657a-asg1-ques2

February 9, 2023

[2]:
```
import pandas as pd
import matplotlib.pyplot as plt
import warnings

warnings.filterwarnings('ignore')
```

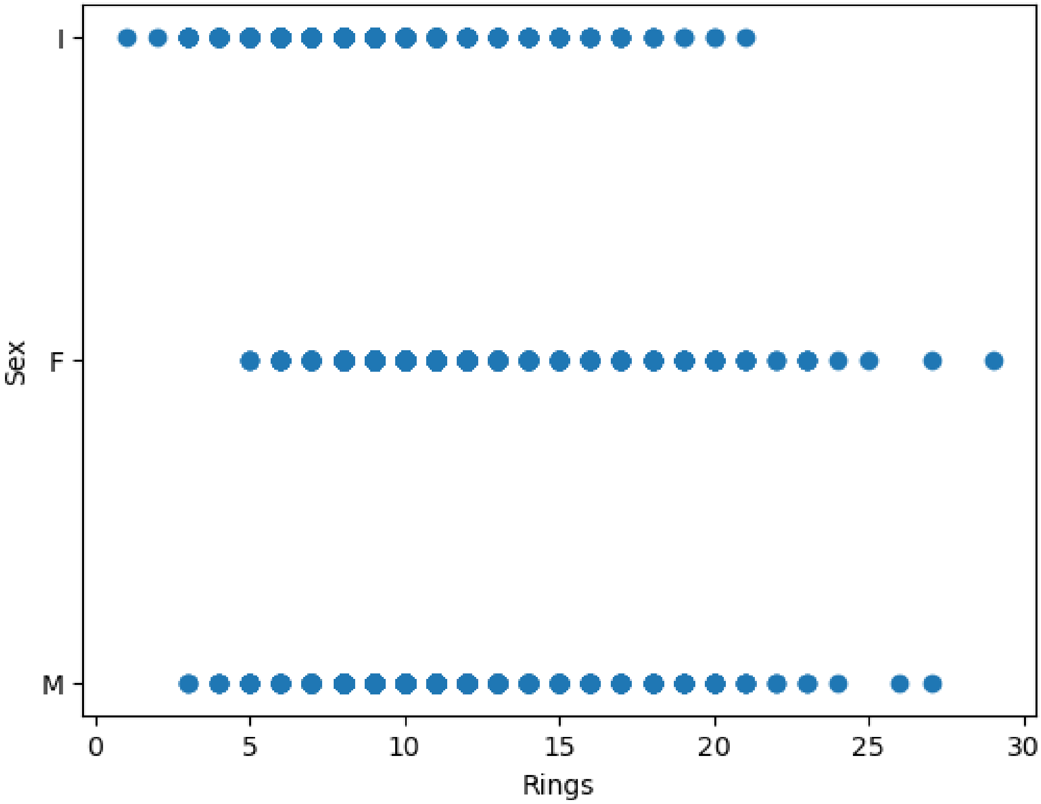
[3]:
```
df = pd.read_csv("D:/UWaterloo/Data Knowledge and Modelling/Assignment 1/
 ↪abalone.csv", names = ['Sex', 'Length', 'Diameter', 'Height', 'Whole_weight',
                          'Sucked_weight', 'Viscera_weight', 'Shell_weight',␣
 ↪'Rings'], sep = ',')
```

[4]:
```
df
```

[4]:
```
     Sex  Length  Diameter  Height  Whole_weight  Sucked_weight  \
0      M   0.455     0.365   0.095        0.5140         0.2245
1      M   0.350     0.265   0.090        0.2255         0.0995
2      F   0.530     0.420   0.135        0.6770         0.2565
3      M   0.440     0.365   0.125        0.5160         0.2155
4      I   0.330     0.255   0.080        0.2050         0.0895
…     ..     …       …       …             …             …
4172   F   0.565     0.450   0.165        0.8870         0.3700
4173   M   0.590     0.440   0.135        0.9660         0.4390
4174   M   0.600     0.475   0.205        1.1760         0.5255
4175   F   0.625     0.485   0.150        1.0945         0.5310
4176   M   0.710     0.555   0.195        1.9485         0.9455

      Viscera_weight  Shell_weight  Rings
0             0.1010        0.1500     15
1             0.0485        0.0700      7
2             0.1415        0.2100      9
3             0.1140        0.1550     10
4             0.0395        0.0550      7
…                …            …     …
4172          0.2390        0.2490     11
4173          0.2145        0.2605     10
4174          0.2875        0.3080      9
4175          0.2610        0.2960     10
4176          0.3765        0.4950     12
```

```
[4177 rows x 9 columns]
```

```
[5]: # Check any relationship between Sex and Rings
     plt.scatter(y=df['Sex'], x=df['Rings'])
     plt.xlabel('Rings')
     plt.ylabel('Sex')
     plt.show()

     # This feature is not a very helpful tool to predict the Rings and hence we can␣
      ↪drop it.
```



```
[6]: X = df.iloc[:, 1:8]  # Removing sex feature
     y = df.iloc[:, 8]
     list_scores = []

     # Split the dataset into 80:20
     from sklearn.model_selection import train_test_split
     X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
      ↪random_state=1)
```

```
# Apply KNN classification
from sklearn.neighbors import KNeighborsClassifier
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X_train, y_train)
knn_initial_score = knn.score(X_test, y_test)
knn_initial_score
```

[6]: 0.20933014354066987

[7]:

```
# Balance the training dataset
from imblearn.over_sampling import RandomOverSampler
os = RandomOverSampler(random_state=1)
X_train_sampled, y_train_sampled = os.fit_resample(X_train, y_train)
```

[8]:

```
# Apply Z-score
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train_sampled.iloc[:, 1:] = sc.fit_transform(X_train_sampled.iloc[:, 1:])
```

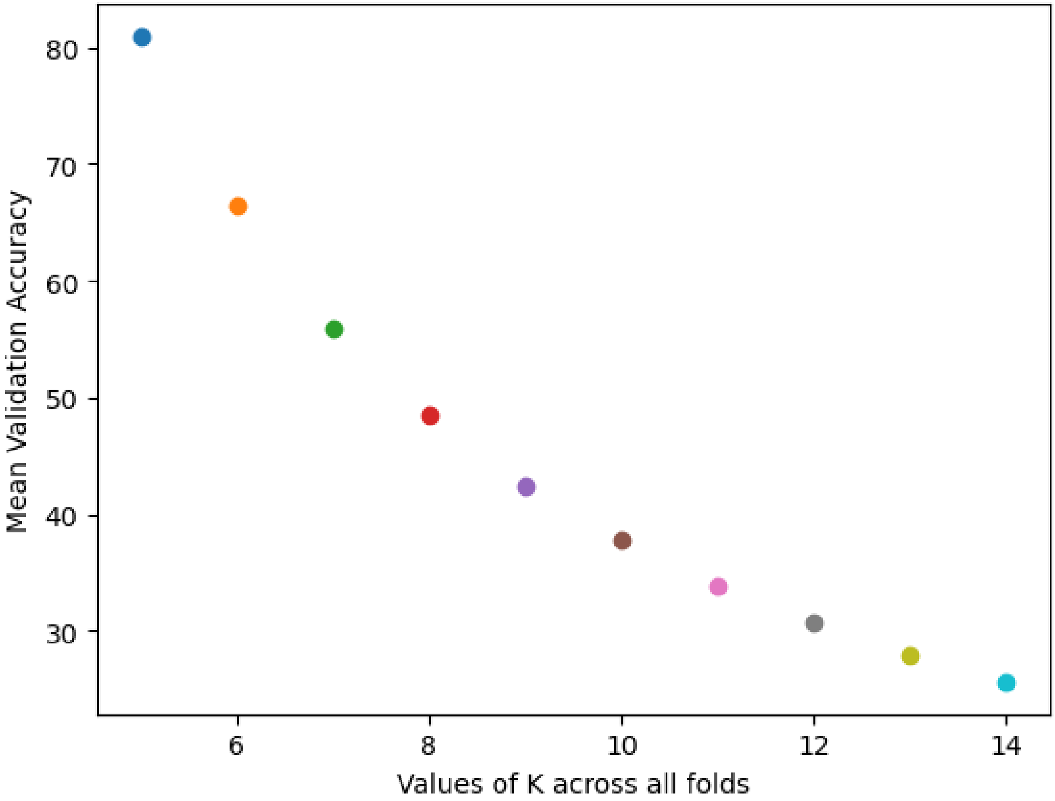
[9]:

```
from sklearn.metrics import accuracy_score
from sklearn.model_selection import StratifiedKFold

def model_training(K):
    model_score = []
    accuracy_list = []
    # Split the 80% training dataset using KFold
    kf = StratifiedKFold(n_splits=5)

    for train_index, test_index in kf.split(X_train_sampled, y_train_sampled):
        X_train, X_test = X_train_sampled.iloc[train_index,:], X_train_sampled.
 ↪iloc[test_index,:]
        y_train, y_test = y_train_sampled[train_index] ,␣
 ↪y_train_sampled[test_index]

        # create model for every fold
        knn = KNeighborsClassifier(n_neighbors=K)
        knn.fit(X_train, y_train)
        model_score.append(knn.score(X_test, y_test))
        pred_values = knn.predict(X_test)

        acc = accuracy_score(pred_values , y_test)
        accuracy_list.append(acc)

    avg_accuracy = sum(accuracy_list)/K
    return avg_accuracy
```

[10]:

```
for i in range(5, 15):
    avg_acc = model_training(i)
    print(i, avg_acc)
    plt.scatter(x=i, y=avg_acc*100)
    plt.xlabel("Values of K across all folds")
    plt.ylabel("Mean Validation Accuracy")
```

```
5 0.8094967681792131
6 0.6637197713314323
7 0.5589758964139399
8 0.4843660310118588
9 0.4236027701517578
10 0.3772862102788529
11 0.338242179434318
12 0.30673061430833964
13 0.279478603049513
14 0.2561674734636406
```



As per the graph and on the basis of the type of dataset, we consider K = 10 to be the best choice.

[11]:

```
# Running KNN using K=10
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=1)
knn = KNeighborsClassifier(n_neighbors=10)
knn.fit(X_train, y_train)
knn_initial_score = knn.score(X_test, y_test)
knn_initial_score
```

[11]:

```
0.22607655502392343
```

[15]:

```
#KNN improvement using Weighted KNN
import numpy as np
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=1)
knn = KNeighborsClassifier(metric='wminkowski', p=1, n_neighbors=10,␣
 ↪weights='distance' ,metric_params={'w': np.random.random(X_train.shape[1])})
knn.fit(X_train, y_train)
knn_initial_score = knn.score(X_test, y_test)
print(knn_initial_score)
```

```
0.23684210526315788
```