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Assignment 2 (written)

Task 1

Let M denotes sensor being in Maine and T denotes that temperature is above 80 degree.

Given, probability of sensor place in Maine is 5%, then P(M)=0.05

Then probability that sensor is in Sahara P(⌐M) =1-P(M) = 1-0.05 =0.95

P(T|M) = 20% = 0.2 P(T|⌐M) = 90% =0.9

P(⌐T|M) = 1- P(T|M) = 0.8 P(⌐T|⌐M) =1- P(T|⌐M) =0.1

Part a:

Here, asked is probability that sensor is placed in Maine given temperature is under 80degree which is P(M|⌐T).

$$P(M|\neg T) = \frac{P(M \cap \neg T)}{P(\neg T)} = \frac{P(\neg T|M)P(M)}{\left(P(\neg T|M)P(M) + P(\neg T|\neg M)P(\neg M)\right)} = \frac{0.8 * 0.05}{0.8 * 0.05 + 0.1 * 0.95}$$

$$= 0.04/0.135 = 0.2963$$

Therefore, probability that the sensor is placed in Maine is 0.2963, that is 29.63%.

Part b:

Let T1 denotes the first email obtained from sensor S indicating daily high above 80 degree.

Let T2 be second email that also indicates a daily high above 80 degree.

This part asks temperature of second email with daily high under 80 degree given first email with daily high under 80 degree that is P(⌐T2|⌐T1).

$$P(\neg T2|\neg T1) = \frac{P(\neg T2 \cap \neg T1)}{P(\neg T1)} = \frac{P\left(\frac{\neg T2 \cap \neg T1}{M}\right).P(M) + P\left(\frac{\neg T2 \cap \neg T1}{\neg M}\right).P(\neg M)}{P(\neg T1)}$$

Here T1, T2 and M are independent. So,

$$= \frac{P(\neg T2|M) * P(\neg T1|M).P(M) + P(\neg T2|\neg M) * P(\neg T1|\neg M).P(\neg M)}{P(\neg T1|M)P(M) + P(\neg T1|\neg M)P(\neg M)}$$

$$= \frac{0.8 * 0.8 * 0.05 + 0.1 * 0.1 * 0.95}{(0.8 * 0.05 + 0.1 * 0.95)} = \frac{0.0415}{0.135} = 0.3074$$

Therefore, probability that the second e-mail also indicates a daily high under 80 degrees is 0.3074 that is 30.74%.

Part c:

Let T1, T2, T3 denotes temperature of first, second and third day when daily high temperature is above 80 degree.

This part asks probability of all 3 emails indicating daily high under 80 degrees that is

$P(\neg T3 \cap \neg T2 \cap \neg T1)$

$$P(\neg T3 \cap \neg T2 \cap \neg T1) = P(\neg T3|M) * P(\neg T2|M) * P(\neg T1|M) * P(M) + P(\neg T3|\neg M) * P(\neg T2|\neg M) * P(\neg T1|\neg M) * P(\neg M)$$

$$=0.8*0.8*0.8*0.05+0.1*0.1*0.1*0.95$$

$$= 0.02655$$

Therefore, probability of all 3 emails indicating daily high under 80 degrees is 0.02655 that is 2.655%.

Task 2

As we have value of P(A)=0.3 and P(B)=0.6 we do not know the value of P(C) and P(D). So, to be probability function the sum of all probability for given sample should be 1. Here, P(A)+P(B) =0.9 so, if the probability of P(C)+P(D) is equal to 0.1 then the function P could be probability function else it is not. ***So, the P is possibly a probability function.***

Task 3

Given, P(x)=0.3 when 0<=x<=10. So, on integrating it we have the value of P greater than 1. The integral of P from negative infinity to positive infinity should be 1 but it is 3 for the given case. ***So, P is definitely not a probability density function.***

Task 4

Given values for the boxes and fruits are as below,

- p(B = r) = 0.4
- p(B = b) = 0.6
- p (F = a | B = r) = 0.25
- p (F = o | B = r) = 0.75
- p (F = a | B = b) = 0.75

- p (F = o | B = b) = 0.25

  For calculating the correct output for x we have to consider the cases where we pick a fruit apple for a both boxes that is P (B = r | F = a) and P (B = b | F = a)

$$P(B = r \mid F = a) = \frac{p\,(F = a \mid B = r) * P(B = r)}{P(F = a \mid B = r)P(B = r) + P(F = a \mid B = b)P(B = b)}$$

$$= \frac{0.25 * 0.4}{(0.25 * 4 + 0.75 * 0.6)} = 0.1818$$

$$P(B = b|F = a) = 1 - P(B = r|F = a) = 1 - 0.1818 = 0.8181$$

  Now calculating when orange is picked,

$$P(B = b|F = 0) \textit{ and } P(B = r \mid F = o)$$

$$P(B = b|F = o) = \frac{p\,(F = o \mid B = b) * P(B = b)}{P(F = o|B = b)P(B = b) + P(F = o|B = r)P(B = r)}$$

$$= \frac{0.25 * 0.6}{0.25 * 0.6 + 0.75 * 0.4} = 0.3333$$

$$P(B = r|F = o) = 1 - P(B = b|F = o) = 1 - 0.3333 = 0.6667$$

Here, when the apple is picked the classifier will give correct output 81.81% having probability 0.8181 and when orange is picked the probability to give correct output 0.6667 that is 66.67%.

Task 5

Training OUTPUT:

Class 1, attribute 1, mean = 0.52, std = 0.10
Class 1, attribute 2, mean = 0.54, std = 0.10
Class 1, attribute 3, mean = 0.52, std = 0.07
Class 1, attribute 4, mean = 0.41, std = 0.17
Class 1, attribute 5, mean = 0.50, std = 0.01
Class 1, attribute 6, mean = 0.00, std = 0.01
Class 1, attribute 7, mean = 0.50, std = 0.05
Class 1, attribute 8, mean = 0.24, std = 0.05
Class 2, attribute 1, mean = 0.45, std = 0.11
Class 2, attribute 2, mean = 0.45, std = 0.10
Class 2, attribute 3, mean = 0.53, std = 0.06
Class 2, attribute 4, mean = 0.23, std = 0.11
Class 2, attribute 5, mean = 0.50, std = 0.04

Class 2, attribute 6, mean = 0.00, std = 0.01
Class 2, attribute 7, mean = 0.49, std = 0.06
Class 2, attribute 8, mean = 0.33, std = 0.14
Class 3, attribute 1, mean = 0.43, std = 0.10
Class 3, attribute 2, mean = 0.48, std = 0.11
Class 3, attribute 3, mean = 0.36, std = 0.06
Class 3, attribute 4, mean = 0.22, std = 0.08
Class 3, attribute 5, mean = 0.51, std = 0.05
Class 3, attribute 6, mean = 0.00, std = 0.01
Class 3, attribute 7, mean = 0.51, std = 0.04
Class 3, attribute 8, mean = 0.27, std = 0.09
Class 4, attribute 1, mean = 0.79, std = 0.07
Class 4, attribute 2, mean = 0.76, std = 0.07
Class 4, attribute 3, mean = 0.38, std = 0.06
Class 4, attribute 4, mean = 0.32, std = 0.11
Class 4, attribute 5, mean = 0.50, std = 0.01
Class 4, attribute 6, mean = 0.00, std = 0.01
Class 4, attribute 7, mean = 0.51, std = 0.07
Class 4, attribute 8, mean = 0.27, std = 0.09
Class 5, attribute 1, mean = 0.74, std = 0.16
Class 5, attribute 2, mean = 0.62, std = 0.13
Class 5, attribute 3, mean = 0.42, std = 0.08
Class 5, attribute 4, mean = 0.30, std = 0.12
Class 5, attribute 5, mean = 0.50, std = 0.01
Class 5, attribute 6, mean = 0.00, std = 0.01
Class 5, attribute 7, mean = 0.51, std = 0.06
Class 5, attribute 8, mean = 0.24, std = 0.04
Class 6, attribute 1, mean = 0.54, std = 0.14
Class 6, attribute 2, mean = 0.50, std = 0.12
Class 6, attribute 3, mean = 0.51, std = 0.05
Class 6, attribute 4, mean = 0.24, std = 0.10
Class 6, attribute 5, mean = 0.50, std = 0.01
Class 6, attribute 6, mean = 0.49, std = 0.39
Class 6, attribute 7, mean = 0.51, std = 0.03
Class 6, attribute 8, mean = 0.24, std = 0.05
Class 7, attribute 1, mean = 0.48, std = 0.11
Class 7, attribute 2, mean = 0.47, std = 0.09
Class 7, attribute 3, mean = 0.54, std = 0.06
Class 7, attribute 4, mean = 0.22, std = 0.12
Class 7, attribute 5, mean = 0.50, std = 0.04
Class 7, attribute 6, mean = 0.00, std = 0.03
Class 7, attribute 7, mean = 0.50, std = 0.06
Class 7, attribute 8, mean = 0.26, std = 0.09
Class 8, attribute 1, mean = 0.74, std = 0.11
Class 8, attribute 2, mean = 0.73, std = 0.11
Class 8, attribute 3, mean = 0.49, std = 0.05

Class 8, attribute 4, mean = 0.29, std = 0.07
Class 8, attribute 5, mean = 0.50, std = 0.01
Class 8, attribute 6, mean = 0.00, std = 0.01
Class 8, attribute 7, mean = 0.46, std = 0.08
Class 8, attribute 8, mean = 0.23, std = 0.02
Class 9, attribute 1, mean = 0.55, std = 0.14
Class 9, attribute 2, mean = 0.56, std = 0.16
Class 9, attribute 3, mean = 0.51, std = 0.07
Class 9, attribute 4, mean = 0.20, std = 0.07
Class 9, attribute 5, mean = 0.50, std = 0.01
Class 9, attribute 6, mean = 0.00, std = 0.01
Class 9, attribute 7, mean = 0.53, std = 0.05
Class 9, attribute 8, mean = 0.24, std = 0.05
Class 10, attribute 1, mean = 0.78, std = 0.06
Class 10, attribute 2, mean = 0.73, std = 0.12
Class 10, attribute 3, mean = 0.48, std = 0.11
Class 10, attribute 4, mean = 0.33, std = 0.07
Class 10, attribute 5, mean = 1.00, std = 0.01
Class 10, attribute 6, mean = 0.00, std = 0.01
Class 10, attribute 7, mean = 0.55, std = 0.02
Class 10, attribute 8, mean = 0.23, std = 0.01

CLASSIFICATION ACCURACY

classification accuracy=0.4483