linear_regression_v1_5

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             False                   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  …

       WeirPt2X  WeirPt2Y  WwRawLineMin  WwRawLineMax  WwRawLineMean  \
0            -1        -1           0.0           0.0       0.000000
1            -1        -1           0.0           0.0       0.000000
2            -1        -1           0.0           0.0       0.000000
3            -1        -1           0.0           0.0       0.000000
4            -1        -1           0.0           0.0       0.000000
…          …         …            …             …             …
42054      2446      1900        9284.0       77521.0   38385.370066
42055      2440      1900       10092.0       74614.0   40162.989292
42056      2447      1900        7067.0       83260.0   42095.946590
42057      2443      1900        6283.0       83045.0   45345.490954
42058      2436      1900        7375.0       89813.0   47877.870782

       WwRawLineSigma  WwCurveLineMin  WwCurveLineMax  WwCurveLineMean  \
0            0.000000             0.0             0.0         0.000000
1            0.000000             0.0             0.0         0.000000
2            0.000000             0.0             0.0         0.000000
3            0.000000             0.0             0.0         0.000000
4            0.000000             0.0             0.0         0.000000
…                 …               …               …              …
42054    15952.029728             0.0         70085.0     37550.894823
42055    15467.708856             0.0         70061.0     39397.339095
42056    16770.357949             0.0         76335.0     41350.006568
```

```
42057    17498.432849             0.0         78882.0     44553.920296
42058    19963.166359             0.0         82630.0     47280.270559

       WwCurveLineSigma
0              0.000000
1              0.000000
2              0.000000
3              0.000000
4              0.000000
…                   …
42054      16444.401209
42055      16009.008049
42056      17489.374617
42057      18268.294896
42058      20559.358767

[42059 rows x 48 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([0.64457013, 0.62752881, 0.61573169, 0.64012765, 0.6317496 ])
```

[ ]:
```
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:  0.3088987524584208
mse:  228971.55178299878
rmse:  338.5953149933481
mae:  258.93715036714417
mape:  6.608196898267452e+16
Error estandar:  [3.81475331e-01 5.44333053e+02]
```

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

[ ]:

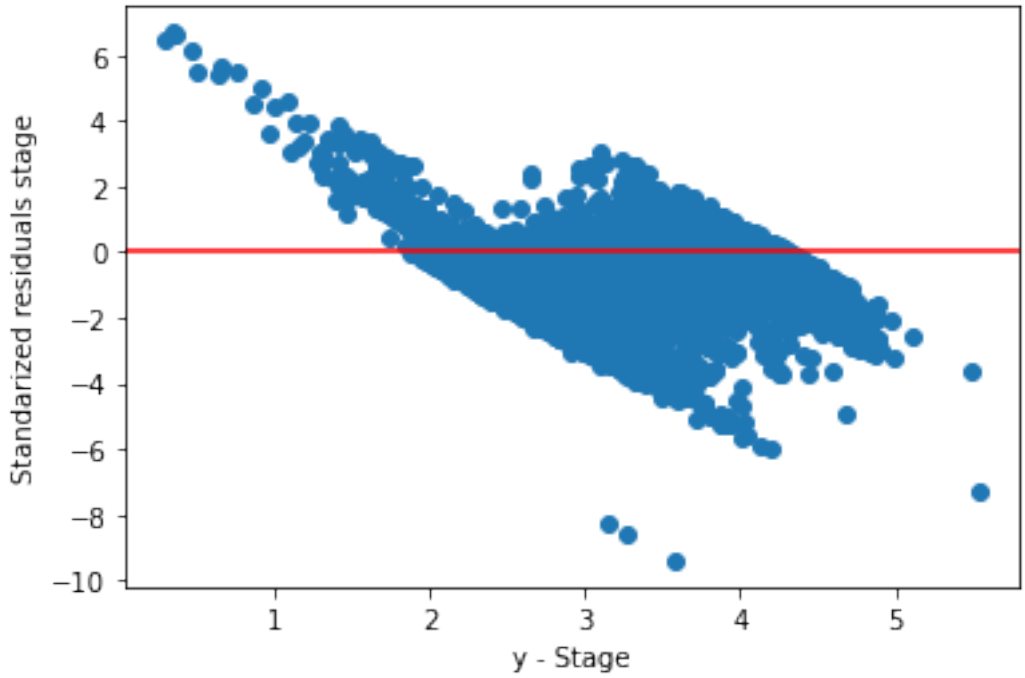
	Stage	Discharge
28811	0.576519	727.453216
28812	1.366664	1850.210392
28813	1.022390	1465.949565
28814	0.296845	263.784384
28815	0.366077	379.183572
…	…	…
42054	0.025829	40.681667
42055	0.173448	232.445362
42056	0.200580	211.101055
42057	0.068820	12.297510
42058	0.117753	119.375216

[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")
```

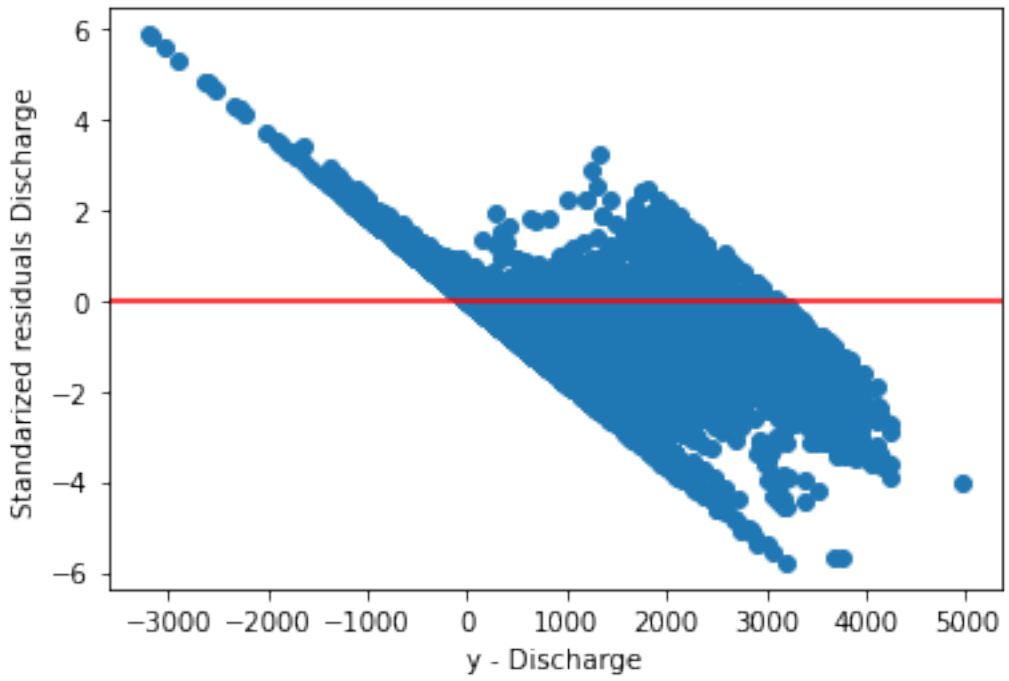
[ ]: Text(0, 0.5, 'Standarized residuals stage')



[ ]:
```
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
6
4
2
0
−2
−4
−6
−3000
−2000
−1000
0
1000
2000
3000
4000
5000
y - Discharge

[ ]: