MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

# Exercise 01

## Estatística Computacional - CAP-417-3 - 2022.1

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## Question

Suppose that the four inspectors at a film factory are supposed to stamp the expiration date on each package of film at the end of the assembly line. John, who stamps 20% of the packages, fails to stamp the expiration date once in every 200 packages; Tom, who stamps 60% of the packages, fails to stamp the expiration date once in every 100 packages; Jeff, who stamps 15% of the packages, fails to stamp the expiration date once in every 90 packages; and Pat, who stamps 5% of the packages, fails to stamp the expiration date once in every 200 packages. If a customer complains that her package of film does not show the expiration date, what is the probability that it was inspected by John? [1]

### Solution

The conditional probability is given by:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)} \tag{1}$$

Let's assume the rule of elimination or, likelihood with the equation:

$$P(B|A)P(A) = P(B_i)\sum_{i=1}^{k} P(A \cap B_i) \tag{2}$$

For this question we will assume assume the followed variables:

| | |
|---|---|
| T | not marked |
| JO | marked by John |
| TO | marked by Tom |
| JE | marked by Jeff |
| PA | marked by Pat |

Table 1: Table with the legends of the decisions made by each member.

Applying the condition of Table 1 in the Equation 2 we get

$$P(T) = P(JO)P(T|JO) + P(TO)P(T|TO) + P(JE)P(T|JE) + P(PA)P(A|PA). \quad (3)$$

Calculating the probabilities,

$$P(JO)P(T|JO) = 0.20 \cdot \frac{1}{200} = 0.001 \quad (4)$$

$$P(TO)P(T|TO) = 0.60 \cdot \frac{1}{100} = 0.006 \quad (5)$$

$$P(JE)P(T|JE) = 0.15 \cdot \frac{1}{90} = 0.00167 \quad (6)$$

$$P(PA)P(T|PA) = 0.05 \cdot \frac{1}{200} = 0.00025 \quad (7)$$

$$(8)$$

The likelihood will be the sum of these values

$$\mathcal{L} = 0.001 + 0.006 + 0.00167 + 0.00025 \quad (9)$$

$$\mathcal{L} = 0.00892 \quad (10)$$

We can calculate the probability that it was reviewed by John by

$$P = \frac{0.001}{0.00892} \quad (11)$$

$$P = 0.1121. \quad (12)$$

# References


[1] V. A. Santiago Júnior. CAP-417: Estatística Computacional (Computational Statistics), 2022. Acessed on: 2022/04/15. Available at: https://github.com/vsantjr/CAP/tree/master/CAP417