**PART 2**

1. P(A U B) = 1 -  P((A U B)c) = 1 – 0.42 = 0.58

P(A U B) = P(A) + P(B) – P(A n B)

0.58 = 0.4 + 0.3 – P(A n B)

0.58 – 0.7 = - P(A n B)

P(A n B) = 0.12

For two events to be independent their intersection should be equal to the product of their two probabilities (i.e. P(A) \* P(B) = P(A n B)).

0.4 \* 0.3 = 0.12 == P(A n B). Therefore, they are independent

1. A = ‘sum of two dice equals 3’

B = ‘sum of two dice equals 7’

C = ‘at least one of the dice shows a 1’

1. P(A | C) = P(A n C) / P(C)

For P(A n C) to happen the sum must be three which is going to be either 2, 1 or 1, 2 so 2/36.

At least one dice showing up, which is P(C) is 11/36

Plugging in the values: = (2/36) / (11/36) = 2/11

1. For P(B | C), we can deduce that P(B n C) = 2/36. And from before we know that P(C) = 11/36

So plugging in these values to our formula we get the same value as A|C = 2/11

1. In order to check if two events are independent here we can check if P(A | C) = P(A)

P(A) = 2/36 != 2/11 = P(A|C). This means the events are not independent.

Now to check if event B and event C are independent:

P(B) = P(B | C)

P(B) = 6/36 = 1/6

1/6 != 2/11

Therefore, events B and C are not independent

1. P(Cc n D) = P(D) – P(C n D) = 0.45 – 0.1 = 0.35
2. Number of arrangements = length of word / number of repeating words

11! / 2!2! = 9,979,200

1. P(A v B) = 1 – P(A v B)c

= 1 – 2/3

=1/3

1. p(Y>X)=p(0,1)+p(0,2)+p(1,2)  for p(x,y)

             =0.05+0+0.05

              =0.1

The marginal probability of x is:

|  |  |
| --- | --- |
| X | p(x) |
| 0 | 0.2 |
| 1 | 0.5 |
| 2 | 0.2 |
| 3 | 0.1 |

The marginal probability of y is:

|  |  |
| --- | --- |
| Y | p(y) |
| 0 | 0.5 |
| 1 | 0.3 |
| 2 | 0.2 |

* x and y are not independent because the number of times a technician is called depends on the number of malfunction. this  can be seen in multiple instances for example if there is no malfunction the probability of the technician being twice is zero but in other cases it is not .this shows the probability of the technician being called twice depends on the number of malfunction

1. For perceptron we use the equation w(new) = w(old) + (label - proposed outcome) \* xi

(1, 2, 3, 4), 1

(5, 6, 7, 8), 0

(9, 10, 11, 12), 1

w1 = 0.1

w2 = 0.2

w3 = -0.1

w4 = 0.0

To get the proposed outcome we use w.x for each data:

w.(1,2,3,4) = (0.1, 0.2, -0.1, 0.0) . (1,2,3,4) = 0.2 > 0, which is correct so we don't make any update.

w.(5,6,7,8) = (0.1, 0.2, -0.1, 0.0) . (5,6,7,8) =  1 > 0 which is not correct so we will update the weight.

W1 = 0.1 + (0 - 1)\*5 = -4.9

W2 = 0.2 + (0 - 1)\*6 = -5.8

W3 = -0.1 + (0 - 1)\*7 = -7.1

W4 = 0.0 + (0 - 1)\*8 = -8

w.(9,10,11,12)  =  (-4.9, -5.8, -7.1, -8). (9,10,11,12) = -276.2 which is not correct so we will update the weight

W1 = -4.9 + (1 - 0)\*9 = -4.1

W2 = -5.8 + (1 - 0)\*10 = 4.2

W3 = -7.1 + (1 - 0)\*11 = 3.9

W4 = -8 + (1 - 0)\*12 = 4

For logistic regression we use the equation w(new) = w(old) + learning rate(label- proposed outcome) \* xi. And we use 0 as the threshold.

To check we use sigmoid’s equation (1/(1+e\*\*(-w.x))

(1, 2, 3, 4), 1

(5, 6, 7, 8), 0

(9, 10, 11, 12), 1

w1 = 0.1

w2 = 0.2

w3 = -0.1

w4 = 0.0

For the first w.x = (0.1, 0.2, -0.1, 0.0) . (1,2,3,4) = 0.2

 = (1/(1+e\*\*(-0.2)) = 0.55 which is correct, so we don't update the weight

For the second w.x = (0.1, 0.2, -0.1, 0.0) . (5,6,7,8) = 1

= (1/(1+e\*\*(-1)) = 0.73 which is incorrect, so we update the weight

W1 = 0.1 + 0.1(0 - 1)\* 5 = -0.4

W2 = 0.2 + 0.1(0 - 1)\*6 = -0.4

W3 = -0.1 + 0.1(0 - 1)\*7 =-0.8

W4 = 0.0 + 0.1(0 - 1)\*8 = -0.8

For the third w.x = (-0.4, -0.4, -0.8, -0.8).(9,10,11,12) = -36

= (1/(1+e\*\*(36)) >0 which is correct so we won't update the weight