

Previous Year CAT QP – M05

Q1. A. Suppose you go for a test to find whether you have COVID-19 disease or not? to a lab. Let there be 1 out of 100 people in your county is affected with this disease. Assume that there is a 5% chance of you being tested falsely positive (i.e. you do not have the disease but the test comes positive). Also, there is a 10% chance that you have the disease but tested negative (i.e. you have the disease, but the test comes positive). Apply Bayes Rule to find out the probability of you being tested positive and actually having the disease. [5 M]

B. Consider that 1% of the population in this world is having the COVID-19 disease. Assume that if you really have the disease, then there is a 95 % chance that you tested positive. Also, there is 1% chance that you have tested positive, even if you do not have the disease (because of inaccuracy of the test results). Using Bayes Rule find out the probability that you have tested positive and actually have the COVID-19 disease. [5 M] [CAT-2 Winter 2020-21]

Q2. Using the probability values given in the table answer the following statements with proper justifications (5 Marks) [CAT-2 Winter 2023-24]

- Does the probability of wind increase given the probability of rain?
- What is the dependency between wind and Headache? Does the probability of wind remain unchanged given headache?
- . Is rain conditionally independent of Headache, given wind?

P(rain \wedge wind \wedge Headache)	rain		\neg rain	
	wind	\neg wind	wind	\neg wind
Headache	0.432	0.16	0.084	0.008
\neg Headache	0.048	0.16	0.036	0.072

Q3. Apply Naïve Bayes Classification for the given dataset of animals along with their attributes.

S.No	Give Birth	Can Fly	Live in Water	Have Legs	Class
1	yes	no	no	yes	mammals
2	no	no	yes	no	non-mammals
3	no	no	yes	yes	non-mammals
4	yes	no	no	no	mammals
5	no	no	sometimes	yes	non-mammals
6	no	no	no	no	non-mammals
7	yes	yes	no	yes	mammals
8	no	yes	no	no	non-mammals
9	yes	no	no	yes	mammals
10	no	no	no	no	non-mammals
11	no	no	sometimes	yes	non-mammals

12	no	no	sometimes	yes	non-mammals
13	no	no	no	yes	non-mammals
14	yes	no	no	yes	mammals
15	no	no	sometimes	yes	non-mammals
16	no	no	no	no	non-mammals
17	no	no	no	no	non-mammals
18	yes	no	no	yes	mammals
19	yes	yes	no	no	non-mammals
20	no	yes	no	yes	non-mammals

Execute the following query to predict the class [CAT-2 Winter 2023-24]

Give Birth	Can Fly	Live in Water	Have Legs	Class
Yes	No	Yes	No	?

Q4. Consider the following dataset

S.No	Age	Gender	Income	Education	Occupation	Credit Score
1	<40	Male	High	Graduate	Professional	Low
2	<40	Female	Medium	High School	Managerial	Low
3	>40	Male	High	Postgraduate	Professional	High
4	>40	Female	High	Postgraduate	Professional	High
5	>40	Male	Low	High School	Skilled	Low
6	<40	Female	Medium	Graduate	Managerial	Medium
7	<40	Male	Medium	Graduate	Professional	High
8	>40	Female	High	Postgraduate	Managerial	High
9	>40	Male	High	High School	Skilled	Low
10	<40	Female	Medium	Graduate	Professional	Medium
11	>40	Male	Medium	High School	Skilled	Medium
12	>40	Female	Low	Graduate	Skilled	High

- a) Using the provided dataset, which includes demographic information and credit scores of individuals, apply Naive Bayes classification to predict the credit score of a new individual based on their following demographic features: *Age>40, Gender=Male, Income=Medium, Education=Graduate, Occupation=Skilled*. [6 M]
- b) Based on the data given in the table answer the followings: (4 Marks)
- What is the probability that an individual has a High credit score given that they are Female and have a Postgraduate education?
 - Given that an individual has a High income and a Skilled occupation, what is the probability?

[CAT-2 Winter 2023-24]

Q5. Suppose you live in London, England, and you notice that during the winter, it rains 50% of the time and that it is cloudy 80% of the time (sometimes it is cloudy without rain). You know, of course, that 100% of the time, if it is raining, then it is also cloudy. Using Bayes' rule, compute the chances of rain, given that it is just cloudy. [4 M] **[CAT-2 Winter 2023-24]**

Q6. A) Using the Naïve Bayes classifier diagnoses the person with symptoms (chills= y, running nose = n, Headache=mild, Fever= n) have flu or not? [6 Marks] **[CAT-2 Winter 2023-24]**

S.No	Chills(C)	Running nose(R)	Headache (H)	Fever (Fr)	Flu
1	y	n	mild	y	n
2	y	y	no	n	y
3	y	n	strong	y	y
4	n	y	mild	y	y
5	n	n	no	n	n
6	n	y	strong	y	y
7	n	y	strong	n	n
8	y	y	mild	n	y

B) In a standard two of St. John school, 30% of the children have grey eyes, 50% of them have blue and the other 20%'s eyes are in other colours. One day they play a game together. In the first run, 65% of the grey eye ones, 82% of the blue-eyed ones and 50% of the children with other eye colour were selected. Now, if a child is selected randomly from the class, and we know that he/she was not in the first game, what is the probability that the child has blue eyes? [4 Marks] **[CAT-2 Winter 2019-20 + CAT-2 Winter 2023-24]**

Q7. A) Explain Bayes' rule with a suitable example [3 M]

B) In a reputed engineering college, there are 1000 students. Among them, 700 students got placement offers. Overall, it is seen that 82% of the candidates are strong in 'C language' among the selected candidates. In the class, 660 students are strong in 'C language'. Sweta is strong in 'C language'. How likely is she to get the placement offer? Map the scenario into a set of propositions and apply Bayes' rule to solve the problem. [7 M] **[CAT-2 Fall 2024-25]**

Q8. Consider the following dataset that includes demographic information and symptoms for disease diagnosis:

A) Using the dataset provided, apply Naive Bayes Classification to predict the diagnosis of a new individual based on the following features:

Age Group: 30-40, Gender: Female, Fever: Yes, Cough: Yes, Fatigue: Yes, Sore Throat: No

S.No	Age Group	Gender	Fever	Cough	Fatigue	Sore Throat	Diagnosis
1	30	Female	Yes	Yes	Yes	No	Flu
2	30-40	Male	Yes	Yes	No	Yes	COVID-19
3	>40	Female	No	Yes	Yes	Yes	Allergies
4	<30	Male	Yes	No	Yes	No	Flu
5	30-40	Female	Yes	Yes	Yes	Yes	COVID-19
6	>40	Male	No	No	No	No	Healthy
7	<30	Female	Yes	Yes	No	Yes	COVID-19
8	30-40	Male	Yes	No	Yes	Yes	Flu
9	>40	Female	Yes	Yes	Yes	Yes	COVID-19
10	30-40	Male	No	Yes	No	No	Allergies

B. Based on the data given, answer the following:

- What is the probability that an individual has a COVID-19 diagnosis given that they are Male and have Fatigue and Cough?
- Given that an individual has No Fever and No Cough, what is the probability that their diagnosis is Healthy? **[CAT-2 Fall 2024-25]**

Q9. For the Bayesian network given below: **[CAT-2 Winter 2019-20]**

- Calculate the probability that the door is open, it is wife and not a burglar, also the car is in the garage, and the door is not damaged.
- Calculate the probability that it is the burglar, the door is open and also damaged and there is no car in garage.
- Calculate the probability that the door is closed, it is not wife and not a burglar, also the car is in the garage, and the door is not damaged

