ECGR_4105_HW3_Problem_5

October 17, 2024

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

[3]:
```
file_url = 'https://raw.githubusercontent.com/lnguye782/ECGR-4105-Intro-to-ML/
  ↪refs/heads/main/HW3/cancer.csv'
data = pd.read_csv(file_url)

data.head()
```

[3]:

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	\
0	17.99	10.38	122.80	1001.0	0.11840	
1	20.57	17.77	132.90	1326.0	0.08474	
2	19.69	21.25	130.00	1203.0	0.10960	
3	11.42	20.38	77.58	386.1	0.14250	
4	20.29	14.34	135.10	1297.0	0.10030	

	mean compactness	mean concavity	mean concave points	mean symmetry	\
0	0.27760	0.3001	0.14710	0.2419	
1	0.07864	0.0869	0.07017	0.1812	
2	0.15990	0.1974	0.12790	0.2069	
3	0.28390	0.2414	0.10520	0.2597	
4	0.13280	0.1980	0.10430	0.1809	

	mean fractal dimension	…	worst texture	worst perimeter	worst area	\
0	0.07871	…	17.33	184.60	2019.0	
1	0.05667	…	23.41	158.80	1956.0	
2	0.05999	…	25.53	152.50	1709.0	
3	0.09744	…	26.50	98.87	567.7	
4	0.05883	…	16.67	152.20	1575.0	

	worst smoothness	worst compactness	worst concavity	worst concave points	\
0	0.1622	0.6656	0.7119	0.2654	
1	0.1238	0.1866	0.2416	0.1860	
2	0.1444	0.4245	0.4504	0.2430	
3	0.2098	0.8663	0.6869	0.2575	
4	0.1374	0.2050	0.4000	0.1625	

```
   worst symmetry  worst fractal dimension  target
0          0.4601                  0.11890       0
1          0.2750                  0.08902       0
2          0.3613                  0.08758       0
3          0.6638                  0.17300       0
4          0.2364                  0.07678       0

[5 rows x 31 columns]
```

[4]:
```
# Separate features and target variable (30 input features / 1 output target)
X = data.drop(columns=['target'])
Y = data['target']
```

[5]:
```
# Split the data set into Training Data (80%) and Test Data (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=42)
```

[6]:
```
# Scale the data between 0 and 1 to get better accuracy
from sklearn.preprocessing import StandardScaler

sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)
```

[8]:
```
# Use PCA feature extraction for training
from sklearn.decomposition import PCA
from sklearn.naive_bayes import GaussianNB
from sklearn import metrics

accuracy_scores = []
precision_scores = []
recall_scores = []
f1_scores = []

# Maximum number of features to consider
K_max = 30

for K in range(1, K_max + 1):
    pca = PCA(n_components=K)
    X_train_pca = pca.fit_transform(X_train)
    X_test_pca = pca.transform(X_test)

    classifier_with_nb_and_pca = GaussianNB()
    classifier_with_nb_and_pca.fit(X_train_pca, Y_train)
```

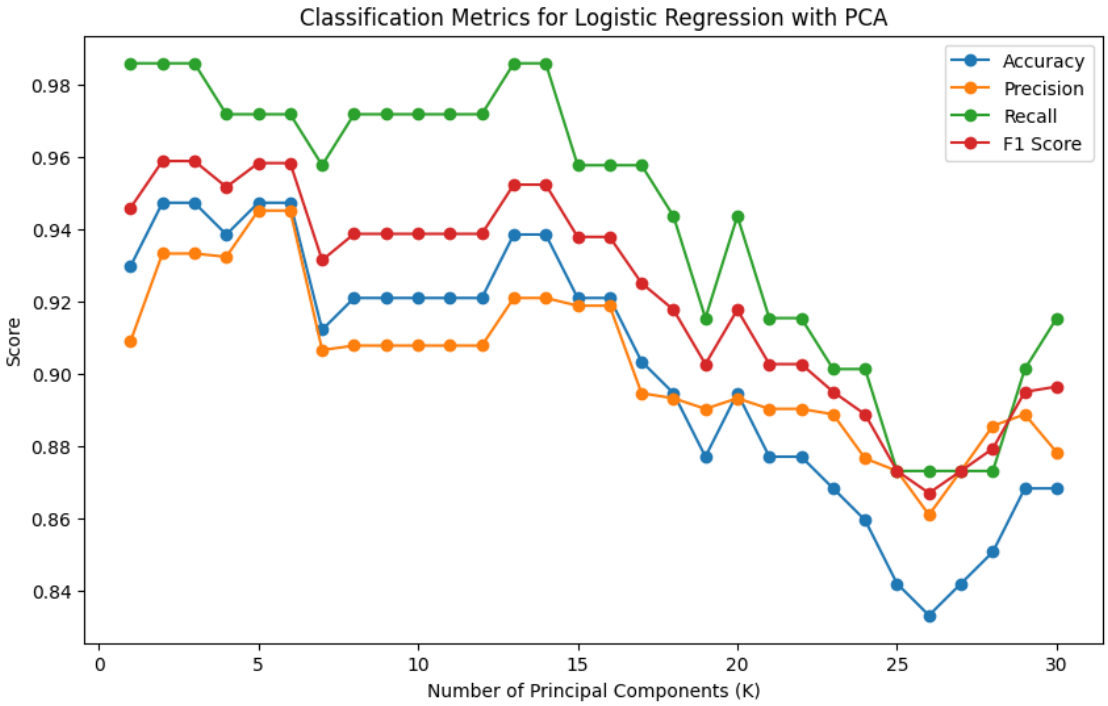
```
    Y_pred_nb_and_pca = classifier_with_nb_and_pca.predict(X_test_pca)

    # Evaluate the model with PCA using model evaluation metrics: accuracy,␣
 ↪precision, recall, and F1 score
    accuracy_scores.append(metrics.accuracy_score(Y_test, Y_pred_nb_and_pca))
    precision_scores.append(metrics.precision_score(Y_test, Y_pred_nb_and_pca))
    recall_scores.append(metrics.recall_score(Y_test, Y_pred_nb_and_pca))
    f1_scores.append(metrics.f1_score(Y_test, Y_pred_nb_and_pca))
```

[9]:
```
# Identify the optimal number of principal components (K) for highest accuracy
optimal_K_nb_and_pca = accuracy_scores.index(max(accuracy_scores)) + 1
optimal_K_nb_and_pca, max(accuracy_scores)
```

[9]:
```
(2, 0.9473684210526315)
```

[10]:
```
# Plot your classification accuracy, precision, recall, and F1 score over a␣
 ↪different number of Ks
plt.figure(figsize=(10, 6))
plt.plot(range(1, K_max + 1), accuracy_scores, label='Accuracy', marker='o')
plt.plot(range(1, K_max + 1), precision_scores, label='Precision', marker='o')
plt.plot(range(1, K_max + 1), recall_scores, label='Recall', marker='o')
plt.plot(range(1, K_max + 1), f1_scores, label='F1 Score', marker='o')
plt.title('Classification Metrics for Logistic Regression with PCA')
plt.xlabel('Number of Principal Components (K)')
plt.ylabel('Score')
plt.legend()
```

[10]:
```
<matplotlib.legend.Legend at 0x7f3c85ce0c40>
```


Classification Metrics for Logistic Regression with PCA
Accuracy
Precision
Recall
F1 Score
Score
Number of Principal Components (K)
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0
5
10
15
20
25
30