Week_09_Quiz-qm2162

November 19, 2021

1 Week 9 Quiz

1.1 Qi Meng- qm2162

1.1.1 Due Sun. Nov 21st, 11:59pm

In this quiz we'll practice scaling data and using PCA for dimensionality reduction.

1.1.2 Load Standard Libraries

[1]:
```
# Import numpy, pandas, matplotlib.pyplot and seaborn
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

# Set matplotlib to display inline
%matplotlib inline
```

1.1.3 Load the Dataset

[2]:
```
# Import the datasets submodule from sklearn.
from sklearn import datasets

# Load the breast cancer dataset using the load_breast_cancer() function.
# Store in the variable 'cancer'.
cancer = datasets.load_breast_cancer()

# Create a new dataframe df with values from cancer.data (which is stored as a␣
 ↪numpy array)
#    and with columns named using cancer.feature_names (also a numpy array)
df = pd.DataFrame(cancer.data, columns=cancer.feature_names)

# For this quiz, only keep the first 15 features/columns
# Store the result back into df
df = df.iloc[:,:15]

# Assert that the shape of the dataframe is (569,15): 569 columns, 15 rows
assert df.shape == (569,15)
```

1.1.4 Calculate Summary Stats

[3]:
```
# The distribution of features in this dataset vary quite a bit, affecting PCA␣
 ↪performance.
# To get a sense of the difference, display the mean and standard deviation of␣
 ↪each feature.
# Use the .agg() function, which takes a list of strings describing the␣
 ↪functions to apply.
# Call .agg() on df using 'mean' and 'std'
df.agg(['mean', 'std'])
```

[3]:

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	\
mean	14.127292	19.289649	91.969033	654.889104	0.096360	
std	3.524049	4.301036	24.298981	351.914129	0.014064	

	mean compactness	mean concavity	mean concave points	mean symmetry	\
mean	0.104341	0.088799	0.048919	0.181162	
std	0.052813	0.079720	0.038803	0.027414	

	mean fractal dimension	radius error	texture error	perimeter error	\
mean	0.062798	0.405172	1.216853	2.866059	
std	0.007060	0.277313	0.551648	2.021855	

	area error	smoothness error
mean	40.337079	0.007041
std	45.491006	0.003003

[4]:
```
# This dataframe has many columns and few rows, so many columns that all of␣
 ↪them cannot be displayed.
# For dataframes like this, it can be helpful to transpose them (turn rows into␣
 ↪columns and columns into rows).
# To do this we can call transpose() on the dataframe, or .T for short.
# Print out the transposed version of the results of the .agg() from above.
df.agg(['mean', 'std']).T
```

[4]:

	mean	std
mean radius	14.127292	3.524049
mean texture	19.289649	4.301036
mean perimeter	91.969033	24.298981
mean area	654.889104	351.914129
mean smoothness	0.096360	0.014064
mean compactness	0.104341	0.052813
mean concavity	0.088799	0.079720
mean concave points	0.048919	0.038803
mean symmetry	0.181162	0.027414
mean fractal dimension	0.062798	0.007060
radius error	0.405172	0.277313
texture error	1.216853	0.551648
perimeter error	2.866059	2.021855
area error	40.337079	45.491006
smoothness error	0.007041	0.003003

1.1.5 Scale the Data

[5]:
```
# Scale the data to mean 0, standard deviation of 1 using sklearn StandardScaler

#Import StandardScaler from sklearn
from sklearn.preprocessing import StandardScaler

# Using StandardScaler with default settings create a new matrix X_scaled that␣
 ↪is a scaled version of df.
X_scaled = StandardScaler().fit_transform(df)

# Store X_scaled as a dataframe df_scaled, with the same column names as the␣
 ↪original dataframe
df_scaled = pd.DataFrame(X_scaled, columns=df.columns)

# Call .agg() on df_scaled using 'mean' and 'std' and display the transpose␣
 ↪using .T
# Note that all features have been scaled
df_scaled.agg(['mean', 'std']).T
```

[5]:

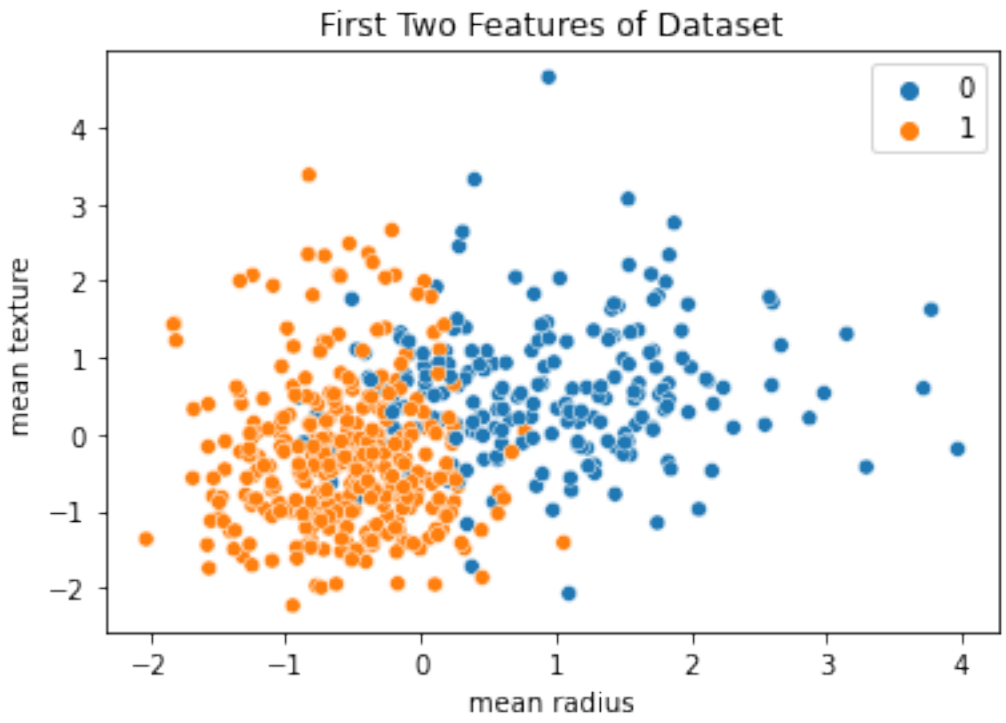
	mean	std
mean radius	-3.153111e-15	1.00088
mean texture	-6.568462e-15	1.00088
mean perimeter	-6.993039e-16	1.00088
mean area	-8.553985e-16	1.00088
mean smoothness	6.081447e-15	1.00088
mean compactness	-1.136369e-15	1.00088
mean concavity	-2.997017e-16	1.00088
mean concave points	1.023981e-15	1.00088
mean symmetry	-1.860648e-15	1.00088
mean fractal dimension	-1.504752e-15	1.00088
radius error	-9.740305e-16	1.00088
texture error	-9.084707e-16	1.00088
perimeter error	1.860648e-15	1.00088
area error	-7.679856e-16	1.00088
smoothness error	-7.352057e-16	1.00088

1.1.6 Plot the First 2 Features From the Scaled Dataset

[6]:
```
# Using seaborn, create a scatterplot with 'mean radius' on the x-axis and␣
↪'mean texture' on the y-axis.
# Use the scaled data in df_scaled.
# Color the points by their class assignment by setting hue=cancer.target.
# Capture the returned axis in ax
ax = sns.scatterplot(x='mean radius', y='mean texture', data=df_scaled,␣
↪hue=cancer.target)

# Set the title to 'First Two Features of Dataset' using ax
ax.set_title('First Two Features of Dataset')
```

[6]:
```
Text(0.5, 1.0, 'First Two Features of Dataset')
```



1.1.7 Reduce Data to 2 Dimensions Using PCA

[7]:
```
# Import PCA from sklearn.
from sklearn.decomposition import PCA

# Create a 2D transformation of the dataframe df_scaled using PCA() and␣
 ↪fit_transform() and store in X_pca.
X_pca = PCA(n_components=2).fit_transform(df_scaled)

# Assert that the pca representation has the same number of rows (569) but now␣
 ↪2 columns
assert X_pca.shape == (569,2)
```

1.1.8 Plot the Reduced Representation

[8]:
```
# Using seaborn, create a scatterplot with the first column of X_pca on the␣
 ↪x-axis
#    and the second column of X_pca on the y-axis.
# Color the points by their class assignment by setting hue as cancer.target.
# Capture the returned axis in ax
ax = sns.scatterplot(x=X_pca[:,0], y=X_pca[:,1], hue=cancer.target)

# Set the title to '2D PCA' using ax
```

```
ax.set_title('2D PCA')

# Note that the plot won't look significantly different, but there should be␣
 ↪more than just
# a rotation of the points seen in the plot above of the first 2 dimensions of␣
 ↪the dataset
```

[8]: Text(0.5, 1.0, '2D PCA')