evidence='A']}$$

      $$= \frac{e/n * n/t}{a/t}$$

   c. Show that the results from a and b are equivalent.

      $$\frac{e/n * n/t}{a/t} = \frac{e/t}{a/t} = e/a$$

d. What is the value of Pr[class ≠ 'X' | evidence='A'] using the variables above?

$$\Pr[\text{class} \neq \text{'X'} \mid \text{evidence='A'}] = (a-e)/a$$

e. Use Bayes formula, and the variables above, to give a formula of Pr[class≠'X' | evidence='A'].

$$\Pr[\text{class} \neq \text{'X'} \mid \text{evidence='A'}] = \frac{\Pr[\text{evidence='A'} \mid \text{class} \neq \text{'X'}] * \Pr[\text{class} \neq \text{'X'}]}{\Pr[\text{evidence='A'}]} = \frac{(a-e)/(t-n) * (t-n)/t}{a/t}$$

f. Show that the results from d and e are equivalent.

$$\frac{(a-e)/(t-n) * (t-n)/t}{a/t} = \frac{(a-e)}{a}$$

g. Show that the result for part e, can be gotten by subtracting the result from part e from 1.

$$1 - \frac{(a-e)/(t-n) * (t-n)/t}{a/t} = 1 - \frac{(a-e)}{a} = e/a$$