

## Laboratory Session 02 : April 7, 2021

Exercises due on : April 25, 2021

### Exercise 1

- a set of measurements have been performed on the concentration of a contaminant in tap water. The following tables reports a set of values ( $x$ ), with the corresponding probabilities given by the two methods ( $p_1$  and  $p_2$ )

x	15.58	15.9	16	16.1	16.2
$p_1$	0.15	0.21	0.35	0.15	0.14
$p_2$	0.14	0.05	0.64	0.08	0.09

- Evaluate the expected values,  $E[X]$ , and the variance,  $Var(X)$ , for both methods

### Exercise 2

- the waiting time, in minutes, at the doctor's is about 30 minutes, and the distribution follows an exponential pdf with rate  $1/30$
- A) **simulate** the waiting time for 50 people at the doctor's office and plot the relative histogram
- B) what is the probability that a person will wait for less than 10 minutes ?
- C) evaluate the average waiting time from the simulated data and compare it with the expected value (calculated from theory and by manipulating the probability distributions using R)
- B) what is the probability for waiting more than one hour before being received ?

### Exercise 3

- let's suppose that on a book, on average, there is one typo error every three pages. If the number of errors follows a Poisson distribution, plot the pdf and cdf, and calculate the probability that there is at least one error on a specific page of the book

### Exercise 4

- we randomly draw cards from a deck of 52 cards, with replacement, until one ace is drawn. Calculate the probability that at least 10 draws are needed.

## Exercise 5

- the time it takes a student to complete a TOLC-I University orientation and evaluation test follows a density function of the form

$$f(X) = \begin{cases} c(t-1)(2-t) & 1 < t < 2 \\ 0 & \text{otherwise} \end{cases}$$

where  $t$  is the time in hours.

- a) using the `integrate()` R function, determine the constant  $c$  (and verify it analytically)
- b) write the set of four R functions and plot the pdf and cdf, respectively
- c) evaluate the probability that the student will finish the aptitude test in more than 75 minutes. And that it will take <sup>between</sup> 90 and 120 minutes.

## Exercise 6

- the lifetime of tires sold by an used tires shop is  $10^4 \cdot x$  km, where  $x$  is a random variable following the distribution function

$$f(X) = \begin{cases} 2/x^2 & 1 < x < 2 \\ 0 & \text{otherwise} \end{cases}$$

- a) write the set of four R functions and plot the pdf and cdf, respectively
- b) determine the probability that tires will last less than 15000 km
- c) sample 3000 random variables from the distribution and determine the mean value and the variance, using the expression  $Var(X) = E[X^2] - E[X]^2$