**Assignment 8**

**Task 1:**

Probability of sensor S in Maine, P(M) = 0.05

Probability of sensor S in Sahara, P(S) = 1 – 0.05 = 0.95

Let, X = probability of getting a daily high temperature of 80 degrees or more.

Y = probability of getting a daily high temperature less than 80 degrees.

P(X|M) = probability of getting a daily high temperature of 80 degrees or more in Maine.

P(X|M) = 0.2

P(Y|M) = probability of getting a daily high temperature less than 80 degrees or more in Maine.

P(Y|M) = 1 – 0.2 = 0.8

P(X|S) = = probability of getting a daily high temperature of 80 degrees or more in Sahara.

P(X|S) = 0.9

P(Y|S) = = probability of getting a daily high temperature less than 80 degrees or more in Sahara.

P(Y|S) = 1 - 0.9 = 0.1

1. Let P(M|Y) = probability that the sensor is placed in Maine given a daily high temperature under 80 degrees.

P(M|Y) = [(P(M) \* P(Y|M)) / P(Y)]

Here, P(Y) = P(Y|M) \* P(M) + (Y|S) \* P(S)

= 0.8 \* 0.05 + 0.1 \* 0.95 = 0.135

Therefore, P(M|Y) = [(P(M) \* P(Y|M)) / P1(Y)]

= [(0.05 \* 0.8) / 0.135]

= 0.2963

The probability that the sensor is placed in Maine given the first email you got from sensor S indicates a daily high under 80 degrees is **29.63%.**

1. P2(M) = [(P(Y|M) \* P(M)) / P1(Y)]

= [(0.8 \* 0.05) / 0.135] = 0.2963

P2(S) = [(P(Y|S) \* P1(S)) / P1(Y)]

= [(0.1 \* 0.95) / 0.135] = 0.704

P2(Y) = P(Y|S) \* P2(S) + P(Y|M) \* P2(M)

= 0.1 \* 0.704 + 0.8 \* 0.2963 = 0.3074

The probability that the second email also indicates a daily high under 80 degrees if the first email indicates a daily high under 90 degrees is **30.74%.**

1. P3(M) = [(P(Y|M) \* P(M)) / P2(Y)]

= [(0.8 \* 0.2963) / 0.3074] = 0.771

P3(S) = [(P(Y|S) \* P(S)) / P2(Y)]

= [(0.1 \* 0.704) / 0.3074] = 0.229

P3(Y) = P(Y|S) \* P3(S) + P(Y|M) \* P3(M)

= 0.1 \* 0.229 + 0.8 \* 0.771 = 0.6397

The probability that the first three emails all indicate daily highs under 80 degrees is,

P1(Y) \* P2(Y) \* P3(Y) = 0.135 \* 0.3074 \* 0.6397

= **0.02654**

**Task 2:**

1. As A is independent and it has 5 values, we have to store all of them. Also, B1,……,B10 is dependent on A, so for single variable we have to store 7 values. Therefore, total number of values we need to store In joint distribution table for these 11 variables will be = **5 \* (7^10) values.**
2. For each variable of B, we need to store 5 \* 6 = 30 values; as we can calculate the 7th value from 1 – total of 6 values. Similarly, for variable A we need to store only 4 values as we can calculate 5th value. For each variables we only need to store 30 \* 10 + 4 = **304 values.**

**Task 3:**

P(A=T, B=T, C=T) = 0.048

P(A=T, B=T, C=F) = 0.196

P(A=T, B=F, C=T) = 0.192

P(A=T, B=F, C=F) = 0.084

P(A=F, B=T, C=T) = 0.012

P(A=F, B=T, C=F) = 0.294

P(A=F, B=F, C=T) = 0.048

P(A=F, B=F, C=F) = 0.126

1. P(A|B) = P(A=T, B=T, C=T)+ P(A=T, B=T, C=F)

P(A=T, B=F, C=T) + P(A=T, B=F, C=F)

P(A=F, B=T, C=T) + P(A=F, B=T, C=F)

P(A=F, B=F, C=T) + P(A=F, B=F, C=F)

= 0.048 + 0.196

0.192 + 0.084

0.012 + 0.294

0.048 + 0.126

= 0.244/0.982 0.276/0.982 0.288/0.982 0.174/0.982

1. P(A|B, C) = P(A=T, B=T, C=T) P(A=T, B=F, C=T)

P(A=T, B=T, C=F) P(A=T, B=F, C=F)

P(A=F, B=T, C=T) P(A=F, B=F, C=T)

P(A=F, B=T, C=F) P(A=F, B=F, C=F)

= 0.048 0.192 0.196 0.084

0.012 0.048 0.294 0.126

1. P(A, C|B) = P(A=T, B=T, C=T)+ P(A=T, B=T, C=F)

+ P(A=F, B=T, C=T) + P(A=F, B=T, C=F)

P(A=T, B=F, C=T) + P(A=T, B=F, C=F)

+ P(A=F, B=F, C=T) + P(A=F, B=F, C=F)

= 0.048 + 0.196 + 0.012 + 0.294

0.192 + 0.084 + 0.048 + 0.126

= 0.55 0.45

1. Given B, is A conditionally independent of C?

For A to be conditionally independent of C,

P(A|B, C) = P(A|B)

From b, we have

P(A|B, C) = 0.048 0.192 0.196 0.084

0.012 0.048 0.294 0.126

From a, we have

P(A|B) = 0.244/0.982 0.276/0.982 0.288/0.982 0.174/0.982

We see that P(A|B, C) != P(A|B). Therefore, A is not conditionally independent of C.