Assignment 8

Task 2 :

Let T be the event of temperature recorded < 80°
M be the event of sensor place in Maine.

Given :
In Maine, the probability of daily hight temp > 80 is 20%.

$$\therefore \quad P\left(\frac{T}{M}\right) = 0.8$$

In Sahara, the probability of daily high temp > 80 is 90%

$$\therefore \quad P\left(\frac{T}{M'}\right) = 0.1$$

Prior probability that sensor placed in Maine is 5%.

$$\therefore \quad P(M) = 0.05$$

Sensor not place in Maine $P(M') = 0.95$

a) Using Baye's theorem,
then, $$P\left(\frac{M}{T}\right) = \frac{P(M) \cdot P\left(\frac{T}{M}\right)}{P(M) \cdot P\left(\frac{T}{M}\right) + P(M') \cdot P\left(\frac{T}{M'}\right)}$$

$$= \frac{0.05 \times 0.8}{0.05 \times 0.8 + 0.95 \times 0.1} = 0.2963$$

∴ probability that sensor placed in Maine with temp recorded $< 80°$ is 0.2963.

Part b) From the part a we can see that the probability of sensor recording daily hight less than 80 is 0.2963 in Maine

$$P\left(\frac{M}{T}\right) = 0.2963$$

$$\therefore P\left(\frac{M'}{T}\right) = 0.7037$$

By the law of total probability,

$$P(T) = P\left(\frac{M}{T}\right) \cdot 0.8 + P\left(\frac{M'}{T}\right) \times 0.1$$

$$= 0.2963 \times 0.8 + 0.7037 \times 0.1$$

$$= 0.30741$$

∴ the probability that second email also indicates a daily high under $80°$ is 0.31.

Part c :

L_1, L_2, L_3 be the first three emails all indicate daily highs under 80 degrees.

$$p(L_1, L_2, L_3) = p(L_3, L_2, L_1)$$

$$= p(L3/L_2, L_1) * p(L2|L_1) * p(L_1)$$

$$= p(L3|L2, L1) * 0.3074 * 0.135$$

$$p(L3/L2, L1) = p(L3|L2, L1, M) * p(m|L2, L1) + P(L3/L2, L1, M') * P(M'/L_2, L_1)$$

$$= P(L3|m) * p(L2, L1|M) \cdot P(M) / p(L2, L1) + p(L3/M') * P(L2, L_1/M') * P(M') / P(L2, L1)$$

$$P(L3/L2, L1) = 0.63977$$

$$P(L1, L2, L3) = 0.63977 \times 0.3074 \times 0.135$$

$$= 0.02654$$

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Task 3

Given
11 variables $A, B_1, B_2, B_3, B_4, B_5, B_6, B_7, B_8, B_9, B_{10}$.
Variable A has 5 values.
$B_1, B_2, \ldots B_{10}$ has 7 values.

(a) Total numbers that will stored in joint probability distribution table is

$$= (7^{10} \times 5) \text{ values in the table.}$$

(b) Total numbers needed to store these 11 variables is 350, because in this case we can consider the independence of variables i.e. B_i is independent of B_j

so we have ~~2X 3X 1X7~~ $7 \times 5 \times 10 = 350$.

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