CS156 (Introduction to AI), Fall 2022

Homework 3 submission

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References and sources

https://www.kaggle.com/maajdl/yeh-concret-data

Also referenced from file Regression.Boston.ipynb

Solution

Load libraries and set random number generator seed

```
import numpy as np
import pandas as pd
from sklearn import datasets
from sklearn import linear_model
from sklearn import preprocessing
from sklearn.preprocessing import PolynomialFeatures
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker
import seaborn as sns
```

```
np.random.seed(42)
```

Code the solution

1. Load the dataset.

```
concrete_file = pd.read_csv(r'/content/homework3_input_data.csv')
```

```
df = pd.DataFrame(concrete_file, columns=concrete_file.columns)
df.head()
feature_names = ['cement', 'slag', 'flyash', 'water', 'superplasticizer', 'coarseaggr
X = df[feature_names]
Y = df['csMPa']
```

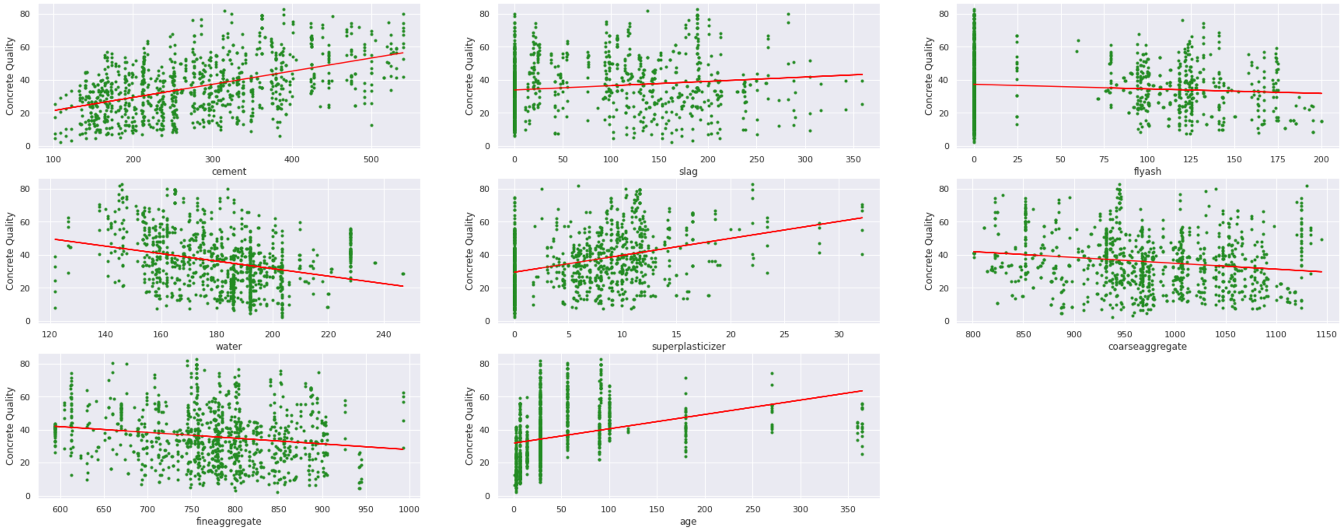
```
print(df.columns)
df.describe()
```

```
Index(['cement', 'slag', 'flyash', 'water', 'superplasticizer',
       'coarseaggregate', 'fineaggregate', 'age', 'csMPa'],
      dtype='object')
```

	cement	slag	flyash	water	superplasticizer	coarseagg
count	1030.000000	1030.000000	1030.000000	1030.000000	1030.000000	1030
mean	281.167864	73.895825	54.188350	181.567282	6.204660	972
std	104.506364	86.279342	63.997004	21.354219	5.973841	77
min	102.000000	0.000000	0.000000	121.800000	0.000000	801
25%	192.375000	0.000000	0.000000	164.900000	0.000000	932
50%	272.900000	22.000000	0.000000	185.000000	6.400000	968
75%	350.000000	142.950000	118.300000	192.000000	10.200000	1029
max	540.000000	359.400000	200.100000	247.000000	32.200000	1145

2. Plot all independent variables vs. the dependent variable

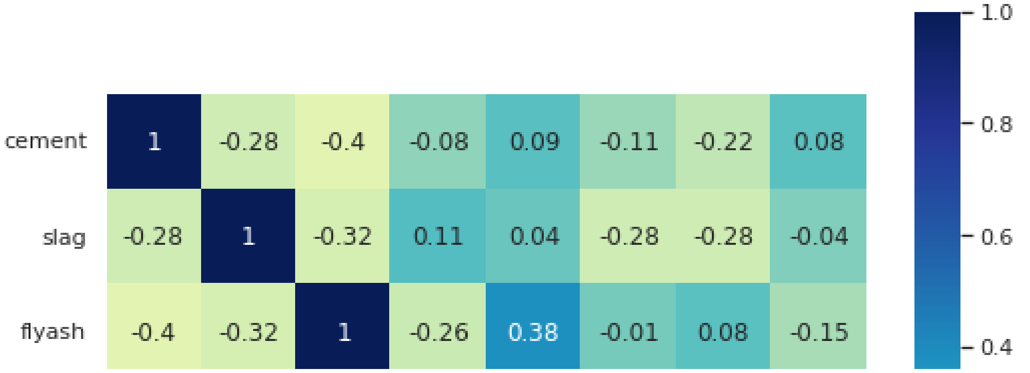
```
plt.figure(figsize=(30,20))
for i, col in enumerate(df.columns[0:8]):
    plt.subplot(5, 3, i+1)
    x = df[col]
    y = df['csMPa']
    plt.plot(x, y, '.', color="forestgreen")
    m, b = np.polyfit(x, y, 1)
    plt.plot(x, m*x + b, color="red")
    plt.xlabel(col)
    plt.ylabel('Concrete Quality')
```



3. Compute and plot a correlation matrix between the independent variables

```
features = df[feature_names]
sns.set(rc={'figure.figsize': (8.5,8.5)})
sns.heatmap(features.corr().round(2), square=True, cmap='YlGnBu', annot=True)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fa097eb9d90>
```



cement	1	-0.28	-0.4	-0.08	0.09	-0.11	-0.22	0.08
slag	-0.28	1	-0.32	0.11	0.04	-0.28	-0.28	-0.04
flyash	-0.4	-0.32	1	-0.26	0.38	-0.01	0.08	-0.15

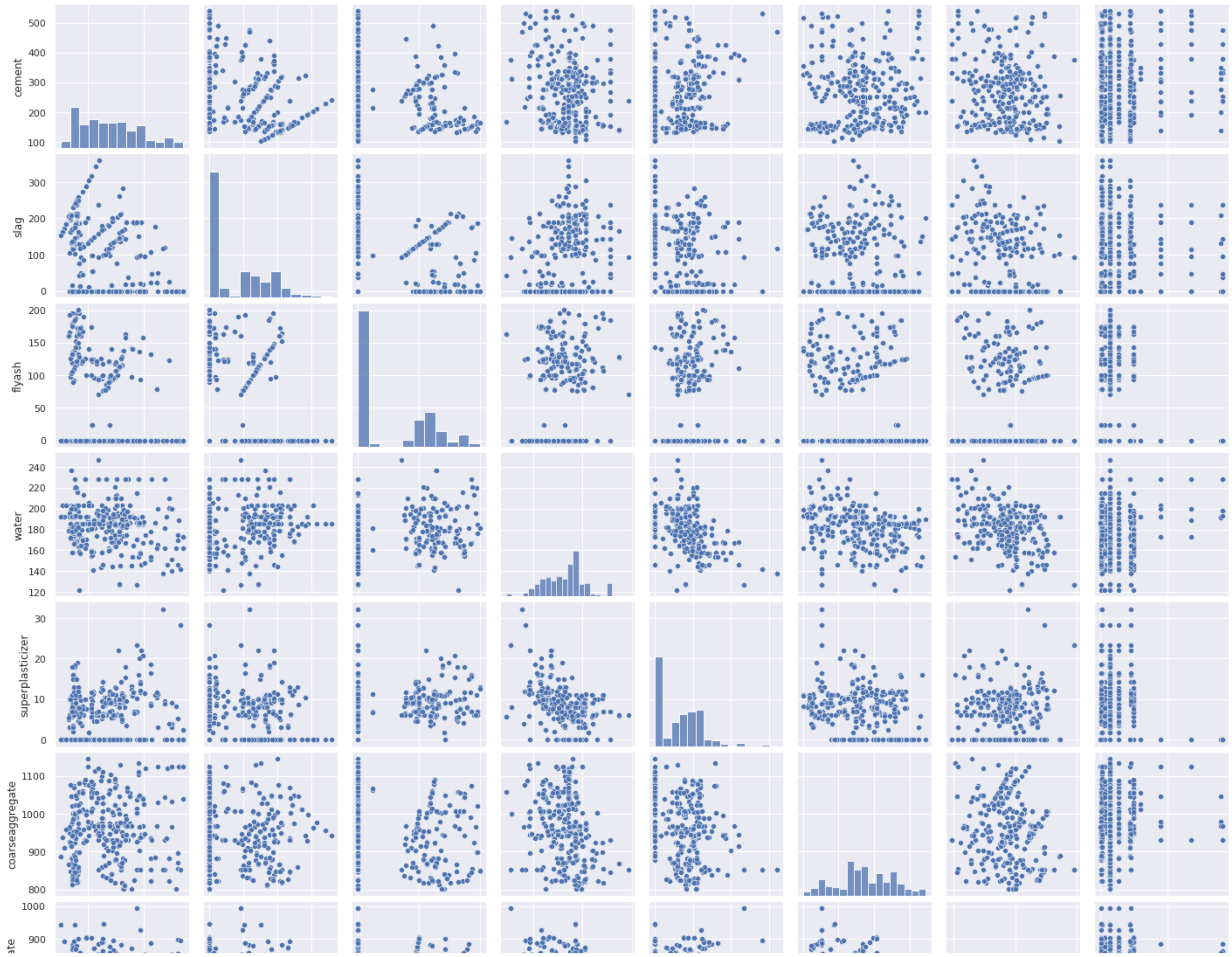
4. Break the data into the training and test datasets

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_state
X_train.shape, Y_train.shape, X_test.shape, Y_test.shape
```

```
((824, 8), (824,), (206, 8), (206,))
```

```
train_df = pd.DataFrame(X_train, columns=feature_names)
train_df['csMPa'] = Y_train
sns.pairplot(train_df, vars = feature_names)
```

```
<seaborn.axisgrid.PairGrid at 0x7fa0987b6a10>
```



5. Train a linear regression model to predict the output/dependent variable (csMPa) based on the input variables I specified in the description of this assignment.

```
model = linear_model.LinearRegression().fit(X_train, Y_train)
```

6. Report (print out) the mean squared error and coefficient of determination for the test data as your model performance indicators.

```
print('Coefficients: \n', model.coef_)

Y_test_pred = model.predict(X_test)

print('Mean squared error: %.2f' % mean_squared_error(Y_test, Y_test_pred))

print('Coefficient of determination: %.2f' % r2_score(Y_test, Y_test_pred))
```

```
Coefficients:
  [ 0.11923772  0.10881555  0.0911555  -0.14527714  0.31551104  0.02225423
   0.02248514  0.11520355]
Mean squared error: 95.62
Coefficient of determination: 0.64
```

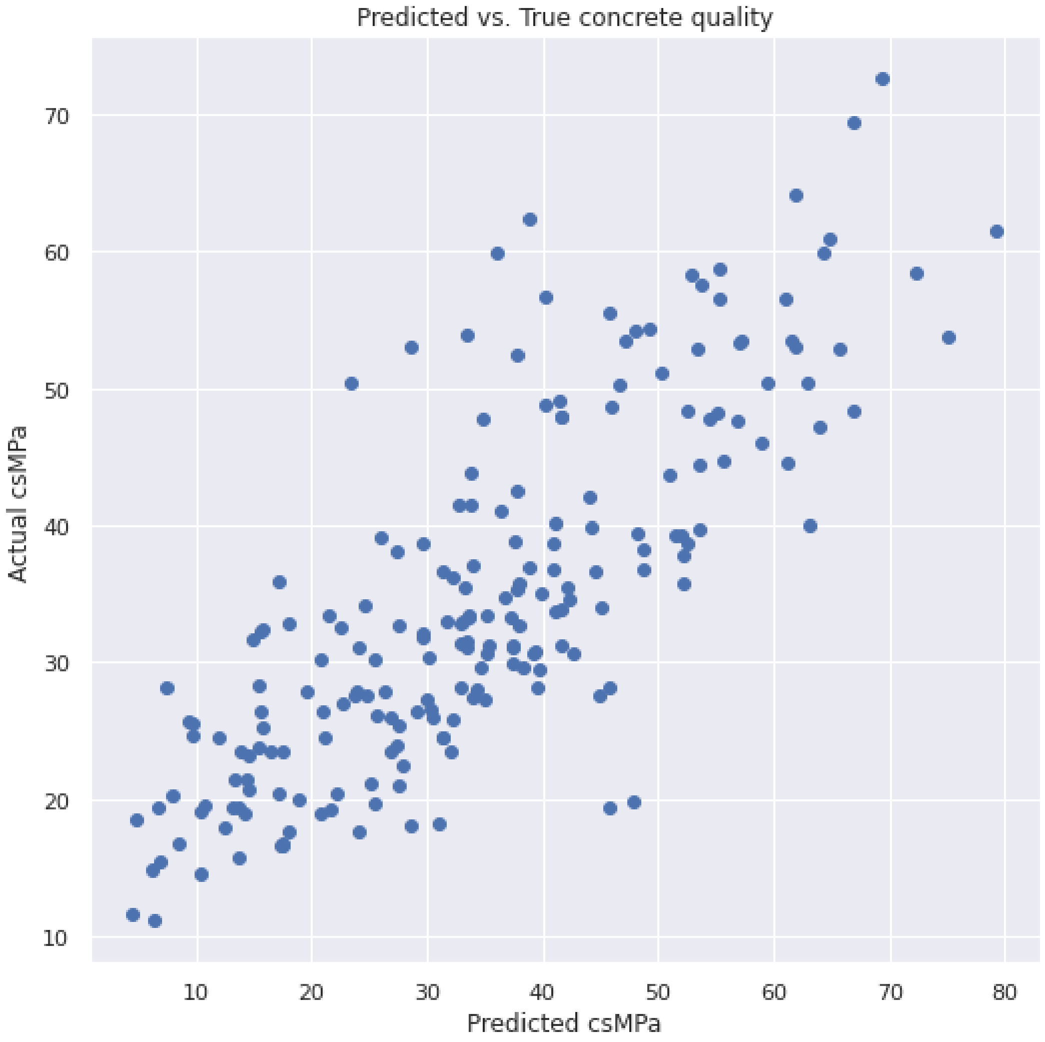
```
pred_df = pd.DataFrame({'Actual': Y_test, 'Predicted':Y_test_pred})
pred_df.head()
```

	Actual	Predicted
747	26.06	39.161683
718	10.35	14.619856
175	79.30	61.440067
828	74.99	53.777042
713	9.69	24.668431

7. Plot the predicted vs. actual csMPa values

```
plt.scatter(Y_test,Y_test_pred)
plt.title('Predicted vs. True concrete quality')
plt.xlabel('Predicted csMPa')
plt.ylabel('Actual csMPa')
```

```
Text(0, 0.5, 'Actual csMPa')
```



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