CS156 (Introduction to AI), Fall 2021

Homework 3 submission

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Any special notes or anything you would like to communicate to me about this homework submission goes in here.

References and sources

List all your references and sources here. This includes all sites/discussion boards/blogs/posts/etc. where you grabbed some code examples.

1) Regression.Boston (Example class file)

Solution

Load libraries and set random number generator seed

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn import linear_model
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_scc
```

In [2]:
```
np.random.seed(42)
```

Code the solution

In [3]:
```
datafile = pd.read_csv("/Users/becoming1/Desktop/homework3_input_data.csv")
```

In [4]:
```
print(datafile)
```

```
      cement   slag  flyash  water  superplasticizer  coarseaggregate  \
0      540.0    0.0     0.0  162.0               2.5           1040.0
1      540.0    0.0     0.0  162.0               2.5           1055.0
2      332.5  142.5     0.0  228.0               0.0            932.0
3      332.5  142.5     0.0  228.0               0.0            932.0
4      198.6  132.4     0.0  192.0               0.0            978.4
5      266.0  114.0     0.0  228.0               0.0            932.0
6      380.0   95.0     0.0  228.0               0.0            932.0
7      380.0   95.0     0.0  228.0               0.0            932.0
8      266.0  114.0     0.0  228.0               0.0            932.0
9      475.0    0.0     0.0  228.0               0.0            932.0
10     198.6  132.4     0.0  192.0               0.0            978.4
11     198.6  132.4     0.0  192.0               0.0            978.4
12     427.5   47.5     0.0  228.0               0.0            932.0
13     190.0  190.0     0.0  228.0               0.0            932.0
14     304.0   76.0     0.0  228.0               0.0            932.0
15     380.0    0.0     0.0  228.0               0.0            932.0
16     139.6  209.4     0.0  192.0               0.0           1047.0
17     342.0   38.0     0.0  228.0               0.0            932.0
```

In [5]:
```
features= ['cement','slag','flyash','water','superplasticizer','coarseaggre
print(features)
```

```
['cement', 'slag', 'flyash', 'water', 'superplasticizer', 'coarseaggregat
e', 'fineaggregate', 'age']
```

In [6]:
```
X, Y = datafile[['cement','slag','flyash','water','superplasticizer','coars


```

In [7]:
```
X.shape, Y.shape
```

Out[7]:
```
((1030, 8), (1030,))
```

In [8]:
```
print(X)
```

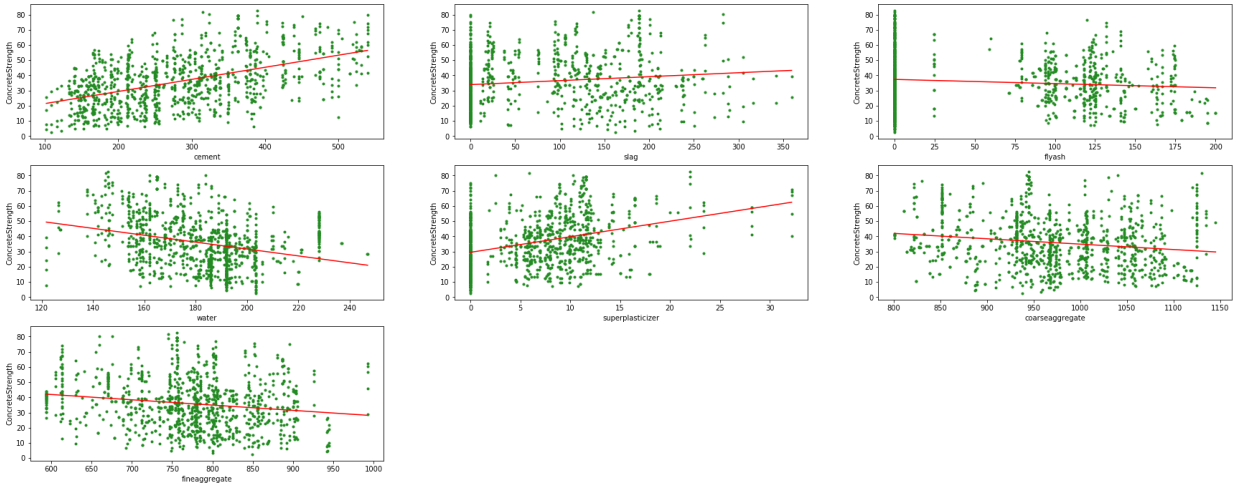
```
      cement   slag  flyash  water  superplasticizer  coarseaggregate  \
0      540.0    0.0     0.0  162.0               2.5           1040.0
1      540.0    0.0     0.0  162.0               2.5           1055.0
2      332.5  142.5     0.0  228.0               0.0            932.0
3      332.5  142.5     0.0  228.0               0.0            932.0
4      198.6  132.4     0.0  192.0               0.0            978.4
5      266.0  114.0     0.0  228.0               0.0            932.0
6      380.0   95.0     0.0  228.0               0.0            932.0
7      380.0   95.0     0.0  228.0               0.0            932.0
8      266.0  114.0     0.0  228.0               0.0            932.0
9      475.0    0.0     0.0  228.0               0.0            932.0
10     198.6  132.4     0.0  192.0               0.0            978.4
11     198.6  132.4     0.0  192.0               0.0            978.4
12     427.5   47.5     0.0  228.0               0.0            932.0
13     190.0  190.0     0.0  228.0               0.0            932.0
14     304.0   76.0     0.0  228.0               0.0            932.0
15     380.0    0.0     0.0  228.0               0.0            932.0
16     139.6  209.4     0.0  192.0               0.0           1047.0
17     342.0   38.0     0.0  228.0               0.0            932.0
```

In [9]:
```
concrete_df = pd.DataFrame(X, columns = features )
concrete_df['csMPa'] = Y
concrete_df.head()
```

Out[9]:

	cement	slag	flyash	water	superplasticizer	coarseaggregate	fineaggregate	age	csMPa
0	540.0	0.0	0.0	162.0	2.5	1040.0	676.0	28	79.99
1	540.0	0.0	0.0	162.0	2.5	1055.0	676.0	28	61.89
2	332.5	142.5	0.0	228.0	0.0	932.0	594.0	270	40.27
3	332.5	142.5	0.0	228.0	0.0	932.0	594.0	365	41.05
4	198.6	132.4	0.0	192.0	0.0	978.4	825.5	360	44.30

In [10]:
```
# all independent variables vs. the dependent variable
plt.figure(figsize=(30,20))
for i, col in enumerate(datafile.columns[0:7]):
    plt.subplot(5,3,i+1)
    x = concrete_df[col]
    y= concrete_df['csMPa']
    plt.plot(x,y, '.', color="forestgreen")
    # create linear regression line:
    plt.plot(np.unique(x), np.poly1d(np.polyfit(x, y, 1))(np.unique(x)),col
    plt.xlabel(col)
    plt.ylabel('ConcreteStrength')
```



In [11]:
```
# correlation matrix between the independent variable
features= ['cement','slag','flyash','water','superplasticizer','coarseaggre
sns.set(rc={'figure.figsize': (8.5,8.5)})
sns.heatmap(concrete_df.corr().round(2), square=True, cmap='YlGnBu', annot=
```

Out[11]: <matplotlib.axes._subplots.AxesSubplot at 0x1a27315da0>

Split into training-test sets

In [12]:
```
# Breaking 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, ra
X_train.shape, Y_train.shape, X_test.shape, Y_test.shape
```

Out[12]:
```
((824, 8), (824,), (206, 8), (206,))
```

In [13]:
```
# train a linear regression model
model = linear_model.LinearRegression().fit(X_train, Y_train)
```

In [14]:
```
# The coefficients:
print('Coefficients: \n', model.coef_)

Y_test_pred = model.predict(X_test)

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

# The coefficient of determination (1 is perfect prediction):
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
```

In [ ]:
```
```