TC1002S Herramientas computacionales: el arte de la analítica

This is a notebook with all your work for the final evidence of this course

Niveles de dominio a demostrar con la evidencia

SING0202A

Interpreta interacciones entre variables relevantes en un problema, como base para la construcción de modelos bivariados basados en datos de un fenómeno investigado que le permita reproducir la respuesta del mismo. Es capaz de construir modelos bivariados que expliquen el comportamiento de un fenómeno.

Student information

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- My carreer: ITC

Importing libraries

```
# Importar librerías
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
```

PART 1

Use your assigned dataset

A1 Load data

```
RunInColab = True     # (False: no  | True: yes)

# colab:
if RunInColab:
    # Mount your google drive in google colab
    from google.colab import drive
    drive.mount('/content/drive')

    # Define ruta del proyecto
    Ruta = "/content/drive/My Drive/Reto_Sistemas_Eléctricos/NotebooksProfessor/"

else:
    # Define ruta del proyecto
    Ruta = ""
    # Import the packages that we will be using
import numpy as np                  # For array
import pandas as pd                 # For data handling
import seaborn as sns               # For advanced plotting
import matplotlib.pyplot as plt
# Dataset url
url = Ruta + "datasets/A01637736_X.csv"

# Load the dataset
data = pd.read_csv(url)

dataset=data.drop(data.columns[0], axis=1)

# Print the data
dataset
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mou
```

	x1	x2	x3	x4
0	2.549398	-2.757125	-1.690812	-8.365819
1	0.846170	-3.220898	-1.984883	-7.574196
2	8.929031	-2.851495	1.860909	-4.544940
3	-1.510962	7.473982	-2.367350	-0.681757
4	-1.075005	9.367548	-4.702216	-1.949144
...	...	...	...	...
355	6.904517	-1.614177	4.176567	8.131997
356	-3.040871	10.618309	-4.491209	0.728506
357	6.043151	-0.338058	1.589036	5.070806
358	-5.359209	9.926980	-5.959197	0.539257
359	7.860161	-2.893433	2.332576	-7.043664

360 rows × 4 columns

Next steps: View recommended plots

A2 Data managment

Print the first 7 rows

```
dataset.head(7)
```

	x1	x2	x3	x4
0	2.549398	-2.757125	-1.690812	-8.365819
1	0.846170	-3.220898	-1.984883	-7.574196
2	8.929031	-2.851495	1.860909	-4.544940
3	-1.510962	7.473982	-2.367350	-0.681757
4	-1.075005	9.367548	-4.702216	-1.949144
5	6.914782	1.349436	7.909729	-5.694879
6	7.180507	0.028263	2.852077	-0.266221

Next steps: View recommended plots

Print the last 4 rows

```
dataset.tail(4)
```

	x1	x2	x3	x4
356	-3.040871	10.618309	-4.491209	0.728506
357	6.043151	-0.338058	1.589036	5.070806
358	-5.359209	9.926980	-5.959197	0.539257
359	7.860161	-2.893433	2.332576	-7.043664

How many rows and columns are in your data?

Use the `shape` method

```
dataset.shape

nRow=dataset.shape[0]
nCol=dataset.shape[1]

print("There's",nRow,"rows and",nCol,"columns")
```

```
There's 360 rows and 4 columns
```

Print the name of all columns

Use the `columns` method

```
dataset.columns
```

```
Index(['x1', 'x2', 'x3', 'x4'], dtype='object')
```

What is the data type in each column

Use the `dtypes` method

```
dataset.dtypes
```

```
x1    float64
x2    float64
x3    float64
x4    float64
dtype: object
```

What is the meaning of rows and columns?

```
# Your responses here
#The values given in the dataset are categorized in the columns x1 all the way to x4 and in the begining we also have a column with irrel
```

Print a statistical summary of your columns

```
summary=dataset.describe()
print(summary)
```

```
               x1          x2          x3          x4
count  360.000000  360.000000  360.000000  360.000000
mean     3.075623    0.825403   -1.455600   -2.053291
std      4.304319    4.997778    3.319690    5.434017
min     -8.379232   -7.411863  -10.397119  -14.131241
25%     -0.308021   -2.827983   -3.957236   -5.990170
50%      3.845536   -0.634826   -1.513325   -2.842402
75%      6.713674    3.415968    1.094146    1.896324
max     12.139372   12.430935    7.909729   10.274692
```

```
# 1) What is the minumum and maximum values of each variable
min_vals= summary.loc['min']
max_vals= summary.loc['max']
print('the min values are\n',min_vals,'\nAnd the max values are\n',max_vals)

# 2) What is the mean and standar deviation of each variable
mean_vals= summary.loc['mean']
std_vals= summary.loc['std']
print('the mean values are\n',mean_vals,'\nAnd the std values are\n',std_vals)

# 3) What the 25%, 50% and 75% represent?

#They represent the divition of the values in equal parts. The 25% value,is the number below in which we can find the 25% of the data, an
```

```
the min values are
 x1    -8.379232
x2    -7.411863
x3   -10.397119
x4   -14.131241
Name: min, dtype: float64
And the max values are
 x1    12.139372
x2    12.430935
x3     7.909729
x4    10.274692
Name: max, dtype: float64
the mean values are
 x1    3.075623
x2    0.825403
x3   -1.455600
x4   -2.053291
Name: mean, dtype: float64
And the std values are
 x1    4.304319
x2    4.997778
x3    3.319690
x4    5.434017
Name: std, dtype: float64
```

Rename the columns using the same name with capital letters

```
dataset_1 = dataset.rename(columns=lambda x: x.upper())
dataset_1
```

	X1	X2	X3	X4
0	2.549398	-2.757125	-1.690812	-8.365819
1	0.846170	-3.220898	-1.984883	-7.574196
2	8.929031	-2.851495	1.860909	-4.544940
3	-1.510962	7.473982	-2.367350	-0.681757
4	-1.075005	9.367548	-4.702216	-1.949144
...	...	...	...	...
355	6.904517	-1.614177	4.176567	8.131997
356	-3.040871	10.618309	-4.491209	0.728506
357	6.043151	-0.338058	1.589036	5.070806
358	-5.359209	9.926980	-5.959197	0.539257
359	7.860161	-2.893433	2.332576	-7.043664

360 rows × 4 columns

Next steps: View recommended plots

Rename the columns to their original names

```
dataset_2 = dataset.rename(columns=lambda x: x.lower())
dataset_2
```

	x1	x2	x3	x4
0	2.549398	-2.757125	-1.690812	-8.365819
1	0.846170	-3.220898	-1.984883	-7.574196
2	8.929031	-2.851495	1.860909	-4.544940
3	-1.510962	7.473982	-2.367350	-0.681757
4	-1.075005	9.367548	-4.702216	-1.949144
...	...	...	...	...
355	6.904517	-1.614177	4.176567	8.131997
356	-3.040871	10.618309	-4.491209	0.728506
357	6.043151	-0.338058	1.589036	5.070806
358	-5.359209	9.926980	-5.959197	0.539257
359	7.860161	-2.893433	2.332576	-7.043664

360 rows × 4 columns

Next steps: View recommended plots

Use two different alternatives to get one of the columns

```
columna=dataset_2["x1"]
columna
```

```
0      2.549398
1      0.846170
2      8.929031
3     -1.510962
4     -1.075005
         ...
355    6.904517
356   -3.040871
357    6.043151
358   -5.359209
359    7.860161
Name: x1, Length: 360, dtype: float64
```

```
column=dataset_2.x1
column
```

```
0      2.549398
1      0.846170
2      8.929031
3     -1.510962
4     -1.075005
         ...
355    6.904517
356   -3.040871
357    6.043151
358   -5.359209
359    7.860161
Name: x1, Length: 360, dtype: float64
```

Get a slice of your data set: second and thrid columns and rows from 62 to 72

```
ds=data.iloc[62:73, 2:4]
ds
```

	x2	x3
62	-2.260690	-2.051261
63	-2.792249	-2.355391
64	-0.506335	3.068402
65	-3.277837	0.782141
66	-0.441184	-1.088238
67	-1.497845	1.139948
68	-0.430815	1.719460
69	9.648281	-6.636877
70	10.560367	-6.872886
71	1.812991	-2.127175
72	-1.593420	0.062120

Next steps: View recommended plots

For the second and thrid columns, calculate the number of null and not null values and verify that their sum equals the total number of rows

```
Ns = data.iloc[:, 2].isnull().sum()
Nt = data.iloc[:, 3].isnull().sum()

NNs = data.iloc[:, 2].notnull().sum()
NNt = data.iloc[:, 3].notnull().sum()

# Verificar que la suma de valores nulos y no nulos sea igual al total de filas
if Ns + NNs and Nt+ NNt ==len(data):
    print("Everything is correct, the sum of null data and not null data is equal to the total number of rows.")
    print("Null data for second column:",Ns,"\nNull data for third column:",Nt,"\nRelevant data for the second column:",NNs,"\nRelevant d
else:
    print("There is an error.")
```

```
Everything is correct, the sum of null data and not null data is equal to the total number of rows.
Null data for second column: 0
Null data for third column: 0
Relevant data for the second column: 360
Relevant data for third column: 360
```

Discard the last column

```
dataset_3=data.drop(data.columns[4], axis=1)
dataset_3
```

	Unnamed: 0	x1	x2	x3
0	0	2.549398	-2.757125	-1.690812
1	1	0.846170	-3.220898	-1.984883
2	2	8.929031	-2.851495	1.860909
3	3	-1.510962	7.473982	-2.367350
4	4	-1.075005	9.367548	-4.702216
...	...	...	...	...
355	355	6.904517	-1.614177	4.176567
356	356	-3.040871	10.618309	-4.491209
357	357	6.043151	-0.338058	1.589036
358	358	-5.359209	9.926980	-5.959197
359	359	7.860161	-2.893433	2.332576

360 rows × 4 columns

Next steps: View recommended plots

Questions

Based on the previos results, provide a description of yout dataset

Your response: On the last points we were able to see from a detailed description of our data showing minimum, maximum, mean and many other values which could give us more information of our dataset. Also we were able to identify the data in our excel and figure out there is a column which provide no value whatsoever, which lead us to delete it. Finally something worthy of mention is that our table has all its data, meaning there were no null values, which I checked viewing column by column in the point where we were supposed to check only columns two and three.

A3 Data visualization

```
dataset_1
```

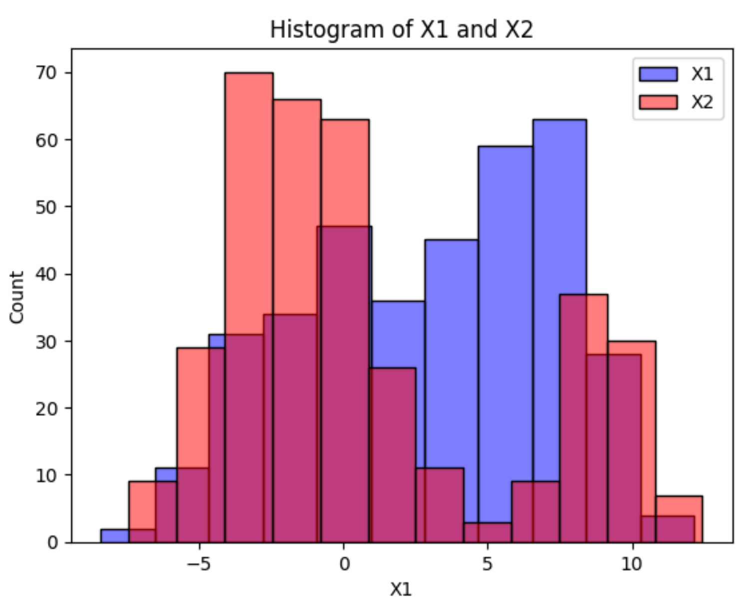
	X1	X2	X3	X4
0	2.549398	-2.757125	-1.690812	-8.365819
1	0.846170	-3.220898	-1.984883	-7.574196
2	8.929031	-2.851495	1.860909	-4.544940
3	-1.510962	7.473982	-2.367350	-0.681757
4	-1.075005	9.367548	-4.702216	-1.949144
...	...	...	...	...
355	6.904517	-1.614177	4.176567	8.131997
356	-3.040871	10.618309	-4.491209	0.728506
357	6.043151	-0.338058	1.589036	5.070806
358	-5.359209	9.926980	-5.959197	0.539257
359	7.860161	-2.893433	2.332576	-7.043664

360 rows × 4 columns

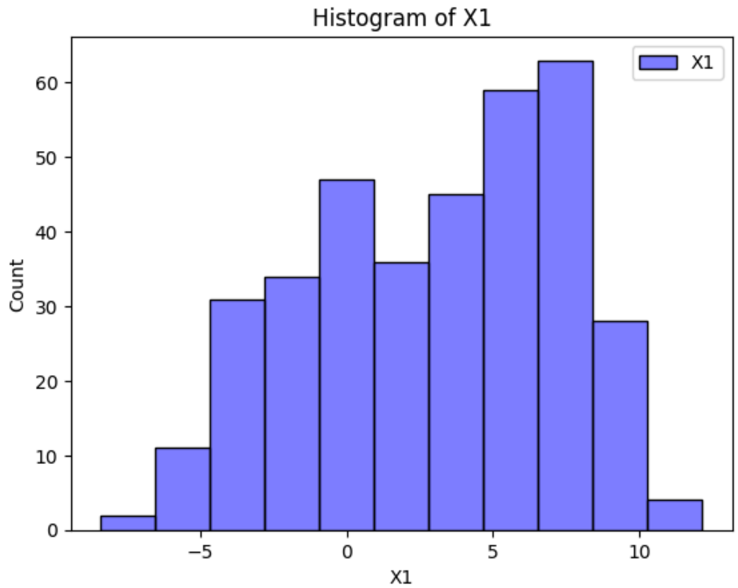
Next steps: View recommended plots

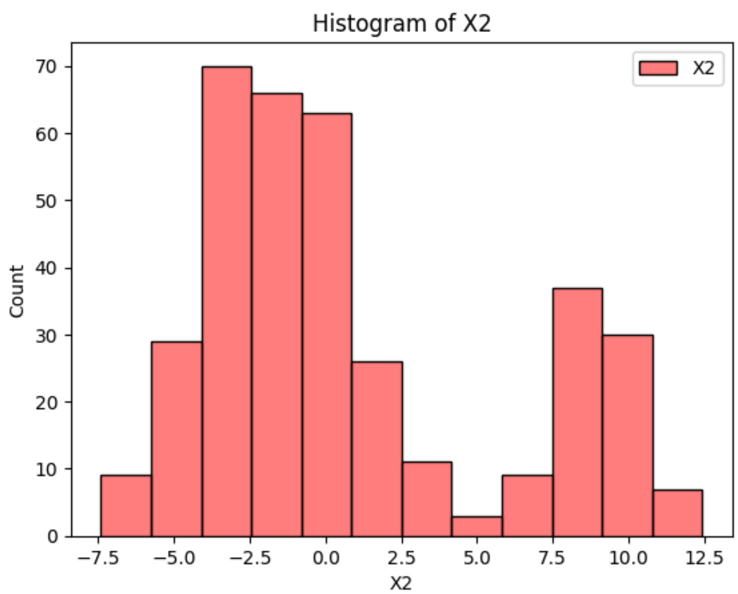
Plot in the same figure the histogram of two variables

```
sns.histplot(dataset_1['X1'], alpha=0.5, label='X1',color='b')
sns.histplot(dataset_1['X2'], alpha=0.5, label='X2',color='r')
plt.title('Histogram of X1 and X2')
plt.legend()

plt.show()
```



```
sns.histplot(dataset_1['X1'], alpha=0.5, label='X1',color='b')
plt.title('Histogram of X1')
plt.legend()
plt.show()

sns.histplot(dataset_1['X2'], alpha=0.5, label='X2',color='r')
plt.title('Histogram of X2')
plt.legend()
plt.show()
```



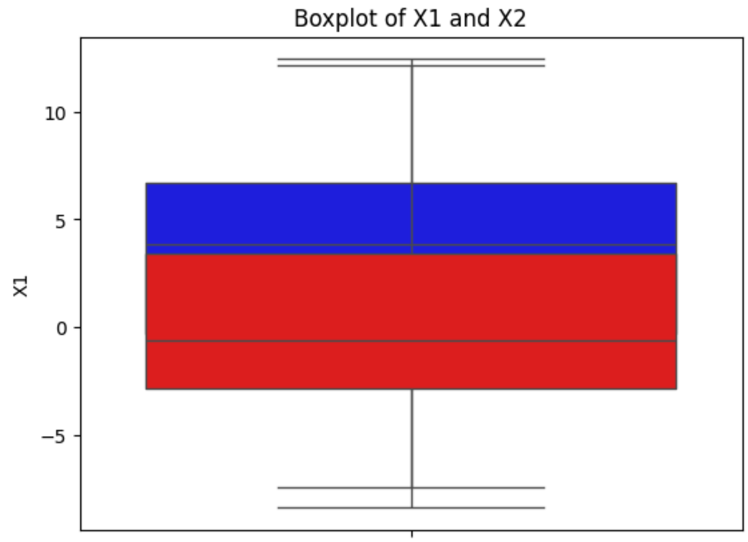


Based on these plots, provide a description of your data:

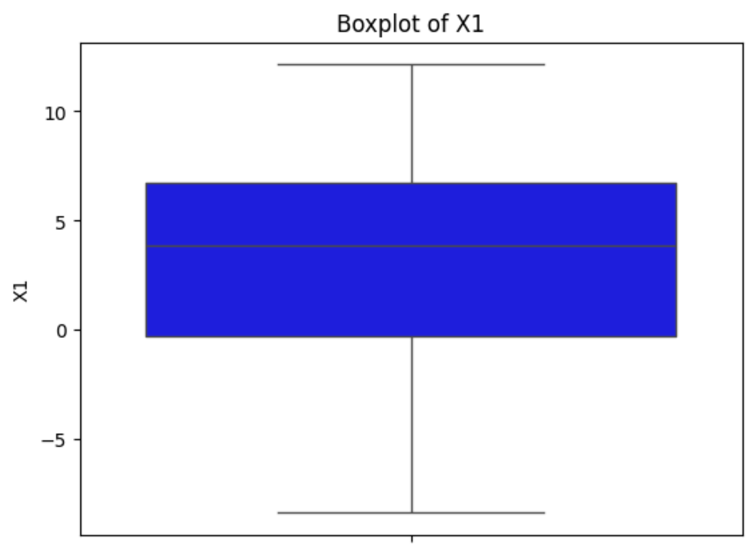
Your response here:

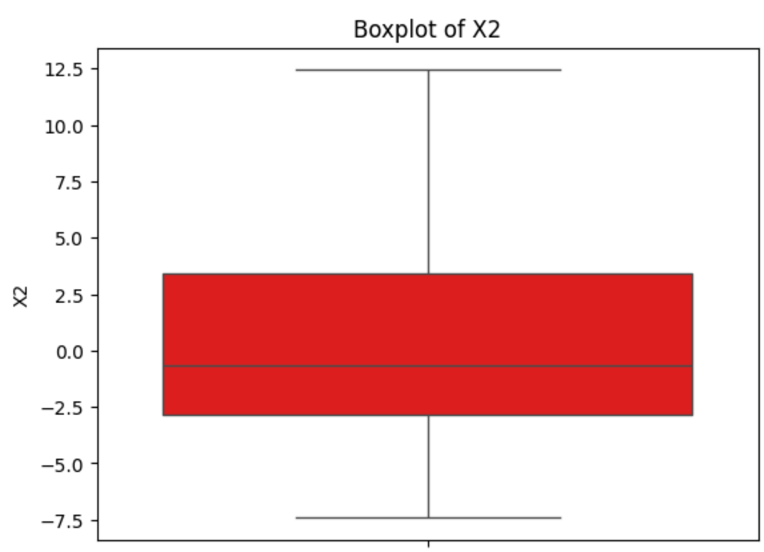
Plot in the same figure the boxplot of two variables

```
sns.boxplot(dataset_1['X1'],color='b')
sns.boxplot(dataset_1['X2'],color='r')
plt.title('Boxplot of X1 and X2')
plt.show()
```



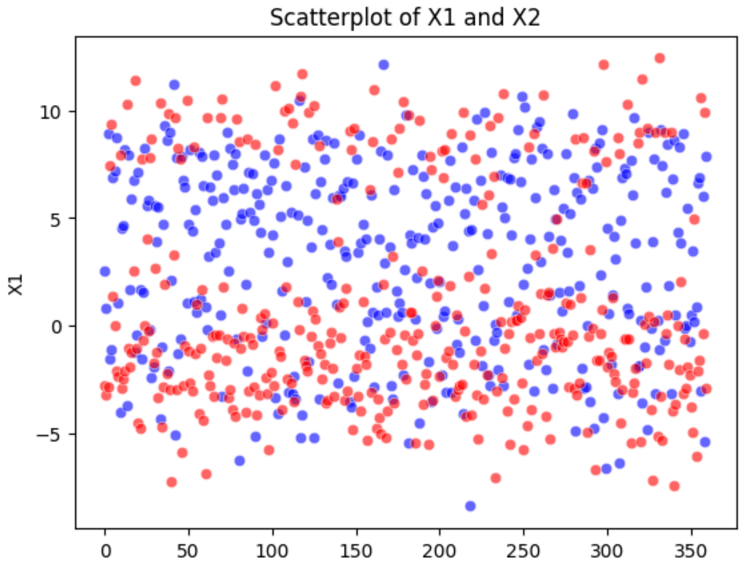

```
sns.boxplot(dataset_1['X1'],color='b')
plt.title('Boxplot of X1')
plt.show()

sns.boxplot(dataset_1['X2'],color='r')
plt.title('Boxplot of X2')
plt.show()
```



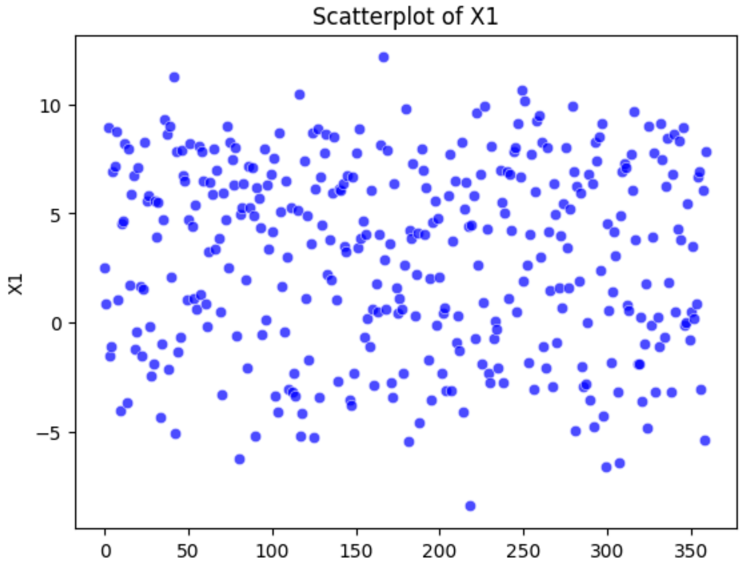


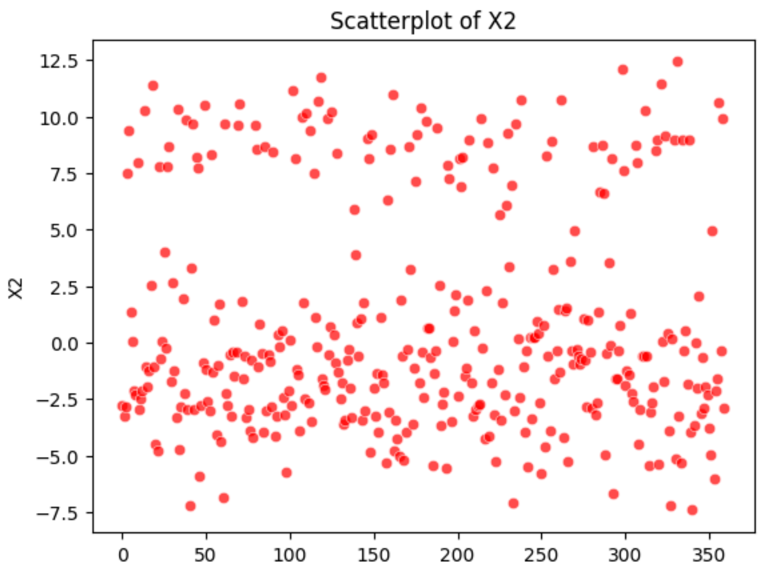
Plot the scatter plot of two variables

```
sns.scatterplot(dataset_1['X1'],color='b',alpha=0.6)
sns.scatterplot(dataset_1['X2'],color='r',alpha=0.6)
plt.title('Scatterplot of X1 and X2')
plt.show()
```




```
sns.scatterplot(dataset_1['X1'],color='b',alpha=0.7)
plt.title('Scatterplot of X1')
plt.show()

sns.scatterplot(dataset_1['X2'],color='r',alpha=0.7)
plt.title('Scatterplot of X2')
plt.show()
```





Questions

Based on the previos plots, provide a description of yout dataset

Your response: From what we've been ploting we can now have a better idea of our data, we can now see the frecuency of the values in our data, we can also know now the dispersion of our data and if there's any atypical values; which in our data in not the case, finally we can have a better idea of patterns and if we plan to do what we did in the kmeans activity we would have a better idea to see the groups for the scatering

A4 Kmeans

Do Kmeans clustering assuming a number of clusters accorging to your scatter plot

```
K = 5
km = KMeans(n_clusters=K, n_init="auto")

yestimated = km.fit_predict(dataset_1)
yestimated
```

```
array([3, 3, 1, 0, 0, 1, 1, 1, 3, 4, 1, 2, 2, 4, 2, 3, 1, 1, 4, 3, 1, 3,
       4, 3, 2, 2, 1, 0, 0, 3, 2, 1, 1, 4, 3, 2, 2, 1, 0, 1, 3, 2, 4, 1,
       0, 0, 2, 2, 2, 0, 1, 1, 1, 0, 2, 3, 1, 3, 1, 1, 3, 4, 3, 2, 2, 2,
       2, 1, 1, 0, 4, 2, 3, 1, 3, 1, 2, 2, 1, 0, 4, 2, 2, 1, 3, 4, 1, 1,
       2, 2, 4, 2, 1, 1, 3, 1, 3, 2, 3, 1, 2, 1, 4, 4, 2, 2, 3, 4, 2, 3,
       4, 3, 4, 3, 4, 3, 2, 4, 4, 1, 3, 2, 0, 3, 2, 4, 2, 1, 4, 2, 2, 2,
       2, 3, 1, 3, 1, 1, 0, 0, 1, 1, 2, 1, 2, 2, 4, 4, 1, 4, 1, 3, 1, 2,
       2, 3, 2, 3, 0, 2, 0, 4, 3, 3, 1, 2, 1, 3, 3, 1, 2, 4, 0, 2, 2, 0,
       0, 3, 4, 3, 2, 4, 3, 2, 2, 3, 1, 2, 4, 1, 1, 3, 2, 3, 0, 4, 1, 2,
       3, 1, 3, 0, 0, 0, 3, 1, 2, 4, 3, 1, 3, 3, 3, 1, 4, 1, 1, 3, 4, 3,
       2, 0, 2, 3, 2, 0, 3, 2, 2, 4, 4, 2, 0, 3, 3, 4, 1, 3, 4, 2, 1, 3,
```

```
1, 2, 2, 1, 3, 2, 2, 1, 3, 1, 2, 0, 2, 2, 4, 2, 2, 1, 3, 1, 4, 3,
2, 2, 3, 0, 1, 2, 0, 3, 2, 3, 1, 1, 2, 3, 3, 2, 1, 4, 1, 3, 2, 0,
0, 4, 3, 1, 0, 2, 4, 1, 1, 1, 3, 1, 4, 4, 1, 3, 3, 1, 3, 3, 4, 4,
2, 2, 1, 2, 0, 3, 2, 2, 1, 1, 0, 4, 3, 4, 3, 3, 4, 2, 3, 3, 1, 4,
3, 4, 1, 1, 0, 1, 1, 3, 4, 1, 1, 3, 1, 2, 2, 1, 3, 3, 3, 3, 3, 3,
0, 3, 1, 2, 4, 2, 4, 1], dtype=int32)
```

Add to your dataset a column with the estimated cluster to each data point

```
dataset_1['Estimated_Cluster'] = yestimated
print(dataset_1)
```

```
            X1         X2        X3        X4  Estimated_Cluster
0     2.549398  -2.757125 -1.690812 -8.365819                  3
1     0.846170  -3.220898 -1.984883 -7.574196                  3
2     8.929031  -2.851495  1.860909 -4.544940                  1
3    -1.510962   7.473982 -2.367350 -0.681757                  0
4    -1.075005   9.367548 -4.702216 -1.949144                  0
..         ...        ...       ...       ...                ...
355   6.904517  -1.614177  4.176567  8.131997                  2
356  -3.040871  10.618309 -4.491209  0.728506                  4
357   6.043151  -0.338058  1.589036  5.070806                  2
358  -5.359209   9.926980 -5.959197  0.539257                  4
359   7.860161  -2.893433  2.332576 -7.043664                  1

[360 rows x 5 columns]
```

Print the number associated to each cluster

```
cluster_counts = dataset_1['Estimated_Cluster'].value_counts()
print("Asocieted number for each cluster:")
print(cluster_counts)
```

```
Asocieted number for each cluster:
1    91
2    90
3    89
4    54
0    36
Name: Estimated_Cluster, dtype: int64
```

Print the centroids

```
centroids = km.cluster_centers_

print("Centroids:")
print(centroids)
```

```
Centroids:
[[-0.85139726  7.53567874 -4.38499763 -2.51826812]
 [ 6.91101514 -1.76438405  2.150322   -3.80080244]
 [ 6.35373709 -1.00825297 -0.67470778  5.70351051]
 [ 1.44435355 -2.58818158 -2.21691724 -8.29683701]
 [-3.54466061  9.39833982 -5.62603496 -1.43613767]]
```

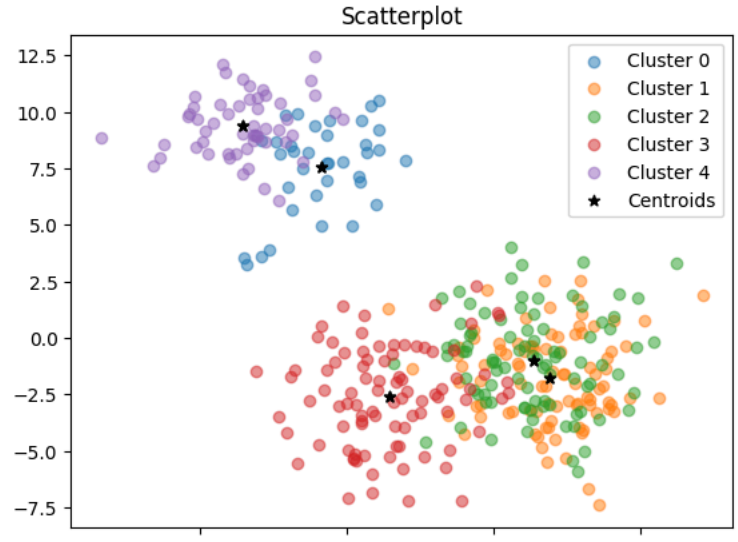
Print the intertia metric

```
inertia = km.inertia_
print("Inertia metric:", inertia)
```

```
Inertia metric: 5442.471807148848
```

Plot a scatter plot of your data using different color for each cluster. Also plot the centroids

```
for cluster in range(K):
    cluster_data = dataset_1[dataset_1['Estimated_Cluster'] == cluster]
    plt.scatter(cluster_data['X1'], cluster_data['X2'], label=f'Cluster {cluster}', alpha=0.5)
    plt.scatter(centroids[cluster, 0], centroids[cluster, 1], marker='*', color='black')

# Trazar los centroides de los clústeres
plt.scatter(centroids[:, 0], centroids[:, 1], marker='*', color='black', label='Centroids')
plt.title('Scatterplot')
plt.legend()
plt.show()
```



Scatterplot
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
−5.0
−7.5
Cluster 0
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Centroids