linear_regression_v1_7

October 21, 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, mean_squared_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              True                   False

   feature_combination  remove_feature_selection  \
0                False                     False

   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  entropyMean  entropySigma       hMean     hSigma  \
0      39.623303     0.203417      0.979825  105.368375  41.572939
1      40.179745     0.206835      1.002624  112.399458  41.795584
2      40.533218     0.204756      0.994246  114.021526  42.145582
3      41.752678     0.202428      0.983170  112.612830  43.575351
4      44.442097     0.202661      0.989625  114.839424  46.302008
…          …          …           …         …        …
42054  57.702652     0.221708      1.076393   87.260572  61.485334
42055  55.840861     0.233168      1.124774   94.175906  59.006132
42056  54.355753     0.240722      1.151833  100.534577  56.921028
42057  52.787629     0.244789      1.171987  102.891159  55.083532
42058  52.025453     0.252812      1.213278  105.292067  53.994155

            sMean    sSigma       vMean     vSigma
0      124.520218  4.111846  132.405971  14.983367
1      124.317679  4.270429  133.070221  15.334166
2      124.304621  4.310293  133.294541  15.502448
3      124.369736  4.120586  133.458381  15.190064
4      124.283191  4.088480  133.573595  14.801143
…           …       …         …        …
42054  127.807813  2.564157  124.073149  13.757842
42055  127.336000  2.585121  124.882812  13.234735
42056  126.958768  2.774867  126.145409  13.408480
42057  126.679956  2.998683  127.508063  13.863205
42058  126.328075  3.258103  128.788256  14.353808

[42059 rows x 14 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([0.35480337, 0.34735783, 0.35186074, 0.3379347 , 0.35390495])
```

[ ]:

```
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_squared_error(y_test, y_pred))
print("rmse: ", mean_squared_error(y_test, y_pred, squared=False))
print("mae: ", 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:  0.20765578843687355
mse:  250149.23256003836
rmse:  353.9215663151034
mae:  289.14866835681914
mape:  3.631923146666917e+16
Error estandar:  [4.53599216e-01 6.20381370e+02]
```

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

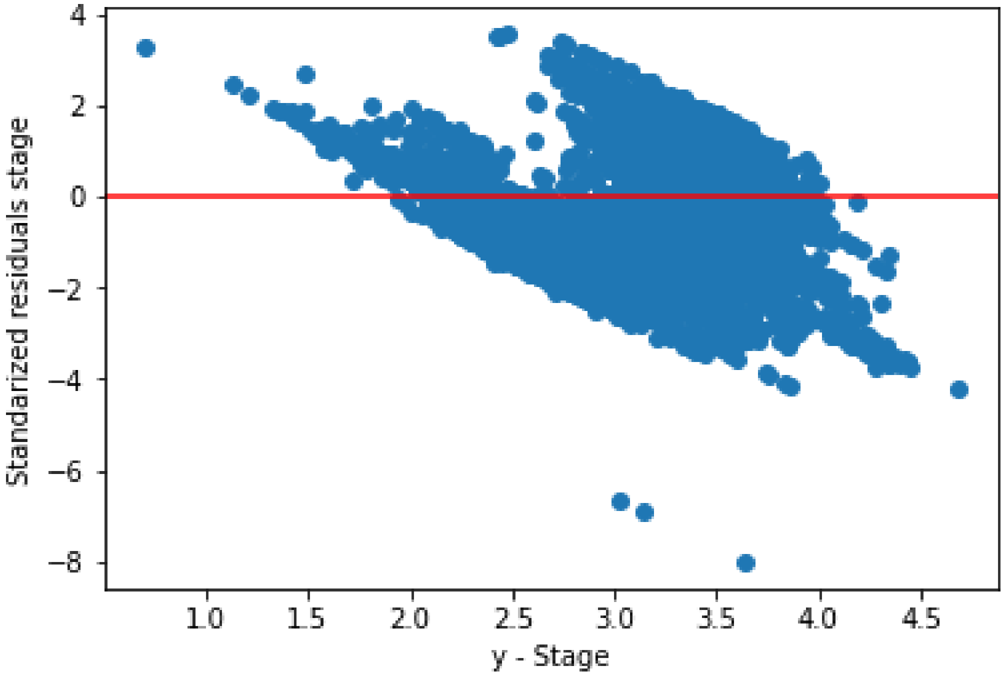
```
[ ]:            Stage    Discharge
     28811 -0.634446 -1035.924075
     28812  0.860892   845.054275
     28813  0.651571   615.180653
     28814  0.651607   653.184582
     28815 -0.261186  -480.739190
     …          …           …
     42054  0.022499    53.364330
     42055  0.052229    80.122600
     42056  0.024390    20.047555
     42057 -0.007539   -45.129367
     42058 -0.007057   -72.281490

     [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")
```

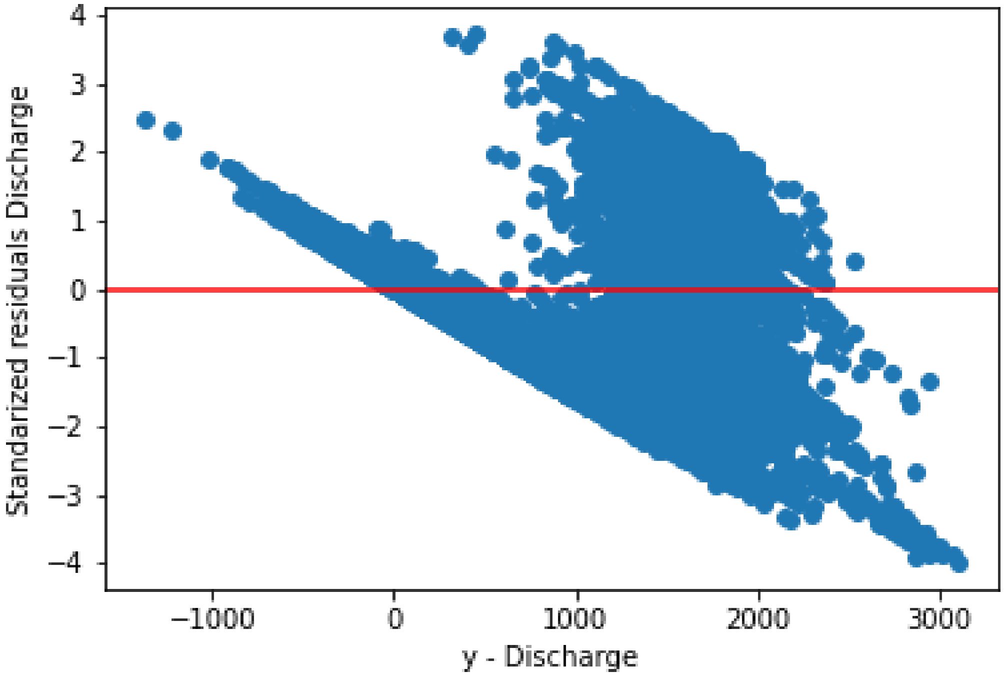
```
[ ]: Text(0, 0.5, 'Standarized residuals stage')
```



```
[ ]: 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')
```



```
[ ]:
```