Mohamed Boudiaf University - M'sila — Faculty of Technology
Department of Electrical Engineering — University year 2024-2025
Module : Probability-Statistics

Worksheet n°2

(Bivariate statistical series)

Exercice n°1 :

Exercice n°1 : We are interested in a group of 40 employees of a certain company. The following data is presented in the form of pairs of values of the form (x_i, y_i) where x_i is the Gender of the person {Male, Female} and y_i is the last diploma {bac, licence, master} :
(M,L), (F,B), (M,L), (M,L), (F,B), (F,L), (M,B), (F,L), (M,B), (F,B),(M,L), (M,B), (F,B), (F,L) , (M,B), (M,B), (M,Ma), (F,B), (M,B), (M,B), (F,B) (M,Ma), (F,B), (M,Ma), (M,B),, (M,B), (M,L), (M,L), (M,B), (F,L), (F,B) , (M,B), (M,B), (M,B), (F,B) , (F,Ma), (M,L), (M,B), (F,B) (M,B).

1. Identify the population and characteristics being studied and their nature.
2. Fill in the contingency table :

Gender \ diploma	bac	licence	Master	total
Male	...	...	...	...
Female	...	...	...	...
total	...	...	...	...

3. Are the two variables X and Y independent ? Justify.

Exercice n°2 : In an exam, each candidate is tested in statistics (mark X) and maths (mark Y). The results for a sample of 100 candidates are as follows :

$X \backslash Y$	$[0,4]$	$]4,8]$	$]8,12]$	$]12,16]$	$]16,20]$	total
$[0,4]$	3	4	2	0	0	...
$]4,8]$	6	9	7	4	0	...
$]8,12]$	1	8	15	12	8	...
$]12,16]$	0	1	7	7	3	...
$]16,20]$	0	0	1	0	2	...
total	...	...	...	...	...	...

1. Identify the population, its size and the type of variables being studied.
2. Determine the marginal distributions of X and Y .
3. Calculate the marginal means and variances of X and Y ;
4. Determine the conditional distribution of Y knowing that X is in the interval $]8; 12]$.
5. Calculate the mean of the conditional distribution of Y given that X is in the interval $]8; 12]$.

Exercice n°3 :

The following table gives the braking distance of a car on a dry road as a function of its speed :

x_i (Speed in kilometres/hour)	40	50	60	70	80	90	100	110
y_i (distance in metres)	8	12	18	24	32	40	48	58

1. Construct a scatterplot of this data $M_i(x_i; y_i)$.
2. Do you think the Fitting a line is justified ? Justify your answer.
3. Using Mayer's method (two-mean method), determine the equation of the straight line representing the braking distance as a function of speed .
4. Verify that the mean point is on the fitting line.

5. Using this equation, estimate the braking distance of a vehicle travelling at 120km/h.
6. Repeat the calculations using the method of least squares.

***Exercice n°4 :** Fit this point cloud with a hyperbola $y = \dfrac{1}{ax+b}$

x_i	0	1	2	3	4	5	6	7	8	9
y_i	0.91	0.63	0.47	0.38	0.32	0.27	0.24	0.21	0.19	0.18

***Exercice n°5 :**
Fit this scatter plots using a power function $y = bx^a$

x_i	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
y_i	0.1	0.5	1.4	2.7	5.1	7.6	11.2	15.9	22.3	28.1

***Exercice n°6 :**
Fit this scatter plots using an exponential function $y = be^{ax}$

x_i	1	1.5	2	2.5	3	3.5	4	4.5	5	x_i	1	1.5	2	2.5	3	3.5	4	4.5	5
y_i	0.2	0.3	0.5	0.6	0.7	1.1	1.6	2.4	3.3	y_i	0.2	0.3	0.5	0.6	0.7	1.1	1.6	2.4	3.3

Exercice n°7 :
Fit this scatter plots using a power function $y = b + a \ln x$

x_i	1	2	3	4	5	6	7	8	9	10
y_i	1.1	2.9	4.4	5.1	5.8	6.5	6.8	7.3	7.7	7.8