w5_ML&DH

November 6, 2021

0.1 Week 5: Machine Learning & Data Mining

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

from sklearn import preprocessing
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, accuracy_score
from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import f_classif, f_regression, chi2,␣
↪mutual_info_classif
```

[5]:
```
pd.set_option('display.max_colwidth',None)
titanic = pd.read_csv('./titanic.csv')
print("Number of points in original data: {}".format(len(titanic.index)))

columns = titanic.columns
print("Features present in dataset: \n", list(columns))

titanic.loc[titanic['Sex'] == 'male', 'Sex'] = 1
titanic.loc[titanic['Sex'] == 'female', 'Sex'] = 0
titanic.head(5)
```

```
Number of points in original data: 887
Features present in dataset:
 ['Survived', 'Pclass', 'Name', 'Sex', 'Age', 'Siblings/Spouses Aboard',
'Parents/Children Aboard', 'Fare']
```

[5]:

	Survived	Pclass	Name	Sex
0	0	3	Mr. Owen Harris Braund	1
1	1	1	Mrs. John Bradley (Florence Briggs Thayer) Cumings	0
2	1	3	Miss. Laina Heikkinen	0
3	1	1	Mrs. Jacques Heath (Lily May Peel) Futrelle	0
4	0	3	Mr. William Henry Allen	1

	Age	Siblings/Spouses Aboard	Parents/Children Aboard	Fare
0	22.0	1	0	7.2500
1	38.0	1	0	71.2833
2	26.0	0	0	7.9250
3	35.0	1	0	53.1000
4	35.0	0	0	8.0500

0.1.1 Q1. Predict the class 'Survived' with a k-nearest neighbours classifier with 3 distance metrics and k=3

Loading data

[17]:
```
le = preprocessing.LabelEncoder()

xd = titanic[["Pclass","Sex","Age","Siblings/Spouses Aboard","Parents/Children␣
 ↪Aboard","Fare"]]
yd = le.fit(titanic["Survived"])
yd = le.transform(titanic["Survived"])


# set the random state
xd_train, xd_test, yd_train, yd_test = train_test_split(xd, yd, test_size = 0.
 ↪25, random_state=0)


print("No of training samples: {}".format(xd_train.shape))
print("No of test samples    : {}".format(xd_test.shape))
print("y training samples    : {}".format(yd_train.shape))
print("y test samples        : {}".format(yd_test.shape))
```

```
No of training samples: (665, 6)
No of test samples    : (222, 6)
y training samples    : (665,)
y test samples        : (222,)
```

Train kNN with Manhattan distance

[95]:
```
knnclassifier = KNeighborsClassifier(n_neighbors = 3, metric = 'manhattan')
knnclassifier.fit(xd_train.values, yd_train)
y_pred_m = knnclassifier.predict(xd_test.values)
acc_manhattan = accuracy_score(yd_test, y_pred_m)
print("Accuracy on test set: {:.2f}".format(100*acc_manhattan))
print("Confusion Matrix:" , confusion_matrix(yd_test,y_pred_m))
```

```
Accuracy on test set: 76.58
Confusion Matrix: [[121  21]
 [ 31  49]]
```

Train kNN with Euclidean distance

[94]:
```
knnclassifier_e = KNeighborsClassifier(n_neighbors = 3, metric = 'euclidean')
knnclassifier_e.fit(xd_train.values, yd_train)
y_pred_e = knnclassifier_e.predict(xd_test.values)
acc_euclidien = accuracy_score(yd_test, y_pred_e)
print("Accuracy on test set: {:.2f}".format(100*acc_euclidien))
print("Confusion Matrix:\n" ,confusion_matrix(yd_test,y_pred_e))
```

```
Accuracy on test set: 69.82
Confusion Matrix:
 [[115  27]
 [ 40  40]]
```

Train kNN with Cosine distance

[89]:
```
knnclassifier_c = KNeighborsClassifier(n_neighbors = 3, metric = 'cosine')
knnclassifier_c.fit(xd_train.values, yd_train)
y_pred_c = knnclassifier_c.predict(xd_test.values)
acc_cosine = accuracy_score(yd_test, y_pred_c)
print("Accuracy on test set: {:.2f}".format(100*acc_cosine))
print("Confusion Matrix:\n" ,confusion_matrix(yd_test,y_pred_c))
```

```
Accuracy on test set: 77.03
Confusion Matrix:
 [[120  22]
 [ 29  51]]
```

which distance do you think is the best distance measure? and why?

Answer. As above accuracy of manhattan, euclidien, cosine, we observe that Cosine distance is best distance measure because it gives the accuracy of 77%.

Why?

Answer. Because the features are not normalized, using absolute distance feaatures is not ideal since some features has different range of values. Like age is range 0-80 but Class is in range 1-3. Hence, cosine which only uses angle is more ideal than finding distances with te current unnormalised features

0.1.2 Q2. determine the number attributes that is capable of giving the best prediction.

Loading data

[23]:
```
df = pd.read_csv('./IBM.txt', delimiter = " ")
df_raw = df
print("Number of rows in original data: {}".format(len(df.index)))
print("Features: ", list(df.columns))
```

```
Number of rows in original data: 3692
Features:  ['Date', 'Open', 'High', 'Low', 'Close', 'Volume', 'Adjusted']
```

Calcuate decision for NEXT day

[97]:
```
df['Daily_returns'] = 100*((df['Close'] - df['Close'].shift())/ df['Close'].
↪shift())
conditions = [(df['Daily_returns'] >= 0.0),(df['Daily_returns'] < 0.0)]
# 1 for UP. -1 for Down

values = [1, -1]
df['Decision'] = np.select(conditions, values)
df['Decision(next_day)'] = df['Decision'].shift(-1)
print("Number of rows in processed data: {}".format(len(df.index)))

df_new = df[1:-2]
df_new['Decision(next_day)'] = df_new['Decision(next_day)'].astype('int32')
df_new.head(8)
```

```
Number of rows in processed data: 3692

/Users/krishna/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:11:
SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  # This is added back by InteractiveShellApp.init_path()
```

[97]:

	Date	Open	High	Low	Close	Volume	Adjusted	Daily_returns	Decision	Decision(next_day)
1	2007-01-04	97.250000	98.790001	96.879997	98.309998	10524500	63.802544	1.069190	1	-1
2	2007-01-05	97.599998	97.949997	96.910004	97.419998	7221300	63.224930	-0.905300	-1	1
3	2007-01-08	98.500000	99.500000	98.349998	98.900002	10340000				
4	2007-01-09	99.080002	100.330002	99.070000	100.070000	11108200				
5	2007-01-10	98.500000	99.050003	97.930000	98.889999	8744800				
6	2007-01-11	99.000000	99.900002	98.500000	98.650002	8000700				
7	2007-01-12	98.989998	99.690002	98.500000	99.339996	6636500				
8	2007-01-16	99.400002	100.839996	99.300003	100.820000	9602200				

```
3  64.185463       1.519199         1                   1
4  64.944771       1.183011         1                  -1
5  64.178978      -1.179176        -1                  -1
6  64.023201      -0.242691        -1                   1
7  64.471024       0.699436         1                   1
8  65.431503       1.489837         1                  -1
```

Split the data. Last 100 rows as test

[26]:
```
df_new_IBM = df_new.copy()
xd_IBM = df_new_IBM[[ "Open", "High", "Low", "Close","Volume", "Adjusted"]]
le = preprocessing.LabelEncoder()
decision = le.fit(df_new_IBM["Decision(next_day)"])
decision = le.transform(df_new_IBM["Decision(next_day)"])

xd_train_knn =  xd_IBM[:-102]
xd_test_knn  =  xd_IBM[-102:-2]

yd_train_knn =  decision[:-102]
yd_test_knn  =  decision[-102:-2]

print("No of training samples : {}".format(xd_train_knn.shape))
print("No of test samples     : {}\n".format(xd_test_knn.shape))
print("y training samples     : {}".format(yd_train_knn.shape))
print("y test samples         : {}\n".format(yd_test_knn.shape))
```

```
No of training samples : (3587, 6)
No of test samples     : (100, 6)

y training samples     : (3587,)
y test samples         : (100,)
```

0.1.3 We used kNN classifier with k=5, 10, 15, 20, 25 and 30 and selected ALL POSSIBLE COMBINATIONS of 6 attributes present in the data

0.1.4 Best configuration: k=30, attributes= [high, low, close] and test accuracy: 63%. More analysis below in the output of cells.

[84]:
```
feat_names = np.array(["Open", "High", "Low", "Close","Volume", "Adjusted"])
from itertools import chain, combinations
s = [x for x in range(6)]
all_combinations = chain.from_iterable(combinations(s, r) for r in␣
 ↪range(len(s)+1))
all_combinations = list(all_combinations)[1:]
```

```
best_acc = 0.0

for k in range(5,35,5):

    print("-----------------------------------------------------------------------------------------------------------")
    print("Evaluating k={} NN classifier\n".format(k))


    for attributes in all_combinations:
        knnclassifier_IBM = KNeighborsClassifier(n_neighbors = k, metric = 'cosine')

        attributes = list(attributes)

        xd_train_knn_i = xd_train_knn.iloc[:, attributes]
        xd_test_knn_i = xd_test_knn.iloc[:,attributes]

        knnclassifier_IBM.fit(xd_train_knn_i.values, yd_train_knn)
        y_pred_knn = knnclassifier_IBM.predict(xd_test_knn_i.values)
        acc_knn = accuracy_score(yd_test_knn, y_pred_knn)
        print("k={} neighbors, selecting {}/6 attributes: {:40s} Accuracy: {:.2f}%"
              .format(k, len(attributes), ",".join(feat_names[attributes]), 100*acc_knn))

        #print("confusion_matrix: \n",confusion_matrix(yd_test_knn,y_pred_knn))

        if best_acc < acc_knn:
            best_attributes = feat_names[attributes]
            best_acc = acc_knn
            best_k = k
```

```
-------------------------------------------------------------------------------
---------------
Evaluating k=5 NN classifier

k=5 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=5 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
k=5 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=5 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=5 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
```

```
k=5 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=5 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 52.00%
k=5 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 47.00%
k=5 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 52.00%
k=5 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 49.00%
k=5 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 43.00%
k=5 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 45.00%
k=5 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 46.00%
k=5 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 45.00%
k=5 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 54.00%
k=5 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 51.00%
k=5 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 51.00%
k=5 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 49.00%
k=5 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 40.00%
k=5 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 53.00%
k=5 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 58.00%
k=5 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 46.00%
k=5 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 45.00%
k=5 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 52.00%
k=5 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 44.00%
k=5 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 52.00%
k=5 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 51.00%
```

```
k=5 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 46.00%
k=5 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 56.00%
k=5 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 41.00%
k=5 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 52.00%
k=5 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 45.00%
k=5 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 49.00%
k=5 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 42.00%
k=5 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 52.00%
k=5 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 46.00%
k=5 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 44.00%
k=5 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 40.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 53.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 48.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 52.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 51.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 50.00%
k=5 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 43.00%
k=5 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 48.00%
k=5 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 46.00%
k=5 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 42.00%
k=5 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 46.00%
k=5 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 53.00%
```

```
k=5 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 46.00%
k=5 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 44.00%
k=5 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 45.00%
k=5 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 45.00%
k=5 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 48.00%
k=5 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 51.00%
k=5 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 50.00%
k=5 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 45.00%
k=5 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 54.00%
--------------------------------------------------------------------------------
---------------
Evaluating k=10 NN classifier

k=10 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=10 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
k=10 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=10 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=10 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
k=10 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=10 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 47.00%
k=10 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 52.00%
k=10 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 49.00%
k=10 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 47.00%
k=10 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 45.00%
k=10 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 47.00%
```

```
k=10 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 49.00%
k=10 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 38.00%
k=10 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 41.00%
k=10 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 50.00%
k=10 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 45.00%
k=10 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 45.00%
k=10 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 50.00%
k=10 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 52.00%
k=10 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 35.00%
k=10 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 54.00%
k=10 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 41.00%
k=10 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 48.00%
k=10 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 53.00%
k=10 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 55.00%
k=10 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 44.00%
k=10 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 50.00%
k=10 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 45.00%
k=10 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 50.00%
k=10 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 46.00%
k=10 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 59.00%
k=10 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 41.00%
k=10 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 51.00%
k=10 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 50.00%
k=10 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 49.00%
```

```
k=10 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 47.00%
k=10 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 52.00%
k=10 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 51.00%
k=10 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 47.00%
k=10 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 54.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 55.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 43.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 50.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 47.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 46.00%
k=10 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 49.00%
k=10 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 43.00%
k=10 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 52.00%
k=10 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 48.00%
k=10 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 50.00%
k=10 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 49.00%
k=10 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 46.00%
k=10 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 49.00%
k=10 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 54.00%
k=10 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 52.00%
k=10 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 43.00%
k=10 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 47.00%
k=10 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 50.00%
k=10 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 52.00%
```

```
k=10 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 49.00%
k=10 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 48.00%
k=10 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 53.00%
--------------------------------------------------------------------------------
---------------
Evaluating k=15 NN classifier

k=15 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=15 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
k=15 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=15 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=15 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
k=15 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=15 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 50.00%
k=15 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 50.00%
k=15 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 51.00%
k=15 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 49.00%
k=15 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 43.00%
k=15 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 48.00%
k=15 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 46.00%
k=15 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 44.00%
k=15 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 45.00%
k=15 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 56.00%
k=15 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 53.00%
k=15 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 52.00%
k=15 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 49.00%
```

```
k=15 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 52.00%
k=15 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 44.00%
k=15 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 57.00%
k=15 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 43.00%
k=15 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 43.00%
k=15 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 52.00%
k=15 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 56.00%
k=15 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 48.00%
k=15 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 54.00%
k=15 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 49.00%
k=15 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 51.00%
k=15 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 60.00%
k=15 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 41.00%
k=15 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 51.00%
k=15 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 46.00%
k=15 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 54.00%
k=15 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 53.00%
k=15 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 50.00%
k=15 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 58.00%
k=15 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 60.00%
k=15 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 46.00%
```

```
k=15 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 46.00%
k=15 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 52.00%
k=15 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 56.00%
k=15 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 49.00%
k=15 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 54.00%
k=15 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 58.00%
k=15 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 49.00%
k=15 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 53.00%
k=15 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 55.00%
k=15 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 55.00%
k=15 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 52.00%
k=15 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 46.00%
k=15 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 55.00%
k=15 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 56.00%
k=15 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 61.00%
k=15 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 58.00%
k=15 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 60.00%
k=15 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 57.00%
--------------------------------------------------------------------------------
---------------
Evaluating k=20 NN classifier

k=20 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=20 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
```

```
k=20 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=20 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=20 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
k=20 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=20 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 46.00%
k=20 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 50.00%
k=20 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 49.00%
k=20 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 44.00%
k=20 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 47.00%
k=20 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 46.00%
k=20 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 46.00%
k=20 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 40.00%
k=20 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 42.00%
k=20 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 60.00%
k=20 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 49.00%
k=20 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 49.00%
k=20 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 48.00%
k=20 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 52.00%
k=20 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 39.00%
k=20 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 59.00%
k=20 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 53.00%
k=20 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 41.00%
k=20 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 52.00%
k=20 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 55.00%
```

```
k=20 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 45.00%
k=20 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 52.00%
k=20 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 50.00%
k=20 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 51.00%
k=20 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 49.00%
k=20 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 53.00%
k=20 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 41.00%
k=20 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 47.00%
k=20 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 49.00%
k=20 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 43.00%
k=20 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 54.00%
k=20 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 47.00%
k=20 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 49.00%
k=20 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 56.00%
k=20 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 52.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 60.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 41.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 56.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 46.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 57.00%
k=20 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 53.00%
k=20 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 44.00%
k=20 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 56.00%
k=20 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 52.00%
```

```
k=20 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 53.00%
k=20 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 47.00%
k=20 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 53.00%
k=20 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 52.00%
k=20 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 50.00%
k=20 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 50.00%
k=20 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 42.00%
k=20 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 54.00%
k=20 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 59.00%
k=20 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 56.00%
k=20 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 54.00%
k=20 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 54.00%
k=20 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 57.00%
--------------------------------------------------------------------------------
---------------
Evaluating k=25 NN classifier

k=25 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=25 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
k=25 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=25 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=25 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
k=25 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=25 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 47.00%
k=25 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 45.00%
k=25 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 51.00%
```

```
k=25 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 43.00%
k=25 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 47.00%
k=25 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 50.00%
k=25 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 46.00%
k=25 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 48.00%
k=25 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 45.00%
k=25 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 58.00%
k=25 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 47.00%
k=25 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 51.00%
k=25 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 51.00%
k=25 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 52.00%
k=25 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 44.00%
k=25 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 61.00%
k=25 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 56.00%
k=25 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 48.00%
k=25 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 59.00%
k=25 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 54.00%
k=25 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 45.00%
k=25 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 54.00%
k=25 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 47.00%
k=25 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 55.00%
k=25 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 53.00%
k=25 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 60.00%
k=25 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 40.00%
```

```
k=25 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 52.00%
k=25 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 49.00%
k=25 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 54.00%
k=25 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 48.00%
k=25 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 58.00%
k=25 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 53.00%
k=25 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 57.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 49.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 54.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 46.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 58.00%
k=25 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 50.00%
k=25 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 52.00%
k=25 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 59.00%
k=25 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 46.00%
k=25 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 43.00%
k=25 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 57.00%
k=25 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 41.00%
```

```
k=25 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 58.00%
k=25 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 47.00%
k=25 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 50.00%
k=25 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 47.00%
k=25 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 48.00%
k=25 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 47.00%
--------------------------------------------------------------------------------
---------------
Evaluating k=30 NN classifier

k=30 neighbors, selecting 1/6 attributes: Open
Accuracy: 56.00%
k=30 neighbors, selecting 1/6 attributes: High
Accuracy: 56.00%
k=30 neighbors, selecting 1/6 attributes: Low
Accuracy: 56.00%
k=30 neighbors, selecting 1/6 attributes: Close
Accuracy: 56.00%
k=30 neighbors, selecting 1/6 attributes: Volume
Accuracy: 56.00%
k=30 neighbors, selecting 1/6 attributes: Adjusted
Accuracy: 56.00%
k=30 neighbors, selecting 2/6 attributes: Open,High
Accuracy: 45.00%
k=30 neighbors, selecting 2/6 attributes: Open,Low
Accuracy: 48.00%
k=30 neighbors, selecting 2/6 attributes: Open,Close
Accuracy: 51.00%
k=30 neighbors, selecting 2/6 attributes: Open,Volume
Accuracy: 51.00%
k=30 neighbors, selecting 2/6 attributes: Open,Adjusted
Accuracy: 46.00%
k=30 neighbors, selecting 2/6 attributes: High,Low
Accuracy: 50.00%
k=30 neighbors, selecting 2/6 attributes: High,Close
Accuracy: 45.00%
k=30 neighbors, selecting 2/6 attributes: High,Volume
Accuracy: 45.00%
k=30 neighbors, selecting 2/6 attributes: High,Adjusted
Accuracy: 46.00%
k=30 neighbors, selecting 2/6 attributes: Low,Close
Accuracy: 58.00%
```

```
k=30 neighbors, selecting 2/6 attributes: Low,Volume
Accuracy: 41.00%
k=30 neighbors, selecting 2/6 attributes: Low,Adjusted
Accuracy: 53.00%
k=30 neighbors, selecting 2/6 attributes: Close,Volume
Accuracy: 48.00%
k=30 neighbors, selecting 2/6 attributes: Close,Adjusted
Accuracy: 44.00%
k=30 neighbors, selecting 2/6 attributes: Volume,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 3/6 attributes: Open,High,Low
Accuracy: 63.00%
k=30 neighbors, selecting 3/6 attributes: Open,High,Close
Accuracy: 51.00%
k=30 neighbors, selecting 3/6 attributes: Open,High,Volume
Accuracy: 52.00%
k=30 neighbors, selecting 3/6 attributes: Open,High,Adjusted
Accuracy: 50.00%
k=30 neighbors, selecting 3/6 attributes: Open,Low,Close
Accuracy: 51.00%
k=30 neighbors, selecting 3/6 attributes: Open,Low,Volume
Accuracy: 41.00%
k=30 neighbors, selecting 3/6 attributes: Open,Low,Adjusted
Accuracy: 49.00%
k=30 neighbors, selecting 3/6 attributes: Open,Close,Volume
Accuracy: 45.00%
k=30 neighbors, selecting 3/6 attributes: Open,Close,Adjusted
Accuracy: 53.00%
k=30 neighbors, selecting 3/6 attributes: Open,Volume,Adjusted
Accuracy: 54.00%
k=30 neighbors, selecting 3/6 attributes: High,Low,Close
Accuracy: 63.00%
k=30 neighbors, selecting 3/6 attributes: High,Low,Volume
Accuracy: 43.00%
k=30 neighbors, selecting 3/6 attributes: High,Low,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 3/6 attributes: High,Close,Volume
Accuracy: 48.00%
k=30 neighbors, selecting 3/6 attributes: High,Close,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 3/6 attributes: High,Volume,Adjusted
Accuracy: 56.00%
k=30 neighbors, selecting 3/6 attributes: Low,Close,Volume
Accuracy: 44.00%
k=30 neighbors, selecting 3/6 attributes: Low,Close,Adjusted
Accuracy: 55.00%
k=30 neighbors, selecting 3/6 attributes: Low,Volume,Adjusted
Accuracy: 53.00%
```

```
k=30 neighbors, selecting 3/6 attributes: Close,Volume,Adjusted
Accuracy: 57.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Low,Close
Accuracy: 52.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Low,Volume
Accuracy: 47.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Low,Adjusted
Accuracy: 49.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Close,Volume
Accuracy: 46.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Close,Adjusted
Accuracy: 53.00%
k=30 neighbors, selecting 4/6 attributes: Open,High,Volume,Adjusted
Accuracy: 49.00%
k=30 neighbors, selecting 4/6 attributes: Open,Low,Close,Volume
Accuracy: 46.00%
k=30 neighbors, selecting 4/6 attributes: Open,Low,Close,Adjusted
Accuracy: 54.00%
k=30 neighbors, selecting 4/6 attributes: Open,Low,Volume,Adjusted
Accuracy: 49.00%
k=30 neighbors, selecting 4/6 attributes: Open,Close,Volume,Adjusted
Accuracy: 48.00%
k=30 neighbors, selecting 4/6 attributes: High,Low,Close,Volume
Accuracy: 40.00%
k=30 neighbors, selecting 4/6 attributes: High,Low,Close,Adjusted
Accuracy: 51.00%
k=30 neighbors, selecting 4/6 attributes: High,Low,Volume,Adjusted
Accuracy: 48.00%
k=30 neighbors, selecting 4/6 attributes: High,Close,Volume,Adjusted
Accuracy: 48.00%
k=30 neighbors, selecting 4/6 attributes: Low,Close,Volume,Adjusted
Accuracy: 46.00%
k=30 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Volume
Accuracy: 43.00%
k=30 neighbors, selecting 5/6 attributes: Open,High,Low,Close,Adjusted
Accuracy: 51.00%
k=30 neighbors, selecting 5/6 attributes: Open,High,Low,Volume,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 5/6 attributes: Open,High,Close,Volume,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 5/6 attributes: Open,Low,Close,Volume,Adjusted
Accuracy: 41.00%
k=30 neighbors, selecting 5/6 attributes: High,Low,Close,Volume,Adjusted
Accuracy: 45.00%
k=30 neighbors, selecting 6/6 attributes: Open,High,Low,Close,Volume,Adjusted
Accuracy: 43.00%
```

0.1.5 Best accu: 63.00% with 3 attributes: ['Open' 'High' 'Low'] with k=30 nearest_neighbours

[85]:
```
print("\nBest accu: {:.2f}% with {} attributes: {} with k={} nearest_neighbours"
      .format(best_acc*100, len(best_attributes), best_attributes, best_k))
```

```
Best accu: 63.00% with 3 attributes: ['Open' 'High' 'Low'] with k=30
nearest_neighbours
```

0.2 Using SelectKBest to select attributes

By using *f_classif* feature selection it gives good score for the feature "Volume"

[139]:
```
features = SelectKBest(f_classif, k=6).fit(xd_train_knn, yd_train_knn)
df_scores = pd.DataFrame(features.scores_)
df_cols = pd.DataFrame(xd_train_knn.columns)

feature_scores = pd.concat([df_cols, df_scores], axis=1)
feature_scores.columns = ["Feature", "Score"]
print(feature_scores.nlargest(6, "Score"))
```

```
    Feature     Score
4    Volume  4.265510
0      Open  1.504121
5  Adjusted  0.633138
3     Close  0.394569
1      High  0.133339
2       Low  0.063128
```

[136]:
```
features = SelectKBest(f_regression, k=6).fit(xd_train_knn, yd_train_knn)
df_scores = pd.DataFrame(features.scores_)
df_cols = pd.DataFrame(xd_train_knn.columns)

feature_scores = pd.concat([df_cols, df_scores], axis=1)
feature_scores.columns = ["Feature", "Score"]
print(feature_scores.nlargest(6, "Score"))
```

```
    Feature     Score
4    Volume  4.265510
0      Open  1.504121
5  Adjusted  0.633138
3     Close  0.394569
1      High  0.133339
2       Low  0.063128
```

[137]:
```
features = SelectKBest(chi2, k=6).fit(xd_train_knn, yd_train_knn)
df_scores = pd.DataFrame(features.scores_)
df_cols = pd.DataFrame(xd_train_knn.columns)

feature_scores = pd.concat([df_cols, df_scores], axis=1)
feature_scores.columns = ["Feature", "Score"]
print(feature_scores.nlargest(6, "Score"))
```

```
    Feature         Score
4    Volume  7.994296e+06
0      Open  9.952064e+00
5  Adjusted  3.605536e+00
3     Close  2.608075e+00
1      High  8.737601e-01
2       Low  4.220623e-01
```

[138]:
```
features = SelectKBest(mutual_info_classif, k=6).fit(xd_train_knn, yd_train_knn)
df_scores = pd.DataFrame(features.scores_)
df_cols = pd.DataFrame(xd_train_knn.columns)

feature_scores = pd.concat([df_cols, df_scores], axis=1)
feature_scores.columns = ["Feature", "Score"]
print(feature_scores.nlargest(6, "Score"))
```

```
    Feature     Score
3     Close  0.008422
0      Open  0.000000
1      High  0.000000
2       Low  0.000000
4    Volume  0.000000
5  Adjusted  0.000000
```