knn_regression_v1_stage_4

November 25, 2022

1 KNN regression

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

import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split, RandomizedSearchCV
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline
from sklearn.neighbors import KNeighborsRegressor
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                    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
0      39.623303  105.368375  41.572939
1      40.179745  112.399458  41.795584
2      40.533218  114.021526  42.145582
3      41.752678  112.612830  43.575351
4      44.442097  114.839424  46.302008
…          …          …         …
42054  57.702652   87.260572  61.485334
42055  55.840861   94.175906  59.006132
42056  54.355753  100.534577  56.921028
42057  52.787629  102.891159  55.083532
42058  52.025453  105.292067  53.994155

[42059 rows x 8 columns]
```

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

[ ]:
```python
df.dtypes
```

[ ]:
```
SensorTime     datetime64[ns]
CaptureTime            object
Stage                 float64
Discharge             float64
grayMean              float64
graySigma             float64
hMean                 float64
hSigma                float64
Year                    int64
dtype: object
```

[ ]:
```python
df = df[(df.Stage > 0) & (df.Discharge > 0)]
```

[ ]:
```python
df.isna().sum()
```

```
[ ]: SensorTime     0
     CaptureTime    0
     Stage          0
     Discharge      0
     grayMean       0
     graySigma      0
     hMean          0
     hSigma         0
     Year           0
     dtype: int64
```

1.3 Divide dataset to X and Y

```
[ ]: np.random.seed(0)

     df_train = df[(df.Year >= 2012) & (df.Year <= 2017)]
     df_train = df_train.iloc[np.random.permutation(len(df_train))]

     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"])
```

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

     #param_grid = {'clf__hidden_layer_sizes': [(10), (10, 20), (10, 5, 15), (20,␣
      ↪30, 10, 15)], 'clf__alpha': np.arange(1e-3, 1, 0.001),␣
      ↪'clf__learning_rate_init': np.arange(1e-3, 0.1, 0.001), 'clf__activation':␣
      ↪['tanh', 'relu']}

     param_grid = {'clf__n_neighbors': [5, 10, 15, 20, 40, 60], 'clf__leaf_size':␣
      ↪[10, 15, 20, 30, 45, 50, 60]}
```

```
clf = RandomizedSearchCV(pipeline, param_distributions=param_grid, n_iter=30,␣
↪n_jobs=10, verbose=3, scoring="neg_mean_squared_error")
```

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

```
Fitting 5 folds for each of 30 candidates, totalling 150 fits
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[CV 4/5] END clf__leaf_size=30, clf__n_neighbors=20;, score=-0.636 total time=
0.1s
[CV 5/5] END clf__leaf_size=15, clf__n_neighbors=5;, score=-0.693 total time=
0.0s
[CV 1/5] END clf__leaf_size=60, clf__n_neighbors=20;, score=-0.640 total time=
0.1s
[CV 4/5] END clf__leaf_size=20, clf__n_neighbors=40;, score=-0.638 total time=
0.1s
[CV 1/5] END clf__leaf_size=30, clf__n_neighbors=20;, score=-0.640 total time=
0.0s
[CV 2/5] END clf__leaf_size=15, clf__n_neighbors=60;, score=-0.629 total time=
0.1s
[CV 2/5] END clf__leaf_size=60, clf__n_neighbors=20;, score=-0.634 total time=
0.0s
[CV 5/5] END clf__leaf_size=30, clf__n_neighbors=20;, score=-0.634 total time=
0.1s
[CV 3/5] END clf__leaf_size=15, clf__n_neighbors=60;, score=-0.632 total time=
0.1s
```

[ ]:
```
RandomizedSearchCV(estimator=Pipeline(steps=[('scaler', StandardScaler()),
                                             ('clf', KNeighborsRegressor())]),
                   n_iter=30, n_jobs=10,
                   param_distributions={'clf__leaf_size': [10, 15, 20, 30, 45,
                                                           50, 60],
                                        'clf__n_neighbors': [5, 10, 15, 20, 40,
                                                             60]},
                   scoring='neg_mean_squared_error', verbose=3)
```

[ ]:
```
clf.best_score_
```

[ ]:
```
-0.6313548212887989
```

[ ]:
```
clf.best_params_
```

[ ]:
```
{'clf__n_neighbors': 40, 'clf__leaf_size': 50}
```

1.5 Test model

[ ]:
```
clf.score(X_test, y_test)
```

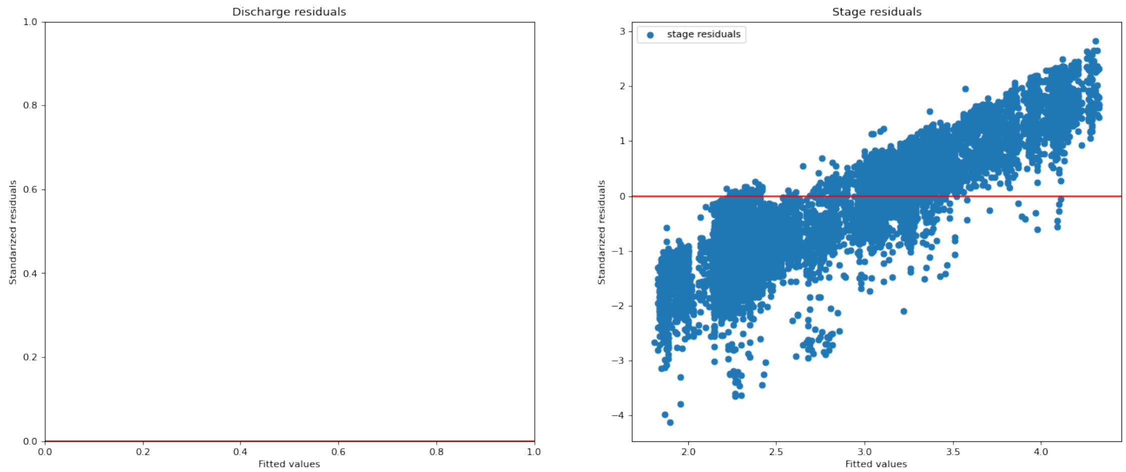
[ ]:
```
-0.5155112509330557
```

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

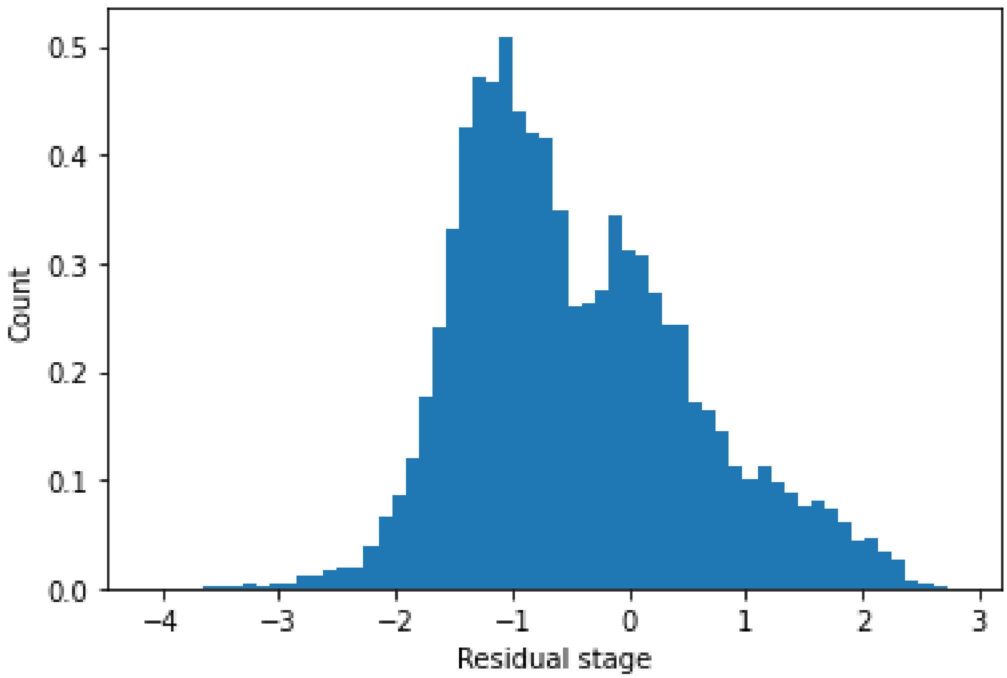
[ ]:
```
print("R^2: ", r2_score(y_test, y_pred))
print("mse: ", mean_squared_error(y_test, y_pred))
print("rmse: ", mean_squared_error(y_test, y_pred, squared=False))
print("mae: ", mean_absolute_error(y_test, y_pred))
print("mape: ", mean_absolute_percentage_error(y_test, y_pred))
print("Error estandar: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

```
R^2:  -0.31999955749369935
mse:  0.5155112509330557
rmse:  0.717991121764786
mae:  0.6056847253869726
mape:  0.24220264858080118
Error estandar:  0.6542629990005242
```

[ ]:
```
residuals = y_test - y_pred
residuals_std = residuals/residuals.std()

y_real_stage = y_test
residual_stage = residuals

#y_real_discharge = np.array([i[-1] for i in y_test])
#residual_discharge = np.array([i[-1] for i in residuals])


figure, ax = plt.subplots(ncols=2, figsize=(20, 8), dpi=80)

ax[1].scatter(y_real_stage, residual_stage / residual_stage.std(), label="stage␣
 ↪residuals")
#ax[0].scatter(y_real_discharge, residual_discharge / residual_discharge.std(),␣
 ↪label="discharge residuals")
ax[1].axhline(y=0.0, color='r', linestyle='-')
ax[0].axhline(y=0.0, color='r', linestyle='-')

ax[1].set_title("Stage residuals")
ax[0].set_title("Discharge residuals")

ax[1].set_xlabel("Fitted values")
ax[0].set_xlabel("Fitted values")
ax[1].set_ylabel("Standarized residuals")
ax[0].set_ylabel("Standarized residuals")

plt.legend()
plt.show()
```

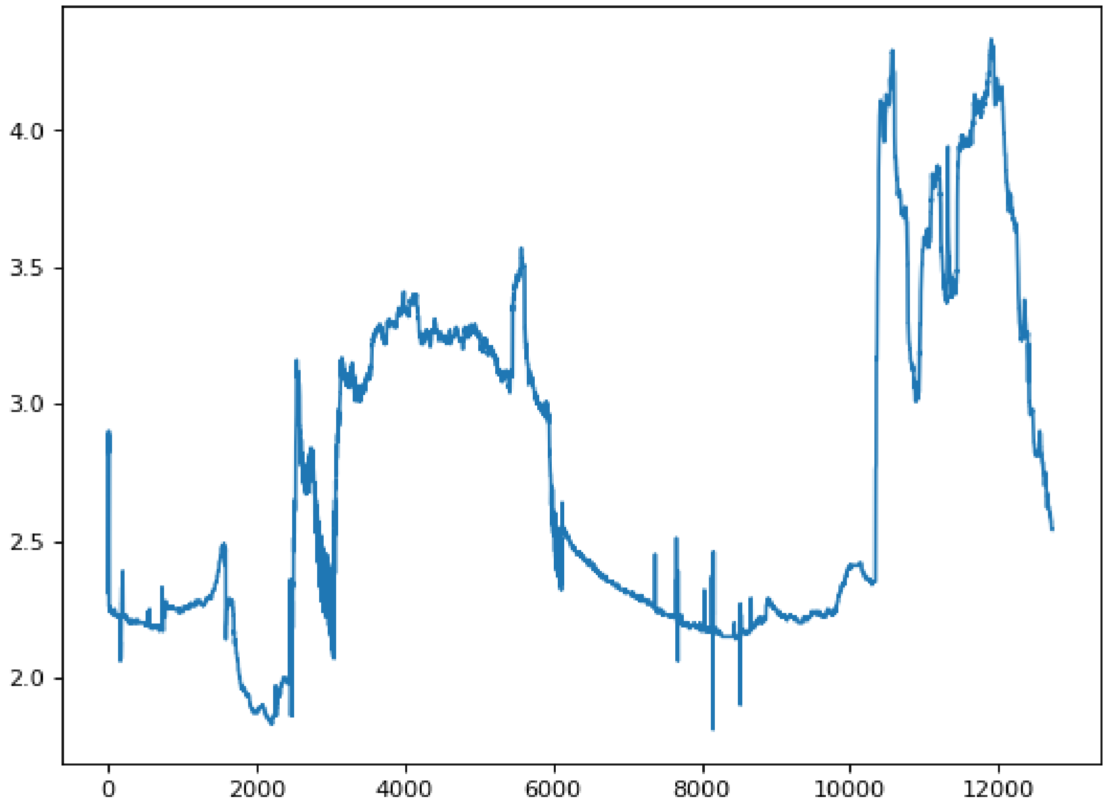



```
[ ]: plt.hist(residual_stage / residual_stage.std(), density=True, bins = 60)
     plt.ylabel('Count')
     plt.xlabel('Residual stage');
     plt.show()
```



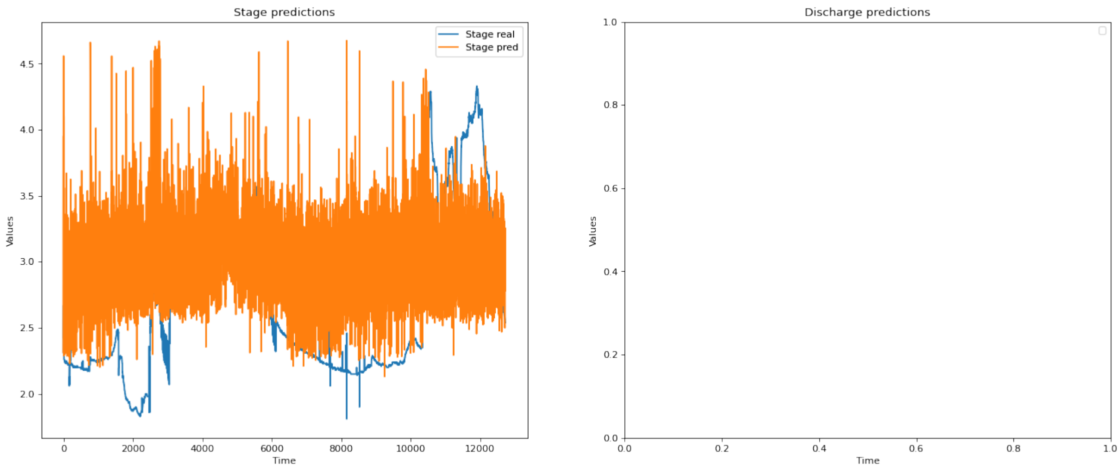

```
[ ]: plt.figure(figsize=(8, 6), dpi=80)
     plt.plot(np.arange(len(y_test)), y_test, label="Stage real")
```

```
[ ]: [<matplotlib.lines.Line2D at 0x7f1e548c9090>]
```




```
[ ]: figure, ax = plt.subplots(ncols=2, figsize=(20, 8), dpi=80)

     ax[0].plot(np.arange(len(y_test)), y_test, label="Stage real")
     ax[0].plot(np.arange(len(y_test)), y_pred, label="Stage pred")

     ax[0].set_title("Stage predictions")
     ax[1].set_title("Discharge predictions")

     ax[1].set_ylabel("Values")
     ax[0].set_ylabel("Values")
     ax[1].set_xlabel("Time")
     ax[0].set_xlabel("Time")

     ax[0].legend()
     ax[1].legend()
     plt.show()
```

```
No artists with labels found to put in legend.  Note that artists whose label
start with an underscore are ignored when legend() is called with no argument.
```


Stage predictions
Stage real
Stage pred
Values
Time
Discharge predictions
Values
Time