Naive Bayes Classification

What if we have multiple predictors?

$$P(A \mid B,C,D...) = \frac{P(B,C,D... \mid A)P(A)}{P(B,C,D...)}$$

P(A) = count(A) / total
P(B) = count(B) / total

P(A|B) = count(A,B) / count(B)
P(B|A) = count(B,A) / count(A)

P(A|B,C,D...) = count(A,B,C,D,...) / count(A)
P(B,C,D...|A) = count(B,C,D,...,A) / count(B,C,D,...)

Chapter 18 in Machine Learning with Python Cookbook

Weather	Temp	Play
Sunny	Hot	No
Sunny	Hot	No
Overcast	Hot	Yes
Rainy	Mild	Yes
Rainy	Cool	Yes
Rainy	Cool	No
Overcast	Cool	Yes
Sunny	Mild	No
Sunny	Cool	Yes
Rainy	Mild	Yes
Sunny	Mild	Yes
Rainy	Mild	No
Overcast	Hot	Yes

n = 13

Will we play tennis if it is rainy and mild?

1. Calculate the prior probability of each class.

2. Calculate the conditional probability for each category given the class

3. Calculate the posterior probability using Bayes Theorem

Weather	Temp	Play
Sunny	Hot	No
Sunny	Hot	No
Overcast	Hot	Yes
Rainy	Mild	Yes
Rainy	Cool	Yes
Rainy	Cool	No
Overcast	Cool	Yes
Sunny	Mild	No
Sunny	Cool	Yes
Rainy	Mild	Yes
Sunny	Mild	Yes
Rainy	Mild	No
Overcast	Hot	Yes

n = 13

Will we play tennis if it is rainy and mild? P(Yes | Rainy, Mild) = ??

1. Calculate the prior probability of each class.

P(No) =
P(Yes) =
P(Rainy,Mild) =

2. Calculate the conditional probability for each category given the class

P(Rainy,Mild | No) =
P(Rainy,Mild | Yes) =

3. Calculate the posterior probability using Bayes Theorem

P(Yes | Rainy,Mild) =
P(Rainy, Mild | Yes) * P(Yes) /
P(Rainy,Mild) =

Weather	Temp	Play
Sunny	Hot	No
Sunny	Hot	No
Overcast	Hot	Yes
Rainy	Mild	Yes
Rainy	Cool	Yes
Rainy	Cool	No
Overcast	Cool	Yes
Sunny	Mild	No
Sunny	Cool	Yes
Rainy	Mild	Yes
Sunny	Mild	Yes
Rainy	Mild	No
Overcast	Hot	Yes

n = 13

Will we play tennis if it is rainy and mild? P(Yes | Rainy, Mild) = ??

1. Calculate the prior probability of each class.

P(No) = 5/13
P(Yes) = 8/13
P(Rainy,Mild) = 3/13

2. Calculate the conditional probability for each category given the class

P(Rainy,Mild|No) = 1/5
P(Rainy,Mild|Yes) = 2/8

3. Calculate the posterior probability using Bayes Theorem

P(Yes|Rainy,Mild) =
P(Rainy, Mild|Yes) * P(Yes) /
P(Rainy,Mild) =

Weather	Temp	Play
Sunny	Hot	No
Sunny	Hot	No
Overcast	Hot	Yes
Rainy	Mild	Yes
Rainy	Cool	Yes
Rainy	Cool	No
Overcast	Cool	Yes
Sunny	Mild	No
Sunny	Cool	Yes
Rainy	Mild	Yes
Sunny	Mild	Yes
Rainy	Mild	No
Overcast	Hot	Yes

n = 13

Will we play tennis if it is rainy and mild? P(Yes | Rainy, Mild) = ??

1. Calculate the prior probability of each class.

P(No) = 5/13
P(Yes) = 8/13
P(Rainy,Mild) = 3/13

2. Calculate the conditional probability for each category given the class

P(Rainy,Mild | No) = 1/5
P(Rainy,Mild | Yes) = 2/8

3. Calculate the posterior probability using Bayes Theorem

P(Yes | Rainy,Mild) =
P(Rainy, Mild | Yes) * P(Yes) /
P(Rainy,Mild) =
(2/8) * (8/13) * (13/3) = 66.6%