linear_regression_v1_6

October 20, 2022

1 Linear regression

[ ]:
```
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split, cross_val_score, KFold
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LinearRegression
from sklearn.feature_selection import SelectFromModel
from sklearn.metrics import r2_score, mean_absolute_percentage_error,␣
↪mean_absolute_error
from statsmodels.tools.eval_measures import stde
```

1.1 Read the etl info results

[ ]:
```
df_info = pd.read_csv('../dataset_clean/options_csv_v1_etl.csv')
df_info
```

[ ]:
```
   remove_time_features  generic_features  remove_atypical_values  \
0                 False             False                   False

   feature_combination remove_feature_selection  \
0                False                   Lasso

   remove_invalid_correlated_features
0                               False
```

1.2 Read the dataset

[ ]:
```
df = pd.read_csv('../dataset_clean/PlatteRiverWeir_features_v1_clean.csv')
df
```

[ ]:
```
               SensorTime          CaptureTime  Stage  Discharge    grayMean  \
0     2012-06-09 13:15:00  2012-06-09T13:09:07   2.99      916.0   97.405096
```

```
1       2012-06-09 13:15:00  2012-06-09T13:10:29   2.99      916.0  104.066757
2       2012-06-09 13:45:00  2012-06-09T13:44:01   2.96      873.0  105.636831
3       2012-06-09 14:45:00  2012-06-09T14:44:30   2.94      846.0  104.418949
4       2012-06-09 15:45:00  2012-06-09T15:44:59   2.94      846.0  106.763541
…                       …                    …    …         …          …
42054   2019-10-11 09:00:00  2019-10-11T08:59:53   2.54      434.0   82.872720
42055   2019-10-11 10:00:00  2019-10-11T09:59:52   2.54      434.0   89.028383
42056   2019-10-11 11:00:00  2019-10-11T10:59:52   2.54      434.0   94.722097
42057   2019-10-11 12:00:00  2019-10-11T11:59:53   2.54      434.0   96.693270
42058   2019-10-11 12:45:00  2019-10-11T12:59:52   2.54      434.0   98.738399

        graySigma       hMean     hSigma   grayMean0      hMean0  entropyMean1  \
0       39.623303  105.368375  41.572939   97.084576  106.047217      0.092532
1       40.179745  112.399458  41.795584  105.668610  114.886049      0.090279
2       40.533218  114.021526  42.145582  106.786307  116.053131      0.090561
3       41.752678  112.612830  43.575351  107.674299  117.005027      0.095616
4       44.442097  114.839424  46.302008  114.858589  124.519271      0.101601
…             …           …         …           …           …             …
42054   57.702652   87.260572  61.485334   43.737485   46.616662      0.120668
42055   55.840861   94.175906  59.006132   46.268458   49.716207      0.113951
42056   54.355753  100.534577  56.921028   49.841325   53.984763      0.110346
42057   52.787629  102.891159  55.083532   53.912185   58.857575      0.112571
42058   52.025453  105.292067  53.994155   59.611803   65.697745      0.110247

        entropySigma1      hMean1  WwRawLineMean  WwRawLineSigma  \
0            0.632319  169.963345       0.000000        0.000000
1            0.620077  175.220945       0.000000        0.000000
2            0.620853  179.554842       0.000000        0.000000
3            0.651642  180.921521       0.000000        0.000000
4            0.688024  183.131779       0.000000        0.000000
…                 …           …              …               …
42054        0.824195  126.181417   38385.370066    15952.029728
42055        0.783437  131.754200   40162.989292    15467.708856
42056        0.766074  138.014068   42095.946590    16770.357949
42057        0.777376  146.470365   45345.490954    17498.432849
42058        0.760248  156.957374   47877.870782    19963.166359

        WwCurveLineMean  WwCurveLineSigma
0              0.000000          0.000000
1              0.000000          0.000000
2              0.000000          0.000000
3              0.000000          0.000000
4              0.000000          0.000000
…                   …                 …
42054      37550.894823      16444.401209
42055      39397.339095      16009.008049
42056      41350.006568      17489.374617
```

```
42057     44553.920296      18268.294896
42058     47280.270559      20559.358767

[42059 rows x 17 columns]
```

[ ]:
```
df['SensorTime'] = pd.to_datetime(df['SensorTime'])
df['Year'] = df['SensorTime'].dt.year
```

[ ]:
```
df_train = df[(df.Year >= 2012) & (df.Year <= 2017)]
df_test = df[(df.Year >= 2018) & (df.Year <= 2019)]
```

[ ]:
```
df_train = df_train.drop(columns=["Year", "SensorTime", "CaptureTime"])
df_test = df_test.drop(columns=["Year", "SensorTime", "CaptureTime"])
```

1.3 Divide dataset to X and Y

[ ]:
```
y_train = df_train[["Stage", "Discharge"]]
X_train = df_train.drop(columns=["Stage", "Discharge"])
y_test = df_test[["Stage", "Discharge"]]
X_test = df_test.drop(columns=["Stage", "Discharge"])
```

[ ]:
```
#X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33,␣
↪random_state=0)
```

1.4 Train model

[ ]:
```
pipeline = Pipeline([
    ('scaler', StandardScaler()),
    ('clf', LinearRegression())
])

folds = KFold(n_splits = 5, shuffle = True, random_state = 100)
clf = cross_val_score(pipeline, X_train, y_train, scoring='r2', cv=folds)
```

[ ]:
```
clf
```

[ ]:
```
array([0.53525285, 0.50164879, 0.51134036, 0.52088088, 0.51037645])
```

[ ]:
```
pipeline.fit(X_train, y_train)
```

[ ]:
```
Pipeline(steps=[('scaler', StandardScaler()), ('clf', LinearRegression())])
```

1.5 Test Model

[ ]:
```
y_pred = pipeline.predict(X_test)
```

[ ]:
```
print("R^2: ", r2_score(y_test, y_pred))
print("mse: ", mean_absolute_error(y_test, y_pred))
print("rmse: ", np.sqrt(mean_absolute_error(y_test, y_pred)))
print("mape: ", mean_absolute_percentage_error(y_test, y_pred))
print("Error estandar: ", stde(y_test.squeeze(),
      y_pred.squeeze(), ddof=len(X_train.columns) + 1))
```

```
R^2:  0.373124526987939
mse:  244.34624629172143
rmse:  15.631578496483375
mape:  5.430417554322287e+16
Error estandar:  [4.03637584e-01 5.77961421e+02]
```

[ ]:
```
residuals = y_test - y_pred
residuals
```

[ ]:

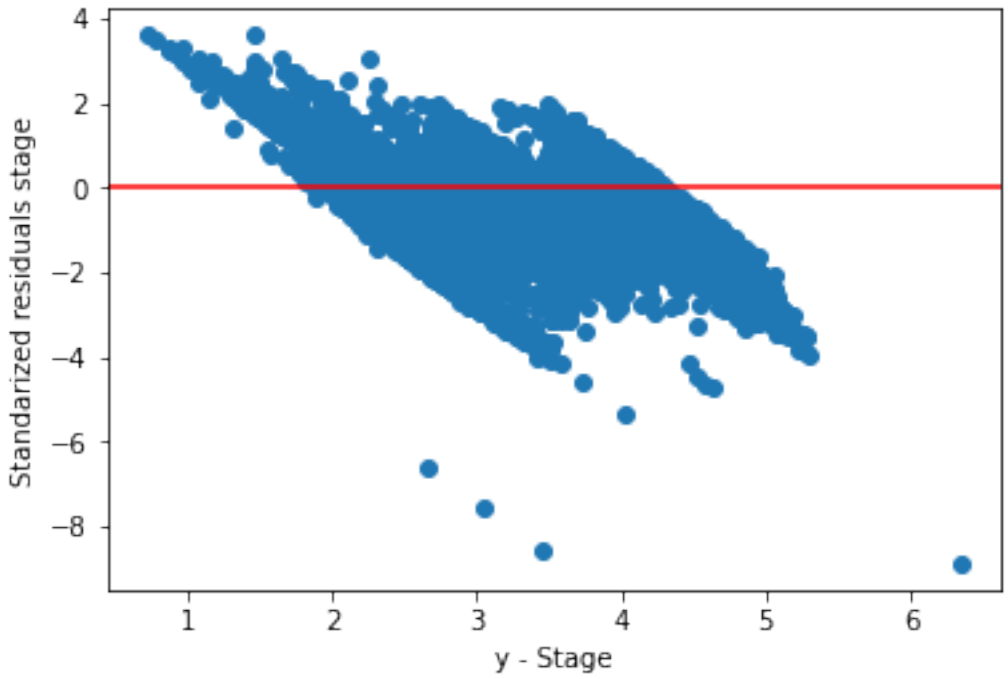
	Stage	Discharge
28811	0.708571	587.242215
28812	0.455103	674.541071
28813	0.266308	510.926784
28814	-0.150912	-386.781792
28815	-0.000826	-153.112795
…	…	…
42054	-0.734245	-1186.849453
42055	-0.684354	-1138.988056
42056	-0.654575	-1143.137572
42057	-0.712917	-1213.642199
42058	-0.718341	-1186.481649

[13248 rows x 2 columns]

[ ]:
```
resid = np.array(residuals["Stage"])
norm_resid = resid / resid.std()

plt.scatter([i[0] for i in y_pred], norm_resid)
plt.axhline(y = 0.0, color = 'r', linestyle = '-')
plt.xlabel("y - Stage")
plt.ylabel("Standarized residuals stage")
```

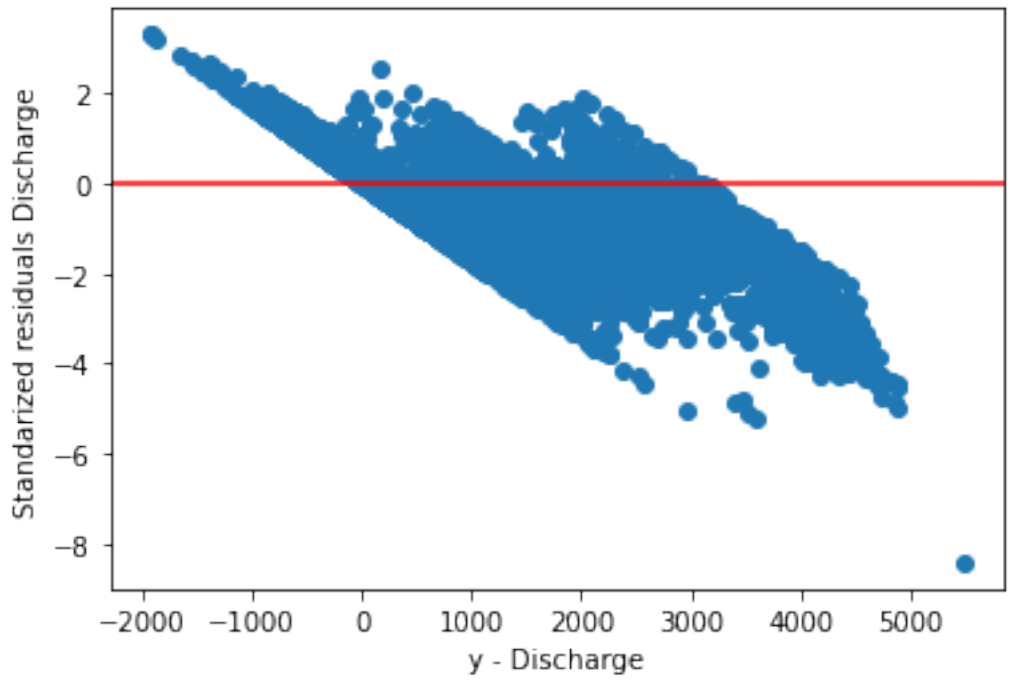
[ ]:
```
Text(0, 0.5, 'Standarized residuals stage')
```



[ ]:
```
resid = np.array(residuals["Discharge"])
norm_resid = resid / resid.std()

plt.scatter([i[1] for i in y_pred], norm_resid)
plt.axhline(y = 0.0, color = 'r', linestyle = '-')
plt.xlabel("y - Discharge")
plt.ylabel("Standarized residuals Discharge")
```

[ ]:
```
Text(0, 0.5, 'Standarized residuals Discharge')
```


Standarized residuals Discharge
2
0
−2
−4
−6
−8
−2000
−1000
0
1000
2000
3000
4000
5000
y - Discharge

[ ]: