MLPRegressor_v1_1

October 5, 2022

[ ]:
```
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.neural_network import MLPRegressor
from sklearn.feature_selection import SelectFromModel
from sklearn.metrics import r2_score
from statsmodels.tools.eval_measures import stde
```

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

[ ]:
```
   generic_features  remove_atypical_values  feature_combination  \
0             False                   False  degree 2 polynomial

   remove_feature_selection  remove_time_features  \
0                     False                  True

   remove_invalid_correlated_features
0                               False
```

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

[ ]:
```
        Stage  Discharge  exposure  fNumber  isoSpeed  shutterSpeed  \
0        2.99      916.0  0.000250      4.0     200.0          -1.0
1        2.99      916.0  0.000312      4.0     200.0          -1.0
2        2.96      873.0  0.000312      4.0     200.0          -1.0
3        2.94      846.0  0.000312      4.0     200.0          -1.0
4        2.94      846.0  0.000312      4.0     200.0          -1.0
…        …         …      …         …        …         …
42054    2.54      434.0  0.000312      4.0     200.0          -1.0
42055    2.54      434.0  0.000250      4.0     200.0          -1.0
```

```
42056   2.54      434.0  0.000250      4.0     200.0          -1.0
42057   2.54      434.0  0.000312      4.0     200.0          -1.0
42058   2.54      434.0  0.000400      4.0     200.0          -1.0

         grayMean  graySigma  entropyMean  entropySigma  …  \
0       97.405096  39.623303     0.203417      0.979825  …
1      104.066757  40.179745     0.206835      1.002624  …
2      105.636831  40.533218     0.204756      0.994246  …
3      104.418949  41.752678     0.202428      0.983170  …
4      106.763541  44.442097     0.202661      0.989625  …
…           …         …          …          …  …
42054   82.872720  57.702652     0.221708      1.076393  …
42055   89.028383  55.840861     0.233168      1.124774  …
42056   94.722097  54.355753     0.240722      1.151833  …
42057   96.693270  52.787629     0.244789      1.171987  …
42058   98.738399  52.025453     0.252812      1.213278  …

       WwCurveLineMin^2  WwCurveLineMin WwCurveLineMax  \
0                   0.0                           0.0
1                   0.0                           0.0
2                   0.0                           0.0
3                   0.0                           0.0
4                   0.0                           0.0
…                   …                          …
42054               0.0                           0.0
42055               0.0                           0.0
42056               0.0                           0.0
42057               0.0                           0.0
42058               0.0                           0.0

       WwCurveLineMin WwCurveLineMean  WwCurveLineMin WwCurveLineSigma  \
0                                 0.0                             0.0
1                                 0.0                             0.0
2                                 0.0                             0.0
3                                 0.0                             0.0
4                                 0.0                             0.0
…                                 …                            …
42054                             0.0                             0.0
42055                             0.0                             0.0
42056                             0.0                             0.0
42057                             0.0                             0.0
42058                             0.0                             0.0

       WwCurveLineMax^2  WwCurveLineMax WwCurveLineMean  \
0          0.000000e+00                   0.000000e+00
1          0.000000e+00                   0.000000e+00
2          0.000000e+00                   0.000000e+00
```

```
3          0.000000e+00                    0.000000e+00
4          0.000000e+00                    0.000000e+00
…                 …                               …
42054      4.911907e+09                    2.631754e+09
42055      4.908544e+09                    2.760217e+09
42056      5.827032e+09                    3.156453e+09
42057      6.222370e+09                    3.514502e+09
42058      6.827717e+09                    3.906769e+09

       WwCurveLineMax WwCurveLineSigma  WwCurveLineMean^2  \
0                        0.000000e+00       0.000000e+00
1                        0.000000e+00       0.000000e+00
2                        0.000000e+00       0.000000e+00
3                        0.000000e+00       0.000000e+00
4                        0.000000e+00       0.000000e+00
…                                 …                  …
42054                    1.152506e+09       1.410070e+09
42055                    1.121607e+09       1.552150e+09
42056                    1.335051e+09       1.709823e+09
42057                    1.441040e+09       1.985052e+09
42058                    1.698820e+09       2.235424e+09

       WwCurveLineMean WwCurveLineSigma  WwCurveLineSigma^2
0                        0.000000e+00        0.000000e+00
1                        0.000000e+00        0.000000e+00
2                        0.000000e+00        0.000000e+00
3                        0.000000e+00        0.000000e+00
4                        0.000000e+00        0.000000e+00
…                                 …                   …
42054                    6.175020e+08        2.704183e+08
42055                    6.307123e+08        2.562883e+08
42056                    7.231858e+08        3.058782e+08
42057                    8.139242e+08        3.337306e+08
42058                    9.720520e+08        4.226872e+08

[42059 rows x 1226 columns]
```

[ ]:
```
y = df[["Stage", "Discharge"]]
X = df.drop(columns=["Stage", "Discharge"])
```

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

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

```
param_grid = {'clf__hidden_layer_sizes': [(10), (10, 20), (10, 5, 15)],␣
 ↪'clf__alpha': [np.arange(0.0001, 1, 10)], 'clf__learning_rate_init': np.
 ↪arange(0.001, 10, 20)}

clf = RandomizedSearchCV(pipeline, param_distributions=param_grid, n_iter=3,␣
 ↪n_jobs=6, verbose=3)
```

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

```
Fitting 5 folds for each of 3 candidates, totalling 15 fits

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
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packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 4/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=10,
clf__learning_rate_init=0.001;, score=0.775 total time= 1.1min
[CV 5/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=10,
clf__learning_rate_init=0.001;, score=0.771 total time= 1.1min
[CV 3/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=10,
clf__learning_rate_init=0.001;, score=0.755 total time= 1.1min
[CV 1/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=10,
clf__learning_rate_init=0.001;, score=0.754 total time= 1.1min
[CV 2/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=10,
clf__learning_rate_init=0.001;, score=0.762 total time= 1.1min
```

```
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 1/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 20),
clf__learning_rate_init=0.001;, score=0.748 total time= 1.2min

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 5/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 20),
clf__learning_rate_init=0.001;, score=0.828 total time= 1.1min
[CV 4/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 20),
clf__learning_rate_init=0.001;, score=0.758 total time= 1.1min
[CV 2/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 20),
clf__learning_rate_init=0.001;, score=0.785 total time= 1.1min

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 3/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 20),
clf__learning_rate_init=0.001;, score=0.814 total time= 1.1min

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 1/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 5, 15),
clf__learning_rate_init=0.001;, score=0.836 total time= 1.1min

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
```

```
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 2/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 5, 15),
clf__learning_rate_init=0.001;, score=0.832 total time= 1.1min

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(
/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:702:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and
the optimization hasn't converged yet.
  warnings.warn(

[CV 3/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 5, 15),
clf__learning_rate_init=0.001;, score=0.823 total time=  54.2s
[CV 4/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 5, 15),
clf__learning_rate_init=0.001;, score=0.817 total time=  54.1s
[CV 5/5] END clf__alpha=[0.0001], clf__hidden_layer_sizes=(10, 5, 15),
clf__learning_rate_init=0.001;, score=0.837 total time=  54.1s

/Users/andresnowak/miniforge3/envs/AI/lib/python3.10/site-
packages/sklearn/neural_network/_multilayer_perceptron.py:709: UserWarning:
Training interrupted by user.
  warnings.warn("Training interrupted by user.")
```

[ ]:
```
RandomizedSearchCV(estimator=Pipeline(steps=[('scaler', StandardScaler()),
                                             ('clf', MLPRegressor())]),
                   n_iter=3, n_jobs=6,
                   param_distributions={'clf__alpha': [array([0.0001])],
                                        'clf__hidden_layer_sizes': [10,
                                                                    (10, 20),
                                                                    (10, 5,
                                                                     15)],
                                        'clf__learning_rate_init':
array([0.001])},
                   verbose=3)
```

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

[ ]: 0.8290972420571633

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

[ ]:
```
{'clf__learning_rate_init': 0.001,
 'clf__hidden_layer_sizes': (10, 5, 15),
 'clf__alpha': array([0.0001])}
```

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

[ ]: 0.6746941413334422

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

print("R^2: ", r2_score(y_test, y_pred))
print("Error estandar: ", stde(y_test.squeeze(),
      y_pred.squeeze(), ddof=len(X.columns) + 1))
```

```
R^2:  0.6746941413334422
Error estandar:  [  0.59001592 515.73848425]
```

[ ]: