Naive Bayes Classifier

06 April 2022 08:05

total cards = 52

proba of pulling a red king.

2 colors = red & black

suits = 4 spade, diamond, heart, club

red

will have 2 red king

$\frac{26}{52}$ =

$\frac{4}{52}$ =

$\frac{2}{52}$ >> Joint proba.

evidence = it's red

heart, diamond

13 13

28

$\frac{2}{26} = \boxed{\frac{1}{13}}$

$\frac{2}{52} = \frac{2}{26}$

recalibrate when we get info

joint proba

JP :- red king

$\frac{2}{52}$ ..

info | evidence = $\frac{2}{26}$.

its a red card

when you get evidence you recalibrate the proba.

Bayes theorem

Mr. Bayesian.

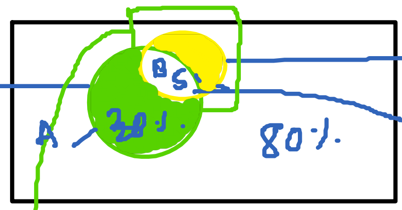
Conditional proba:- p of king given it's red
Info

$\frac{2}{26} = \frac{1}{13}$.

$\frac{0}{52}$:

ex.. flight info.

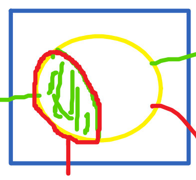
Flight delayed.



Fog but no flight delay

flight delay & fog.
(A∩B) =

20% . delayed. → green.
80% on ine



(A∩B)
fog
base
[illegible]

Cond. Prob.

im seeing fog at airport.
(it red card)

TP CP

JP CP

$\frac{2}{52}$ >? $\frac{2}{26}$

Shrank

$\frac{\quad}{\text{fog}}$

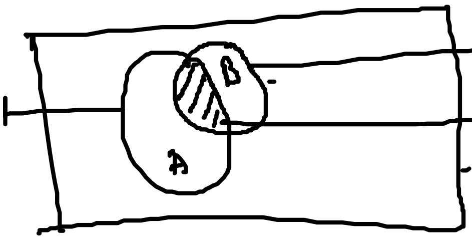
ex(1) Prob of king given its red $\frac{2}{26}$.

ex(2) prob of flight delay given fog.

P(Flight delay given fog)

$P(\text{flight delay} \mid \text{fog}) = \frac{P(A \cap B)}{P(B)}$

Total card 52



red cards = 26 $P(B)$

Red king = 2 $P(A \cap B)$

$JP = \frac{2}{52}$

$P(B)$

$\downarrow$

$\frac{2}{26}$

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \mid B) \times P(B) = P(A \cap B) \quad \ldots\ldots \text{ eqn (1)}$$

$p(B \cap A)$

$p(B \cap A) = p(B|A) \times p(A)$

$$P(A|B) = \frac{P(B|A) \times P(A)}{P(B)}$$ } – Bayesian model.

hi

eg. A = target i.e. diabetic or non-diabetic

B = ind var.

$P(A|B) \Rightarrow$ diabetic for given condition

$p(B|A)$ = likelihood

posterior → $P(A|B) = \dfrac{P(B|A) \times P(A)}{P(B)}$

$P(B|A)$ → likelihood.

$P(A)$ → prior.

$P(B)$ → evidence / marginal

A = Target

B = ind. (x_1, x_2, x_3)

$P(A|B) = P$ (person being diabetic given condition)

$A \Rightarrow$ diabetic

$B \Rightarrow$ ind

20 120 150

those who are already diabetic

$P(A) \Rightarrow$ diabetic people.

$p(B|A) \Rightarrow$ condition for given diabetic

frequencies	Fog yes	No	total	likelihood of Fog p(yes)	p(N)
Flight delay	4	16	20	4/20	16/20
not delay	1	79	80	1/80	79/80
$A \cap B$	5	95	100	5/100	95/100

$$p(\text{fog} = \text{yes} \mid \text{flight delay}) = \frac{4}{20} = \underline{0.2}$$

20% prob. that flight is delayed given Fog.

$$p(A \cap B) \Rightarrow p(\text{flight delay} \mid \text{Fog}) = p(\text{fog} \mid \text{flight delay}) \times p(FD)$$

$$= \frac{4}{20} \times \frac{20}{100}$$

$$= \underline{0.04}$$

4%

P(B)

Case 1.

$$p(A|B) = \frac{p(B|A) \times p(A)}{p(B)}$$

eq $= 0.5 >$ class B
or $= 0.5 \not>$ class A

Case 2

$$1 - P(A|B) = 1 - \frac{P(B|A \times p(A)}{p(B)}$$

$$= \frac{p(B) - p(B|A) \times p(A)}{p(B)}$$

hi

prob. of a card is king

$$P(\text{king}) = \frac{4}{52} = \frac{1}{13}$$

$$P(\text{king} \mid \text{face}) = \frac{P(\text{face} \mid \text{king}) \times P(\text{king})}{P(\text{face})}$$

$$P(\text{face}) = \frac{12}{52}$$

$$P(\text{face} \mid \text{king}) = \frac{4}{4} = 1$$

$$P(\text{king} \mid \text{face}) = \frac{1 \times 1/13}{12/52} = \frac{1}{3}$$

$$\boxed{\frac{4}{12} = \frac{1}{3}}$$

#

frequency table

	play Y	play N	outlook total
overcast	4	0	4
rainy	3	2	5
sunny.	2	3	5
	9	5	14

likelihood table.

	play Y	play N	
	4/9	0/5	4/14
	3/9	2/5	5/14
	2/9	3/5	5/14
	9/14	5/14	

$$P(A \mid B) = \frac{P(B \mid A) \times P(A)}{P(B)}$$

A = yes (play)

B = Sunny

A|B = yes | sunny

B|A = sunny | yes.

$$P(\text{yes} \mid \text{sunny}) = \frac{P(\text{sunny} \mid \text{yes}) \times P(\text{yes})}{P(\text{sunny})}$$

p(sunny)

$$p(sunny|yes) = \frac{2}{9} = 0.22$$

$$p(sunny) = \frac{5}{14} = 0.36$$

$$p(yes) = \frac{9}{14} = 0.64$$

hi

$$p(yes|sunny) = \frac{0.22 \times 0.64}{0.36}$$

$$= 0.39$$

For NO

$$p(sunny) = 0.36$$

$$p(NO) = 0.36$$

$$p(sunny|NO) = \frac{3}{5} = 0.6$$

$$p(NO|sunny) = \frac{0.6 \times 0.36}{0.36}$$

$$= 0.6$$

$$p(yes) = 0.39$$

$$p(NO) = 0.6$$

$$0.99 \approx 1$$

Humidity

	Y	N	T	p(Y)	p(N)	P
high	3	4	7	3/9	4/5	7/14
normal	6	1	7	6/9	1/5	7/14
		5	14	9/14	5/14	

normal	6	1	1	6/9	1/5	7/14
	9	5	14	9/14	5/14	

Windy

hi

	Y	N	T	p(Y)	p(N)	P
True	3	3	6	3/9	3/5	6/14
False	6	2	8	6/9	2/5	8/14
	9	5	14	9/14	5/14	

ex outlook = rainy, Hu = normal
windy = false. play ? :

$$Yes = p(out = rainy \mid yes) \times p(Hum = normal \mid yes) \times p(wind = false \mid yes) \times p(yes)$$

$$= \frac{3}{9} \times \frac{6}{9} \times \frac{6}{9} \times \frac{9}{14}$$

$$yes = 0.035$$

$$p(yes \mid x_1, x_2, x_3) = p(yes \mid rainy, normal, false)$$

$$No = p(out = rainy \mid No) \times p(H = norm \mid No) \times p(wind = false \mid No) \times p(No)$$

$$= \frac{2}{5} \times \frac{1}{5} \times \frac{2}{5} \times \frac{5}{14}$$

$$= 0.011$$

$$p(yes) = \frac{0.035}{0.035 + 0.011} = 0.896$$

$$p(No) = \frac{0.011}{} = 0.103$$

$+ = \underline{1}$

$$P(No) = \frac{0.011}{0.095 + 0.011} = 0.103$$

Ans = outlook = rainy, Humidity = normal, windy = false

play = E

there are 89 % chance there will a match today.