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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Importing libraries

```
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     # For showing plots
from sklearn.cluster import KMeans
                                  _blobs
```

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PART 1

Use your assigned dataset

```
# Define where you are running the code: colab or local
RunInColab          = True     # (False: no  | True: yes)

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

    # Find location
    #!pwd
    #!ls
    #!ls "/content/drive/My Drive/Colab Notebooks/MachineLearningWithPython/"

    # Define path del proyecto
    Ruta            = "/content/drive/My Drive/Colab Notebooks/MachineLearningWithPython/"

else:
    # Define path del proyecto
    Ruta            = ""
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=Tru
```

A1 Load data

```
url = Ruta + "datasets/A01640086.csv"
df = pd.read_csv(url)
```

A2 Data managment

Print the first 7 rows

```
df.head(7)
```

	Unnamed: 0	x1	x2
0	0	-0.651854	0.565605
1	1	0.123377	1.043726
2	2	0.469727	0.836234
3	3	0.032707	0.473639
4	4	0.854605	0.646451
5	5	1.815734	0.229342
6	6	-0.253257	0.907183

Print the first 4 last rows

```
df.tail(4)
```

	Unnamed: 0	x1	x2
1796	1796	0.058201	0.123785
1797	1797	0.886349	0.506972
1798	1798	1.880795	0.244915
			427839

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How many rows and columns are in your data?

Use the `shape` method

```
print('Number of rows:', df.shape[0])
print('Number of columns:', df.shape[1])

    Number of rows: 1800
    Number of columns: 3
```

Print the name of all columns

Use the `columns` method

```
df.columns

    Index(['Unnamed: 0', 'x1', 'x2'], dtype='object')
```

What is the data type in each column

Use the `dtypes` method

```
df.dtypes

    Unnamed: 0      int64
    x1            float64
    x2            float64
    dtype: object
```

What is the meaning of rows and columns?

```
# The rows represent the observations in our data, which in this case represent values for x1 and x2. The columns represent those
```

Print a statistical summary of your columns

```
df.describe()
```

	Unnamed: 0	x1	x2
count	1800.00000	1800.000000	1800.000000
mean	899.50000	0.502621	0.248948
std	519.75956	0.868574	0.498505
min	0.00000	-1.238466	-0.703688
25%	449.75000	-0.060800	-0.204963
50%	899.50000	0.499840	0.237693
75%	1349.25000	1.079877	0.687771
max	1799.00000	2.196111	1.244663

1) What is the minumum and maximum values of each variable

Variable 1: min = 0 max = 1799

Variable 2: min = -1.238466 max = 2.196111

Variable 3: min = -0.703688 max = 1.244663

2) What is the mean and standar deviation of each variable

Variable 1: 519.75956

Variable 2: 0.868574

Variable 3: 0.498505

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3) [illegible]nt? They represent the first 3 quartiles of our data

Rename the columns using the same name with capital letters

```
df.columns.values[1] = 'X1'
df.columns.values[2] = 'X2'
```

Rename the columns to their original names

```
df.columns.values[1] = 'x1'
df.columns.values[2] = 'x2'
```

Use two different alternatives to get one of the columns

```
df.iloc[:,-1]
```

```
0       0.565605
1       1.043726
2       0.836234
3       0.473639
4       0.646451
          ...
1795    0.645813
1796    0.123785
1797    0.506972
1798    0.244915
1799    0.427839
Name: x2, Length: 1800, dtype: float64
```

```
df['x2']
```

```
0       0.565605
1       1.043726
2       0.836234
3       0.473639
4       0.646451
```

```
                ...
    1795    0.645813
    1796    0.123785
    1797    0.506972
    1798    0.244915
    1799    0.427839
    Name: x2, Length: 1800, dtype: float64
```

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

```
df.iloc[62:73, 1:3]
```

	x1	x2
62	0.213176	0.849439
63	-0.284166	0.903374
64	-0.253319	1.040368
65	-0.884553	0.545882
66	0.896189	0.690316
67	-0.940785	0.304416
68	1.975759	0.177643
69	0.140821	0.768065
70	-0.858495	0.421620
71	1.989865	0.338419
72	-0.847507	0.271195

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

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```
sum1 = df[['x1', 'x2']].isnull().sum()
sum1
```

```
    x1    0
    x2    0
    dtype: int64
```

```
sum2 = df[['x1', 'x2']].notnull().sum()
sum2
```

```
    x1    1800
    x2    1800
    dtype: int64
```

```
sum1 + sum2 == df.shape[0]
```

```
    x1    True
    x2    True
    dtype: bool
```

Discard the first column

```
df = df.drop(df.columns[0], axis=1)
```

Questions

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

Your response:

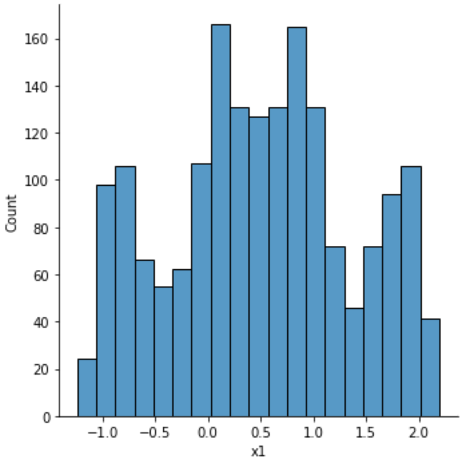
My dataset consists of 1800 observations and 2 variables, it doesn't contain any null values. It also looks like our data doesn't have any categorical values, they are all numerical (float).

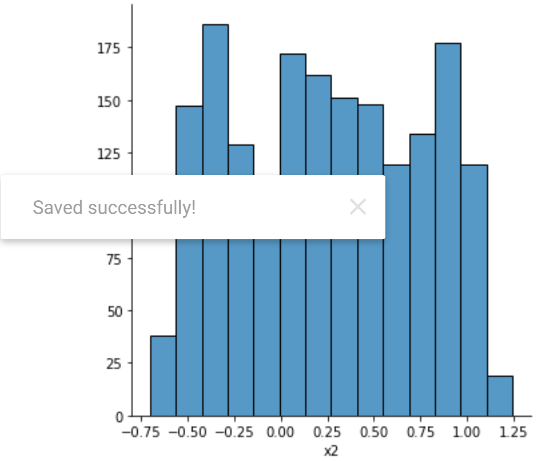
A3 Data visualization

Plot in the same figure the histogram of the two variables

```
sns.displot(df['x1'], kde = False)
sns.displot(df['x2'], kde = False)

plt.show()
```





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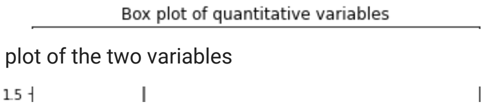
Based on this plots, provide a description of your data:

Your response here:

The values are between -0.75 and 3, they have several variations.

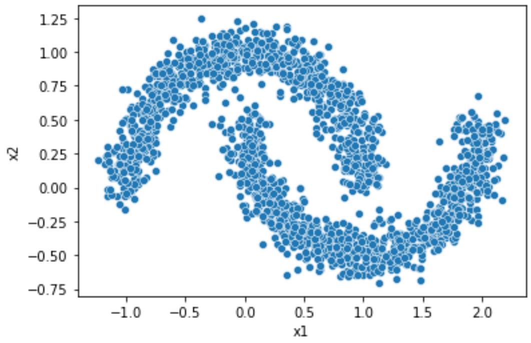
Plot in the same figure the boxplot of the two variables

```
X = df.loc[:, ['x1', 'x2']]
x2bp = sns.boxplot(data=X, orient="v", palette="viridis")
x2bp.set_title("Box plot of quantitative variables")
plt.show()
```



Scatter plot of the two variables

```
sns.scatterplot(data = df, x = 'x1', y = 'x2')
plt.show()
```



Questions

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

Your response:

As seen on the boxplots, my dataset has no outliers. It also looks like it could be divided into two clusters.

A4 Kmeans

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

```
K = 2
km = KMeans(n_clusters=K, n_init="auto")

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

```
    array([1, 1, 1, ..., 0, 0, 0], dtype=int32)
```

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

```
df['yestimated'] = yestimated
```

Print the number associated to each cluster

```
df.yestimated.unique()
```

```
    array([1, 0], dtype=int32)
```

Print the centroids

```
km.cluster_centers_
```

```
    array([[ 1.19498506, -0.07216986],
           [-0.20216244,  0.57582572]])
```

Print the intertia metric

```
km.inertia_
```

```
    736.9872239926983
```

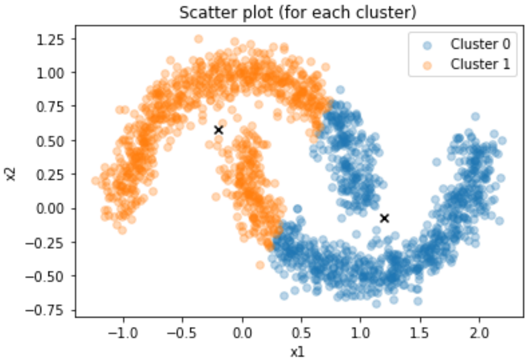
Plot a scatter plot of your data assigned to each cluster. Also plot the centroids

```
df1 = df[df.yestimated==0]
df2 = df[df.yestimated==1]

plt.scatter(df1.x1, df1.x2, label='Cluster 0', marker='o', s=32, alpha=0.3)
plt.scatter(df2.x1, df2.x2, label='Cluster 1', marker='o', s=32, alpha=0.3)

plt.scatter(km.cluster_centers_[:,0], km.cluster_centers_[:,1], color='black', marker='x')

plt.title('Scatter plot (for each cluster)')
plt.xlabel('x1')
plt.ylabel('x2')
plt.legend()
plt.show()
```



Questions

Saved successfully! results

Your response:

It looks like selecting 2 clusters was the right choice, the results show our data and its respective cluster. From the centroids, we can observe that it is almost evenly devided, the blue cluster having a bit more points.

A5 Elbow plot

Compute the Elbow plot

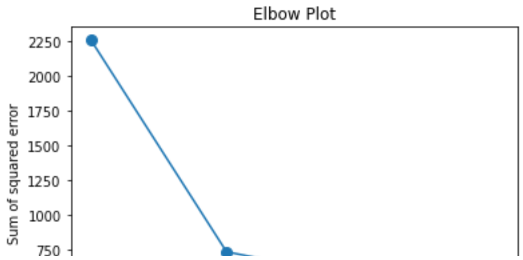
```
sse = []

# Define values of k
k_rng = range(1,5)

# For each k
for k in k_rng:
  # Create model
  km = KMeans(n_clusters=k, n_init="auto")
  # Do K-means clustering
  km.fit_predict(df)
  # Save sse for each k
  sse.append(km.inertia_)


plt.plot(k_rng, sse, 'o-', markersize=8)

plt.title('Elbow Plot')
plt.xlabel('K')
plt.ylabel('Sum of squared error')
plt.show()
```



Questions

What is the best number of clusters K? (argue your response)

Your response:

The best number is 2. As we can see in the elbow plot, theres a clear threshold at (2, 750).

Does this number of clusters agree with your inital guess? (argue your response)

Your response:

Yes, my initial guess was also 2. I observed that the data concentrated on two different areas.

PART 2

Create a dataset and do clustering

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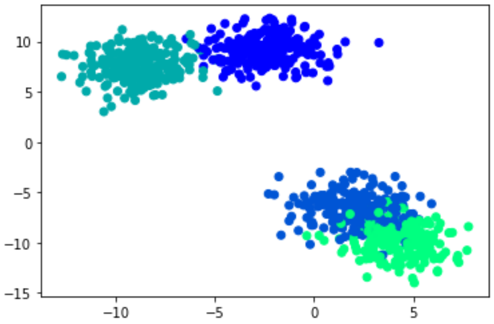
e_blobs" function from "sklearn.datasets"

- The number of observations is equal to the three last digits in your ID (if this number is lower than 99, then multiply it by ten)
- 3 variables
- 4 clusters
- Standar deviation of each cluster of 1.5

```
x, y = make_blobs(n_samples=860, n_features=3, centers=4, cluster_std=1.5, random_state=42)
```

2) Plot the scatter plot of your data using the real cluster labels

```
plt.scatter(x[:, 0], x[:, 1], c=y, cmap='winter')
plt.show()
```

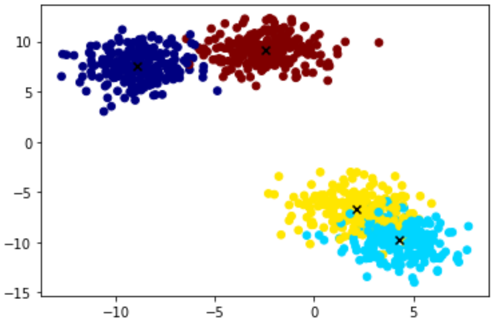


3) Do K means clustering

```
K = 4
km = KMeans(n_clusters=K, n_init="auto").fit(x)
yestimated = km.fit_predict(x)
```

4) Plot the scatter plot of your data using the estimated cluster labels

```
plt.scatter(x[:,0], x[:,1], c = yestimated, s = 32, cmap='jet')
plt.scatter(km.cluster_centers_[:,0], km.cluster_centers_[:,1], color='black', marker='x')
plt.show()
```



Questions

Provides a detailed description of your results.

Your response:

The scatter plot shows clearly our 4 clusters. What caught my eye is that they overlap and there are points that look closer to centroids of different color, which could be a visualization error when plotting the points.

PART 3

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Descripcion de tu percepcion del nivel de desarrollo de la subcompetencia

SING0202A Interpretación de variables

Escribe tu description del nivel de logro del siguiente criterio de la subcompetencia

Interpreta interacciones. 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.

Tu respuesta:

Puedo encontrar sentido en las interacciones entre variables, entendiendo cómo diferentes variables en un problema pueden afectarse entre sí y cómo contribuyen al resultado. Por consiguiente, considero que cumplo con la subcompetencia.

Escribe tu description del nivel de logro del siguiente criterio de la subcompetencia

Construcción de modelos. Es capaz de construir modelos bivariados que expliquen el comportamiento de un fenómeno.

Tu respuesta:

Gracias a las herramientas de Python, fui capaz de generar modelos a partir de una base de datos, en este caso involucrando las variables de x1 y x2.

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