Introduction to Machine Learning

Assignment- Week 4

TYPE OF QUESTION: MCQ

Number of questions: **10** **Total mark: 10 X 2 = 20**

QUESTION 1:

A man is known to speak the truth 2 out of 3 times. He throws a die and reports that the number obtained is 4. Find the probability that the number obtained is actually 4 :

A. 2/3
B. 3/4
C. 5/22
D. 2/7

Correct Answer : D. 2/7

Detailed Solution : Suppose,

$A: \text{The man reports that 4 is obtained.}$
$B: \text{Number 4 is obtained}$

$P(B|A) = \frac{P(A|B)P(B)}{P(A|B)P(B)+P(A|\bar{B})P(\bar{B})}$ here,

$P(A|B) = \frac{2}{3},\ P(B) = \frac{1}{6}, P(A|\overline{B}) = \frac{1}{3},\ P(\overline{B}) = \frac{5}{6}$

$P(B|A) = \frac{2}{7}$

QUESTION 2:

Two cards are drawn at random from a deck of 52 cards without replacement. What is the probability of drawing a 2 and an Ace in that order?

A. 4/51
B. 1/13
C. 4/256
D. 4/663

Correct Answer : D. 4/663

Detailed Solution :

A : Drawing a 2

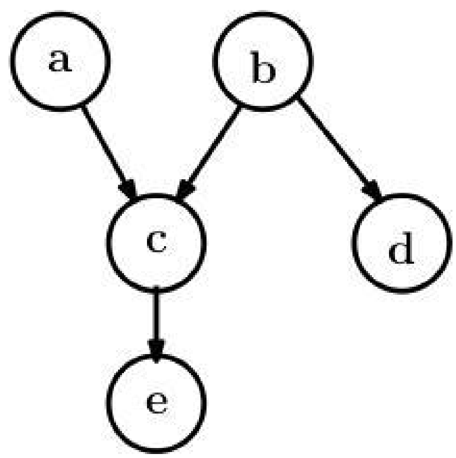
B : Drawing an Ace from the remaining 51 cards

$P(AB) = P(A) * P(B|A)$ here, $P(A) = \frac{4}{52} = \frac{1}{13}, P(B|A) = \frac{4}{51}$

$P(AB) = \frac{1*4}{13*51} = \frac{4}{663}$

QUESTION 3:

Consider the following graphical model, mark which of the following pair of random variables are independent given no evidence?



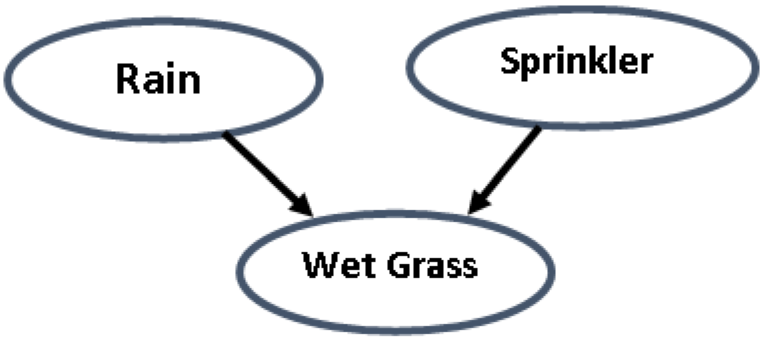
A. a,b
B. c,d
C. e,d
D. c,e

Correct Answer : A. a,b

Detailed Solution : Nodes a and b don't have any predecessor nodes. As they don't have any common parent nodes, a and b are independent.

QUESTION 4:

Consider the following Bayesian network. The random variables given in the model are modeled as discrete variables (Rain = R, Sprinkler = S and Wet Grass = W) and the corresponding probability values are given below. (**Note**: (¬ X) represents complement of X)



P(R) = 0.1
P(S) = 0.2
P(W | R, S) = 0.8
P(W | R, ¬ S) = 0.7
P(W | ¬ R, S) = 0.6
P(W | ¬ R, ¬ S) = 0.5

Calculate P(S | W, R).

A. 1
B. 0.5
C. 0.22
D. 0.78

Correct Answer : C. 0.22

Detailed Solution : $P(S|W,R) = \frac{P(W,S,R)}{P(W,R)} = \frac{P(WSR)}{P(WSR)+P(W\bar{S}R)}$

$$P(WSR) = P(W|S,R) * P(R) * P(S) = 0.8 * 0.1 * 0.2 = 0.016$$

$$P(W\bar{S}R) = P(W|\bar{S},R) * P(R) * P(\bar{S}) = 0.7 * 0.1 * 0.8 = 0.056$$

$$P(S|W,R) = \frac{P(W,S,R)}{P(W,R)} = \frac{P(WSR)}{P(WSR)+P(W\bar{S}R)} = \frac{0.016}{0.016+0.056} = 0.22$$

QUESTION 5:

What is the naive assumption in a Naive Bayes Classifier?

A. All the classes are independent of each other
B. All the features of a class are independent of each other
C. The most probable feature for a class is the most important feature to be considered for classification
D. All the features of a class are conditionally dependent on each other.

Correct Answer: B. All the features of a class are independent of each other

Detailed Solution: Naive Bayes Assumption is that all the features of a class are independent of each other.

QUESTION 6:

A drug test (random variable T) has 1% false positives (i.e., 1% of those not taking drugs show positive in the test), and 5% false negatives (i.e., 5% of those taking drugs test negative). Suppose that 2% of those tested are taking drugs. Determine the probability that somebody who tests positive is actually taking drugs (random variable D).

A. 0.66
B. 0.34
C. 0.50
D. 0.91

Correct Answer : A. 0.66
Detailed Solution :

$P(D|T) = \frac{P(T|D)P(D)}{P(T|D)P(D)+P(T|\overline{D})P(\overline{D})}$, $P(T|D) = \frac{95}{100}$, $P(T|\overline{D}) = \frac{1}{100}$, $P(D) = \frac{2}{100}$

$P(D|T) = 0.66$

QUESTION 7:

It is given that $P(A|B) = 2/3$ and $P(A|\overline{B}) = 1/4$. Compute the value of $P(B|A)$.

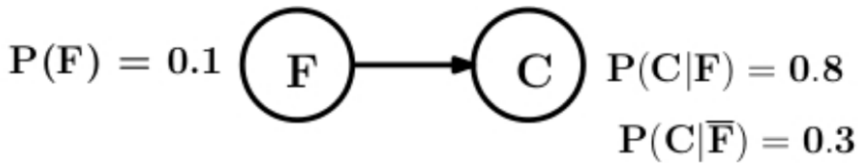
A. ½
B. ⅔
C. ¾
D. Not enough information.

Correct Solution : D. Not enough information.

Detailed Solution : There are 3 unknown probabilities $P(A), P(B), P(AB)$ which can not be computed from the 2 given probabilities. So, we don't have enough information to compute $P(B|A)$.

QUESTION 8:

Consider the following Bayesian network, where F = having the flu and C = coughing:



Find P(C) and P(F|C).

A. 0.35, 0.23
B. 0.35,0.77
C. 0.24, 0.024
D. 0.5, 0.23

Correct Answer: A. 0.35, 0.23

Detailed Solution :

$$P(C) = P(C|F) * P(F) + P(C|\overline{F}) * P(\overline{F})$$

$$P(F|C) = \frac{P(C|F)*P(F)}{P(C|F)*P(F)+P(C|\overline{F})*P(\overline{F})}$$

QUESTION 9:

Bag I contains 4 white and 6 black balls while another Bag II contains 4 white and 3 black balls. One ball is drawn at random from one of the bags and it is found to be black. Find the probability that it was drawn from Bag I.

A. 1/2
B. 2/3
C. 7/12
D. 9/23

Correct Answer : C. 7/12

Detailed Solution :

Consider the random variables:

B1: “Ball is drawn from bag **I**”,

B2: “Ball is drawn from bag **II**”,

W: “Drawn ball is white”,

B: “Drawn ball is black”

We have to find $P(B1|B)$

$$P(B1|B) = \frac{P(B|B1)*P(B1)}{P(B|B1)*P(B1)+P(B|B2)*P(B2)} = \frac{(6/10)*(1/2)}{(6/10)*(1/2)+(3/7)*(1/2)} = \frac{3/10}{3/10+3/14} = \frac{7}{12}$$

QUESTION 10:

In a Bayesian network a node with only outgoing edge(s) represents

A. a variable conditionally independent of the other variables.
B. a variable dependent on its siblings.
C. a variable whose dependency is uncertain.
D. None of the above.

Correct Answer: A. a variable conditionally independent of the other variables.

Detailed Solution : As there is no incoming edge for the node, the node is not conditionally dependent on any other node.

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