report3

May 19, 2024

[1]:
```
#import all of the libries that i need
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
import seaborn as sns
from scipy import stats
from sklearn import linear_model
from sklearn import metrics
from sklearn.model_selection import train_test_split
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
import itertools
import warnings
import copy
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.feature_selection import SequentialFeatureSelector
from sklearn.linear_model import LinearRegression
import statsmodels.api as sm
from sklearn.metrics import mean_squared_error
from scipy.stats import normaltest
from statsmodels.stats.diagnostic import lilliefors
from sklearn.model_selection import train_test_split, cross_val_score
from sklearn.metrics import confusion_matrix
from sklearn.ensemble import RandomForestClassifier
from sklearn.impute import SimpleImputer
from sklearn.decomposition import PCA
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline
from joblib import parallel_backend

from sklearn import preprocessing
```

[2]:
```
pip install --upgrade bottleneck
```

```
Requirement already satisfied: bottleneck in c:\users\spin 3\anaconda3\lib\site-
packages (1.3.5)
```

```
Collecting bottleneck
  Obtaining dependency information for bottleneck from https://files.pythonhoste
d.org/packages/a7/ef/f5ee62f290f61842b34413ae82042825556ee1078e195d0e34c674fdc72
e/Bottleneck-1.3.8-cp311-cp311-win_amd64.whl.metadata
  Downloading Bottleneck-1.3.8-cp311-cp311-win_amd64.whl.metadata (8.1 kB)
Requirement already satisfied: numpy in c:\users\spin 3\anaconda3\lib\site-
packages (from bottleneck) (1.24.3)
Downloading Bottleneck-1.3.8-cp311-cp311-win_amd64.whl (110 kB)
   ---------------------------------------- 0.0/110.1 kB ? eta -:--:--
   ---------------------- ----------------- 61.4/110.1 kB 1.6 MB/s eta 0:00:01
   ---------------------------------------- 110.1/110.1 kB 3.1 MB/s eta 0:00:00
Installing collected packages: bottleneck
  Attempting uninstall: bottleneck
    Found existing installation: Bottleneck 1.3.5
    Uninstalling Bottleneck-1.3.5:
      Successfully uninstalled Bottleneck-1.3.5
Successfully installed bottleneck-1.3.8
Note: you may need to restart the kernel to use updated packages.
```

[75]:
```
head= ['Subject_ID','Sex','Age_(years)','Weight_(kg)','Height_(cm)']
```

[76]:
```
df_subjects=pd.
 ↪DataFrame(data=[[101,'Female',55,73,169],[102,'Male',61,85,180],[103,'Male',23,95,180],[104
```

[77]:
```
df_subjects.head(5)
```

[77]:

	Subject_ID	Sex	Age_(years)	Weight_(kg)	Height_(cm)
0	101	Female	55	73	169
1	102	Male	61	85	180
2	103	Male	23	95	180
3	104	Female	48	55	158
4	105	Male	53	98	175

[78]:
```
#creat a data for the candidates
# initialising dataframe

head2= ['Subject_ID','activity_id','unit']
headers =␣
 ↪['time_index','acc_x','acc_y','acc_z','gyr_x','gyr_y','gyr_z','mag_x','mag_y','mag_z']

df_raw=pd.DataFrame(columns=headers)
for i in range(1,len(head2)+1):

    df_raw.insert(loc=0,column=head2[-i],value="")
```

[79]:
```
df_raw.head(5)
```

[79]:
```
Empty DataFrame
Columns: [Subject_ID, activity_id, unit, time_index, acc_x, acc_y, acc_z, gyr_x,
gyr_y, gyr_z, mag_x, mag_y, mag_z]
Index: []
```

[80]:
```
import pandas as pd

# Define column headers
head3 = ['Subject_ID', 'activity_id']
headers3 = ['execution_type','start','end']

# Create an empty DataFrame with column headers

df_raw3 = pd.DataFrame(columns=headers)
# Insert empty columns for 'Subject_ID', 'activity_id', 'unit'
for i in range(1, len(head2) + 1):

    df_raw3.insert(loc=0, column=head2[-i], value="")
```

[81]:
```
filename = '111template.txt'
df = pd.read_csv(filename, sep=';', header=0)

# Display the DataFrame
```

[82]:
```
df.head(5)
```

[82]:
```
   time index     acc_x     acc_y     acc_z     gyr_x     gyr_y     gyr_z  \
0           1 -9.665799 -1.677241  0.615063 -0.014956  0.004388  0.010589
1           2 -9.665806 -1.684737  0.622513  0.000607 -0.003094 -0.007589
2           3 -9.628410 -1.699724  0.585751  0.006007  0.000557 -0.004879
3           4 -9.628372 -1.684836  0.600733 -0.003085 -0.000281 -0.000340
4           5 -9.643291 -1.639893  0.585661 -0.002932 -0.006807 -0.013043

      mag_x     mag_y     mag_z
0  0.587318  0.455106 -0.094949
1  0.587428  0.455621 -0.093364
2  0.588389  0.454722 -0.094907
3  0.588673  0.455759 -0.092664
4  0.589193  0.453927 -0.093143
```

[83]:
```
#df_raw=pd.DataFrame(columns=headers)
df_raw.head(5)
```

[83]:
```
Empty DataFrame
Columns: [Subject_ID, activity_id, unit, time_index, acc_x, acc_y, acc_z, gyr_x,
gyr_y, gyr_z, mag_x, mag_y, mag_z]
Index: []
```

[84]:
```
for i in range(1, 6):
    for k in range(1, 9):
        for j in range(1, 6):
            # Read data from template file
            df2 = pd.read_csv(f"{i}{k}{j}template.txt", sep=';', header=0)
            # Read data from test file
            #df3 = pd.read_csv(f"{i}{k}{j}test.txt", sep=';', header=0)
            # Add Subject_ID, activity_id, and unit columns
            df2["Subject_ID"] = i
            df2["activity_id"] = k
            df2["unit"] = j
            #df3["Subject_ID"] = i
            #df3["activity_id"] = k
            #df3["unit"] = j
            # Concatenate df2 and df3 to df_raw
            df_raw = pd.concat([df_raw, df2], ignore_index=True)
            #df_raw = pd.concat([df_raw, df3], ignore_index=True)
```

```
C:\Users\spin 3\AppData\Local\Temp\ipykernel_10436\736965609.py:16:
FutureWarning: The behavior of DataFrame concatenation with empty or all-NA
entries is deprecated. In a future version, this will no longer exclude empty or
all-NA columns when determining the result dtypes. To retain the old behavior,
exclude the relevant entries before the concat operation.
  df_raw = pd.concat([df_raw, df2], ignore_index=True)
```

[85]:
```
#drop  column
df_raw.drop(columns=["time_index"],inplace=True)
```

[86]:
```
#change columns name
headers=['time index']
columns = {"time index" : "time_index"
          }

df_raw.rename(columns=columns,inplace=True)
```

[87]:
```
df_raw.head(5)
```

[87]:

	Subject_ID	activity_id	unit	acc_x	acc_y	acc_z	gyr_x	gyr_y	gyr_z	mag_x	mag_y	mag_z	time_index
0	1	1	1	-9.665799	-1.677241	0.615063	-0.014956	0.004388	0.010589	0.587318	0.455106	-0.094949	1.0
1	1	1	1	-9.665806	-1.684737	0.622513	0.000607	-0.003094	-0.007589	0.587428	0.455621	-0.093364	2.0
2	1	1	1	-9.628410	-1.699724	0.585751	0.006007	0.000557	-0.004879	0.588389	0.454722	-0.094907	3.0
3	1	1	1	-9.628372	-1.684836	0.600733	-0.003085						
4	1	1	1	-9.643291	-1.639893	0.585661	-0.002932						

```
3 -0.000281 -0.000340  0.588673  0.455759 -0.092664         4.0
4 -0.006807 -0.013043  0.589193  0.453927 -0.093143         5.0
```

[88]:
```
for i in range(1, 6):
    for k in range(1, 9):
        for j in range(1, 6):
            # Read data from template file
            #df2 = pd.read_csv(f"{i}{k}{j}template.txt", sep=';', header=0)
            # Read data from test file
            df3 = pd.read_csv(f"{i}{k}{j}test.txt", sep=';', header=0)
            # Add Subject_ID, activity_id, and unit columns
            #df2["Subject_ID"] = i
            #df2["activity_id"] = k
            #df2["unit"] = j
            df3["Subject_ID"] = i
            df3["activity_id"] = k
            df3["unit"] = j
            # Concatenate df2 and df3 to df_raw
            #df_raw = pd.concat([df_raw, df2], ignore_index=True)
            df_raw2 = pd.concat([df_raw, df3], ignore_index=True)
```

[89]:
```
#drop  column
df_raw2.drop(columns=["time_index"],inplace=True)
```

[90]:
```
#change columns name
headers=['time index']
columns = {"time index" : "time_index"
          }

df_raw2.rename(columns=columns,inplace=True)
```

[91]:
```
df_raw2.head(5)
```

[91]:
```
  Subject_ID activity_id unit     acc_x     acc_y     acc_z     gyr_x  \
0          1           1    1 -9.665799 -1.677241  0.615063 -0.014956
1          1           1    1 -9.665806 -1.684737  0.622513  0.000607
2          1           1    1 -9.628410 -1.699724  0.585751  0.006007
3          1           1    1 -9.628372 -1.684836  0.600733 -0.003085
4          1           1    1 -9.643291 -1.639893  0.585661 -0.002932

      gyr_y     gyr_z     mag_x     mag_y     mag_z  time_index
0  0.004388  0.010589  0.587318  0.455106 -0.094949         NaN
1 -0.003094 -0.007589  0.587428  0.455621 -0.093364         NaN
2  0.000557 -0.004879  0.588389  0.454722 -0.094907         NaN
3 -0.000281 -0.000340  0.588673  0.455759 -0.092664         NaN
4 -0.006807 -0.013043  0.589193  0.453927 -0.093143         NaN
```

[92]:
```
df_raw2.dtypes
```

[92]:
```
Subject_ID      object
activity_id     object
unit            object
acc_x          float64
acc_y          float64
acc_z          float64
gyr_x          float64
gyr_y          float64
gyr_z          float64
mag_x          float64
mag_y          float64
mag_z          float64
time_index     float64
dtype: object
```

[93]:
```
df_raw['unit'] = df_raw['unit'].astype(int)
df_raw['Subject_ID'] = df_raw['Subject_ID'].astype(int)
df_raw['activity_id'] = df_raw['activity_id'].astype(int)
df_raw2['unit'] = df_raw2['unit'].astype(int)
df_raw2['Subject_ID'] = df_raw2['Subject_ID'].astype(int)
df_raw2['activity_id'] = df_raw2['activity_id'].astype(int)
```

[94]:
```
print(df_raw2['activity_id'].unique())
```

```
[1 2 3 4 5 6 7 8]
```

[183]:
```
df_raw2['activity_id'].value_counts()
```

[183]:
```
activity_id
1    39845
2    37345
8    36902
3    36380
7    33505
6    33285
4    32660
5    31795
Name: count, dtype: int64
```

[152]:
```
print(df_raw.columns)
```

```
Index(['Subject_ID', 'activity_id', 'unit', 'acc_x', 'acc_y', 'acc_z', 'gyr_x',
       'gyr_y', 'gyr_z', 'mag_x', 'mag_y', 'mag_z', 'time_index'],
      dtype='object')
```

[200]:
```
#count time_index missing
time_index_count=df_raw2['time_index'].isna().sum()
print("There are " + f'{time_index_count:,.0f}' + " mtime_index rate records␣
 ↪due to difference in frequency.")
```

```
There are 276,625 mtime_index rate records due to difference in frequency.
```

[ ]:
```
#replace heart rate missing
df_heart_fill=df_raw2
df_heart_fill.loc[:,'heart_rate']=df_raw2.loc[:,['heart_rate']].
 ↪fillna(method='bfill',axis=0)
incomplete_records_count=df_heart_fill.isna().any(axis=0).sum()
data_set_size=df_heart_fill.shape[0]
print("After filling the missing heart data, there are " +␣
 ↪f'{incomplete_records_count:,.0f}'.format(incomplete_records_count) +
      " records missing one or more values, out of a data set of size " +␣
 ↪f'{data_set_size:,.0f}'+".")
df_master=df_heart_fill.dropna(axis=0,how='any')
```

[203]:
```
#replace heart rate missing
time_index_fill=df_raw2
time_index_fill.loc[:,'time_index']=df_raw2.loc[:,['time_index']].
 ↪fillna(method='bfill',axis=0)
incomplete_records_count=time_index_fill.isna().any(axis=0).sum()
data_set_size=time_index_fill.shape[0]
print("After filling the missing time_index, there are " +␣
 ↪f'{incomplete_records_count:,.0f}'.format(incomplete_records_count) +
      " records missing one or more values, out of a data set of size " +␣
 ↪f'{data_set_size:,.0f}'+".")
df_master=time_index_fill.dropna(axis=0,how='any')
```

```
After filling the missing time_index, there are 0 records missing one or more
values, out of a data set of size 281,717.
```

```
C:\Users\spin 3\AppData\Local\Temp\ipykernel_10436\3366435413.py:3:
FutureWarning: DataFrame.fillna with 'method' is deprecated and will raise in a
future version. Use obj.ffill() or obj.bfill() instead.
  time_index_fill.loc[:,'time_index']=df_raw2.loc[:,['time_index']].fillna(metho
d='bfill',axis=0)
```

[204]:
```
X_train = df_raw[['Subject_ID', 'unit', 'acc_x', 'acc_y', 'acc_z', 'gyr_x',
       'gyr_y', 'gyr_z', 'mag_x', 'mag_y', 'mag_z', 'time_index']] .values
X_test = df_raw2[['Subject_ID', 'unit', 'acc_x', 'acc_y', 'acc_z', 'gyr_x',
       'gyr_y', 'gyr_z', 'mag_x', 'mag_y', 'mag_z', 'time_index']] .values
y_train = df_raw['activity_id'].values
y_test = df_raw2['activity_id'].values
```

[205]:
```
print(type(y_train))
print(type(X_train))
```

```
<class 'numpy.ndarray'>
<class 'numpy.ndarray'>
```

[207]:
```
X_train[:5]
```

[207]:
```
array([[ 1.000000e+00,  1.000000e+00, -9.665799e+00, -1.677241e+00,
         6.150630e-01, -1.495600e-02,  4.388000e-03,  1.058900e-02,
         5.873180e-01,  4.551060e-01, -9.494900e-02,  1.000000e+00],
       [ 1.000000e+00,  1.000000e+00, -9.665806e+00, -1.684737e+00,
         6.225130e-01,  6.070000e-04, -3.094000e-03, -7.589000e-03,
         5.874280e-01,  4.556210e-01, -9.336400e-02,  2.000000e+00],
       [ 1.000000e+00,  1.000000e+00, -9.628410e+00, -1.699724e+00,
         5.857510e-01,  6.007000e-03,  5.570000e-04, -4.879000e-03,
         5.883890e-01,  4.547220e-01, -9.490700e-02,  3.000000e+00],
       [ 1.000000e+00,  1.000000e+00, -9.628372e+00, -1.684836e+00,
         6.007330e-01, -3.085000e-03, -2.810000e-04, -3.400000e-04,
         5.886730e-01,  4.557590e-01, -9.266400e-02,  4.000000e+00],
       [ 1.000000e+00,  1.000000e+00, -9.643291e+00, -1.639893e+00,
         5.856610e-01, -2.932000e-03, -6.807000e-03, -1.304300e-02,
         5.891930e-01,  4.539270e-01, -9.314300e-02,  5.000000e+00]])
```

[208]:
```
scaler = preprocessing.StandardScaler().fit(X_train)
X_train = scaler.transform(X_train.astype(float))

scaler = preprocessing.StandardScaler().fit(X_test)
X_test = scaler.transform(X_test.astype(float))


X_train[0:5]
```

[208]:
```
array([[-1.2329518 , -1.41421356, -1.75633635, -0.41221348,  0.04125777,
        -0.09617866, -0.00213778,  0.05693358,  1.64821913,  0.94716039,
        -0.03203682, -1.573816  ],
       [-1.2329518 , -1.41421356, -1.7563376 , -0.41343728,  0.0426764 ,
        -0.01592446, -0.02586684, -0.00453226,  1.6484745 ,  0.94818087,
        -0.02836432, -1.57165335],
       [-1.2329518 , -1.41421356, -1.74964295, -0.41588405,  0.03567619,
         0.01192189, -0.01428774,  0.00463115,  1.65070556,  0.94639948,
        -0.0319395 , -1.56949069],
       [-1.2329518 , -1.41421356, -1.74963615, -0.41345344,  0.03852906,
        -0.03496311, -0.01694545,  0.01997901,  1.6513649 ,  0.94845432,
        -0.0267424 , -1.56732804],
       [-1.2329518 , -1.41421356, -1.75230696, -0.40611607,  0.03565905,
        -0.03417413, -0.03764257, -0.02297404,  1.65257213,  0.94482417,
        -0.02785226, -1.56516539]])
```

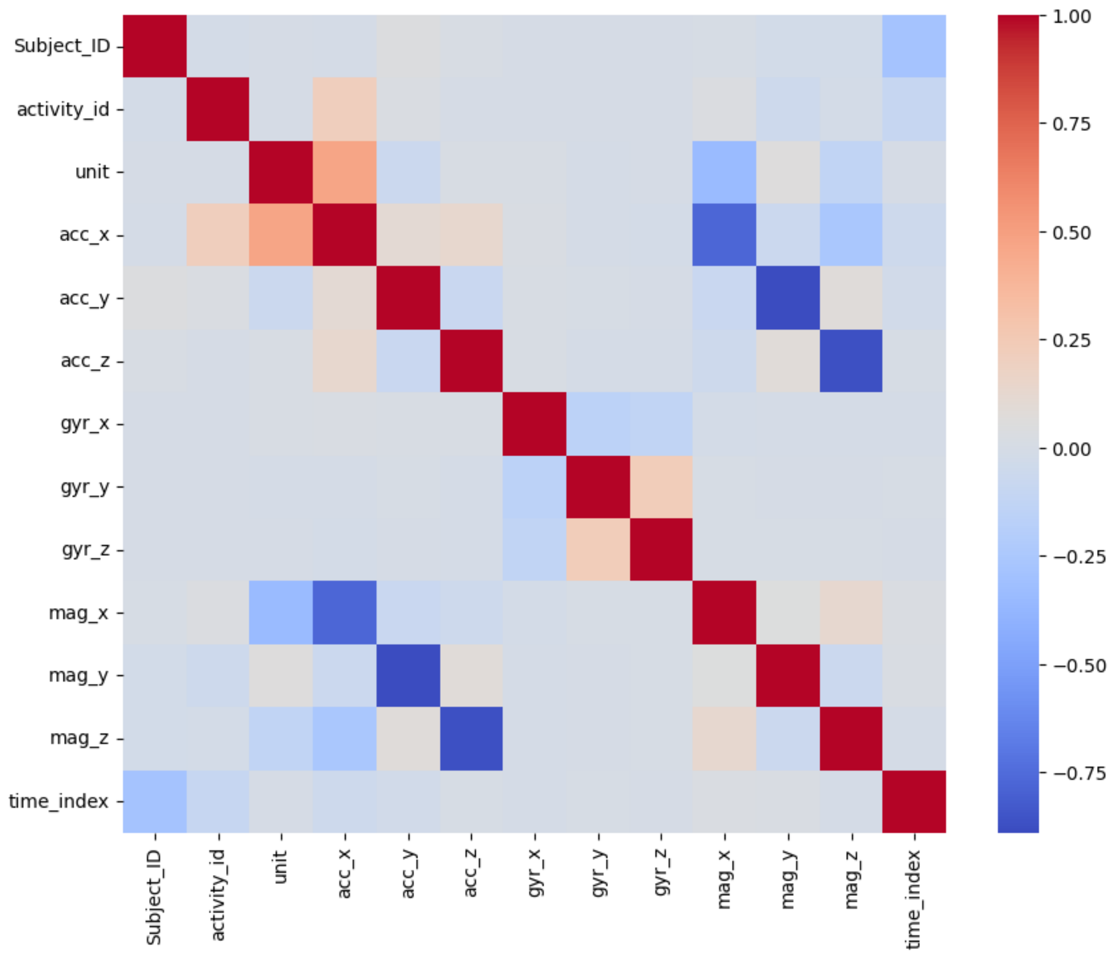
[119]:
```
df_raw2.dtypes
```

[119]:
```
Subject_ID       int32
activity_id      int32
unit             int32
acc_x          float64
acc_y          float64
acc_z          float64
gyr_x          float64
gyr_y          float64
gyr_z          float64
mag_x          float64
mag_y          float64
mag_z          float64
time_index     float64
dtype: object
```

[121]:
```
y_train.dtypes
```

[121]:
```
activity_id    int32
dtype: object
```

[123]:
```
numerical_columns = df_raw.select_dtypes(include=['float64', 'int64','int32',]).
  ↪columns
correlation_matrix = df_raw[numerical_columns].corr(method='pearson')
plt.figure(figsize=(10, 8))
sns.heatmap(data=correlation_matrix, cmap='coolwarm', annot=False, fmt=".2f")
plt.show()
```

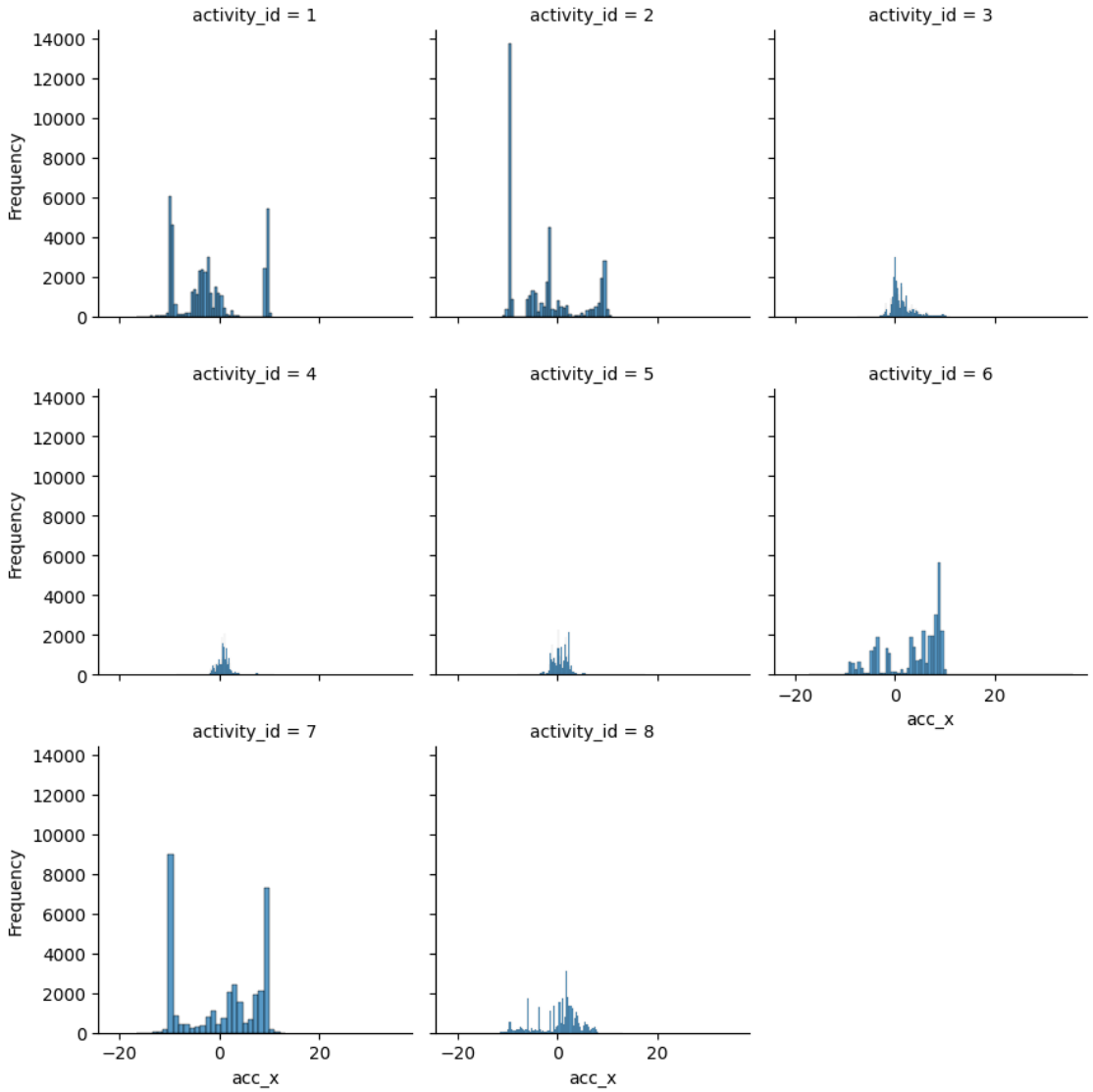


[126]:
```
g = sns.FacetGrid(df_raw, col='activity_id', col_wrap=3)
g.map(sns.histplot, "acc_x")
g.set_axis_labels("acc_x", "Frequency")
```

```
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
```

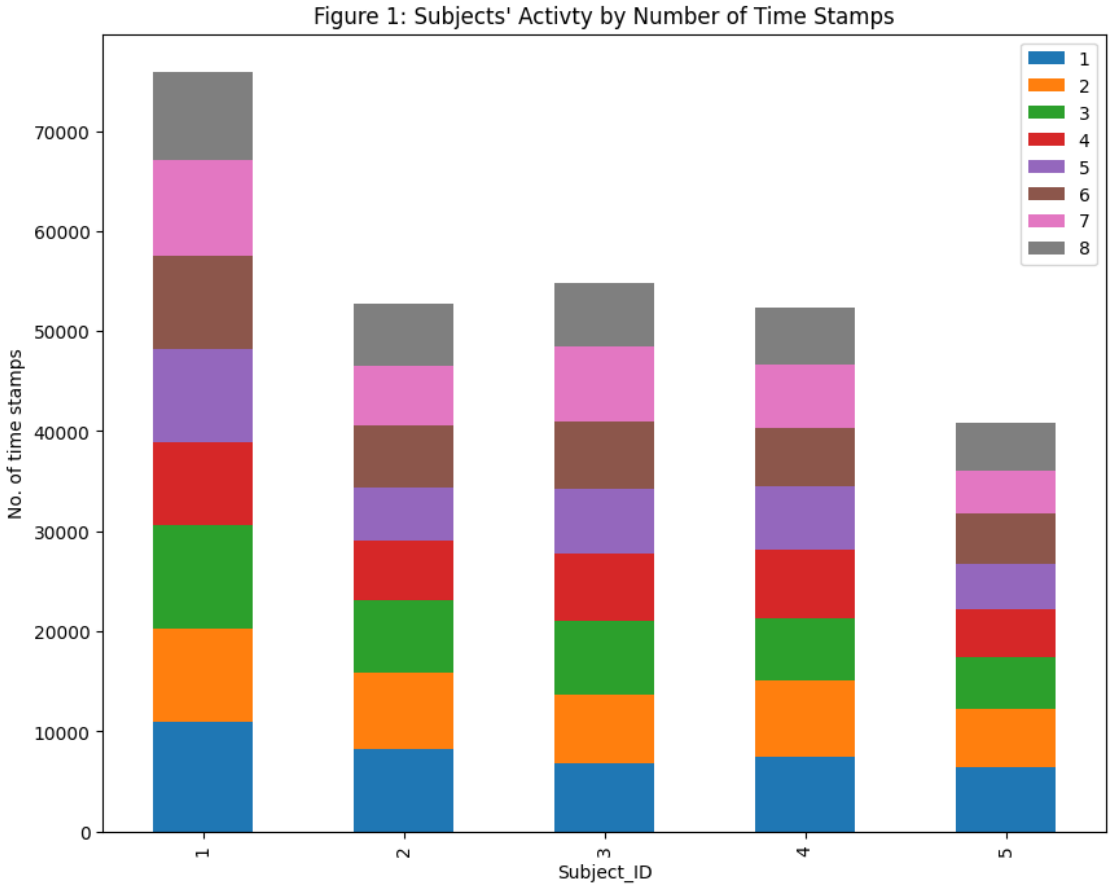
```
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\spin 3\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed in a
future version. Convert inf values to NaN before operating instead.
  with pd.option_context('mode.use_inf_as_na', True):
```

```
[126]: <seaborn.axisgrid.FacetGrid at 0x18a23834990>
```

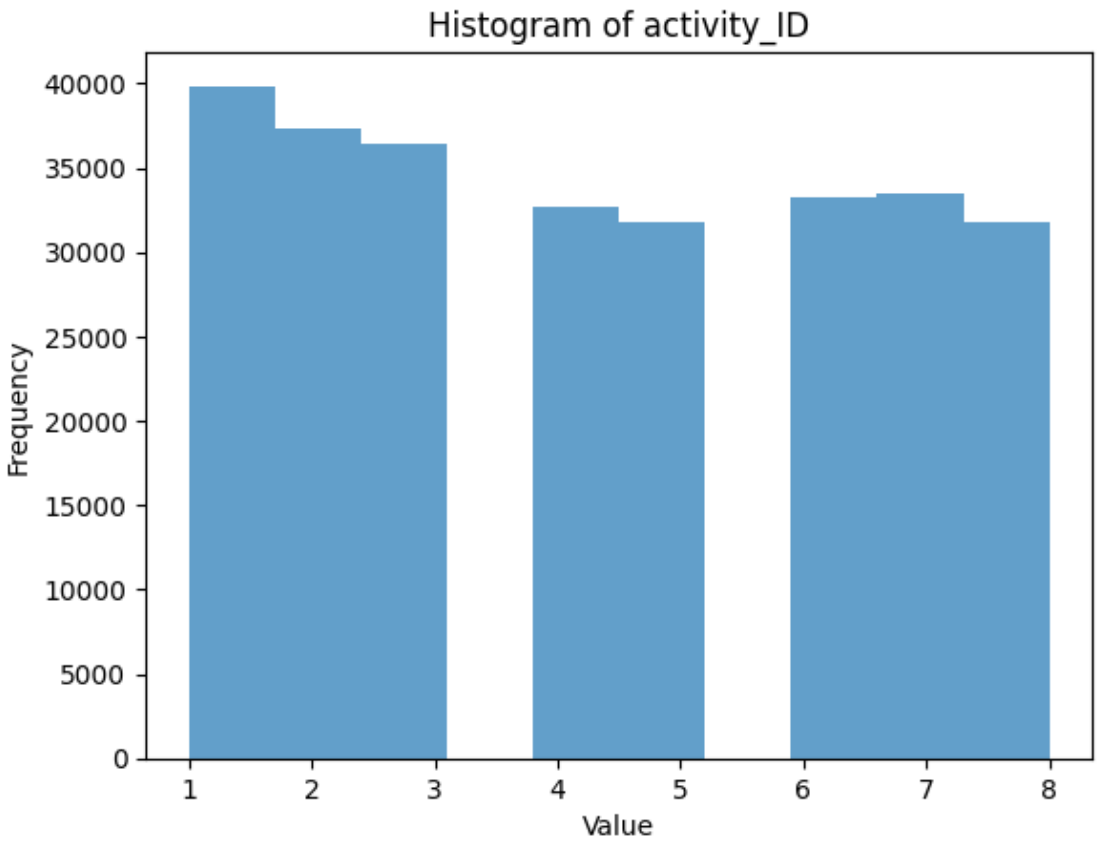


[127]:
```
#bar chart
pivot1= pd.
 ↪pivot_table(df_raw,values='time_index',index='Subject_ID',columns='activity_id',margins=Fal
 ↪aggfunc='count')
#pivot1.style.format('{:,.0f}') #apply(lambda x: '{,:.0}'.format(x))

ax=pivot1.plot(kind="bar",title="Figure 1: Subjects' Activty by Number of Time␣
 ↪Stamps",figsize=(10,8),stacked=True);

#ax.yaxis.set_major_formatter('{x:,.0f}')
ax.set_ylabel("No. of time stamps")
#box=ax((1,1))
```

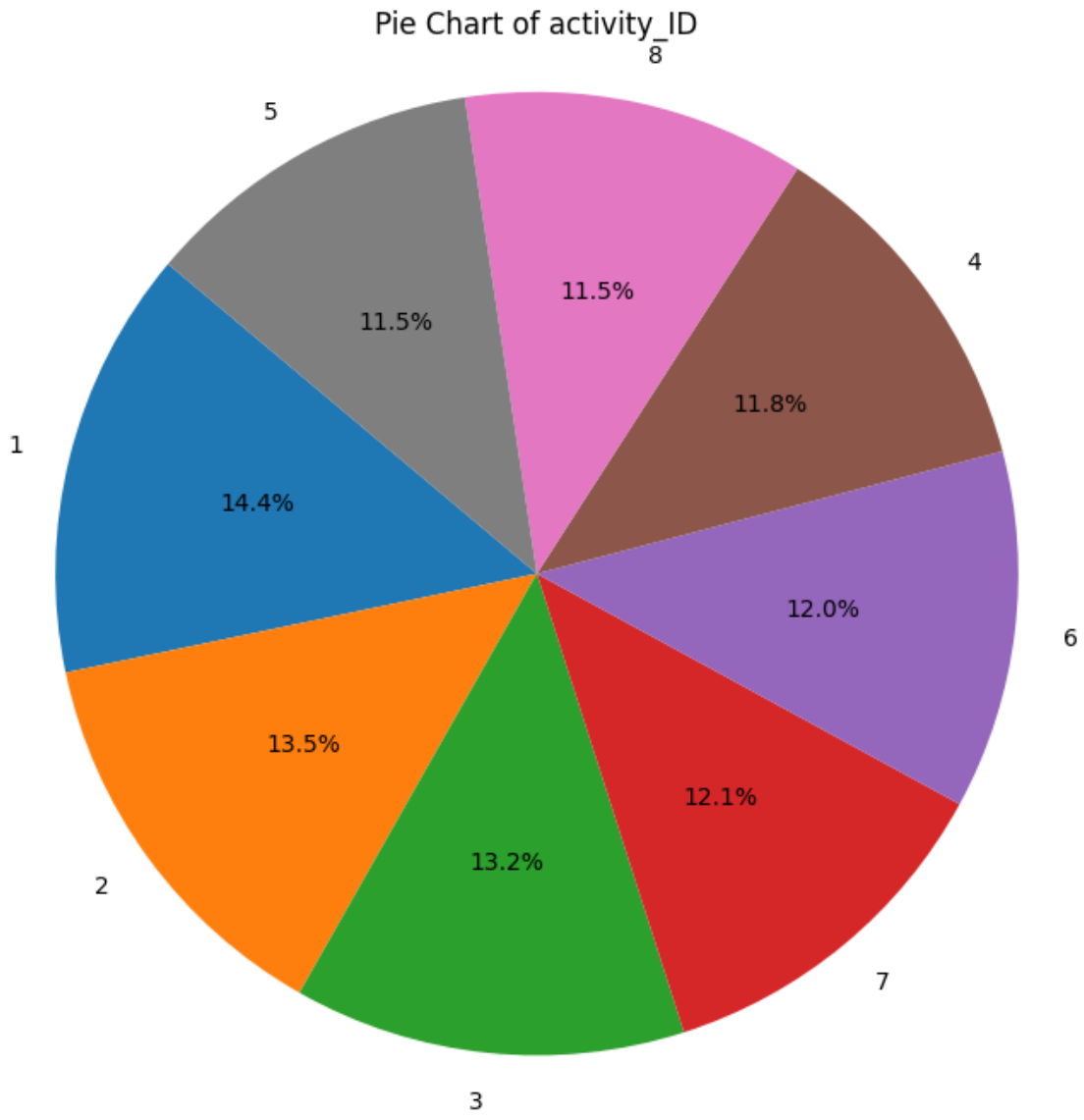
```
plt.legend(bbox_to_anchor=(1,1));
#ax.set_position(1,1.1)
```



[128]:
```
df_raw['activity_id'].plot(kind='hist', bins=10, alpha=0.7)
plt.xlabel('Value')  # Optional: customize X-axis label
plt.ylabel('Frequency')  # Optional: customize Y-axis label
plt.title('Histogram of activity_ID')  # Optional: add title
plt.show()
```



[130]:
```
# Calculate value counts for 'activity_id' column
value_counts = df_raw['activity_id'].value_counts()

# Plot pie chart
plt.figure(figsize=(8, 8))  # Optional: customize figure size
plt.pie(value_counts, labels=value_counts.index, autopct='%1.1f%%',␣
 ↪startangle=140)
plt.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
plt.title('Pie Chart of activity_ID')  # Optional: add title
plt.show()
```



[46]:
```
df_raw['activity_id'].value_counts()
```

[46]:
```
activity_id
1    39845
2    37345
3    36380
7    33505
6    33285
4    32660
8    31810
5    31795
Name: count, dtype: int64
```

[181]:
```
y_train
```

[181]:
```
array([1, 1, 1, …, 8, 8, 8])
```

[209]:
```
print ('Train set:', X_train.shape,  y_train.shape)
print ('Test set:', X_test.shape,  y_test.shape)
```

```
Train set: (276625, 12) (276625,)
Test set: (281717, 12) (281717,)
```

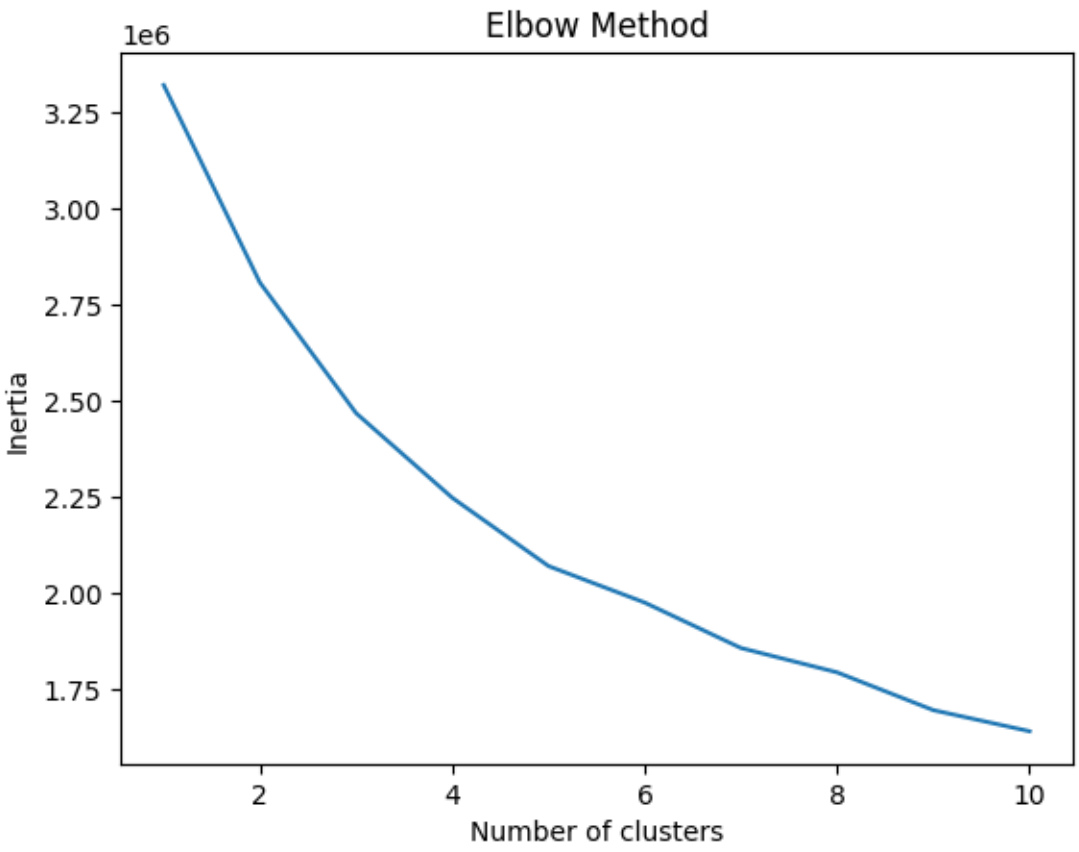
[190]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.cluster import KMeans
from sklearn.metrics import silhouette_score
```

[193]:
```
import numpy as np

# Assuming X_test is a NumPy array
#nan_mask_test = ~np.isnan(X_test).any(axis=1)
#X_test = X_test[nan_mask_test]

# Assuming X_train is a NumPy array
#nan_mask_train = ~np.isnan(X_train).any(axis=1)
#X_train = X_train[nan_mask_train]
```

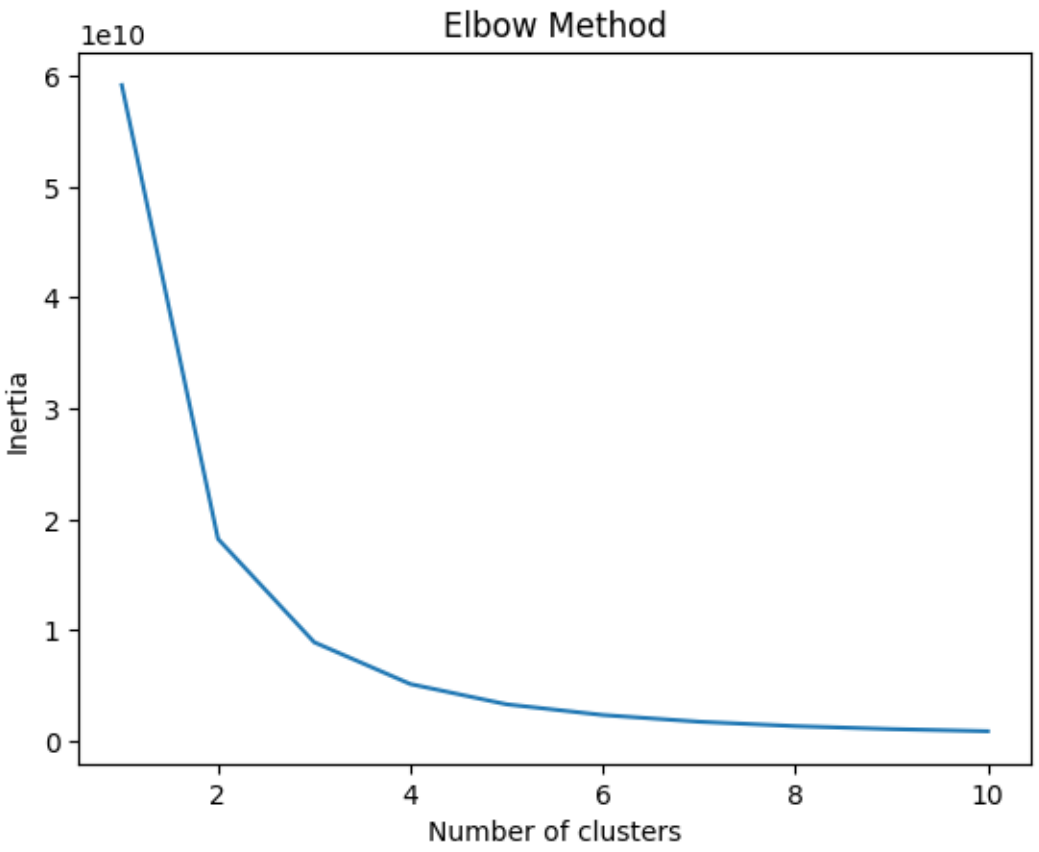
[194]:
```
print ('Train set:', X_train.shape,  y_train.shape)
print ('Test set:', X_test.shape,  y_test.shape)
```

```
Train set: (276625, 12) (276625,)
Test set: (5092, 12) (281717,)
```

[170]:
```
# Example data X

# Elbow Method
inertia = []
for k in range(1, 11):
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(X_train)
    inertia.append(kmeans.inertia_)
plt.plot(range(1, 11), inertia)
plt.xlabel('Number of clusters')
plt.ylabel('Inertia')
plt.title('Elbow Method')
plt.show()
```



[45]:
```python
# Example data X

# Elbow Method
inertia = []
for k in range(1, 11):
    kmeans = KMeans(n_clusters=k, random_state=42)
    kmeans.fit(X_train)
    inertia.append(kmeans.inertia_)
plt.plot(range(1, 11), inertia)
plt.xlabel('Number of clusters')
plt.ylabel('Inertia')
plt.title('Elbow Method')
plt.show()
```



[101]:
```
# Check if there are any NaN values in y_trainv
if np.isnan(y_train.astype(float)).any():
    print("NaN values found in y_train")
else:
    print("No NaN values in y_train")
```

```
No NaN values in y_train
```

[102]:
```
# Check if there are any NaN values in y_trainv
if np.isnan(X_train.astype(float)).any():
    print("NaN values found in X_trainv")
else:
    print("No NaN values in x_trainv")
```

```
No NaN values in x_trainv
```

[210]:
```
k = 4
#Train Model and Predict
neigh = KNeighborsClassifier(n_neighbors = k).fit(X_train,y_train)
neigh
```

[210]:
```
KNeighborsClassifier(n_neighbors=4)
```

[168]:
```

```

[ ]:
```

```

[211]:
```
yhat = neigh.predict(X_test)
```

[212]:
```
print(y_test[0:5])
print(yhat[0:5])
```

```
[1 1 1 1 1]
[1 1 1 1 1]
```

[213]:
```
from sklearn import metrics
print("Train set Accuracy: ", metrics.accuracy_score(y_train, neigh.
↪predict(X_train)))
```

```
Train set Accuracy:  0.9985286940804338
```

[214]:
```
print("Test set Accuracy: ", metrics.accuracy_score(y_test, yhat))
```

```
Test set Accuracy:  0.9769804449145774
```

[218]:
```
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
```

[236]:
```
drugTree = DecisionTreeClassifier(criterion="entropy", max_depth = 11)
drugTree # it shows the default parameters
```

[236]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=11)
```

[237]:
```
drugTree.fit(X_train,y_train)
```

[237]:
```
DecisionTreeClassifier(criterion='entropy', max_depth=11)
```

[238]:
```
predTree = drugTree.predict(X_test)
```

[239]:
```
print (predTree [0:5])
print (y_test [0:5])
```

```
[1 1 1 1 1]
[1 1 1 1 1]
```

[240]:
```
from sklearn import metrics
import matplotlib.pyplot as plt
print("DecisionTrees's Accuracy: ", metrics.accuracy_score(y_test, predTree))
```

```
DecisionTrees's Accuracy:  0.9488884234888203
```

[300]:
```
from sklearn import svm
clf = svm.SVC(kernel='rbf')
clf.fit(X_train, y_train)
```

[300]:
```
SVC()
```

[301]:
```
yhatsvm = clf.predict(X_test)
```

[302]:
```
print(yhatsvm [0:5])
print(y_test[0:5])
```

```
[1 1 1 1 1]
[1 1 1 1 1]
```

[303]:
```
from sklearn.metrics import f1_score
f1_score(y_test, yhatsvm, average='weighted')
```

[303]:
```
0.9911951688362133
```

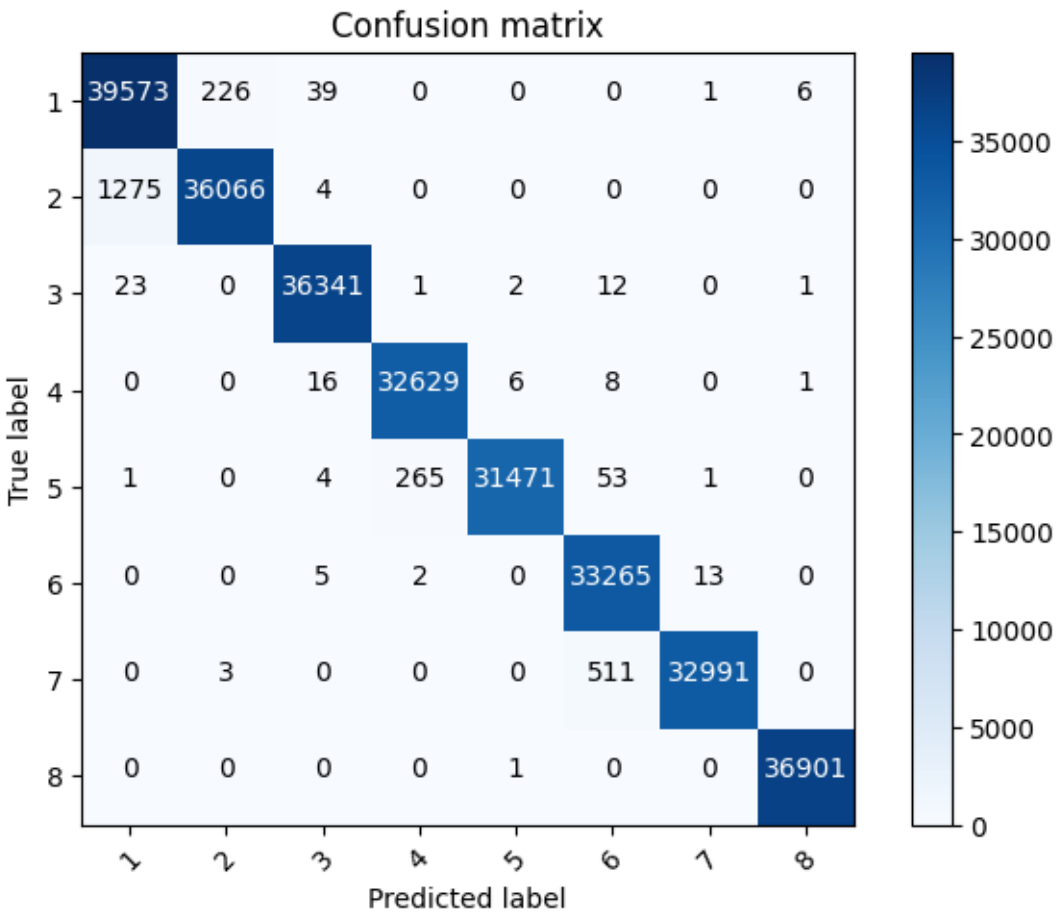
[307]:
```
from sklearn.metrics import classification_report, confusion_matrix
import itertools
```

[308]:
```
def plot_confusion_matrix(cm, classes,
                          normalize=False,
                          title='Confusion matrix',
                          cmap=plt.cm.Blues):
    """
    This function prints and plots the confusion matrix.
    Normalization can be applied by setting `normalize=True`.
    """
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        print("Normalized confusion matrix")
    else:
        print('Confusion matrix, without normalization')

    print(cm)

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
```

```
        plt.text(j, i, format(cm[i, j], fmt),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

[309]:
```
cnf_matrix = confusion_matrix(y_test, yhatsvm, labels=[1,2,3,4,5,6,7,8])
np.set_printoptions(precision=8)

print (classification_report(y_test, yhatsvm))

# Plot non-normalized confusion matrix
plt.figure()
plot_confusion_matrix(cnf_matrix, classes=['1',␣
 ↪'2','3','4','5','6','7','8'],normalize= False,  title='Confusion matrix')
```

```
              precision    recall  f1-score   support

           1       0.97      0.99      0.98     39845
           2       0.99      0.97      0.98     37345
           3       1.00      1.00      1.00     36380
           4       0.99      1.00      1.00     32660
           5       1.00      0.99      0.99     31795
           6       0.98      1.00      0.99     33285
           7       1.00      0.98      0.99     33505
           8       1.00      1.00      1.00     36902

    accuracy                           0.99    281717
   macro avg       0.99      0.99      0.99    281717
weighted avg       0.99      0.99      0.99    281717

Confusion matrix, without normalization
[[39573   226    39     0     0     0     1     6]
 [ 1275 36066     4     0     0     0     0     0]
 [   23     0 36341     1     2    12     0     1]
 [    0     0    16 32629     6     8     0     1]
 [    1     0     4   265 31471    53     1     0]
 [    0     0     5     2     0 33265    13     0]
 [    0     3     0     0     0   511 32991     0]
 [    0     0     0     0     1     0     0 36901]]
```


Confusion matrix
True label
Predicted label
1 2 3 4 5 6 7 8
39573 226 39 0 0 0 1 6
1275 36066 4 0 0 0 0 0
23 0 36341 1 2 12 0 1
0 0 16 32629 6 8 0 1
1 0 4 265 31471 53 1 0
0 0 5 2 0 33265 13 0
0 3 0 0 0 511 32991 0
0 0 0 0 1 0 0 36901
35000
30000
25000
20000
15000
10000
5000
0