

Machine Learning Exercise 3

April 7, 2019

This exercise is composed of 2 parts :

1. Probability Theory Part
2. Coding Part

Probability Theory Questions

1. In a bar in Tel Aviv there are 15 Goldstar beer bottles and 20 Stella beer bottles. If you ask for a random beer at the bar there is $\frac{15}{35}$ probability that you will get a Goldstar.
In the bar storage, there are 4 boxes (each box has 6 beers) of Goldstar and 7 boxes of Stella (also 6 in each box). A random box is moved from the storage to the bar. You ask for a random beer at the bar and get a Goldstar. What is the probability that the box that was moved from storage was Stella?
2. A radar at the beach is used to detect ships. Ships are located in 1 of four zones : A, B C and D. The probability of detection per zone is 0.8, 0.7, 0.6, 0.5 for A, B, C and D respectively. The probability of being at a specific zone is 0, 0.2, 0.3, 0.5 for A, B, C and D respectively.
 - (a) What is the probability that a ship will be detected.
 - (b) Given that a ship is detected, what is the probability that it was in Zone C?
 - (c) Given that a ship is detected, what is the probability that it was in Zone B?
3. Find 3 random variables X, Y, C such that:
 - (a) $X \perp Y|C$ - meaning X and Y are independent given C.
* $X \perp Y|C$ if $\forall x, y, c \ P(X = x, Y = y|C = c) = P(X = x|C = c) \cdot P(Y = y|C = c)$
 - (b) $X \not\perp Y$ - meaning X and Y are not independent.
 - (c) X, Y, C are all binary.
 - (d) The following conditions hold:
 - i. $P(X = 0) = 0.3$
 - ii. $P(Y = 0) = 0.3$
 - iii. $P(C = 0) = 0.5$

You need to specify the value of $P(X = x, Y = y, C = c)$ (there are 8 of them)

4. The probability of having a descent meal in Karnaf is 0.7.
 - (a) What is the probability of having 3 descent meals in a week (5 days)
 - (b) What is the probability of having at least 2 descent meals in a week.
 - (c) A class of 100 students recorded the number of descent meal they had during a specific week. They averaged their results, what do you expect the value of that average to have been?
5. Let $U = \{(x, y) | 0 \leq x, y \leq 1\}$ and let $C = \{(x, y) | x^2 + y^2 < 1\}$.
 Suppose we sample 50 points from U , denoted as D , and let $X = |D \cap C|$, meaning, X count the number of sampled points from C .
 - (a) How is X distributed?
 - (b) Using python, plot the CDF of X from 1 to 50.
 This means you'll need to compute $P(X \leq i)$ where i ranges from 1 to 50. Your x axis is i and the y axis $P(X \leq i)$. You can use whichever library you wish.
 Hand in only the plot.

Coding exercise

Follow the instructions supplied for you in the MAP Classifier jupyter notebook.