Machine Learning Exercise 3 - 2021

This exercise is composed of 2 parts:

1. probability theory part

2. coding part

Probability Theory Questions

1. Given a random sample $\{x_1, x_2, \dots, x_n\}$, derive the maximum likelihood estimator p of the Binomial distribution.

$$B(x,p) = \binom{n}{x} p^x (1-p)^{n-x}$$

2. A student wants to know her chances to pass and fail an exam if she studies and if she doesn't study. From last year's results, she sees that $P(pass) = 60\%$. She also found out that $P(studied|pass) = 95\%$, $P(studied|failed) = 60\%$. You can assume that every student either studied or didn't study, and either passed or failed.
    a. What is her probability of passing the exam if she studies?
    b. What is her probability of passing if doesn't study?

3. Find 3 random variables X, Y, C such that:
    a. $X \perp Y \mid C$ (X and Y are independent given C).
    b. X and Y are not independent.
    c. X, Y are integers such that $3 \leq X, Y \leq 9$ and C is binary.
    d. The following conditions hold:
        i. $P(1 \leq X \leq 5) = 0.4$
        ii. $P(1 \leq Y \leq 5) = 0.4$
        iii. $P(C = 0) = 0.3$

    You need to specify the value of $P(X = x, Y = y, C = c)$. How many relevant values exist?

4. The probability of Wolt arriving on time is 0.75.
    a. What is the probability of having 2 on-time meals in a week (7 days)?
    b. What is the probability of having at least 4 on-time meals in a week?
    c. A company of 100 employees recorded the number of on-time meals they had during a particular week and averaged their results. What do you expect the value of that average to be?

Coding exercise

Follow the instructions supplied for you in the MAP classifier Jupyter notebook.