

1. 설계한 AutoML pipeline 및 search space

(1) AutoML pipeline:

세 개의 데이터셋 모두 회귀 문제이므로, Pipeline의 step은 preprocessing과 regression으로 구성했습니다.

(2) Search space:

기본적인 전처리 없이 Autogloun을 이용해 모델별 성능을 알아보고, 성능이 높은 RandomForestRegressor, KNN Regressor, MLPRegressor을 사용했습니다. 이를 통해 기본적인 성능 Baseline을 설정할 수 있었습니다.

preprocessing: [None, StandardScaler, MinmaxScaler]

하이퍼파라미터는 { KNN의 n_neighbors: [3,5,7] , distance metric의 p: [1,2] / RandomForest의 n_estimators: [100, 300, 500], max_depth:[None, 10 , 30] / MLPRegressor의 'regressor__hidden_layer_sizes': [(50,), (100,), (100, 50)], 'regressor__learning_rate_init': [0.001, 0.01, 0.1] }을 search 했습니다.

2. 각 데이터셋 별 최적의 모델 상세 정보 및 test set에서의 성능 평가 결과

Airfoil Data의 경우, 타겟의 분포가 정규분포와 하기에 RMSE를 사용해 평가했습니다.

Concrete Data의 경우 타겟의 분산이 크고 값의 범위가 넓기 때문에, MAE를 이용해 평가했습니다.

Abalone Data의 경우 타겟의 단위가 '년'이기에, 오차의 민감도를 줄이기 위해 MAE를 이용했습니다.

(1) Airfoil Data:

최적의 모델 및 하이퍼파라미터 조합: RandomForestRegressor (n_estimators=500, max_depth= 30)

학습 당시 최고 RMSE: 1.9659, Test set의 RMSE: 1.8115

(2) Concrete Data:

최적의 모델 및 하이퍼파라미터 조합: RandomForestRegressor(n_estimators=300, max_depth= None)

학습 당시 최고 MAE: 3.7032, Test set의 MAE: 3.7151

(3) Abalone Data:

최적의 모델 및 하이퍼파라미터 조합: MLPRegressor (hidden_layer_sizes=(100, 50), learning_rate=0.001)

전처리 방법: Standard scaling

학습 당시 최고 MAE: 1.5195, Test set의 MAE: 1.5365

3. 추가 성능 개선 및 AutoML 효율성 개선 방안 논의

모델과 하이퍼파라미터의 선택지를 줄이고자 AutoML을 먼저 사용하고 탐색을 진행했었습니다. 그러나 사용되는 모델의 다양성이 높지 않았고, 하이퍼파라미터의 기본값을 사용하기 때문에 큰 효율성을 얻지 못했습니다. CatBoost, WeightedEnsemble, NeuralNetTorch 등 다른 모델을 사용해본다면, 성능을 개선할 여지가 있을 것 같습니다.

도메인 지식을 반영하여 파생변수를 생성하는 등의 방법을 통해 성능을 개선할 수 있을 것 같습니다.

지금까지 배웠던 피쳐 엔지니어링을 이용해 성능 개선을 생각해볼 수 있을 것 같습니다. 가령 가우시안 분포를 따르지 않는 피쳐 분포들의 경우, log나 exp를 취하여 피쳐 전처리를 해줄 수 있을 것 같습니다.

또한 계산 성능이 더 높은 기기를 사용한다면, 간결한 코드로 많은 하이퍼파라미터와 조건들을 탐색함으로써 성능을 개선할 수 있을 것 같습니다.

Code for Airfoil Dataset

```
In [1]: pip install ucimlrepo
```

```
Requirement already satisfied: ucimlrepo in c:\anacon\lib\site-packages (0.0.7)
Requirement already satisfied: pandas>=1.0.0 in c:\anacon\lib\site-packages (from
ucimlrepo) (2.1.4)
Requirement already satisfied: certifi>=2020.12.5 in c:\anacon\lib\site-packages
(from ucimlrepo) (2024.2.2)
Requirement already satisfied: numpy<2,>=1.23.2 in c:\anacon\lib\site-packages (f
rom pandas>=1.0.0->ucimlrepo) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\anacon\lib\site-packa
ges (from pandas>=1.0.0->ucimlrepo) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\anacon\lib\site-packages (from
pandas>=1.0.0->ucimlrepo) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in c:\anacon\lib\site-packages (fro
m pandas>=1.0.0->ucimlrepo) (2023.3)
Requirement already satisfied: six>=1.5 in c:\anacon\lib\site-packages (from pyth
on-dateutil>=2.8.2->pandas>=1.0.0->ucimlrepo) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

```
In [1]: from ucimlrepo import fetch_ucirepo

# fetch dataset
airfoil_self_noise = fetch_ucirepo(id=291)

# data (as pandas dataframes)
X = airfoil_self_noise.data.features
y = airfoil_self_noise.data.targets

# metadata
print(airfoil_self_noise.metadata)

# variable information
print(airfoil_self_noise.variables)
```

```
{'uci_id': 291, 'name': 'Airfoil Self-Noise', 'repository_url': 'https://archive.ics.uci.edu/dataset/291/airfoil+self+noise', 'data_url': 'https://archive.ics.uci.edu/static/public/291/data.csv', 'abstract': 'NASA data set, obtained from a series of aerodynamic and acoustic tests of two and three-dimensional airfoil blade sections conducted in an anechoic wind tunnel.', 'area': 'Physics and Chemistry', 'tasks': ['Regression'], 'characteristics': ['Multivariate'], 'num_instances': 1503, 'num_features': 5, 'feature_types': ['Real'], 'demographics': [], 'target_col': ['scaled-sound-pressure'], 'index_col': None, 'has_missing_values': 'no', 'missing_values_symbol': None, 'year_of_dataset_creation': 1989, 'last_updated': 'Fri Mar 29 2024', 'dataset_doi': '10.24432/C5VW2C', 'creators': ['Thomas Brooks', 'D. Pope', 'Michael Marcolini'], 'intro_paper': None, 'additional_info': {'summary': 'The NASA data set comprises different size NACA 0012 airfoils at various wind tunnel speeds and angles of attack. The span of the airfoil and the observer position were the same in all of the experiments. ', 'purpose': None, 'funded_by': None, 'instances_represent': None, 'recommended_data_splits': None, 'sensitive_data': None, 'preprocessing_description': None, 'variable_info': 'This problem has the following inputs:\n\n1. Frequency, in Hertz. \n\n2. Angle of attack, in degrees. \n\n3. Chord length, in meters.\n\n4. Free-stream velocity, in meters per second. \n\n5. Suction side displacement thickness, in meters. \n\n\nThe only output is:\n\n6. Scaled sound pressure level, in decibels. \n\n', 'citation': None}}
```

	name	role	type	demographic
0	frequency	Feature	Integer	None
1	attack-angle	Feature	Binary	None
2	chord-length	Feature	Continuous	None
3	free-stream-velocity	Feature	Continuous	None
4	suction-side-displacement-thickness	Feature	Continuous	None
5	scaled-sound-pressure	Target	Continuous	None

	description	units	missing_values
0	None	Hz	no
1	None	deg	no
2	None	m	no
3	None	m/s	no
4	None	m	no
5	None	dB	no

In [3]: X

Out[3]:

	frequency	attack-angle	chord-length	free-stream-velocity	suction-side-displacement-thickness
0	800	0.0	0.3048	71.3	0.002663
1	1000	0.0	0.3048	71.3	0.002663
2	1250	0.0	0.3048	71.3	0.002663
3	1600	0.0	0.3048	71.3	0.002663
4	2000	0.0	0.3048	71.3	0.002663
...
1498	2500	15.6	0.1016	39.6	0.052849
1499	3150	15.6	0.1016	39.6	0.052849
1500	4000	15.6	0.1016	39.6	0.052849
1501	5000	15.6	0.1016	39.6	0.052849
1502	6300	15.6	0.1016	39.6	0.052849

1503 rows × 5 columns

In [4]: y

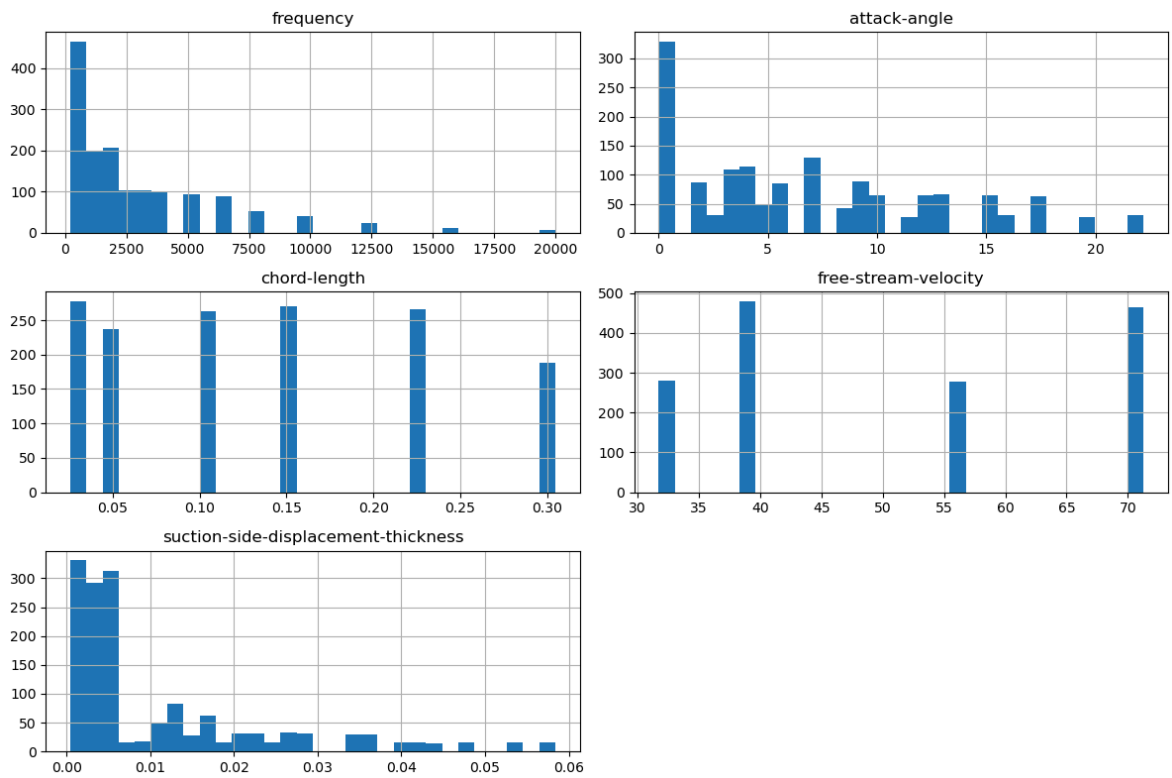
Out[4]:

	scaled-sound-pressure
0	126.201
1	125.201
2	125.951
3	127.591
4	127.461
...	...
1498	110.264
1499	109.254
1500	106.604
1501	106.224
1502	104.204

1503 rows × 1 columns

```
In [11]: import matplotlib.pyplot as plt

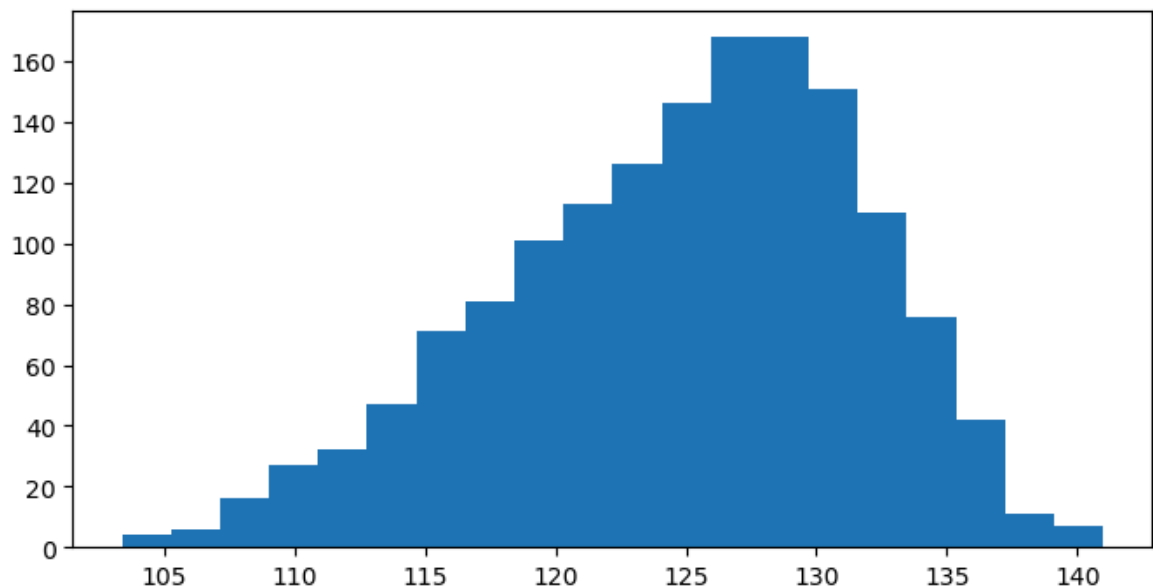
X.hist(figsize=(12, 8), bins=30)
plt.tight_layout()
plt.show()
```



```
In [19]: import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(8, 4))
plt.hist(y, bins=20)
plt.show()

print(y.describe())
```



```
scaled-sound-pressure
count      1503.000000
mean       124.835943
std         6.898657
min        103.380000
25%        120.191000
50%        125.721000
75%        129.995500
max        140.987000
```

```
In [15]: !pip install autogluon.tabular
```

Collecting autogluon.tabular

Using cached autogluon.tabular-1.3.1-py3-none-any.whl.metadata (14 kB)

Requirement already satisfied: numpy<2.3.0,>=1.25.0 in c:\anacon\lib\site-packages (from autogluon.tabular) (1.26.4)

Requirement already satisfied: scipy<1.16,>=1.5.4 in c:\anacon\lib\site-packages (from autogluon.tabular) (1.11.4)

Requirement already satisfied: pandas<2.3.0,>=2.0.0 in c:\anacon\lib\site-packages (from autogluon.tabular) (2.1.4)

Collecting scikit-learn<1.7.0,>=1.4.0 (from autogluon.tabular)

Using cached scikit_learn-1.6.1-cp311-cp311-win_amd64.whl.metadata (15 kB)

Requirement already satisfied: networkx<4,>=3.0 in c:\anacon\lib\site-packages (from autogluon.tabular) (3.1)

Collecting autogluon.core==1.3.1 (from autogluon.tabular)

Using cached autogluon.core-1.3.1-py3-none-any.whl.metadata (12 kB)

Collecting autogluon.features==1.3.1 (from autogluon.tabular)

Using cached autogluon.features-1.3.1-py3-none-any.whl.metadata (11 kB)

Requirement already satisfied: tqdm<5,>=4.38 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.tabular) (4.65.0)

Requirement already satisfied: requests in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.tabular) (2.31.0)

Requirement already satisfied: matplotlib<3.11,>=3.7.0 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.tabular) (3.8.0)

Collecting boto3<2,>=1.10 (from autogluon.core==1.3.1->autogluon.tabular)

Using cached boto3-1.38.32-py3-none-any.whl.metadata (6.6 kB)

Collecting autogluon.common==1.3.1 (from autogluon.core==1.3.1->autogluon.tabular)

Using cached autogluon.common-1.3.1-py3-none-any.whl.metadata (11 kB)

Requirement already satisfied: psutil<7.1.0,>=5.7.3 in c:\anacon\lib\site-packages (from autogluon.common==1.3.1->autogluon.core==1.3.1->autogluon.tabular) (5.9.0)

Requirement already satisfied: python-dateutil>=2.8.2 in c:\anacon\lib\site-packages (from pandas<2.3.0,>=2.0.0->autogluon.tabular) (2.8.2)

Requirement already satisfied: pytz>=2020.1 in c:\anacon\lib\site-packages (from pandas<2.3.0,>=2.0.0->autogluon.tabular) (2023.3.post1)

Requirement already satisfied: tzdata>=2022.1 in c:\anacon\lib\site-packages (from pandas<2.3.0,>=2.0.0->autogluon.tabular) (2023.3)

Requirement already satisfied: joblib>=1.2.0 in c:\anacon\lib\site-packages (from scikit-learn<1.7.0,>=1.4.0->autogluon.tabular) (1.2.0)

Collecting threadpoolctl>=3.1.0 (from scikit-learn<1.7.0,>=1.4.0->autogluon.tabular)

Using cached threadpoolctl-3.6.0-py3-none-any.whl.metadata (13 kB)

Collecting botocore<1.39.0,>=1.38.32 (from boto3<2,>=1.10->autogluon.core==1.3.1->autogluon.tabular)

Using cached botocore-1.38.32-py3-none-any.whl.metadata (5.7 kB)

Requirement already satisfied: jmespath<2.0.0,>=0.7.1 in c:\anacon\lib\site-packages (from boto3<2,>=1.10->autogluon.core==1.3.1->autogluon.tabular) (1.0.1)

Collecting s3transfer<0.14.0,>=0.13.0 (from boto3<2,>=1.10->autogluon.core==1.3.1->autogluon.tabular)

Using cached s3transfer-0.13.0-py3-none-any.whl.metadata (1.7 kB)

Requirement already satisfied: contourpy>=1.0.1 in c:\anacon\lib\site-packages (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (1.2.0)

Requirement already satisfied: cyclers>=0.10 in c:\anacon\lib\site-packages (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (0.11.0)

Requirement already satisfied: fonttools>=4.22.0 in c:\anacon\lib\site-packages (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (4.25.0)

Requirement already satisfied: kiwisolver>=1.0.1 in c:\anacon\lib\site-packages (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (1.4.4)

Requirement already satisfied: packaging>=20.0 in c:\anacon\lib\site-packages (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (23.1)

Requirement already satisfied: pillow>=6.2.0 in c:\anacon\lib\site-packages (from

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matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (10.2.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\anacon\lib\site-packages (f
rom matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.tabular) (3.0.9)
Requirement already satisfied: six>=1.5 in c:\anacon\lib\site-packages (from pyth
on-dateutil>=2.8.2->pandas<2.3.0,>=2.0.0->autogluon.tabular) (1.16.0)
Requirement already satisfied: colorama in c:\anacon\lib\site-packages (from tqdm
<5,>=4.38->autogluon.core==1.3.1->autogluon.tabular) (0.4.6)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\anacon\lib\site-pac
kages (from requests->autogluon.core==1.3.1->autogluon.tabular) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\anacon\lib\site-packages (from
requests->autogluon.core==1.3.1->autogluon.tabular) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\anacon\lib\site-packages
(from requests->autogluon.core==1.3.1->autogluon.tabular) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in c:\anacon\lib\site-packages
(from requests->autogluon.core==1.3.1->autogluon.tabular) (2024.2.2)
Downloading autogluon.tabular-1.3.1-py3-none-any.whl (382 kB)
----- 0.0/382.4 kB ? eta -:--:--
- ----- 10.2/382.4 kB ? eta -:--:--
-- ----- 20.5/382.4 kB 131.3 kB/s eta 0:00:03
-- ----- 20.5/382.4 kB 131.3 kB/s eta 0:00:03
---- ----- 41.0/382.4 kB 196.9 kB/s eta 0:00:02
----- 71.7/382.4 kB 280.5 kB/s eta 0:00:02
----- 358.4/382.4 kB 1.3 MB/s eta 0:00:01
----- 382.4/382.4 kB 1.3 MB/s eta 0:00:00
Downloading autogluon.core-1.3.1-py3-none-any.whl (222 kB)
----- 0.0/222.7 kB ? eta -:--:--
----- 222.7/222.7 kB 14.2 MB/s eta 0:00:00
Downloading autogluon.features-1.3.1-py3-none-any.whl (64 kB)
----- 0.0/64.2 kB ? eta -:--:--
----- 64.2/64.2 kB ? eta 0:00:00
Downloading autogluon.common-1.3.1-py3-none-any.whl (69 kB)
----- 0.0/69.1 kB ? eta -:--:--
----- 69.1/69.1 kB 3.9 MB/s eta 0:00:00
Downloading scikit_learn-1.6.1-cp311-cp311-win_amd64.whl (11.1 MB)
----- 0.0/11.1 MB ? eta -:--:--
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----- 2.7/11.1 MB 17.2 MB/s eta 0:00:01
----- 4.1/11.1 MB 20.1 MB/s eta 0:00:01
----- 4.9/11.1 MB 19.6 MB/s eta 0:00:01
----- 5.6/11.1 MB 18.8 MB/s eta 0:00:01
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----- 8.2/11.1 MB 13.4 MB/s eta 0:00:01
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----- 0.0/139.9 kB ? eta -:--:--
----- 30.7/139.9 kB 660.6 kB/s eta 0:00:01
----- 133.1/139.9 kB 2.0 MB/s eta 0:00:01
----- 139.9/139.9 kB 1.7 MB/s eta 0:00:00
Downloading threadpoolctl-3.6.0-py3-none-any.whl (18 kB)
Downloading botocore-1.38.32-py3-none-any.whl (13.6 MB)
----- 0.0/13.6 MB ? eta -:--:--
----- 0.4/13.6 MB 13.2 MB/s eta 0:00:01
----- 1.4/13.6 MB 15.0 MB/s eta 0:00:01
----- 2.4/13.6 MB 19.3 MB/s eta 0:00:01
----- 2.7/13.6 MB 15.4 MB/s eta 0:00:01
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----- 5.7/13.6 MB 18.3 MB/s eta 0:00:01
----- 6.2/13.6 MB 17.9 MB/s eta 0:00:01
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----- 10.6/13.6 MB 18.7 MB/s eta 0:00:01
----- 11.4/13.6 MB 18.7 MB/s eta 0:00:01
----- 12.2/13.6 MB 18.2 MB/s eta 0:00:01
----- 13.1/13.6 MB 19.8 MB/s eta 0:00:01
----- 13.6/13.6 MB 19.3 MB/s eta 0:00:01
----- 13.6/13.6 MB 19.3 MB/s eta 0:00:01
----- 13.6/13.6 MB 16.8 MB/s eta 0:00:00
Downloading s3transfer-0.13.0-py3-none-any.whl (85 kB)
----- 0.0/85.2 kB ? eta -:--:--
----- 85.2/85.2 kB 5.0 MB/s eta 0:00:00
Installing collected packages: threadpoolctl, scikit-learn, botocore, s3transfer,
boto3, autogluon.common, autogluon.features, autogluon.core, autogluon.tabular
Attempting uninstall: threadpoolctl
  Found existing installation: threadpoolctl 2.2.0
  Uninstalling threadpoolctl-2.2.0:
    Successfully uninstalled threadpoolctl-2.2.0
Attempting uninstall: scikit-learn
  Found existing installation: scikit-learn 1.2.2
  Uninstalling scikit-learn-1.2.2:
    Successfully uninstalled scikit-learn-1.2.2
Attempting uninstall: botocore
  Found existing installation: botocore 1.31.64
  Uninstalling botocore-1.31.64:
    Successfully uninstalled botocore-1.31.64
Successfully installed autogluon.common-1.3.1 autogluon.core-1.3.1 autogluon.featur
es-1.3.1 autogluon.tabular-1.3.1 boto3-1.38.32 botocore-1.38.32 s3transfer-0.1
3.0 scikit-learn-1.6.1 threadpoolctl-3.6.0
ERROR: pip's dependency resolver does not currently take into account all the pac
kages that are installed. This behaviour is the source of the following dependenc
y conflicts.
aiobotocore 2.7.0 requires botocore<1.31.65,>=1.31.16, but you have botocore 1.3
8.32 which is incompatible.

```

```

In [17]: from autogluon.tabular import TabularPredictor
         from sklearn.model_selection import train_test_split
         from sklearn.metrics import r2_score

```

```
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)

# AutoGluon용 데이터 준비
train_data = X_train.copy()
train_data['target'] = y_train

test_data = X_test.copy()
test_data['target'] = y_test
# AutoML 모델 학습
predictor = TabularPredictor(label='target').fit(train_data)

predictions = predictor.predict(test_data.drop(columns=['target']))
print(predictor.evaluate(test_data))
```

```

No path specified. Models will be saved in: "AutogluonModels\ag-20250609_163129"
Verbosity: 2 (Standard Logging)
===== System Info =====
AutoGluon Version: 1.3.1
Python Version: 3.11.7
Operating System: Windows
Platform Machine: AMD64
Platform Version: 10.0.26100
CPU Count: 12
Memory Avail: 6.58 GB / 15.69 GB (41.9%)
Disk Space Avail: 320.74 GB / 476.05 GB (67.4%)
=====
No presets specified! To achieve strong results with AutoGluon, it is recommended
to use the available presets. Defaulting to 'medium'...
Recommended Presets (For more details refer to https://auto.gluon.ai/stable/tutorials/tabular/tabular-essentials.html#presets):
presets='experimental' : New in v1.2: Pre-trained foundation model + parallel fits. The absolute best accuracy without consideration for inference speed. Does not support GPU.
presets='best' : Maximize accuracy. Recommended for most users. Use in competitions and benchmarks.
presets='high' : Strong accuracy with fast inference speed.
presets='good' : Good accuracy with very fast inference speed.
presets='medium' : Fast training time, ideal for initial prototyping.
Beginning AutoGluon training ...
AutoGluon will save models to "C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250609_163129"
Train Data Rows: 1127
Train Data Columns: 5
Label Column: target
AutoGluon infers your prediction problem is: 'regression' (because dtype of label-column == float and many unique label-values observed).
Label info (max, min, mean, stddev): (140.987, 103.38, 124.91494, 6.89457)
If 'regression' is not the correct problem_type, please manually specify the problem_type parameter during Predictor init (You may specify problem_type as one of: ['binary', 'multiclass', 'regression', 'quantile'])
Problem Type: regression
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
Available Memory: 6730.07 MB
Train Data (Original) Memory Usage: 0.04 MB (0.0% of available memory)
Inferring data type of each feature based on column values. Set feature_metadata_in to manually specify special dtypes of the features.
Stage 1 Generators:
Fitting AsTypeFeatureGenerator...
Stage 2 Generators:
Fitting FillNaFeatureGenerator...
Stage 3 Generators:
Fitting IdentityFeatureGenerator...
Stage 4 Generators:
Fitting DropUniqueFeatureGenerator...
Stage 5 Generators:
Fitting DropDuplicatesFeatureGenerator...
Types of features in original data (raw dtype, special dtypes):
('float', []) : 4 | ['attack-angle', 'chord-length', 'free-stream-velocity', 'suction-side-displacement-thickness']
('int', []) : 1 | ['frequency']

```

```

Types of features in processed data (raw dtype, special dtypes):
('float', []) : 4 | ['attack-angle', 'chord-length', 'free-stream
-velocity', 'suction-side-displacement-thickness']
('int', [])   : 1 | ['frequency']
0.1s = Fit runtime
5 features in original data used to generate 5 features in processed dat
a.
Train Data (Processed) Memory Usage: 0.04 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.12s ...
AutoGluon will gauge predictive performance using evaluation metric: 'root_mean_s
quared_error'
This metric's sign has been flipped to adhere to being higher_is_better.
The metric score can be multiplied by -1 to get the metric value.
To change this, specify the eval_metric parameter of Predictor()
Automatically generating train/validation split with holdout_frac=0.2, Train Row
s: 901, Val Rows: 226
User-specified model hyperparameters to be fit:
{
  'NN_TORCH': [{}],
  'GBM': [{'extra_trees': True, 'ag_args': {'name_suffix': 'XT'}}, {}, {'le
arning_rate': 0.03, 'num_leaves': 128, 'feature_fraction': 0.9, 'min_data_in_lea
f': 3, 'ag_args': {'name_suffix': 'Large', 'priority': 0, 'hyperparameter_tune_kw
args': None}}],
  'CAT': [{}],
  'XGB': [{}],
  'FASTAI': [{}],
  'RF': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
  'XT': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
  'KNN': [{'weights': 'uniform', 'ag_args': {'name_suffix': 'Unif'}}, {'wei
ghts': 'distance', 'ag_args': {'name_suffix': 'Dist'}}],
}
Fitting 11 L1 models, fit_strategy="sequential" ...
Fitting model: KNeighborsUnif ...
-5.8642 = Validation score (-root_mean_squared_error)
0.02s   = Training runtime
0.05s   = Validation runtime
Fitting model: KNeighborsDist ...
-6.3493 = Validation score (-root_mean_squared_error)
0.01s   = Training runtime
0.03s   = Validation runtime
Fitting model: LightGBMXT ...
[1000] valid_set's rmse: 2.00326
[2000] valid_set's rmse: 1.86357
[3000] valid_set's rmse: 1.78471
[4000] valid_set's rmse: 1.74176
[5000] valid_set's rmse: 1.70833
[6000] valid_set's rmse: 1.6827
[7000] valid_set's rmse: 1.66524
[8000] valid_set's rmse: 1.64576
[9000] valid_set's rmse: 1.63127
[10000] valid_set's rmse: 1.61927

```

```
-1.6193 = Validation score (-root_mean_squared_error)
62.88s  = Training runtime
0.2s    = Validation runtime
Fitting model: LightGBM ...
[1000] valid_set's rmse: 1.65768
[2000] valid_set's rmse: 1.60659
[3000] valid_set's rmse: 1.61047

-1.6029 = Validation score (-root_mean_squared_error)
29.44s  = Training runtime
0.09s   = Validation runtime
Fitting model: RandomForestMSE ...
-2.0073 = Validation score (-root_mean_squared_error)
2.61s   = Training runtime
0.16s   = Validation runtime
Fitting model: CatBoost ...
```

```

Collecting autogluon
  Downloading autogluon-1.3.1-py3-none-any.whl.metadata (11 kB)
Collecting autogluon.core==1.3.1 (from autogluon.core[all]==1.3.1->autogluon)
  Downloading autogluon.core-1.3.1-py3-none-any.whl.metadata (12 kB)
Collecting autogluon.features==1.3.1 (from autogluon)
  Downloading autogluon.features-1.3.1-py3-none-any.whl.metadata (11 kB)
Collecting autogluon.tabular==1.3.1 (from autogluon.tabular[all]==1.3.1->autogluon)
  Downloading autogluon.tabular-1.3.1-py3-none-any.whl.metadata (14 kB)
Collecting autogluon.multimodal==1.3.1 (from autogluon)
  Downloading autogluon.multimodal-1.3.1-py3-none-any.whl.metadata (13 kB)
Collecting autogluon.timeseries==1.3.1 (from autogluon.timeseries[all]==1.3.1->autogluon)
  Downloading autogluon.timeseries-1.3.1-py3-none-any.whl.metadata (12 kB)
Requirement already satisfied: numpy<2.3.0,>=1.25.0 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (1.26.4)
Requirement already satisfied: scipy<1.16,>=1.5.4 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (1.11.4)
Collecting scikit-learn<1.7.0,>=1.4.0 (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)
  Downloading scikit_learn-1.6.1-cp311-cp311-win_amd64.whl.metadata (15 kB)
Requirement already satisfied: networkx<4,>=3.0 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (3.1)
Requirement already satisfied: pandas<2.3.0,>=2.0.0 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (2.1.4)
Requirement already satisfied: tqdm<5,>=4.38 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (4.65.0)
Requirement already satisfied: requests in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (2.31.0)
Requirement already satisfied: matplotlib<3.11,>=3.7.0 in c:\anacon\lib\site-packages (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (3.8.0)
Collecting boto3<2,>=1.10 (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)
  Downloading boto3-1.38.32-py3-none-any.whl.metadata (6.6 kB)
Collecting autogluon.common==1.3.1 (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)
  Downloading autogluon.common-1.3.1-py3-none-any.whl.metadata (11 kB)
Collecting ray<2.45,>=2.10.0 (from ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)
  Downloading ray-2.44.1-cp311-cp311-win_amd64.whl.metadata (20 kB)
Collecting hyperopt<0.2.8,>=0.2.7 (from autogluon.core[all]==1.3.1->autogluon)
  Downloading hyperopt-0.2.7-py2.py3-none-any.whl.metadata (1.7 kB)
Collecting pyarrow>=15.0.0 (from autogluon.core[all]==1.3.1->autogluon)
  Downloading pyarrow-20.0.0-cp311-cp311-win_amd64.whl.metadata (3.4 kB)
Requirement already satisfied: Pillow<12,>=10.0.1 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (10.2.0)
Collecting torch<2.7,>=2.2 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading torch-2.6.0-cp311-cp311-win_amd64.whl.metadata (28 kB)
Collecting lightning<2.7,>=2.2 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading lightning-2.5.1.post0-py3-none-any.whl.metadata (39 kB)
Collecting transformers<4.50,>=4.38.0 (from transformers[sentencepiece]<4.50,>=4.38.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading transformers-4.49.0-py3-none-any.whl.metadata (44 kB)
----- 0.0/44.0 kB ? eta -:-:--
----- 44.0/44.0 kB 2.3 MB/s eta 0:00:00
Collecting accelerate<2.0,>=0.34.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading accelerate-1.7.0-py3-none-any.whl.metadata (19 kB)
Requirement already satisfied: jsonschema<4.24,>=4.18 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (4.19.2)
Collecting sequeval<1.3.0,>=1.2.2 (from autogluon.multimodal==1.3.1->autogluon)

```

```

Downloading sequeval-1.2.2.tar.gz (43 kB)
----- 0.0/43.6 kB ? eta -:--:--
----- 43.6/43.6 kB 2.2 MB/s eta 0:00:00
Preparing metadata (setup.py): started
Preparing metadata (setup.py): finished with status 'done'
Collecting evaluate<0.5.0,>=0.4.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading evaluate-0.4.3-py3-none-any.whl.metadata (9.2 kB)
Collecting timm<1.0.7,>=0.9.5 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading timm-1.0.3-py3-none-any.whl.metadata (43 kB)
----- 0.0/43.6 kB ? eta -:--:--
----- 43.6/43.6 kB 1.1 MB/s eta 0:00:00
Collecting torchvision<0.22.0,>=0.16.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading torchvision-0.21.0-cp311-cp311-win_amd64.whl.metadata (6.3 kB)
Requirement already satisfied: scikit-image<0.26.0,>=0.19.1 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (0.22.0)
Requirement already satisfied: text-unidecode<1.4,>=1.3 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (1.3)
Collecting torchmetrics<1.8,>=1.2.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading torchmetrics-1.7.2-py3-none-any.whl.metadata (21 kB)
Collecting omegaconf<2.4.0,>=2.1.1 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading omegaconf-2.3.0-py3-none-any.whl.metadata (3.9 kB)
Collecting pytorch-metric-learning<2.9,>=1.3.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading pytorch_metric_learning-2.8.1-py3-none-any.whl.metadata (18 kB)
Collecting nlpaug<1.2.0,>=1.1.10 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading nlpaug-1.1.11-py3-none-any.whl.metadata (14 kB)
Requirement already satisfied: nltk<3.9,>=3.4.5 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (3.8.1)
Collecting openmim<0.4.0,>=0.3.7 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading openmim-0.3.9-py2.py3-none-any.whl.metadata (16 kB)
Requirement already satisfied: defusedxml<0.7.2,>=0.7.1 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (0.7.1)
Requirement already satisfied: jinja2<3.2,>=3.0.3 in c:\anacon\lib\site-packages (from autogluon.multimodal==1.3.1->autogluon) (3.1.3)
Collecting tensorboard<3,>=2.9 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading tensorboard-2.19.0-py3-none-any.whl.metadata (1.8 kB)
Collecting pytesseract<0.4,>=0.3.9 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading pytesseract-0.3.13-py3-none-any.whl.metadata (11 kB)
Collecting nvidia-ml-py3<8.0,>=7.352.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading nvidia-ml-py3-7.352.0.tar.gz (19 kB)
  Preparing metadata (setup.py): started
  Preparing metadata (setup.py): finished with status 'done'
Collecting pdf2image<1.19,>=1.17.0 (from autogluon.multimodal==1.3.1->autogluon)
  Downloading pdf2image-1.17.0-py3-none-any.whl.metadata (6.2 kB)
Requirement already satisfied: catboost<1.3,>=1.2 in c:\anacon\lib\site-packages (from autogluon.tabular[all]==1.3.1->autogluon) (1.2.8)
Collecting einops<0.9,>=0.7 (from autogluon.tabular[all]==1.3.1->autogluon)
  Downloading einops-0.8.1-py3-none-any.whl.metadata (13 kB)
Requirement already satisfied: xgboost<3.1,>=2.0 in c:\anacon\lib\site-packages (from autogluon.tabular[all]==1.3.1->autogluon) (3.0.0)
Collecting fastai<2.9,>=2.3.1 (from autogluon.tabular[all]==1.3.1->autogluon)
  Downloading fastai-2.8.2-py3-none-any.whl.metadata (9.5 kB)
Collecting huggingface-hub[torch] (from autogluon.tabular[all]==1.3.1->autogluon)
  Downloading huggingface_hub-0.32.4-py3-none-any.whl.metadata (14 kB)
Requirement already satisfied: lightgbm<4.7,>=4.0 in c:\anacon\lib\site-packages (from autogluon.tabular[all]==1.3.1->autogluon) (4.6.0)
Collecting spacy<3.9 (from autogluon.tabular[all]==1.3.1->autogluon)
  Downloading spacy-3.8.7-cp311-cp311-win_amd64.whl.metadata (28 kB)

```

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Requirement already satisfied: joblib<2,>=1.1 in c:\anacon\lib\site-packages (from
autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (1.2.
0)
Collecting pytorch-lightning (from autogluon.timeseries==1.3.1->autogluon.timeser
ies[all]==1.3.1->autogluon)
  Downloading pytorch_lightning-2.5.1.post0-py3-none-any.whl.metadata (20 kB)
Collecting gluonts<0.17,>=0.15.0 (from autogluon.timeseries==1.3.1->autogluon.tim
eseries[all]==1.3.1->autogluon)
  Downloading gluonts-0.16.1-py3-none-any.whl.metadata (9.8 kB)
Collecting statsforecast<2.0.2,>=1.7.0 (from autogluon.timeseries==1.3.1->autoglu
on.timeseries[all]==1.3.1->autogluon)
  Downloading statsforecast-2.0.1-cp311-cp311-win_amd64.whl.metadata (30 kB)
Collecting mlforecast<0.14,>0.13 (from autogluon.timeseries==1.3.1->autogluon.tim
eseries[all]==1.3.1->autogluon)
  Downloading mlforecast-0.13.6-py3-none-any.whl.metadata (12 kB)
Collecting utilsforecast<0.2.11,>=0.2.3 (from autogluon.timeseries==1.3.1->autogl
uon.timeseries[all]==1.3.1->autogluon)
  Downloading utilsforecast-0.2.10-py3-none-any.whl.metadata (7.4 kB)
Collecting coreforecast<0.0.16,>=0.0.12 (from autogluon.timeseries==1.3.1->autogl
uon.timeseries[all]==1.3.1->autogluon)
  Downloading coreforecast-0.0.15-cp311-cp311-win_amd64.whl.metadata (3.8 kB)
Collecting fugue>=0.9.0 (from autogluon.timeseries==1.3.1->autogluon.timeseries[a
ll]==1.3.1->autogluon)
  Downloading fugue-0.9.1-py3-none-any.whl.metadata (18 kB)
Collecting orjson~3.9 (from autogluon.timeseries==1.3.1->autogluon.timeseries[al
l]==1.3.1->autogluon)
  Downloading orjson-3.10.18-cp311-cp311-win_amd64.whl.metadata (43 kB)
----- 0.0/43.0 kB ? eta -:-:-
----- 43.0/43.0 kB 1.1 MB/s eta 0:00:00
Requirement already satisfied: psutil<7.1.0,>=5.7.3 in c:\anacon\lib\site-package
s (from autogluon.common==1.3.1->autogluon.core==1.3.1->autogluon.core[all]==1.3.
1->autogluon) (5.9.0)
Requirement already satisfied: packaging>=20.0 in c:\anacon\lib\site-packages (fr
om accelerate<2.0,>=0.34.0->autogluon.multimodal==1.3.1->autogluon) (23.1)
Requirement already satisfied: pyyaml in c:\anacon\lib\site-packages (from accele
rate<2.0,>=0.34.0->autogluon.multimodal==1.3.1->autogluon) (6.0.1)
Collecting safetensors>=0.4.3 (from accelerate<2.0,>=0.34.0->autogluon.multimodal
==1.3.1->autogluon)
  Downloading safetensors-0.5.3-cp38-abi3-win_amd64.whl.metadata (3.9 kB)
Collecting boto3<1.39.0,>=1.38.32 (from boto3<2,>=1.10->autogluon.core==1.3.1->
autogluon.core[all]==1.3.1->autogluon)
  Downloading boto3-1.38.32-py3-none-any.whl.metadata (5.7 kB)
Requirement already satisfied: jmespath<2.0.0,>=0.7.1 in c:\anacon\lib\site-packa
ges (from boto3<2,>=1.10->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->auto
gluon) (1.0.1)
Collecting s3transfer<0.14.0,>=0.13.0 (from boto3<2,>=1.10->autogluon.core==1.3.1
->autogluon.core[all]==1.3.1->autogluon)
  Downloading s3transfer-0.13.0-py3-none-any.whl.metadata (1.7 kB)
Requirement already satisfied: graphviz in c:\anacon\lib\site-packages (from catb
oost<1.3,>=1.2->autogluon.tabular[all]==1.3.1->autogluon) (0.20.3)
Requirement already satisfied: plotly in c:\anacon\lib\site-packages (from catboo
st<1.3,>=1.2->autogluon.tabular[all]==1.3.1->autogluon) (5.9.0)
Requirement already satisfied: six in c:\anacon\lib\site-packages (from catboost<
1.3,>=1.2->autogluon.tabular[all]==1.3.1->autogluon) (1.16.0)
Collecting datasets>=2.0.0 (from evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.
3.1->autogluon)
  Downloading datasets-3.6.0-py3-none-any.whl.metadata (19 kB)
Requirement already satisfied: dill in c:\anacon\lib\site-packages (from evaluate
<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->autogluon) (0.3.7)
Collecting xxhash (from evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->auto

```



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gluon)
  Downloading xxhash-3.5.0-cp311-cp311-win_amd64.whl.metadata (13 kB)
Collecting multiprocessing (from evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading multiprocessing-0.70.18-py311-none-any.whl.metadata (7.5 kB)
Requirement already satisfied: fsspec>=2021.05.0 in c:\anacon\lib\site-packages (from fsspec[http]>=2021.05.0->evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->autogluon) (2023.10.0)
Requirement already satisfied: pip in c:\anacon\lib\site-packages (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon) (23.3.1)
Collecting fastdownload<2,>=0.0.5 (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading fastdownload-0.0.7-py3-none-any.whl.metadata (5.5 kB)
Collecting fastcore<1.9,>=1.8.0 (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading fastcore-1.8.2-py3-none-any.whl.metadata (3.7 kB)
Collecting fasttransform>=0.0.2 (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading fasttransform-0.0.2-py3-none-any.whl.metadata (7.6 kB)
Collecting fastprogress>=0.2.4 (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading fastprogress-1.0.3-py3-none-any.whl.metadata (5.6 kB)
Collecting plum-dispatch (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading plum_dispatch-2.5.7-py3-none-any.whl.metadata (7.5 kB)
Requirement already satisfied: cloudpickle in c:\anacon\lib\site-packages (from fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon) (2.2.1)
Collecting triad>=0.9.7 (from fugue>=0.9.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)
  Downloading triad-0.9.8-py3-none-any.whl.metadata (6.3 kB)
Collecting adagio>=0.2.4 (from fugue>=0.9.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)
  Downloading adagio-0.2.6-py3-none-any.whl.metadata (1.8 kB)
Requirement already satisfied: pydantic<3,>=1.7 in c:\anacon\lib\site-packages (from gluonts<0.17,>=0.15.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (1.10.12)
Requirement already satisfied: toolz~0.10 in c:\anacon\lib\site-packages (from gluonts<0.17,>=0.15.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (0.12.0)
Requirement already satisfied: typing-extensions~4.0 in c:\anacon\lib\site-packages (from gluonts<0.17,>=0.15.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (4.9.0)
Requirement already satisfied: future in c:\anacon\lib\site-packages (from hyperopt<0.2.8,>=0.2.7->autogluon.core[all]==1.3.1->autogluon) (0.18.3)
Collecting py4j (from hyperopt<0.2.8,>=0.2.7->autogluon.core[all]==1.3.1->autogluon)
  Downloading py4j-0.10.9.9-py2.py3-none-any.whl.metadata (1.3 kB)
Requirement already satisfied: MarkupSafe>=2.0 in c:\anacon\lib\site-packages (from jinja2<3.2,>=3.0.3->autogluon.multimodal==1.3.1->autogluon) (2.1.3)
Requirement already satisfied: attrs>=22.2.0 in c:\anacon\lib\site-packages (from jsonschema<4.24,>=4.18->autogluon.multimodal==1.3.1->autogluon) (23.1.0)
Requirement already satisfied: jsonschema-specifications>=2023.03.6 in c:\anacon\lib\site-packages (from jsonschema<4.24,>=4.18->autogluon.multimodal==1.3.1->autogluon) (2023.7.1)
Requirement already satisfied: referencing>=0.28.4 in c:\anacon\lib\site-packages (from jsonschema<4.24,>=4.18->autogluon.multimodal==1.3.1->autogluon) (0.30.2)
Requirement already satisfied: rpds-py>=0.7.1 in c:\anacon\lib\site-packages (from jsonschema<4.24,>=4.18->autogluon.multimodal==1.3.1->autogluon) (0.10.6)
Collecting lightning-utilities<2.0,>=0.10.0 (from lightning<2.7,>=2.2->autogluon.multimodal==1.3.1->autogluon)

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Downloading lightning_utilities-0.14.3-py3-none-any.whl.metadata (5.6 kB)
Requirement already satisfied: contourpy>=1.0.1 in c:\anacon\lib\site-packages (f
rom matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->a
utogluon) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\anacon\lib\site-packages (from
matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autog
luon) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\anacon\lib\site-packages
(from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1-
>autogluon) (4.25.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\anacon\lib\site-packages
(from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1-
>autogluon) (1.4.4)
Requirement already satisfied: pyparsing>=2.3.1 in c:\anacon\lib\site-packages (f
rom matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->a
utogluon) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\anacon\lib\site-package
s (from matplotlib<3.11,>=3.7.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.
1->autogluon) (2.8.2)
Requirement already satisfied: numba in c:\anacon\lib\site-packages (from mlforec
ast<0.14,>0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->au
togluon) (0.59.0)
Collecting optuna (from mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->autog
luon.timeseries[all]==1.3.1->autogluon)
  Downloading optuna-4.3.0-py3-none-any.whl.metadata (17 kB)
Collecting window-ops (from mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->a
utogluon.timeseries[all]==1.3.1->autogluon)
  Downloading window_ops-0.0.15-py3-none-any.whl.metadata (6.8 kB)
Collecting gdown>=4.0.0 (from nlpaug<1.2.0,>=1.1.10->autogluon.multimodal==1.3.1-
>autogluon)
  Downloading gdown-5.2.0-py3-none-any.whl.metadata (5.8 kB)
Requirement already satisfied: click in c:\anacon\lib\site-packages (from nltk<3.
9,>=3.4.5->autogluon.multimodal==1.3.1->autogluon) (8.1.7)
Requirement already satisfied: regex>=2021.8.3 in c:\anacon\lib\site-packages (fr
om nltk<3.9,>=3.4.5->autogluon.multimodal==1.3.1->autogluon) (2023.10.3)
Collecting antlr4-python3-runtime==4.9.* (from omegaconf<2.4.0,>=2.1.1->autogluo
n.multimodal==1.3.1->autogluon)
  Downloading antlr4-python3-runtime-4.9.3.tar.gz (117 kB)
----- 0.0/117.0 kB ? eta -:-:--
----- 117.0/117.0 kB ? eta 0:00:00
Preparing metadata (setup.py): started
Preparing metadata (setup.py): finished with status 'done'
Requirement already satisfied: colorama in c:\anacon\lib\site-packages (from open
mim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (0.4.6)
Collecting model-index (from openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->
autogluon)
  Downloading model_index-0.1.11-py3-none-any.whl.metadata (3.9 kB)
Collecting opendatalab (from openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->
autogluon)
  Downloading opendatalab-0.0.10-py3-none-any.whl.metadata (6.4 kB)
Requirement already satisfied: rich in c:\anacon\lib\site-packages (from openmim<
0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (13.3.5)
Requirement already satisfied: tabulate in c:\anacon\lib\site-packages (from open
mim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (0.9.0)
Requirement already satisfied: pytz>=2020.1 in c:\anacon\lib\site-packages (from
pandas<2.3.0,>=2.0.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluo
n) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in c:\anacon\lib\site-packages (fro
m pandas<2.3.0,>=2.0.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogl
uon) (2023.3)

```

Requirement already satisfied: filelock in c:\anacon\lib\site-packages (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (3.13.1)

Requirement already satisfied: msgpack<2.0.0,>=1.0.0 in c:\anacon\lib\site-packages (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (1.0.3)

Requirement already satisfied: protobuf!=3.19.5,>=3.15.3 in c:\anacon\lib\site-packages (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (3.20.3)

Requirement already satisfied: aiosignal in c:\anacon\lib\site-packages (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (1.2.0)

Requirement already satisfied: frozenlist in c:\anacon\lib\site-packages (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (1.4.0)

Requirement already satisfied: aiohttp>=3.7 in c:\anacon\lib\site-packages (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (3.9.3)

Collecting aiohttp_cors (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading aiohttp_cors-0.8.1-py3-none-any.whl.metadata (20 kB)

Collecting colorful (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading colorful-0.5.6-py2.py3-none-any.whl.metadata (16 kB)

Collecting py-spy>=0.2.0 (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading py_spy-0.4.0-py2.py3-none-win_amd64.whl.metadata (16 kB)

Collecting grpcio>=1.42.0 (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading grpcio-1.73.0-cp311-cp311-win_amd64.whl.metadata (4.0 kB)

Collecting opencensus (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading opencensus-0.11.4-py2.py3-none-any.whl.metadata (12 kB)

Requirement already satisfied: prometheus_client>=0.7.1 in c:\anacon\lib\site-packages (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (0.14.1)

Requirement already satisfied: smart_open in c:\anacon\lib\site-packages (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (5.2.1)

Collecting virtualenv!=20.21.1,>=20.0.24 (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading virtualenv-20.31.2-py3-none-any.whl.metadata (4.5 kB)

Collecting tensorboardX>=1.9 (from ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading tensorboardX-2.6.2.2-py2.py3-none-any.whl.metadata (5.8 kB)

Requirement already satisfied: charset-normalizer<4,>=2 in c:\anacon\lib\site-packages (from requests->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (2.0.4)

Requirement already satisfied: idna<4,>=2.5 in c:\anacon\lib\site-packages (from requests->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (3.4)

Requirement already satisfied: urllib3<3,>=1.21.1 in c:\anacon\lib\site-packages (from requests->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (2.0.7)

Requirement already satisfied: certifi>=2017.4.17 in c:\anacon\lib\site-packages (from requests->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon) (2024.2.2)

Requirement already satisfied: imageio>=2.27 in c:\anacon\lib\site-packages (from scikit-image<0.26.0,>=0.19.1->autogluon.multimodal==1.3.1->autogluon) (2.33.1)

Requirement already satisfied: tifffile>=2022.8.12 in c:\anacon\lib\site-packages (from scikit-image<0.26.0,>=0.19.1->autogluon.multimodal==1.3.1->autogluon) (202

3.4.12)

Requirement already satisfied: lazy_loader>=0.3 in c:\anacon\lib\site-packages (from scikit-image<0.26.0,>=0.19.1->autogluon.multimodal==1.3.1->autogluon) (0.3)

Collecting threadpoolctl>=3.1.0 (from scikit-learn<1.7.0,>=1.4.0->autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)

Downloading threadpoolctl-3.6.0-py3-none-any.whl.metadata (13 kB)

Collecting spacy-legacy<3.1.0,>=3.0.11 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading spacy_legacy-3.0.12-py2.py3-none-any.whl.metadata (2.8 kB)

Collecting spacy-loggers<2.0.0,>=1.0.0 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading spacy_loggers-1.0.5-py3-none-any.whl.metadata (23 kB)

Collecting murmurhash<1.1.0,>=0.28.0 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading murmurhash-1.0.13-cp311-cp311-win_amd64.whl.metadata (2.2 kB)

Collecting cymem<2.1.0,>=2.0.2 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading cymem-2.0.11-cp311-cp311-win_amd64.whl.metadata (8.8 kB)

Collecting preshed<3.1.0,>=3.0.2 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading preshed-3.0.10-cp311-cp311-win_amd64.whl.metadata (2.5 kB)

Collecting thinc<8.4.0,>=8.3.4 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading thinc-8.3.6-cp311-cp311-win_amd64.whl.metadata (15 kB)

Collecting wasabi<1.2.0,>=0.9.1 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading wasabi-1.1.3-py3-none-any.whl.metadata (28 kB)

Collecting srsly<3.0.0,>=2.4.3 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading srsly-2.5.1-cp311-cp311-win_amd64.whl.metadata (20 kB)

Collecting catalogue<2.1.0,>=2.0.6 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading catalogue-2.0.10-py3-none-any.whl.metadata (14 kB)

Collecting weasel<0.5.0,>=0.1.0 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading weasel-0.4.1-py3-none-any.whl.metadata (4.6 kB)

Collecting typer<1.0.0,>=0.3.0 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading typer-0.16.0-py3-none-any.whl.metadata (15 kB)

Requirement already satisfied: setuptools in c:\anacon\lib\site-packages (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon) (68.2.2)

Collecting langcodes<4.0.0,>=3.2.0 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading langcodes-3.5.0-py3-none-any.whl.metadata (29 kB)

Requirement already satisfied: statsmodels>=0.13.2 in c:\anacon\lib\site-packages (from statsforecast<2.0.2,>=1.7.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (0.14.0)

Collecting absl-py>=0.4 (from tensorboard<3,>=2.9->autogluon.multimodal==1.3.1->autogluon)

Downloading absl_py-2.3.0-py3-none-any.whl.metadata (2.4 kB)

Requirement already satisfied: markdown>=2.6.8 in c:\anacon\lib\site-packages (from tensorboard<3,>=2.9->autogluon.multimodal==1.3.1->autogluon) (3.4.1)

Collecting tensorboard-data-server<0.8.0,>=0.7.0 (from tensorboard<3,>=2.9->autogluon.multimodal==1.3.1->autogluon)

Downloading tensorboard_data_server-0.7.2-py3-none-any.whl.metadata (1.1 kB)

Requirement already satisfied: werkzeug>=1.0.1 in c:\anacon\lib\site-packages (from tensorboard<3,>=2.9->autogluon.multimodal==1.3.1->autogluon) (2.2.3)

Collecting typing-extensions~4.0 (from gluonts<0.17,>=0.15.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)

Downloading typing_extensions-4.14.0-py3-none-any.whl.metadata (3.0 kB)

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Collecting sympy==1.13.1 (from torch<2.7,>=2.2->autogluon.multimodal==1.3.1->autogluon)
  Downloading sympy-1.13.1-py3-none-any.whl.metadata (12 kB)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in c:\anacon\lib\site-packages (from sympy==1.13.1->torch<2.7,>=2.2->autogluon.multimodal==1.3.1->autogluon) (1.3.0)
Collecting tokenizers<0.22,>=0.21 (from transformers<4.50,>=4.38.0->transformers[sentencepiece]<4.50,>=4.38.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading tokenizers-0.21.1-cp39-abi3-win_amd64.whl.metadata (6.9 kB)
Collecting sentencepiece!=0.1.92,>=0.1.91 (from transformers[sentencepiece]<4.50,>=4.38.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading sentencepiece-0.2.0-cp311-cp311-win_amd64.whl.metadata (8.3 kB)
Requirement already satisfied: multidict<7.0,>=4.5 in c:\anacon\lib\site-packages (from aiohttp>=3.7->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (6.0.4)
Requirement already satisfied: yarll<2.0,>=1.0 in c:\anacon\lib\site-packages (from aiohttp>=3.7->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (1.9.3)
Collecting requests (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)
  Downloading requests-2.32.3-py3-none-any.whl.metadata (4.6 kB)
Collecting tqdm<5,>=4.38 (from autogluon.core==1.3.1->autogluon.core[all]==1.3.1->autogluon)
  Downloading tqdm-4.67.1-py3-none-any.whl.metadata (57 kB)
----- 0.0/57.7 kB ? eta -:-:-
----- 57.7/57.7 kB 3.0 MB/s eta 0:00:00
Collecting multiprocessing (from evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading multiprocessing-0.70.16-py311-none-any.whl.metadata (7.2 kB)
Requirement already satisfied: beautifulsoup4 in c:\anacon\lib\site-packages (from gdown>=4.0.0->nlpaug<1.2.0,>=1.1.10->autogluon.multimodal==1.3.1->autogluon) (4.12.2)
Collecting language-data>=1.2 (from langcodes<4.0.0,>=3.2.0->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading language_data-1.3.0-py3-none-any.whl.metadata (4.3 kB)
Collecting dill (from evaluate<0.5.0,>=0.4.0->autogluon.multimodal==1.3.1->autogluon)
  Downloading dill-0.3.8-py3-none-any.whl.metadata (10 kB)
Requirement already satisfied: llvmlite<0.43,>=0.42.0dev0 in c:\anacon\lib\site-packages (from numba->mlforecast<0.14,>=0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (0.42.0)
Requirement already satisfied: patsy>=0.5.2 in c:\anacon\lib\site-packages (from statsmodels>=0.13.2->statsforecast<2.0.2,>=1.7.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (0.5.3)
Collecting blis<1.4.0,>=1.3.0 (from thinc<8.4.0,>=8.3.4->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading blis-1.3.0-cp311-cp311-win_amd64.whl.metadata (7.6 kB)
Collecting confection<1.0.0,>=0.0.1 (from thinc<8.4.0,>=8.3.4->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading confection-0.1.5-py3-none-any.whl.metadata (19 kB)
INFO: pip is looking at multiple versions of thinc to determine which version is compatible with other requirements. This could take a while.
Collecting thinc<8.4.0,>=8.3.4 (from spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading thinc-8.3.4-cp311-cp311-win_amd64.whl.metadata (15 kB)
Collecting blis<1.3.0,>=1.2.0 (from thinc<8.4.0,>=8.3.4->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading blis-1.2.1-cp311-cp311-win_amd64.whl.metadata (7.6 kB)
Collecting fs (from triad>=0.9.7->fugue>=0.9.0->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)

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Downloading fs-2.4.16-py2.py3-none-any.whl.metadata (6.3 kB)
Collecting shellingham>=1.3.0 (from typer<1.0.0,>=0.3.0->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading shellingham-1.5.4-py2.py3-none-any.whl.metadata (3.5 kB)
Requirement already satisfied: markdown-it-py<3.0.0,>=2.2.0 in c:\anacon\lib\site-packages (from rich->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (2.2.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in c:\anacon\lib\site-packages (from rich->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (2.15.1)
Collecting distlib<1,>=0.3.7 (from virtualenv!=20.21.1,>=20.0.24->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading distlib-0.3.9-py2.py3-none-any.whl.metadata (5.2 kB)
Requirement already satisfied: platformdirs<5,>=3.9.1 in c:\anacon\lib\site-packages (from virtualenv!=20.21.1,>=20.0.24->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon) (3.10.0)
Collecting cloudpathlib<1.0.0,>=0.7.0 (from weasel<0.5.0,>=0.1.0->spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)

Downloading cloudpathlib-0.21.1-py3-none-any.whl.metadata (14 kB)
Collecting ordered-set (from model-index->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon)

Downloading ordered_set-4.1.0-py3-none-any.whl.metadata (5.3 kB)
Collecting opencensus-context>=0.1.3 (from opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading opencensus_context-0.1.3-py2.py3-none-any.whl.metadata (3.3 kB)
Collecting google-api-core<3.0.0,>=1.0.0 (from opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading google_api_core-2.25.0-py3-none-any.whl.metadata (3.0 kB)
Collecting pycryptodome (from opendatalab->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon)

Downloading pycryptodome-3.23.0-cp37-abi3-win_amd64.whl.metadata (3.5 kB)
Collecting openxlab (from opendatalab->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon)

Downloading openxlab-0.1.2-py3-none-any.whl.metadata (3.8 kB)
Requirement already satisfied: pywin32 in c:\anacon\lib\site-packages (from opendatalab->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.3.1->autogluon) (305.1)
Collecting alembic>=1.5.0 (from optuna->mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)

Downloading alembic-1.16.1-py3-none-any.whl.metadata (7.3 kB)
Collecting colorlog (from optuna->mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)

Downloading colorlog-6.9.0-py3-none-any.whl.metadata (10 kB)
Requirement already satisfied: sqlalchemy>=1.4.2 in c:\anacon\lib\site-packages (from optuna->mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon) (2.0.25)
Requirement already satisfied: tenacity>=6.2.0 in c:\anacon\lib\site-packages (from plotly->catboost<1.3,>=1.2->autogluon.tabular[all]==1.3.1->autogluon) (8.2.2)
Collecting beartype>=0.16.2 (from plum-dispatch->fastai<2.9,>=2.3.1->autogluon.tabular[all]==1.3.1->autogluon)

Downloading beartype-0.21.0-py3-none-any.whl.metadata (33 kB)
Collecting Mako (from alembic>=1.5.0->optuna->mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1->autogluon.timeseries[all]==1.3.1->autogluon)

Downloading mako-1.3.10-py3-none-any.whl.metadata (2.9 kB)
Collecting googleapis-common-protos<2.0.0,>=1.56.2 (from google-api-core<3.0.0,>=1.0.0->opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

Downloading googleapis_common_protos-1.70.0-py3-none-any.whl.metadata (9.3 kB)
Collecting proto-plus<2.0.0,>=1.22.3 (from google-api-core<3.0.0,>=1.0.0->opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autogluon)

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Downloading proto_plus-1.26.1-py3-none-any.whl.metadata (2.2 kB)
Collecting google-auth<3.0.0,>=2.14.1 (from google-api-core<3.0.0,>=1.0.0->opence
nsus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1
->autogluon)
  Downloading google_auth-2.40.3-py2.py3-none-any.whl.metadata (6.2 kB)
Collecting marisa-trie>=1.1.0 (from language-data>=1.2->langcodes<4.0.0,>=3.2.0->
spacy<3.9->autogluon.tabular[all]==1.3.1->autogluon)
  Downloading marisa_trie-1.2.1-cp311-cp311-win_amd64.whl.metadata (9.3 kB)
Requirement already satisfied: mdurl~0.1 in c:\anacon\lib\site-packages (from ma
rkdown-it-py<3.0.0,>=2.2.0->rich->openmim<0.4.0,>=0.3.7->autogluon.multimodal==1.
3.1->autogluon) (0.1.0)
Requirement already satisfied: greenlet!=0.4.17 in c:\anacon\lib\site-packages (f
rom sqlalchemy>=1.4.2->optuna->mlforecast<0.14,>0.13->autogluon.timeseries==1.3.1
->autogluon.timeseries[all]==1.3.1->autogluon) (3.0.1)
Requirement already satisfied: soupsieve>1.2 in c:\anacon\lib\site-packages (from
beautifulsoup4->gdown>=4.0.0->nlpaug<1.2.0,>=1.1.10->autogluon.multimodal==1.3.1-
>autogluon) (2.5)
Requirement already satisfied: appdirs~1.4.3 in c:\anacon\lib\site-packages (fro
m fs->triad>=0.9.7->fugue>=0.9.0->autogluon.timeseries==1.3.1->autogluon.timeseri
es[all]==1.3.1->autogluon) (1.4.4)
Collecting filelock (from ray<2.45,>=2.10.0->ray[default]<2.45,>=2.10.0; extra ==
"all"->autogluon.core[all]==1.3.1->autogluon)
  Downloading filelock-3.14.0-py3-none-any.whl.metadata (2.8 kB)
Collecting oss2~2.17.0 (from openxlab->opendatalab->openmim<0.4.0,>=0.3.7->autog
luon.multimodal==1.3.1->autogluon)
  Downloading oss2-2.17.0.tar.gz (259 kB)
----- 0.0/259.5 kB ? eta -:-:-
----- 112.6/259.5 kB 6.8 MB/s eta 0:00:01
----- 259.5/259.5 kB 4.0 MB/s eta 0:00:00
Preparing metadata (setup.py): started
Preparing metadata (setup.py): finished with status 'done'
Collecting packaging>=20.0 (from accelerate<2.0,>=0.34.0->autogluon.multimodal==
1.3.1->autogluon)
  Downloading packaging-24.2-py3-none-any.whl.metadata (3.2 kB)
INFO: pip is looking at multiple versions of openxlab to determine which version
is compatible with other requirements. This could take a while.
Collecting openxlab (from opendatalab->openmim<0.4.0,>=0.3.7->autogluon.multimoda
l==1.3.1->autogluon)
  Downloading openxlab-0.1.1-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.1.0-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.38-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.37-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.36-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.35-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.34-py3-none-any.whl.metadata (3.8 kB)
INFO: pip is still looking at multiple versions of openxlab to determine which ve
rsion is compatible with other requirements. This could take a while.
  Downloading openxlab-0.0.33-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.32-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.31-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.30-py3-none-any.whl.metadata (3.8 kB)
  Downloading openxlab-0.0.29-py3-none-any.whl.metadata (3.8 kB)
INFO: This is taking longer than usual. You might need to provide the dependency
resolver with stricter constraints to reduce runtime. See https://pip.pypa.io/war
nings/backtracking for guidance. If you want to abort this run, press Ctrl + C.
  Downloading openxlab-0.0.28-py3-none-any.whl.metadata (3.7 kB)
  Downloading openxlab-0.0.27-py3-none-any.whl.metadata (3.7 kB)
  Downloading openxlab-0.0.26-py3-none-any.whl.metadata (3.7 kB)
  Downloading openxlab-0.0.25-py3-none-any.whl.metadata (3.7 kB)
  Downloading openxlab-0.0.24-py3-none-any.whl.metadata (3.7 kB)

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Downloading openxlab-0.0.23-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.22-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.21-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.20-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.19-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.18-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.17-py3-none-any.whl.metadata (3.7 kB)
Downloading openxlab-0.0.16-py3-none-any.whl.metadata (3.8 kB)
Downloading openxlab-0.0.15-py3-none-any.whl.metadata (3.8 kB)
Downloading openxlab-0.0.14-py3-none-any.whl.metadata (3.8 kB)
Downloading openxlab-0.0.13-py3-none-any.whl.metadata (4.5 kB)
Downloading openxlab-0.0.12-py3-none-any.whl.metadata (4.5 kB)
Downloading openxlab-0.0.11-py3-none-any.whl.metadata (4.3 kB)
Requirement already satisfied: PySocks!=1.5.7,>=1.5.6 in c:\anacon\lib\site-packa
ges (from requests[socks]->gdown>=4.0.0->nlpaug<1.2.0,>=1.1.10->autogluon.multimo
dal==1.3.1->autogluon) (1.7.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\anacon\lib\site-packa
ges (from google-auth<3.0.0,>=2.14.1->google-api-core<3.0.0,>=1.0.0->opencensus->
ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->auto
gluon) (4.2.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\anacon\lib\site-packag
es (from google-auth<3.0.0,>=2.14.1->google-api-core<3.0.0,>=1.0.0->opencensus->r
ay[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.core[all]==1.3.1->autog
luon) (0.2.8)
Collecting rsa<5,>=3.1.4 (from google-auth<3.0.0,>=2.14.1->google-api-core<3.0.0,
>=1.0.0->opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.c
ore[all]==1.3.1->autogluon)
Downloading rsa-4.9.1-py3-none-any.whl.metadata (5.6 kB)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\anacon\lib\site-package
s (from pyasn1-modules>=0.2.1->google-auth<3.0.0,>=2.14.1->google-api-core<3.0.0,
>=1.0.0->opencensus->ray[default,tune]<2.45,>=2.10.0; extra == "all"->autogluon.c
ore[all]==1.3.1->autogluon) (0.4.8)
Downloading autogluon-1.3.1-py3-none-any.whl (9.8 kB)
Using cached autogluon.core-1.3.1-py3-none-any.whl (222 kB)
Using cached autogluon.features-1.3.1-py3-none-any.whl (64 kB)
Downloading autogluon.multimodal-1.3.1-py3-none-any.whl (454 kB)
----- 0.0/454.5 kB ? eta -:--:--
----- 450.6/454.5 kB 9.4 MB/s eta 0:00:01
----- 454.5/454.5 kB 7.2 MB/s eta 0:00:00
Using cached autogluon.tabular-1.3.1-py3-none-any.whl (382 kB)
Downloading autogluon.timeseries-1.3.1-py3-none-any.whl (181 kB)
----- 0.0/181.3 kB ? eta -:--:--
----- 92.2/181.3 kB ? eta -:--:--
----- 181.3/181.3 kB 2.8 MB/s eta 0:00:00
Using cached autogluon.common-1.3.1-py3-none-any.whl (69 kB)
Downloading accelerate-1.7.0-py3-none-any.whl (362 kB)
----- 0.0/362.1 kB ? eta -:--:--
----- 41.0/362.1 kB ? eta -:--:--
----- 41.0/362.1 kB ? eta -:--:--
----- 92.2/362.1 kB 871.5 kB/s eta 0:00:01
----- 92.2/362.1 kB 871.5 kB/s eta 0:00:01
----- 163.8/362.1 kB 817.0 kB/s eta 0:00:01
----- 194.6/362.1 kB 737.3 kB/s eta 0:00:01
----- 358.4/362.1 kB 1.2 MB/s eta 0:00:01
----- 362.1/362.1 kB 1.2 MB/s eta 0:00:00
Downloading boto3-1.38.32-py3-none-any.whl (139 kB)
----- 0.0/139.9 kB ? eta -:--:--
----- 10.2/139.9 kB ? eta -:--:--
----- 41.0/139.9 kB 653.6 kB/s eta 0:00:01
----- 133.1/139.9 kB 1.1 MB/s eta 0:00:01

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----- 139.9/139.9 kB 1.0 MB/s eta 0:00:00
Downloading coreforecast-0.0.15-cp311-cp311-win_amd64.whl (189 kB)
----- 0.0/189.7 kB ? eta -:--:--
----- 189.7/189.7 kB 5.8 MB/s eta 0:00:00
Downloading einops-0.8.1-py3-none-any.whl (64 kB)
----- 0.0/64.4 kB ? eta -:--:--
----- 64.4/64.4 kB 3.4 MB/s eta 0:00:00
Downloading evaluate-0.4.3-py3-none-any.whl (84 kB)
----- 0.0/84.0 kB ? eta -:--:--
----- 84.0/84.0 kB 2.3 MB/s eta 0:00:00
Downloading fastai-2.8.2-py3-none-any.whl (235 kB)
----- 0.0/235.3 kB ? eta -:--:--
----- 153.6/235.3 kB 4.6 MB/s eta 0:00:01
----- 235.3/235.3 kB 3.6 MB/s eta 0:00:00
Downloading fugue-0.9.1-py3-none-any.whl (278 kB)
----- 0.0/278.2 kB ? eta -:--:--
----- 276.5/278.2 kB 5.7 MB/s eta 0:00:01
----- 278.2/278.2 kB 4.3 MB/s eta 0:00:00
Downloading gluonts-0.16.1-py3-none-any.whl (1.5 MB)
----- 0.0/1.5 MB ? eta -:--:--
----- 0.2/1.5 MB 13.7 MB/s eta 0:00:01
----- 0.5/1.5 MB 5.8 MB/s eta 0:00:01
----- 1.0/1.5 MB 8.0 MB/s eta 0:00:01
----- 1.5/1.5 MB 8.8 MB/s eta 0:00:01
----- 1.5/1.5 MB 8.1 MB/s eta 0:00:00
Downloading hyperopt-0.2.7-py2.py3-none-any.whl (1.6 MB)
----- 0.0/1.6 MB ? eta -:--:--
----- 0.7/1.6 MB 15.1 MB/s eta 0:00:01
----- 1.6/1.6 MB 16.8 MB/s eta 0:00:01
----- 1.6/1.6 MB 12.6 MB/s eta 0:00:00
Downloading lightning-2.5.1.post0-py3-none-any.whl (819 kB)
----- 0.0/819.0 kB ? eta -:--:--
----- 819.0/819.0 kB 26.1 MB/s eta 0:00:00
Downloading mlforecast-0.13.6-py3-none-any.whl (71 kB)
----- 0.0/71.4 kB ? eta -:--:--
----- 71.4/71.4 kB 3.8 MB/s eta 0:00:00
Downloading nlpaug-1.1.11-py3-none-any.whl (410 kB)
----- 0.0/410.5 kB ? eta -:--:--
----- 410.5/410.5 kB 26.7 MB/s eta 0:00:00
Downloading omegaconf-2.3.0-py3-none-any.whl (79 kB)
----- 0.0/79.5 kB ? eta -:--:--
----- 79.5/79.5 kB 4.6 MB/s eta 0:00:00
Downloading openmim-0.3.9-py2.py3-none-any.whl (52 kB)
----- 0.0/52.7 kB ? eta -:--:--
----- 52.7/52.7 kB 2.7 MB/s eta 0:00:00
Downloading orjson-3.10.18-cp311-cp311-win_amd64.whl (134 kB)
----- 0.0/134.6 kB ? eta -:--:--
----- 134.6/134.6 kB 7.8 MB/s eta 0:00:00
Downloading pdf2image-1.17.0-py3-none-any.whl (11 kB)
Downloading pyarrow-20.0.0-cp311-cp311-win_amd64.whl (25.8 MB)
----- 0.0/25.8 MB ? eta -:--:--
----- 1.0/25.8 MB 20.9 MB/s eta 0:00:02
----- 2.1/25.8 MB 21.8 MB/s eta 0:00:02
----- 3.1/25.8 MB 24.7 MB/s eta 0:00:01
----- 4.2/25.8 MB 24.1 MB/s eta 0:00:01
----- 5.4/25.8 MB 24.4 MB/s eta 0:00:01
----- 6.4/25.8 MB 22.6 MB/s eta 0:00:01
----- 7.6/25.8 MB 24.2 MB/s eta 0:00:01
----- 8.8/25.8 MB 23.5 MB/s eta 0:00:01
----- 10.0/25.8 MB 23.6 MB/s eta 0:00:01

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----- 10.9/25.8 MB 24.2 MB/s eta 0:00:01
----- 12.3/25.8 MB 25.2 MB/s eta 0:00:01
----- 12.8/25.8 MB 24.3 MB/s eta 0:00:01
----- 12.9/25.8 MB 21.1 MB/s eta 0:00:01
----- 13.1/25.8 MB 19.8 MB/s eta 0:00:01
----- 13.4/25.8 MB 18.7 MB/s eta 0:00:01
----- 14.2/25.8 MB 18.2 MB/s eta 0:00:01
----- 15.1/25.8 MB 17.7 MB/s eta 0:00:01
----- 16.5/25.8 MB 17.7 MB/s eta 0:00:01
----- 17.2/25.8 MB 17.2 MB/s eta 0:00:01
----- 18.7/25.8 MB 17.7 MB/s eta 0:00:01
----- 19.3/25.8 MB 17.7 MB/s eta 0:00:01
----- 20.0/25.8 MB 16.8 MB/s eta 0:00:01
----- 21.0/25.8 MB 16.4 MB/s eta 0:00:01
----- 22.1/25.8 MB 16.8 MB/s eta 0:00:01
----- 23.0/25.8 MB 16.4 MB/s eta 0:00:01
----- 23.6/25.8 MB 19.3 MB/s eta 0:00:01
----- 24.1/25.8 MB 19.9 MB/s eta 0:00:01
----- 25.8/25.8 MB 20.5 MB/s eta 0:00:01
----- 25.8/25.8 MB 19.8 MB/s eta 0:00:01
----- 25.8/25.8 MB 19.8 MB/s eta 0:00:01
----- 25.8/25.8 MB 16.8 MB/s eta 0:00:00
Downloading pytesseract-0.3.13-py3-none-any.whl (14 kB)
Downloading pytorch_metric_learning-2.8.1-py3-none-any.whl (125 kB)
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----- 0.0/64.9 kB ? eta -:--:--
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Downloading tqdm-4.67.1-py3-none-any.whl (78 kB)
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Downloading fastcore-1.8.2-py3-none-any.whl (78 kB)
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Downloading fastdownload-0.0.7-py3-none-any.whl (12 kB)
Downloading fastprogress-1.0.3-py3-none-any.whl (12 kB)
Downloading fasttransform-0.0.2-py3-none-any.whl (14 kB)
Downloading gdown-5.2.0-py3-none-any.whl (18 kB)
Downloading grpcio-1.73.0-cp311-cp311-win_amd64.whl (4.3 MB)
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----- 1.8/4.3 MB 56.2 MB/s eta 0:00:01
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----- 4.0/4.3 MB 23.3 MB/s eta 0:00:01
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Downloading huggingface_hub-0.32.4-py3-none-any.whl (512 kB)
----- 0.0/512.1 kB ? eta -:--:--
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Downloading langcodes-3.5.0-py3-none-any.whl (182 kB)
----- 0.0/183.0 kB ? eta -:--:--
----- 183.0/183.0 kB 5.6 MB/s eta 0:00:00
Downloading lightning_utilities-0.14.3-py3-none-any.whl (28 kB)
Downloading multiprocessing-0.70.16-py311-none-any.whl (143 kB)
----- 0.0/143.5 kB ? eta -:--:--
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Downloading dill-0.3.8-py3-none-any.whl (116 kB)
----- 0.0/116.3 kB ? eta -:--:--
----- 116.3/116.3 kB ? eta 0:00:00
Downloading murmurhash-1.0.13-cp311-cp311-win_amd64.whl (24 kB)
Downloading preshed-3.0.10-cp311-cp311-win_amd64.whl (117 kB)
----- 0.0/117.7 kB ? eta -:--:--
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Downloading py_spy-0.4.0-py2.py3-none-win_amd64.whl (1.8 MB)
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Using cached s3transfer-0.13.0-py3-none-any.whl (85 kB)
Downloading safetensors-0.5.3-cp38-abi3-win_amd64.whl (308 kB)
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Downloading sentencepiece-0.2.0-cp311-cp311-win_amd64.whl (991 kB)
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Downloading spacy_legacy-3.0.12-py2.py3-none-any.whl (29 kB)
Downloading spacy_loggers-1.0.5-py3-none-any.whl (22 kB)
Downloading srsly-2.5.1-cp311-cp311-win_amd64.whl (632 kB)
----- 0.0/632.6 kB ? eta -:--:--
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Downloading tensorboard_data_server-0.7.2-py3-none-any.whl (2.4 kB)
Downloading tensorboardX-2.6.2.2-py2.py3-none-any.whl (101 kB)
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Downloading thinc-8.3.4-cp311-cp311-win_amd64.whl (1.5 MB)
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----- 1.5/1.5 MB 18.7 MB/s eta 0:00:00
Using cached threadpoolctl-3.6.0-py3-none-any.whl (18 kB)
Downloading tokenizers-0.21.1-cp39-abi3-win_amd64.whl (2.4 MB)
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Downloading triad-0.9.8-py3-none-any.whl (62 kB)
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Downloading typer-0.16.0-py3-none-any.whl (46 kB)
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Downloading typing_extensions-4.14.0-py3-none-any.whl (43 kB)
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Downloading virtualenv-20.31.2-py3-none-any.whl (6.1 MB)
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Downloading wasabi-1.1.3-py3-none-any.whl (27 kB)
Downloading weasel-0.4.1-py3-none-any.whl (50 kB)
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Downloading aiohttp_cors-0.8.1-py3-none-any.whl (25 kB)
Downloading colorful-0.5.6-py2.py3-none-any.whl (201 kB)
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Downloading model_index-0.1.11-py3-none-any.whl (34 kB)
Downloading opencensus-0.11.4-py2.py3-none-any.whl (128 kB)
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Downloading opendatalab-0.0.10-py3-none-any.whl (29 kB)
Downloading optuna-4.3.0-py3-none-any.whl (386 kB)
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Downloading plum_dispatch-2.5.7-py3-none-any.whl (42 kB)
----- 0.0/42.6 kB ? eta -:--:--
----- 42.6/42.6 kB 2.0 MB/s eta 0:00:00
Downloading py4j-0.10.9.9-py2.py3-none-any.whl (203 kB)
----- 0.0/203.0 kB ? eta -:--:--
----- 203.0/203.0 kB 12.0 MB/s eta 0:00:00
Downloading window_ops-0.0.15-py3-none-any.whl (15 kB)
Downloading xxhash-3.5.0-cp311-cp311-win_amd64.whl (30 kB)
Downloading alembic-1.16.1-py3-none-any.whl (242 kB)
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Downloading beartype-0.21.0-py3-none-any.whl (1.2 MB)
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----- 6.2/6.2 MB 14.2 MB/s eta 0:00:01
----- 6.2/6.2 MB 13.3 MB/s eta 0:00:00
Downloading cloudpathlib-0.21.1-py3-none-any.whl (52 kB)
----- 0.0/52.8 kB ? eta -:--:--
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Downloading confection-0.1.5-py3-none-any.whl (35 kB)
Downloading distlib-0.3.9-py2.py3-none-any.whl (468 kB)
----- 0.0/469.0 kB ? eta -:--:--
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Downloading google_api_core-2.25.0-py3-none-any.whl (160 kB)
----- 0.0/160.7 kB ? eta -:--:--
----- 160.7/160.7 kB ? eta 0:00:00
Downloading language_data-1.3.0-py3-none-any.whl (5.4 MB)
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----- 2.9/5.4 MB 20.3 MB/s eta 0:00:01
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----- 5.2/5.4 MB 19.6 MB/s eta 0:00:01
----- 5.4/5.4 MB 18.1 MB/s eta 0:00:01
----- 5.4/5.4 MB 16.4 MB/s eta 0:00:00
Downloading opencensus_context-0.1.3-py2.py3-none-any.whl (5.1 kB)
Downloading shellingham-1.5.4-py2.py3-none-any.whl (9.8 kB)
Downloading colorlog-6.9.0-py3-none-any.whl (11 kB)
Downloading fs-2.4.16-py2.py3-none-any.whl (135 kB)
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Downloading openxlab-0.0.11-py3-none-any.whl (55 kB)
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Downloading ordered_set-4.1.0-py3-none-any.whl (7.6 kB)
Downloading pycryptodome-3.23.0-cp37-abi3-win_amd64.whl (1.8 MB)
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Downloading google_auth-2.40.3-py2.py3-none-any.whl (216 kB)
----- 0.0/216.1 kB ? eta -:--:--
----- 216.1/216.1 kB 13.7 MB/s eta 0:00:00
Downloading googleapis_common_protos-1.70.0-py3-none-any.whl (294 kB)
----- 0.0/294.5 kB ? eta -:--:--
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Downloading marisa_trie-1.2.1-cp311-cp311-win_amd64.whl (152 kB)
----- 0.0/152.0 kB ? eta -:--:--
----- 152.0/152.0 kB 9.5 MB/s eta 0:00:00
Downloading proto_plus-1.26.1-py3-none-any.whl (50 kB)
----- 0.0/50.2 kB ? eta -:--:--
----- 50.2/50.2 kB 2.5 MB/s eta 0:00:00
Downloading mako-1.3.10-py3-none-any.whl (78 kB)
----- 0.0/78.5 kB ? eta -:--:--
----- 78.5/78.5 kB 4.3 MB/s eta 0:00:00
Downloading rsa-4.9.1-py3-none-any.whl (34 kB)

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Building wheels for collected packages: nvidia-ml-py3, antlr4-python3-runtime, se
qeval
  Building wheel for nvidia-ml-py3 (setup.py): started
  Building wheel for nvidia-ml-py3 (setup.py): finished with status 'done'
  Created wheel for nvidia-ml-py3: filename=nvidia_ml_py3-7.352.0-py3-none-any.wh
l size=19181 sha256=1e802ef5aab13f96b8265969a2a24d5a9ea08ccfb1eabfe08fca447191b99
d4e
  Stored in directory: c:\users\준서\AppData\Local\Pip\Cache\wheels\47\50\9e\29dc
79037d74c3c1bb4a8661fb608e8674b7e4260d6a3f8f51
  Building wheel for antlr4-python3-runtime (setup.py): started
  Building wheel for antlr4-python3-runtime (setup.py): finished with status 'don
e'
  Created wheel for antlr4-python3-runtime: filename=antlr4_python3_runtime-4.9.3
-py3-none-any.whl size=144578 sha256=7d273a35a579bd95cd8af991ac7d841f808fe7cdcaaf
e008bd0a25c5c391453a
  Stored in directory: c:\users\준서\AppData\Local\Pip\Cache\wheels\1a\97\32\461f
837398029ad76911109f07047fde1d7b661a147c7c56d1
  Building wheel for sequeval (setup.py): started
  Building wheel for sequeval (setup.py): finished with status 'done'
  Created wheel for sequeval: filename=sequeval-1.2.2-py3-none-any.whl size=16185 s
ha256=067532ba36e09f892cf5fdca165a332e841e444a55212bb29418c6f9f64a8df8
  Stored in directory: c:\users\준서\AppData\Local\Pip\Cache\wheels\bc\92\f0\2432
88f899c2eacdfa8c5f9aede4c71a9bad0ee26a01dc5ead
Successfully built nvidia-ml-py3 antlr4-python3-runtime sequeval
Installing collected packages: sentencepiece, py4j, py-spy, opencensus-context, n
vidia-ml-py3, distlib, cymem, antlr4-python3-runtime, xxhash, wasabi, virtualenv,
typing-extensions, tqdm, threadpoolctl, tensorboardX, tensorboard-data-server, sy
mpy, spacy-loggers, spacy-legacy, shellingham, safetensors, rsa, requests, pytess
eract, pycryptodome, pyarrow, proto-plus, pdf2image, orjson, ordered-set, openxla
b, omegaconf, murmurhash, marisa-trie, Mako, grpcio, googleapis-common-protos, f
s, fastprogress, fastcore, einops, dill, coreforecast, colorlog, colorlog, cloudp
athlib, catalogue, blis, beartype, absl-py, window-ops, torch, tensorboard, srsly,
scikit-learn, preshed, multiprocessing, model-index, lightning-utilities, languag
e-data, hyperopt, huggingface-hub, google-auth, fastdownload, botocore, utilsfore
cast, typer, triad, torchvision, torchmetrics, tokenizers, sequeval, s3transfer, p
ytorch-metric-learning, plum-dispatch, opendatalab, langcodes, google-api-core, g
luonts, gdown, confection, alembic, aiohttp-cors, accelerate, weasel, transformers,
timm, thinc, ray, pytorch-lightning, optuna, openmim, opencensus, nlpaug, fast
transform, datasets, boto3, adagio, spacy, mlforecast, lightning, fugue, evaluat
e, autogluon.common, statsforecast, fastai, autogluon.features, autogluon.core, a
utogluon.tabular, autogluon.multimodal, autogluon.timeseries, autogluon
  Attempting uninstall: typing-extensions
    Found existing installation: typing_extensions 4.9.0
    Uninstalling typing_extensions-4.9.0:
      Successfully uninstalled typing_extensions-4.9.0
  Attempting uninstall: tqdm
    Found existing installation: tqdm 4.65.0
    Uninstalling tqdm-4.65.0:
      Successfully uninstalled tqdm-4.65.0
  Attempting uninstall: threadpoolctl
    Found existing installation: threadpoolctl 3.6.0
    Uninstalling threadpoolctl-3.6.0:
      Successfully uninstalled threadpoolctl-3.6.0
  Attempting uninstall: sympy
    Found existing installation: sympy 1.12
    Uninstalling sympy-1.12:
      Successfully uninstalled sympy-1.12
  Attempting uninstall: requests
    Found existing installation: requests 2.31.0
    Uninstalling requests-2.31.0:

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    Successfully uninstalled requests-2.31.0
Attempting uninstall: pyarrow
    Found existing installation: pyarrow 14.0.2
    Uninstalling pyarrow-14.0.2:
        Successfully uninstalled pyarrow-14.0.2
Attempting uninstall: dill
    Found existing installation: dill 0.3.7
    Uninstalling dill-0.3.7:
        Successfully uninstalled dill-0.3.7
Attempting uninstall: scikit-learn
    Found existing installation: scikit-learn 1.6.1
    Uninstalling scikit-learn-1.6.1:
        Successfully uninstalled scikit-learn-1.6.1
Attempting uninstall: botocore
    Found existing installation: botocore 1.38.32
    Uninstalling botocore-1.38.32:
        Successfully uninstalled botocore-1.38.32
Successfully installed Mako-1.3.10 absl-py-2.3.0 accelerate-1.7.0 adagio-0.2.6 ai
ohttp_cors-0.8.1 alembic-1.16.1 antlr4-python3-runtime-4.9.3 autogluon-1.3.1 auto
gluon.common-1.3.1 autogluon.core-1.3.1 autogluon.features-1.3.1 autogluon.multim
odal-1.3.1 autogluon.tabular-1.3.1 autogluon.timeseries-1.3.1 beartype-0.21.0 bli
s-1.2.1 boto3-1.38.32 botocore-1.38.32 catalogue-2.0.10 cloudpathlib-0.21.1 color
ful-0.5.6 colorlog-6.9.0 confection-0.1.5 coreforecast-0.0.15 cymem-2.0.11 datase
ts-3.6.0 dill-0.3.8 distlib-0.3.9 einops-0.8.1 evaluate-0.4.3 fastai-2.8.2 fastco
re-1.8.2 fastdownload-0.0.7 fastprogress-1.0.3 fasttransform-0.0.2 fs-2.4.16 fugu
e-0.9.1 gdown-5.2.0 gluonts-0.16.1 google-api-core-2.25.0 google-auth-2.40.3 goog
leapis-common-protos-1.70.0 grpcio-1.73.0 huggingface-hub-0.32.4 hyperopt-0.2.7 l
angcodes-3.5.0 language-data-1.3.0 lightning-2.5.1.post0 lightning-utilities-0.1
4.3 marisa-trie-1.2.1 mlforecast-0.13.6 model-index-0.1.11 multiprocessing-0.70.16 m
urmurhash-1.0.13 nlpaug-1.1.11 nvidia-ml-py3-7.352.0 omegaconf-2.3.0 opencensus-
0.11.4 opencensus-context-0.1.3 opendatalab-0.0.10 openmim-0.3.9 openxlab-0.0.11
optuna-4.3.0 ordered-set-4.1.0 orjson-3.10.18 pdf2image-1.17.0 plum-dispatch-2.5.
7 preshed-3.0.10 proto-plus-1.26.1 py-spy-0.4.0 py4j-0.10.9.9 pyarrow-20.0.0 pycr
yptodome-3.23.0 pytesseract-0.3.13 pytorch-lightning-2.5.1.post0 pytorch-metric-l
earning-2.8.1 ray-2.44.1 requests-2.32.3 rsa-4.9.1 s3transfer-0.13.0 safetensors-
0.5.3 scikit-learn-1.6.1 sentencepiece-0.2.0 seqeval-1.2.2 shellingham-1.5.4 spac
y-3.8.7 spacy-legacy-3.0.12 spacy-loggers-1.0.5 srsly-2.5.1 statsforecast-2.0.1 s
ympy-1.13.1 tensorboard-2.19.0 tensorboard-data-server-0.7.2 tensorboardX-2.6.2.2
thinc-8.3.4 threadpoolctl-3.6.0 timm-1.0.3 tokenizers-0.21.1 torch-2.6.0 torchmet
rics-1.7.2 torchvision-0.21.0 tqdm-4.67.1 transformers-4.49.0 triad-0.9.8 typer-
0.16.0 typing-extensions-4.14.0 utilsforecast-0.2.10 virtualenv-20.31.2 wasabi-1.
1.3 weasel-0.4.1 window-ops-0.0.15 xxhash-3.5.0

```

```

WARNING: Skipping C:\anacon\Lib\site-packages\~cikit_learn-1.2.2.dist-info due to
invalid metadata entry 'name'
ERROR: pip's dependency resolver does not currently take into account all the pac
kages that are installed. This behaviour is the source of the following dependenc
y conflicts.
conda-repo-cli 1.0.75 requires requests_mock, which is not installed.
aiobotocore 2.7.0 requires botocore<1.31.65,>=1.31.16, but you have botocore 1.3
8.32 which is incompatible.
conda-repo-cli 1.0.75 requires clyent==1.2.1, but you have clyent 1.2.2 which is
incompatible.
conda-repo-cli 1.0.75 requires requests==2.31.0, but you have requests 2.32.3 whi
ch is incompatible.
    -1.2857 = Validation score    (-root_mean_squared_error)
    289.06s = Training    runtime
    0.01s   = Validation runtime
Fitting model: ExtraTreesMSE ...
    -1.9188 = Validation score    (-root_mean_squared_error)
    2.99s   = Training    runtime
    0.27s   = Validation runtime
Fitting model: NeuralNetFastAI ...
    Warning: Exception caused NeuralNetFastAI to fail during training (Import
Error)... Skipping this model.
            cannot import name 'TypeIs' from 'typing_extensions' (C:\anacon\L
ib\site-packages\typing_extensions.py)
Fitting model: XGBoost ...
    -1.6097 = Validation score    (-root_mean_squared_error)
    4.85s   = Training    runtime
    0.01s   = Validation runtime
Fitting model: NeuralNetTorch ...
    Warning: Exception caused NeuralNetTorch to fail during training (ImportE
rror)... Skipping this model.
            Unable to import dependency torch
A quick tip is to install via `pip install torch`.
The minimum torch version is currently 2.2.
Fitting model: LightGBMLarge ...
[1000] valid_set's rmse: 1.81557
[2000] valid_set's rmse: 1.81246
    -1.8124 = Validation score    (-root_mean_squared_error)
    45.06s  = Training    runtime
    0.05s   = Validation runtime
Fitting model: WeightedEnsemble_L2 ...
    Ensemble Weights: {'CatBoost': 1.0}
    -1.2857 = Validation score    (-root_mean_squared_error)
    0.07s   = Training    runtime
    0.0s    = Validation runtime
AutoGluon training complete, total runtime = 445.9s ... Best model: WeightedEnsem
ble_L2 | Estimated inference throughput: 19767.5 rows/s (226 batch size)
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("C:\Users
\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250609_163129")
{'root_mean_squared_error': -1.383786388410564, 'mean_squared_error': -1.91486476
87503517, 'mean_absolute_error': -0.9338936006261946, 'r2': 0.9598437399593697,
'pearsonr': 0.9798736877423885, 'median_absolute_error': -0.6110858764648412}

```

```
In [18]: predictor.leaderboard(test_data, silent=True)
```

Out[18]:

	model	score_test	score_val	eval_metric	pred_time_test
0	CatBoost	-1.383786	-1.285719	root_mean_squared_error	0.100339
1	WeightedEnsemble_L2	-1.383786	-1.285719	root_mean_squared_error	0.117714
2	LightGBM	-1.681652	-1.602918	root_mean_squared_error	0.460787
3	XGBoost	-1.770830	-1.609658	root_mean_squared_error	0.291502
4	LightGBMLarge	-1.826052	-1.812415	root_mean_squared_error	0.567327
5	LightGBMXT	-1.831408	-1.619263	root_mean_squared_error	1.184950
6	ExtraTreesMSE	-1.896022	-1.918812	root_mean_squared_error	0.268137
7	RandomForestMSE	-1.996238	-2.007346	root_mean_squared_error	0.304966
8	KNeighborsUnif	-6.151130	-5.864178	root_mean_squared_error	0.047666
9	KNeighborsDist	-6.511095	-6.349304	root_mean_squared_error	0.033918



In [4]:

```
from autogluon.tabular import TabularPredictor

# 예: predictor가 저장된 경로가 "AutogluonModels/ag-20240613_123456"
predictor = TabularPredictor.load("AutogluonModels/ag-20250609_163129")
```

In [6]:

```
predictor.leaderboard(silent=True)
```

Out[6]:

	model	score_val	eval_metric	pred_time_val	fit_time
0	WeightedEnsemble_L2	-1.285719	root_mean_squared_error	0.011433	289.125550
1	CatBoost	-1.285719	root_mean_squared_error	0.011433	289.056157
2	LightGBM	-1.602918	root_mean_squared_error	0.091124	29.437424
3	XGBoost	-1.609658	root_mean_squared_error	0.011881	4.850249
4	LightGBMXT	-1.619263	root_mean_squared_error	0.195550	62.883052
5	LightGBMLarge	-1.812415	root_mean_squared_error	0.047870	45.063404
6	ExtraTreesMSE	-1.918812	root_mean_squared_error	0.273062	2.991720
7	RandomForestMSE	-2.007346	root_mean_squared_error	0.158216	2.611996
8	KNeighborsUnif	-5.864178	root_mean_squared_error	0.045999	0.019792
9	KNeighborsDist	-6.349304	root_mean_squared_error	0.034532	0.007371



In [32]:

```
model_names = ['KNeighborsUnif', 'RandomForestMSE']

for model_name in model_names:
    model_obj = predictor._trainer.load_model(model_name)

    print(f"Model: {model_name}")
    print(model_obj.model.get_params())
```

```

Model: KNeighborsUnif
{'algorithm': 'auto', 'leaf_size': 30, 'metric': 'minkowski', 'metric_params': No
ne, 'n_jobs': 12, 'n_neighbors': 5, 'p': 2, 'weights': 'uniform'}
Model: RandomForestMSE
{'bootstrap': True, 'ccp_alpha': 0.0, 'criterion': 'squared_error', 'max_depth':
None, 'max_features': 1.0, 'max_leaf_nodes': 15000, 'max_samples': None, 'min_imp
urity_decrease': 0.0, 'min_samples_leaf': 1, 'min_samples_split': 2, 'min_weight_
fraction_leaf': 0.0, 'monotonic_cst': None, 'n_estimators': 300, 'n_jobs': -1, 'o
ob_score': False, 'random_state': 0, 'verbose': 0, 'warm_start': False}

```

```

In [3]: from ucimlrepo import fetch_ucirepo
import pandas as pd

# fetch dataset
airfoil_self_noise = fetch_ucirepo(id=291)

# data (as pandas dataframes)
X = airfoil_self_noise.data.features
y = airfoil_self_noise.data.targets

airfoil = pd.concat([X,y], axis=1)

airfoil

```

Out[3]:

	frequency	attack- angle	chord- length	free- stream- velocity	suction-side- displacement- thickness	scaled- sound- pressure
0	800	0.0	0.3048	71.3	0.002663	126.201
1	1000	0.0	0.3048	71.3	0.002663	125.201
2	1250	0.0	0.3048	71.3	0.002663	125.951
3	1600	0.0	0.3048	71.3	0.002663	127.591
4	2000	0.0	0.3048	71.3	0.002663	127.461
...
1498	2500	15.6	0.1016	39.6	0.052849	110.264
1499	3150	15.6	0.1016	39.6	0.052849	109.254
1500	4000	15.6	0.1016	39.6	0.052849	106.604
1501	5000	15.6	0.1016	39.6	0.052849	106.224
1502	6300	15.6	0.1016	39.6	0.052849	104.204

1503 rows × 6 columns

```

In [13]: import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.pipeline import Pipeline
from sklearn.model_selection import KFold, GridSearchCV
from sklearn.metrics import mean_squared_error, make_scorer
from sklearn.neural_network import MLPRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor

```



```
X_train_val, X_test, y_train_val, y_test = train_test_split(X, y, random_state=42)
```

```
In [15]: pipe = Pipeline([('preprocessing', None), ('regressor', RandomForestRegressor())])

# 하이퍼파라미터 그리드 정의
hyperparam_grid = [
    # MLPRegressor
    {
        'regressor': [MLPRegressor()],
        'preprocessing': [StandardScaler(), MinMaxScaler()],
        'regressor__hidden_layer_sizes': [(50,), (100,), (100, 50)],
        'regressor__learning_rate_init': [0.001, 0.01, 0.1]
    },

    # RandomForestRegressor
    {
        'regressor': [RandomForestRegressor()],
        'preprocessing': [None], # 트리 기반이므로 스케일링 불필요
        'regressor__n_estimators': [100, 300, 500],
        'regressor__max_depth': [None, 10, 30]
    },

    # KNeighborsRegressor
    {
        'regressor': [KNeighborsRegressor()],
        'preprocessing': [StandardScaler(), MinMaxScaler()],
        'regressor__n_neighbors': [3, 5, 7],
        'regressor__metric': ['minkowski'],
        'regressor__p': [1, 2],
    },
]
```

```
In [16]: #Grid Search
kfold = KFold(n_splits=5, shuffle = True, random_state=42)
grid = GridSearchCV(pipe, hyperparam_grid, scoring = 'neg_root_mean_squared_error')

grid.fit(X_train_val, y_train_val)
best_model = grid.best_estimator_
best_params = grid.best_params_

#최적 모델 정보 출력
print("Best Model:", grid.best_estimator_)
print("Best param:", grid.best_params_)
print("Best performance:", grid.best_score_)

#테스트셋 예측 및 RMSE 계산
y_test_pred = grid.predict(X_test)
test_rmse = np.sqrt(mean_squared_error(y_test, y_test_pred))

print(f"\n Test Set RMSE: {test_rmse:.4f}")
```

```

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ConvergenceWarning: Stochastic Optimizer: Maximum iterations (200) reached and the optimization hasn't converged yet.
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C:\anacon\Lib\site-packages\sklearn\normalization\_normalizer.py:181
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C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
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C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)  
C:\anacon\Lib\site-packages\sklearn\base.py:1363: DataConversionWarning: A column-vector y was passed when a 1d array was expected. Please change the shape of y to (n_samples,), for example using ravel().  
    return fit_method(estimator, *args, **kwargs)
```

```
Best Model: Pipeline(steps=[('preprocessing', None),
                             ('regressor',
                              RandomForestRegressor(max_depth=30, n_estimators=500))])
Best param: {'preprocessing': None, 'regressor': RandomForestRegressor(), 'regres
sor__max_depth': 30, 'regressor__n_estimators': 500}
Best performance: -1.9659778137035793
```

Test Set RMSE: 1.8115

In []:

Code for concrete Dataset

```
In [2]: from ucimlrepo import fetch_ucirepo

# fetch dataset
concrete_compressive_strength = fetch_ucirepo(id=165)

# data (as pandas dataframes)
X = concrete_compressive_strength.data.features
y = concrete_compressive_strength.data.targets

# metadata
print(concrete_compressive_strength.metadata)

# variable information
print(concrete_compressive_strength.variables)
```



```
{'uci_id': 165, 'name': 'Concrete Compressive Strength', 'repository_url': 'http
s://archive.ics.uci.edu/dataset/165/concrete+compressive+strength', 'data_url':
'https://archive.ics.uci.edu/static/public/165/data.csv', 'abstract': 'Concrete i
s the most important material in civil engineering. The concrete compressive stre
ngth is a highly nonlinear function of age and ingredients. ', 'area': 'Physics a
nd Chemistry', 'tasks': ['Regression'], 'characteristics': ['Multivariate'], 'num
_instances': 1030, 'num_features': 8, 'feature_types': ['Real'], 'demographics':
[], 'target_col': ['Concrete compressive strength'], 'index_col': None, 'has_miss
ing_values': 'no', 'missing_values_symbol': None, 'year_of_dataset_creation': 199
8, 'last_updated': 'Sun Feb 11 2024', 'dataset_doi': '10.24432/C5PK67', 'creator
s': ['I-Cheng Yeh'], 'intro_paper': {'ID': 383, 'type': 'NATIVE', 'title': 'Model
ing of strength of high-performance concrete using artificial neural networks',
'authors': 'I. Yeh', 'venue': 'Cement and Concrete Research, Vol. 28, No. 12', 'y
ear': 1998, 'journal': None, 'DOI': '10.1016/S0008-8846(98)00165-3', 'URL': 'http
s://www.semanticscholar.org/paper/9310cae70452ea11465f338483e79cc36a68881c', 'sh
a': None, 'corpus': None, 'arxiv': None, 'mag': None, 'acl': None, 'pmid': None,
'pmcid': None}, 'additional_info': {'summary': 'Number of instances \t1030\r\nNum
ber of Attributes\t9\r\nAttribute breakdown\t8 quantitative input variables, and
1 quantitative output variable\r\nMissing Attribute Values\tNone \r\n', 'purpos
e': None, 'funded_by': None, 'instances_represent': None, 'recommended_data_spli
ts': None, 'sensitive_data': None, 'preprocessing_description': None, 'variable_in
fo': 'Given are the variable name, variable type, the measurement unit and a brie
f description. The concrete compressive strength is the regression problem. The o
rder of this listing corresponds to the order of numerals along the rows of the d
atabase. \r\n\r\nName -- Data Type -- Measurement -- Description\r\n\r\nCement (c
omponent 1) -- quantitative -- kg in a m3 mixture -- Input Variable\r\nBlast Furn
ace Slag (component 2) -- quantitative -- kg in a m3 mixture -- Input Variable\r
\r\nFly Ash (component 3) -- quantitative -- kg in a m3 mixture -- Input Variable
\r\nWater (component 4) -- quantitative -- kg in a m3 mixture -- Input Variable
\r\nSuperplasticizer (component 5) -- quantitative -- kg in a m3 mixture -- Input
Variable\r\nCoarse Aggregate (component 6) -- quantitative -- kg in a m3 mixture
-- Input Variable\r\nFine Aggregate (component 7)\t -- quantitative -- kg in a m
3 mixture -- Input Variable\r\nAge -- quantitative -- Day (1~365) -- Input Varia
ble\r\nConcrete compressive strength -- quantitative -- MPa -- Output Variable\r
\r\n', 'citation': None}}
```

	name	role	type	demographic	description \
0	Cement	Feature	Continuous	None	None
1	Blast Furnace Slag	Feature	Integer	None	None
2	Fly Ash	Feature	Continuous	None	None
3	Water	Feature	Continuous	None	None
4	Superplasticizer	Feature	Continuous	None	None
5	Coarse Aggregate	Feature	Continuous	None	None
6	Fine Aggregate	Feature	Continuous	None	None
7	Age	Feature	Integer	None	None
8	Concrete compressive strength	Target	Continuous	None	None

	units	missing_values
0	kg/m^3	no
1	kg/m^3	no
2	kg/m^3	no
3	kg/m^3	no
4	kg/m^3	no
5	kg/m^3	no
6	kg/m^3	no
7	day	no
8	MPa	no

In [3]: X

Out[3]:

	Cement	Blast Furnace Slag	Fly Ash	Water	Superplasticizer	Coarse Aggregate	Fine Aggregate	Age
0	540.0	0.0	0.0	162.0	2.5	1040.0	676.0	28
1	540.0	0.0	0.0	162.0	2.5	1055.0	676.0	28
2	332.5	142.5	0.0	228.0	0.0	932.0	594.0	270
3	332.5	142.5	0.0	228.0	0.0	932.0	594.0	365
4	198.6	132.4	0.0	192.0	0.0	978.4	825.5	360
...
1025	276.4	116.0	90.3	179.6	8.9	870.1	768.3	28
1026	322.2	0.0	115.6	196.0	10.4	817.9	813.4	28
1027	148.5	139.4	108.6	192.7	6.1	892.4	780.0	28
1028	159.1	186.7	0.0	175.6	11.3	989.6	788.9	28
1029	260.9	100.5	78.3	200.6	8.6	864.5	761.5	28

1030 rows × 8 columns

In [4]:

y

Out[4]:

	Concrete compressive strength
0	79.99
1	61.89
2	40.27
3	41.05
4	44.30
...	...
1025	44.28
1026	31.18
1027	23.70
1028	32.77
1029	32.40

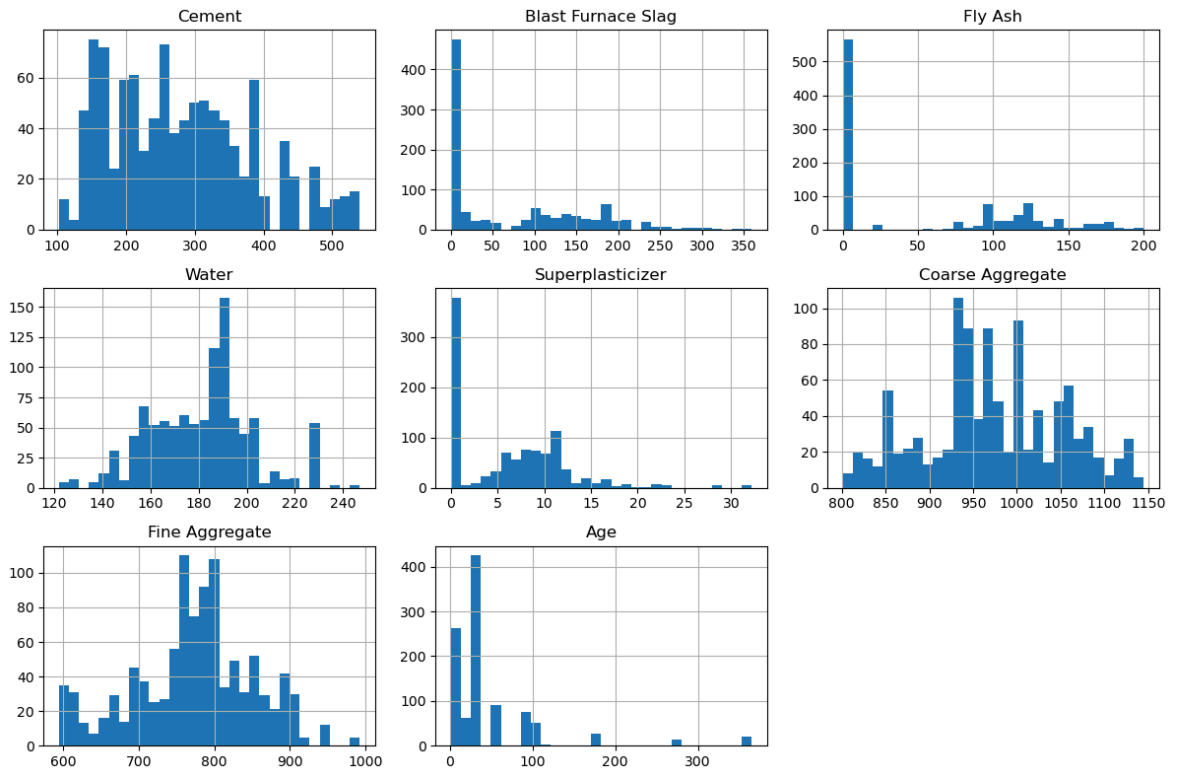
1030 rows × 1 columns

In [4]: `import matplotlib.pyplot as plt`

```

X.hist(figsize=(12, 8), bins=30)
plt.tight_layout()
plt.show()

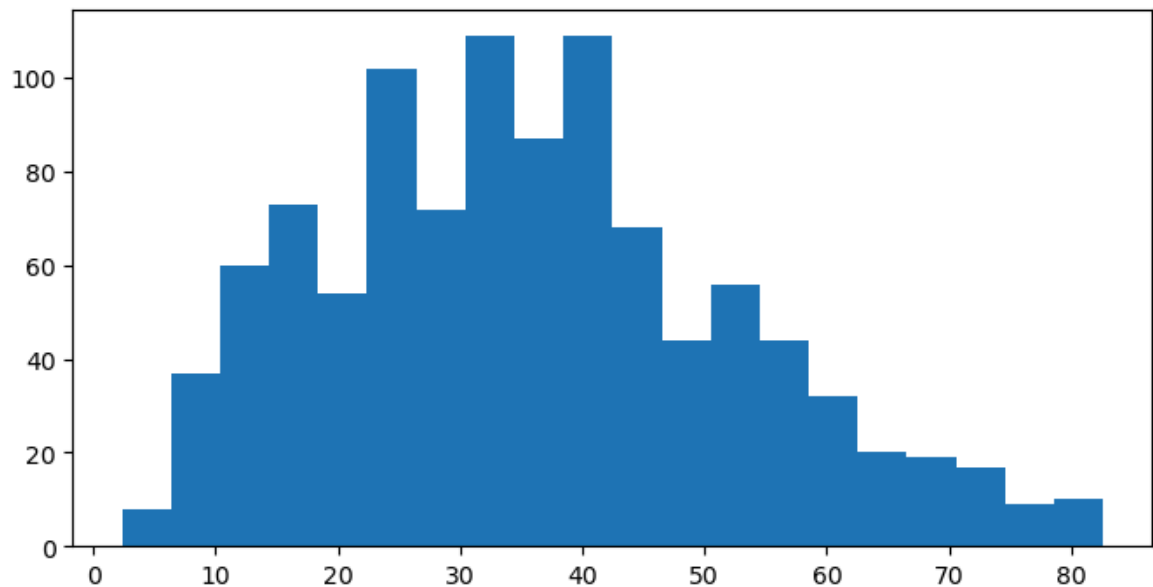
```



```
In [5]: import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(8, 4))
plt.hist(y, bins=20)
plt.show()

print(y.describe())
```



```
Concrete compressive strength
count    1030.000000
mean      35.817961
std       16.705742
min        2.330000
25%       23.710000
50%       34.445000
75%       46.135000
max       82.600000
```

```
In [6]: from autogluon.tabular import TabularPredictor
        from sklearn.model_selection import train_test_split
        from sklearn.metrics import r2_score

        X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)

        # AutoGluon용 데이터 준비
        train_data = X_train.copy()
        train_data['target'] = y_train

        test_data = X_test.copy()
        test_data['target'] = y_test
        # AutoML 모델 학습
        predictor = TabularPredictor(label='target').fit(train_data)

        predictions = predictor.predict(test_data.drop(columns=['target']))
        print(predictor.evaluate(test_data))
```

```

No path specified. Models will be saved in: "AutogluonModels\ag-20250609_165434"
Verbosity: 2 (Standard Logging)
===== System Info =====
AutoGluon Version: 1.3.1
Python Version: 3.11.7
Operating System: Windows
Platform Machine: AMD64
Platform Version: 10.0.26100
CPU Count: 12
Memory Avail: 6.43 GB / 15.69 GB (41.0%)
Disk Space Avail: 320.72 GB / 476.05 GB (67.4%)
=====
No presets specified! To achieve strong results with AutoGluon, it is recommended
to use the available presets. Defaulting to 'medium'...
Recommended Presets (For more details refer to https://auto.gluon.ai/stable/tutorials/tabular/tabular-essentials.html#presets):
presets='experimental' : New in v1.2: Pre-trained foundation model + parallel fits. The absolute best accuracy without consideration for inference speed. Does not support GPU.
presets='best' : Maximize accuracy. Recommended for most users. Use in competitions and benchmarks.
presets='high' : Strong accuracy with fast inference speed.
presets='good' : Good accuracy with very fast inference speed.
presets='medium' : Fast training time, ideal for initial prototyping.
Beginning AutoGluon training ...
AutoGluon will save models to "C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250609_165434"
Train Data Rows: 772
Train Data Columns: 8
Label Column: target
AutoGluon infers your prediction problem is: 'regression' (because dtype of label-column == float and many unique label-values observed).
Label info (max, min, mean, stddev): (82.6, 2.33, 35.89588, 16.78705)
If 'regression' is not the correct problem_type, please manually specify the problem_type parameter during Predictor init (You may specify problem_type as one of: ['binary', 'multiclass', 'regression', 'quantile'])
Problem Type: regression
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
Available Memory: 6574.89 MB
Train Data (Original) Memory Usage: 0.05 MB (0.0% of available memory)
Inferring data type of each feature based on column values. Set feature_metadata_in to manually specify special dtypes of the features.
Stage 1 Generators:
Fitting AsTypeFeatureGenerator...
Stage 2 Generators:
Fitting FillNaFeatureGenerator...
Stage 3 Generators:
Fitting IdentityFeatureGenerator...
Stage 4 Generators:
Fitting DropUniqueFeatureGenerator...
Stage 5 Generators:
Fitting DropDuplicatesFeatureGenerator...
Types of features in original data (raw dtype, special dtypes):
('float', []) : 7 | ['Cement', 'Blast Furnace Slag', 'Fly Ash', 'Water', 'Superplasticizer', ...]
('int', []) : 1 | ['Age']
Types of features in processed data (raw dtype, special dtypes):

```

```

        ('float', []) : 7 | ['Cement', 'Blast Furnace Slag', 'Fly Ash',
'Water', 'Superplasticizer', ...]
        ('int', [])  : 1 | ['Age']
0.2s = Fit runtime
8 features in original data used to generate 8 features in processed dat
a.
Train Data (Processed) Memory Usage: 0.05 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.21s ...
AutoGluon will gauge predictive performance using evaluation metric: 'root_mean_s
quared_error'
This metric's sign has been flipped to adhere to being higher_is_better.
The metric score can be multiplied by -1 to get the metric value.
To change this, specify the eval_metric parameter of Predictor()
Automatically generating train/validation split with holdout_frac=0.2, Train Row
s: 617, Val Rows: 155
User-specified model hyperparameters to be fit:
{
    'NN_TORCH': [{}],
    'GBM': [{'extra_trees': True, 'ag_args': {'name_suffix': 'XT'}}, {}, {'le
arning_rate': 0.03, 'num_leaves': 128, 'feature_fraction': 0.9, 'min_data_in_lea
f': 3, 'ag_args': {'name_suffix': 'Large', 'priority': 0, 'hyperparameter_tune_kw
args': None}}],
    'CAT': [{}],
    'XGB': [{}],
    'FASTAI': [{}],
    'RF': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'XT': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'KNN': [{'weights': 'uniform', 'ag_args': {'name_suffix': 'Unif'}}, {'wei
ghts': 'distance', 'ag_args': {'name_suffix': 'Dist'}}],
}
Fitting 11 L1 models, fit_strategy="sequential" ...
Fitting model: KNeighborsUnif ...
-10.069 = Validation score (-root_mean_squared_error)
8.39s   = Training runtime
0.03s   = Validation runtime
Fitting model: KNeighborsDist ...
-8.794  = Validation score (-root_mean_squared_error)
0.01s   = Training runtime
0.3s    = Validation runtime
Fitting model: LightGBMXt ...
[1000] valid_set's rmse: 4.16861
[2000] valid_set's rmse: 3.98106
[3000] valid_set's rmse: 3.92662
-3.9204 = Validation score (-root_mean_squared_error)
11.92s  = Training runtime
0.02s   = Validation runtime
Fitting model: LightGBM ...
[1000] valid_set's rmse: 4.12691

```

```

-4.1231 = Validation score (-root_mean_squared_error)
5.07s   = Training runtime
0.03s   = Validation runtime
Fitting model: RandomForestMSE ...
-5.356  = Validation score (-root_mean_squared_error)
3.02s   = Training runtime
0.15s   = Validation runtime
Fitting model: CatBoost ...
-4.002  = Validation score (-root_mean_squared_error)
62.65s  = Training runtime
0.0s    = Validation runtime
Fitting model: ExtraTreesMSE ...
-5.0024 = Validation score (-root_mean_squared_error)
2.06s   = Training runtime
0.16s   = Validation runtime
Fitting model: NeuralNetFastAI ...
-5.9813 = Validation score (-root_mean_squared_error)
9.51s   = Training runtime
0.02s   = Validation runtime
Fitting model: XGBoost ...
-4.4457 = Validation score (-root_mean_squared_error)
2.74s   = Training runtime
0.02s   = Validation runtime
Fitting model: NeuralNetTorch ...
-4.284  = Validation score (-root_mean_squared_error)
61.93s  = Training runtime
0.01s   = Validation runtime
Fitting model: LightGBMLarge ...
-4.7878 = Validation score (-root_mean_squared_error)
18.45s  = Training runtime
0.05s   = Validation runtime
Fitting model: WeightedEnsemble_L2 ...
Ensemble Weights: {'LightGBMXT': 0.435, 'NeuralNetTorch': 0.304, 'XGBoost': 0.217, 'CatBoost': 0.043}
-3.6593 = Validation score (-root_mean_squared_error)
0.03s   = Training runtime
0.0s    = Validation runtime
AutoGluon training complete, total runtime = 189.04s ... Best model: WeightedEnsemble_L2 | Estimated inference throughput: 3475.6 rows/s (155 batch size)
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250609_165434")
{'root_mean_squared_error': -4.164963114225586, 'mean_squared_error': -17.34691774285969, 'mean_absolute_error': -2.7846780884173485, 'r2': 0.9359588423483627, 'pearsonr': 0.9684877125538931, 'median_absolute_error': -1.716783065795898}

```

```
In [7]: predictor.leaderboard(test_data, silent=True)
```

Out[7]:

	model	score_test	score_val	eval_metric	pred_time_test
0	LightGBMXT	-3.993391	-3.920355	root_mean_squared_error	0.23489
1	CatBoost	-4.135409	-4.002017	root_mean_squared_error	0.03118
2	WeightedEnsemble_L2	-4.164963	-3.659283	root_mean_squared_error	0.34990
3	LightGBM	-4.531157	-4.123069	root_mean_squared_error	0.15948
4	NeuralNetTorch	-5.019738	-4.284047	root_mean_squared_error	0.03388
5	LightGBMLarge	-5.332880	-4.787760	root_mean_squared_error	0.24262
6	XGBoost	-5.355934	-4.445678	root_mean_squared_error	0.04385
7	ExtraTreesMSE	-5.391887	-5.002444	root_mean_squared_error	0.19540
8	RandomForestMSE	-5.836087	-5.355998	root_mean_squared_error	0.31811
9	NeuralNetFastAI	-6.255705	-5.981301	root_mean_squared_error	0.09511
10	KNeighborsDist	-8.499859	-8.793971	root_mean_squared_error	0.03790
11	KNeighborsUnif	-9.653188	-10.068959	root_mean_squared_error	0.05496

In [3]:

```

from autogluon.tabular import TabularPredictor
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)

# AutoGluon용 데이터 준비
train_data = X_train.copy()
train_data['target'] = y_train

test_data = X_test.copy()
test_data['target'] = y_test
# AutoML 모델 학습
predictor = TabularPredictor(label='target', eval_metric='mae').fit(train_data)

predictions = predictor.predict(test_data.drop(columns=['target']))
print(predictor.evaluate(test_data))

```



```

No path specified. Models will be saved in: "AutogluonModels\ag-20250613_075441"
Verbosity: 2 (Standard Logging)
===== System Info =====
AutoGluon Version: 1.3.1
Python Version: 3.11.7
Operating System: Windows
Platform Machine: AMD64
Platform Version: 10.0.26100
CPU Count: 12
Memory Avail: 6.94 GB / 15.69 GB (44.2%)
Disk Space Avail: 317.33 GB / 476.05 GB (66.7%)
=====
No presets specified! To achieve strong results with AutoGluon, it is recommended
to use the available presets. Defaulting to `medium`...
Recommended Presets (For more details refer to https://auto.gluon.ai/stable/tutorials/tabular/tabular-essentials.html#presets):
presets='experimental' : New in v1.2: Pre-trained foundation model + parallel fits. The absolute best accuracy without consideration for inference speed. Does not support GPU.
presets='best' : Maximize accuracy. Recommended for most users. Use in competitions and benchmarks.
presets='high' : Strong accuracy with fast inference speed.
presets='good' : Good accuracy with very fast inference speed.
presets='medium' : Fast training time, ideal for initial prototyping.
Beginning AutoGluon training ...
AutoGluon will save models to "C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250613_075441"
Train Data Rows: 772
Train Data Columns: 8
Label Column: target
AutoGluon infers your prediction problem is: 'regression' (because dtype of label-column == float and many unique label-values observed).
Label info (max, min, mean, stddev): (82.6, 2.33, 35.89588, 16.78705)
If 'regression' is not the correct problem_type, please manually specify the problem_type parameter during Predictor init (You may specify problem_type as one of: ['binary', 'multiclass', 'regression', 'quantile'])
Problem Type: regression
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
Available Memory: 7108.71 MB
Train Data (Original) Memory Usage: 0.05 MB (0.0% of available memory)
Inferring data type of each feature based on column values. Set feature_metadata_in to manually specify special dtypes of the features.
Stage 1 Generators:
Fitting AsTypeFeatureGenerator...
Stage 2 Generators:
Fitting FillNaFeatureGenerator...
Stage 3 Generators:
Fitting IdentityFeatureGenerator...
Stage 4 Generators:
Fitting DropUniqueFeatureGenerator...
Stage 5 Generators:
Fitting DropDuplicatesFeatureGenerator...
Types of features in original data (raw dtype, special dtypes):
('float', []) : 7 | ['Cement', 'Blast Furnace Slag', 'Fly Ash', 'Water', 'Superplasticizer', ...]
('int', []) : 1 | ['Age']
Types of features in processed data (raw dtype, special dtypes):

```

```

        ('float', []) : 7 | ['Cement', 'Blast Furnace Slag', 'Fly Ash',
'Water', 'Superplasticizer', ...]
        ('int', [])  : 1 | ['Age']
0.1s = Fit runtime
8 features in original data used to generate 8 features in processed dat
a.
Train Data (Processed) Memory Usage: 0.05 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.14s ...
AutoGluon will gauge predictive performance using evaluation metric: 'mean_absolu
te_error'
This metric's sign has been flipped to adhere to being higher_is_better.
The metric score can be multiplied by -1 to get the metric value.
To change this, specify the eval_metric parameter of Predictor()
Automatically generating train/validation split with holdout_frac=0.2, Train Row
s: 617, Val Rows: 155
User-specified model hyperparameters to be fit:
{
    'NN_TORCH': [{}],
    'GBM': [{'extra_trees': True, 'ag_args': {'name_suffix': 'XT'}}, {}, {'le
arning_rate': 0.03, 'num_leaves': 128, 'feature_fraction': 0.9, 'min_data_in_lea
f': 3, 'ag_args': {'name_suffix': 'Large', 'priority': 0, 'hyperparameter_tune_kw
args': None}}],
    'CAT': [{}],
    'XGB': [{}],
    'FASTAI': [{}],
    'RF': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'XT': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'KNN': [{'weights': 'uniform', 'ag_args': {'name_suffix': 'Unif'}}, {'wei
ghts': 'distance', 'ag_args': {'name_suffix': 'Dist'}}],
}
Fitting 11 L1 models, fit_strategy="sequential" ...
Fitting model: KNeighborsUnif ...
-7.5461 = Validation score (-mean_absolute_error)
9.04s = Training runtime
0.03s = Validation runtime
Fitting model: KNeighborsDist ...
-6.2843 = Validation score (-mean_absolute_error)
0.01s = Training runtime
0.03s = Validation runtime
Fitting model: LightGBMXt ...
[1000] valid_set's l1: 2.77311
[2000] valid_set's l1: 2.57863
[3000] valid_set's l1: 2.50672
[4000] valid_set's l1: 2.50416
[5000] valid_set's l1: 2.50931
-2.4943 = Validation score (-mean_absolute_error)
26.03s = Training runtime
0.04s = Validation runtime
Fitting model: LightGBM ...
[1000] valid_set's l1: 2.87384

```

```

-2.8708 = Validation score (-mean_absolute_error)
6.53s   = Training runtime
0.01s   = Validation runtime
Fitting model: RandomForestMSE ...
-3.7755 = Validation score (-mean_absolute_error)
2.45s   = Training runtime
0.14s   = Validation runtime
Fitting model: CatBoost ...
-2.5019 = Validation score (-mean_absolute_error)
342.99s = Training runtime
0.03s   = Validation runtime
Fitting model: ExtraTreesMSE ...
-3.4915 = Validation score (-mean_absolute_error)
1.48s   = Training runtime
0.14s   = Validation runtime
Fitting model: NeuralNetFastAI ...
-4.6301 = Validation score (-mean_absolute_error)
11.2s   = Training runtime
0.03s   = Validation runtime
Fitting model: XGBoost ...
-3.1046 = Validation score (-mean_absolute_error)
4.19s   = Training runtime
0.02s   = Validation runtime
Fitting model: NeuralNetTorch ...
-2.7153 = Validation score (-mean_absolute_error)
215.1s  = Training runtime
0.02s   = Validation runtime
Fitting model: LightGBMLarge ...
-3.3194 = Validation score (-mean_absolute_error)
26.65s  = Training runtime
0.02s   = Validation runtime
Fitting model: WeightedEnsemble_L2 ...
Ensemble Weights: {'LightGBMXT': 0.4, 'CatBoost': 0.32, 'NeuralNetTorch':
0.24, 'XGBoost': 0.04}
-2.3455 = Validation score (-mean_absolute_error)
0.24s   = Training runtime
0.0s    = Validation runtime
AutoGluon training complete, total runtime = 648.78s ... Best model: WeightedEnsemble_L2 | Estimated inference throughput: 1397.5 rows/s (155 batch size)
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250613_075441")
{'mean_absolute_error': -2.517198400460472, 'root_mean_squared_error': -3.889880437086661, 'mean_squared_error': -15.13116981482951, 'r2': 0.9441389158622109, 'pearsonr': 0.9722883572733648, 'median_absolute_error': -1.5021331787109382}

```

```
In [4]: predictor.leaderboard(test_data, silent=True)
```

Out[4]:

	model	score_test	score_val	eval_metric	pred_time_test	pr
0	WeightedEnsemble_L2	-2.517198	-2.345524	mean_absolute_error	0.454177	
1	CatBoost	-2.631002	-2.501859	mean_absolute_error	0.151816	
2	LightGBMXT	-2.708797	-2.494265	mean_absolute_error	0.161564	
3	NeuralNetTorch	-2.922192	-2.715312	mean_absolute_error	0.033558	
4	LightGBM	-3.084810	-2.870789	mean_absolute_error	0.080194	
5	XGBoost	-3.484737	-3.104606	mean_absolute_error	0.089372	
6	LightGBMLarge	-3.589924	-3.319447	mean_absolute_error	0.114019	
7	ExtraTreesMSE	-3.877987	-3.491451	mean_absolute_error	0.416577	
8	RandomForestMSE	-4.165310	-3.775506	mean_absolute_error	0.315052	
9	NeuralNetFastAI	-4.947387	-4.630078	mean_absolute_error	0.144754	
10	KNeighborsDist	-6.281319	-6.284257	mean_absolute_error	0.048090	
11	KNeighborsUnif	-7.542481	-7.546142	mean_absolute_error	0.057068	

```
In [11]: from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score

X_train_val, X_test, y_train_val, y_test = train_test_split(X, y, random_state=4
```

```
In [13]: from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.pipeline import Pipeline
from sklearn.model_selection import KFold, GridSearchCV
from sklearn.metrics import mean_absolute_error, make_scorer
from sklearn.neural_network import MLPRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor

pipe = Pipeline([('preprocessing', None), ('regressor', RandomForestRegressor())])

# 하이퍼파라미터 그리드 정의
hyperparam_grid = [
    # MLPRegressor
    {
        'regressor': [MLPRegressor()],
        'preprocessing': [StandardScaler(), MinMaxScaler()],
        'regressor__hidden_layer_sizes': [(50,), (100,), (100, 50)],
        'regressor__learning_rate_init': [0.001, 0.01, 0.1]
    },
    # RandomForestRegressor
    {
        'regressor': [RandomForestRegressor()],
        'preprocessing': [None], # 트리 기반이므로 스케일링 불필요
        'regressor__n_estimators': [100, 300, 500],
        'regressor__max_depth': [None, 10, 30]
    },
]
```

```

# KNeighborsRegressor
{
    'regressor': [KNeighborsRegressor()],
    'preprocessing': [StandardScaler(),MinMaxScaler()],
    'regressor__n_neighbors': [3, 5, 7],
    'regressor__metric': ['minkowski'],
    'regressor__p': [1, 2],
},
]

```

```

In [14]: #Grid Search
kfold = KFold(n_splits=5, shuffle = True, random_state=42)
grid = GridSearchCV(pipe, hyperparam_grid, scoring = 'neg_mean_absolute_error',

grid.fit(X_train_val,y_train_val)
best_model = grid.best_estimator_
best_params = grid.best_params_

#최적 모델 정보 출력
print("Best Model:", grid.best_estimator_)
print("Best param:", grid.best_params_)
print("Best performance:", grid.best_score_)

#테스트셋 예측 및 MAE 계산
y_test_pred = grid.predict(X_test)
test_mae = mean_absolute_error(y_test, y_test_pred)

print(f"\n Test Set MAE: {test_mae:.4f}")

```

```

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[illegible]

```
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Best Model: Pipeline(steps=[('preprocessing', None),
                             ('regressor', RandomForestRegressor(n_estimators=300))])
Best param: {'preprocessing': None, 'regressor': RandomForestRegressor(), 'regres
sor__max_depth': None, 'regressor__n_estimators': 300}
Best performance: -3.703217729728056
```

Test Set MAE: 3.7151

In []:

Code for Abalone Dataset 무시

```
In [1]: pip install ucimlrepo
```

```
Requirement already satisfied: ucimlrepo in c:\anacon\lib\site-packages (0.0.7)
Requirement already satisfied: pandas>=1.0.0 in c:\anacon\lib\site-packages (from
ucimlrepo) (2.1.4)
Requirement already satisfied: certifi>=2020.12.5 in c:\anacon\lib\site-packages
(from ucimlrepo) (2024.2.2)
Requirement already satisfied: numpy<2,>=1.23.2 in c:\anacon\lib\site-packages (f
rom pandas>=1.0.0->ucimlrepo) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\anacon\lib\site-packa
ges (from pandas>=1.0.0->ucimlrepo) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\anacon\lib\site-packages (from
pandas>=1.0.0->ucimlrepo) (2023.3.post1)
Requirement already satisfied: tzdata>=2022.1 in c:\anacon\lib\site-packages (fro
m pandas>=1.0.0->ucimlrepo) (2023.3)
Requirement already satisfied: six>=1.5 in c:\anacon\lib\site-packages (from pyth
on-dateutil>=2.8.2->pandas>=1.0.0->ucimlrepo) (1.16.0)
Note: you may need to restart the kernel to use updated packages.
```

```
In [11]: from ucimlrepo import fetch_ucirepo
```

```
# fetch dataset
abalone = fetch_ucirepo(id=1)

# data (as pandas dataframes)
X = abalone.data.features
y = abalone.data.targets

# metadata
print(abalone.metadata)

# variable information
print(abalone.variables)
```

```
{'uci_id': 1, 'name': 'Abalone', 'repository_url': 'https://archive.ics.uci.edu/dataset/1/abalone', 'data_url': 'https://archive.ics.uci.edu/static/public/1/data.csv', 'abstract': 'Predict the age of abalone from physical measurements', 'area': 'Biology', 'tasks': ['Classification', 'Regression'], 'characteristics': ['Tabular'], 'num_instances': 4177, 'num_features': 8, 'feature_types': ['Categorical', 'Integer', 'Real'], 'demographics': [], 'target_col': ['Rings'], 'index_col': None, 'has_missing_values': 'no', 'missing_values_symbol': None, 'year_of_dataset_creation': 1994, 'last_updated': 'Mon Aug 28 2023', 'dataset_doi': '10.24432/C55C7W', 'creators': ['Warwick Nash', 'Tracy Sellers', 'Simon Talbot', 'Andrew Cawthorn', 'Wes Ford'], 'intro_paper': None, 'additional_info': {'summary': 'Predicting the age of abalone from physical measurements. The age of abalone is determined by cutting the shell through the cone, staining it, and counting the number of rings through a microscope -- a boring and time-consuming task. Other measurements, which are easier to obtain, are used to predict the age. Further information, such as weather patterns and location (hence food availability) may be required to solve the problem.\r\n\r\nFrom the original data examples with missing values were removed (the majority having the predicted value missing), and the ranges of the continuous values have been scaled for use with an ANN (by dividing by 2000).', 'purpose': None, 'funded_by': None, 'instances_represent': None, 'recommended_data_splits': None, 'sensitive_data': None, 'preprocessing_description': None, 'variable_info': 'Given is the attribute name, attribute type, the measurement unit and a brief description. The number of rings is the value to predict: either as a continuous value or as a classification problem.\r\n\r\nName / Data Type / Measurement Unit / Description\r\n-----\r\nSex / nominal / -- / M, F, and I (infant)\r\nLength / continuous / mm / Longest shell measurement\r\nDiameter / continuous / mm / perpendicular to length\r\nHeight / continuous / mm / with meat in shell\r\nWhole weight / continuous / grams / whole abalone\r\nShucked weight / continuous / grams / weight of meat\r\nViscera weight / continuous / grams / gut weight (after bleeding)\r\nShell weight / continuous / grams / after being dried\r\nRings / integer / -- / +1.5 gives the age in years\r\n\r\nThe readme file contains attribute statistics.', 'citation': None}}
```

	name	role	type	demographic \
0	Sex	Feature	Categorical	None
1	Length	Feature	Continuous	None
2	Diameter	Feature	Continuous	None
3	Height	Feature	Continuous	None
4	Whole_weight	Feature	Continuous	None
5	Shucked_weight	Feature	Continuous	None
6	Viscera_weight	Feature	Continuous	None
7	Shell_weight	Feature	Continuous	None
8	Rings	Target	Integer	None

	description	units	missing_values
0	M, F, and I (infant)	None	no
1	Longest shell measurement	mm	no
2	perpendicular to length	mm	no
3	with meat in shell	mm	no
4	whole abalone	grams	no
5	weight of meat	grams	no
6	gut weight (after bleeding)	grams	no
7	after being dried	grams	no
8	+1.5 gives the age in years	None	no

In [12]: X

Out[12]:

	Sex	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight
0	M	0.455	0.365	0.095	0.5140	0.2245	0.1010
1	M	0.350	0.265	0.090	0.2255	0.0995	0.0485
2	F	0.530	0.420	0.135	0.6770	0.2565	0.1415
3	M	0.440	0.365	0.125	0.5160	0.2155	0.1140
4	I	0.330	0.255	0.080	0.2050	0.0895	0.0395
...
4172	F	0.565	0.450	0.165	0.8870	0.3700	0.2390
4173	M	0.590	0.440	0.135	0.9660	0.4390	0.2145
4174	M	0.600	0.475	0.205	1.1760	0.5255	0.2875
4175	F	0.625	0.485	0.150	1.0945	0.5310	0.2610
4176	M	0.710	0.555	0.195	1.9485	0.9455	0.3765

4177 rows × 8 columns



In [13]: y

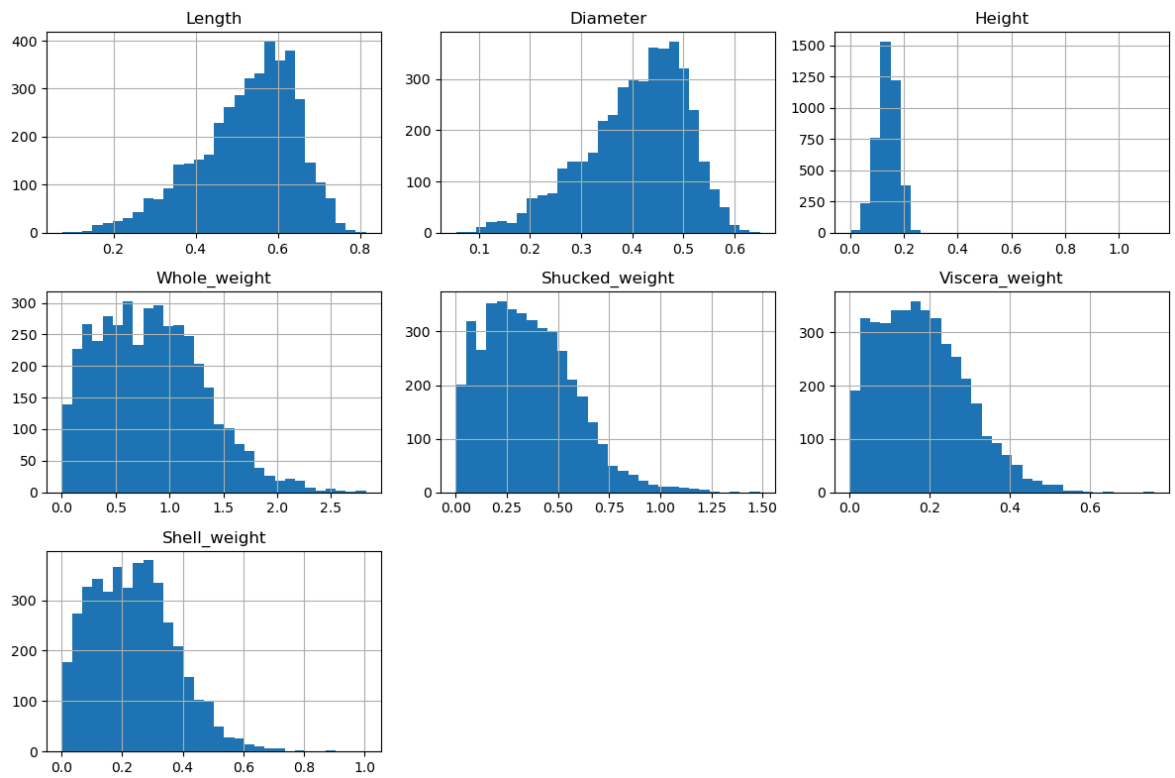
Out[13]:

	Rings
0	15
1	7
2	9
3	10
4	7
...	...
4172	11
4173	10
4174	9
4175	10
4176	12

4177 rows × 1 columns

```
In [7]: import matplotlib.pyplot as plt

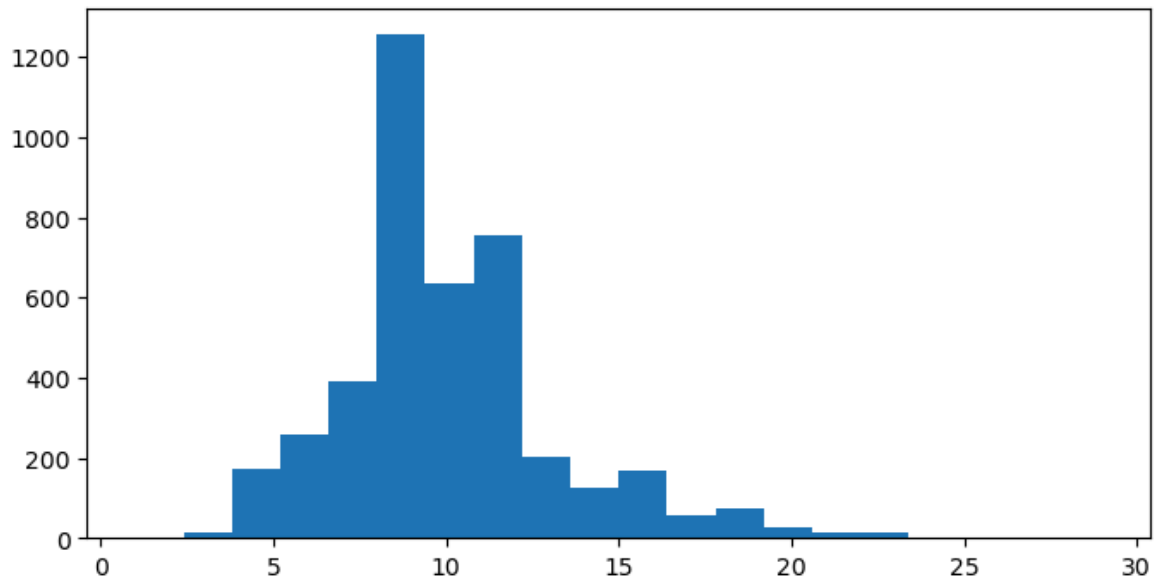
X.hist(figsize=(12, 8), bins=30)
plt.tight_layout()
plt.show()
```



```
In [8]: import matplotlib.pyplot as plt
import seaborn as sns

plt.figure(figsize=(8, 4))
plt.hist(y, bins=20)
plt.show()

print(y.describe())
```



```
Rings
count  4177.000000
mean    9.933684
std     3.224169
min     1.000000
25%     8.000000
50%     9.000000
75%    11.000000
max    29.000000
```

```
In [3]: from autogluon.tabular import TabularPredictor
        from sklearn.model_selection import train_test_split
        from sklearn.metrics import r2_score

        X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)

        # AutoGluon용 데이터 준비
        train_data = X_train.copy()
        train_data['target'] = y_train

        test_data = X_test.copy()
        test_data['target'] = y_test
        # AutoML 모델 학습
        predictor = TabularPredictor(label='target').fit(train_data)

        predictions = predictor.predict(test_data.drop(columns=['target']))
        print(predictor.evaluate(test_data))
```

```

No path specified. Models will be saved in: "AutogluonModels\ag-20250613_050741"
Verbosity: 2 (Standard Logging)
===== System Info =====
AutoGluon Version: 1.3.1
Python Version: 3.11.7
Operating System: Windows
Platform Machine: AMD64
Platform Version: 10.0.26100
CPU Count: 12
Memory Avail: 8.37 GB / 15.69 GB (53.3%)
Disk Space Avail: 317.99 GB / 476.05 GB (66.8%)
=====
No presets specified! To achieve strong results with AutoGluon, it is recommended
to use the available presets. Defaulting to 'medium'...
Recommended Presets (For more details refer to https://auto.gluon.ai/stable/tutorials/tabular/tabular-essentials.html#presets):
presets='experimental' : New in v1.2: Pre-trained foundation model + parallel fits. The absolute best accuracy without consideration for inference speed. Does not support GPU.
presets='best' : Maximize accuracy. Recommended for most users. Use in competitions and benchmarks.
presets='high' : Strong accuracy with fast inference speed.
presets='good' : Good accuracy with very fast inference speed.
presets='medium' : Fast training time, ideal for initial prototyping.
Beginning AutoGluon training ...
AutoGluon will save models to "C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250613_050741"
Train Data Rows: 3132
Train Data Columns: 8
Label Column: target
AutoGluon infers your prediction problem is: 'multiclass' (because dtype of label-column == int, but few unique label-values observed).
First 10 (of 28) unique label values: [9, 12, 10, 15, 6, 8, 5, 11, 7, 14]
If 'multiclass' is not the correct problem_type, please manually specify the problem_type parameter during Predictor init (You may specify problem_type as one of: ['binary', 'multiclass', 'regression', 'quantile'])
Problem Type: multiclass
Preprocessing data ...
Warning: Some classes in the training set have fewer than 10 examples. AutoGluon will only keep 19 out of 28 classes for training and will not try to predict the rare classes. To keep more classes, increase the number of datapoints from these rare classes in the training data or reduce label_count_threshold.
Fraction of data from classes with at least 10 examples that will be kept for training models: 0.9945721583652618
Train Data Class Count: 19
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
Available Memory: 8563.79 MB
Train Data (Original) Memory Usage: 0.34 MB (0.0% of available memory)
Inferring data type of each feature based on column values. Set feature_metadata_in to manually specify special dtypes of the features.
Stage 1 Generators:
Fitting AsTypeFeatureGenerator...
Stage 2 Generators:
Fitting FillNaFeatureGenerator...
Stage 3 Generators:
Fitting IdentityFeatureGenerator...
Fitting CategoryFeatureGenerator...

```



```

Fitting CategoryMemoryMinimizeFeatureGenerator...
Stage 4 Generators:
    Fitting DropUniqueFeatureGenerator...
Stage 5 Generators:
    Fitting DropDuplicatesFeatureGenerator...
Types of features in original data (raw dtype, special dtypes):
    ('float', []) : 7 | ['Length', 'Diameter', 'Height', 'Whole_weight', 'Shucked_weight', ...]
    ('object', []) : 1 | ['Sex']
Types of features in processed data (raw dtype, special dtypes):
    ('category', []) : 1 | ['Sex']
    ('float', []) : 7 | ['Length', 'Diameter', 'Height', 'Whole_weight', 'Shucked_weight', ...]
0.4s = Fit runtime
8 features in original data used to generate 8 features in processed data.

Train Data (Processed) Memory Usage: 0.17 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.45s ...
AutoGluon will gauge predictive performance using evaluation metric: 'accuracy'
To change this, specify the eval_metric parameter of Predictor()
Automatically generating train/validation split with holdout_frac=0.15964240102171137, Train Rows: 2617, Val Rows: 498
User-specified model hyperparameters to be fit:
{
    'NN_TORCH': [{}],
    'GBM': [{'extra_trees': True, 'ag_args': {'name_suffix': 'XT'}}, {}, {'learning_rate': 0.03, 'num_leaves': 128, 'feature_fraction': 0.9, 'min_data_in_leaf': 3, 'ag_args': {'name_suffix': 'Large', 'priority': 0, 'hyperparameter_tune_kwargs': None}}],
    'CAT': [{}],
    'XGB': [{}],
    'FASTAI': [{}],
    'RF': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_suffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square_d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quantile']}],
    'XT': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_suffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square_d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quantile']}],
    'KNN': [{'weights': 'uniform', 'ag_args': {'name_suffix': 'Unif'}}, {'weights': 'distance', 'ag_args': {'name_suffix': 'Dist'}}],
}
Fitting 13 L1 models, fit_strategy="sequential" ...
Fitting model: KNeighborsUnif ...
    0.2028 = Validation score (accuracy)
    10.77s = Training runtime
    0.03s = Validation runtime
Fitting model: KNeighborsDist ...
    0.2269 = Validation score (accuracy)
    0.02s = Training runtime
    0.03s = Validation runtime
Fitting model: NeuralNetFastAI ...
    0.2791 = Validation score (accuracy)
    22.56s = Training runtime
    0.07s = Validation runtime
Fitting model: LightGBMXT ...
    0.2831 = Validation score (accuracy)

```

```

34.03s = Training runtime
0.1s = Validation runtime
Fitting model: LightGBM ...
0.2369 = Validation score (accuracy)
35.66s = Training runtime
0.02s = Validation runtime
Fitting model: RandomForestGini ...
0.2329 = Validation score (accuracy)
3.69s = Training runtime
0.22s = Validation runtime
Fitting model: RandomForestEntr ...
0.239 = Validation score (accuracy)
2.81s = Training runtime
0.24s = Validation runtime
Fitting model: CatBoost ...
0.2892 = Validation score (accuracy)
65.45s = Training runtime
0.02s = Validation runtime
Fitting model: ExtraTreesGini ...
0.245 = Validation score (accuracy)
3.0s = Training runtime
0.22s = Validation runtime
Fitting model: ExtraTreesEntr ...
0.2369 = Validation score (accuracy)
2.98s = Training runtime
0.21s = Validation runtime
Fitting model: XGBoost ...
0.2631 = Validation score (accuracy)
19.77s = Training runtime
0.03s = Validation runtime
Fitting model: NeuralNetTorch ...
0.2912 = Validation score (accuracy)
27.62s = Training runtime
0.03s = Validation runtime
Fitting model: LightGBMLarge ...
0.239 = Validation score (accuracy)
170.19s = Training runtime
0.11s = Validation runtime
Fitting model: WeightedEnsemble_L2 ...
Ensemble Weights: {'NeuralNetTorch': 0.4, 'CatBoost': 0.3, 'NeuralNetFast
AI': 0.15, 'LightGBMXt': 0.05, 'ExtraTreesGini': 0.05, 'XGBoost': 0.05}
0.3052 = Validation score (accuracy)
0.32s = Training runtime
0.0s = Validation runtime
AutoGluon training complete, total runtime = 406.03s ... Best model: WeightedEnse
mble_L2 | Estimated inference throughput: 1066.9 rows/s (498 batch size)
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("C:\Users
\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250613_050741")
{'accuracy': 0.29473684210526313, 'balanced_accuracy': 0.1577012626196434, 'mcc':
0.19763505959395405}

```

```
In [4]: predictor.leaderboard(test_data, silent=True)
```

Out[4]:

	model	score_test	score_val	eval_metric	pred_time_test	pred_time_val
0	CatBoost	0.298565	0.289157	accuracy	0.110805	0.0167
1	WeightedEnsemble_L2	0.294737	0.305221	accuracy	2.289722	0.4667
2	NeuralNetTorch	0.288038	0.291165	accuracy	0.127230	0.0317
3	LightGBMXT	0.279426	0.283133	accuracy	0.291936	0.0961
4	ExtraTreesGini	0.270813	0.244980	accuracy	0.821686	0.2223
5	RandomForestGini	0.266986	0.232932	accuracy	0.758744	0.2226
6	XGBoost	0.263158	0.263052	accuracy	0.697042	0.0317
7	RandomForestEntr	0.262201	0.238956	accuracy	0.959423	0.2403
8	NeuralNetFastAI	0.256459	0.279116	accuracy	0.161646	0.0679
9	ExtraTreesEntr	0.253589	0.236948	accuracy	0.734684	0.2064
10	LightGBM	0.243062	0.236948	accuracy	0.065602	0.0160
11	LightGBMLarge	0.243062	0.238956	accuracy	0.617127	0.1105
12	KNeighborsUnif	0.233493	0.202811	accuracy	0.062595	0.0311
13	KNeighborsDist	0.226794	0.226908	accuracy	0.062432	0.0327

```

In [10]: from autogluon.tabular import TabularPredictor
from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42)

# AutoGluon용 데이터 준비
train_data = X_train.copy()
train_data['target'] = y_train

test_data = X_test.copy()
test_data['target'] = y_test
# AutoML 모델 학습
predictor = TabularPredictor(label='target', eval_metric='mae', problem_type='reg

predictions = predictor.predict(test_data.drop(columns=['target']))
print(predictor.evaluate(test_data))

```

```

No path specified. Models will be saved in: "AutogluonModels\ag-20250613_081951"
Verbosity: 2 (Standard Logging)
===== System Info =====
AutoGluon Version: 1.3.1
Python Version: 3.11.7
Operating System: Windows
Platform Machine: AMD64
Platform Version: 10.0.26100
CPU Count: 12
Memory Avail: 6.38 GB / 15.69 GB (40.7%)
Disk Space Avail: 317.28 GB / 476.05 GB (66.6%)
=====
No presets specified! To achieve strong results with AutoGluon, it is recommended
to use the available presets. Defaulting to `medium`...
Recommended Presets (For more details refer to https://auto.gluon.ai/stable/tutorials/tabular/tabular-essentials.html#presets):
presets='experimental' : New in v1.2: Pre-trained foundation model + parallel fits. The absolute best accuracy without consideration for inference speed. Does not support GPU.
presets='best' : Maximize accuracy. Recommended for most users. Use in competitions and benchmarks.
presets='high' : Strong accuracy with fast inference speed.
presets='good' : Good accuracy with very fast inference speed.
presets='medium' : Fast training time, ideal for initial prototyping.
Beginning AutoGluon training ...
AutoGluon will save models to "C:\Users\준서\Desktop\Jun\3-2\데과프\A5\AutogluonModels\ag-20250613_081951"
Train Data Rows: 3132
Train Data Columns: 8
Label Column: target
Problem Type: regression
Preprocessing data ...
Using Feature Generators to preprocess the data ...
Fitting AutoMLPipelineFeatureGenerator...
Available Memory: 6535.08 MB
Train Data (Original) Memory Usage: 0.34 MB (0.0% of available memory)
Inferring data type of each feature based on column values. Set feature_metadata_in to manually specify special dtypes of the features.
Stage 1 Generators:
Fitting AsTypeFeatureGenerator...
Stage 2 Generators:
Fitting FillNaFeatureGenerator...
Stage 3 Generators:
Fitting IdentityFeatureGenerator...
Fitting CategoryFeatureGenerator...
Fitting CategoryMemoryMinimizeFeatureGenerator...
Stage 4 Generators:
Fitting DropUniqueFeatureGenerator...
Stage 5 Generators:
Fitting DropDuplicatesFeatureGenerator...
Types of features in original data (raw dtype, special dtypes):
('float', []) : 7 | ['Length', 'Diameter', 'Height', 'Whole_weight', 'Shucked_weight', ...]
('object', []) : 1 | ['Sex']
Types of features in processed data (raw dtype, special dtypes):
('category', []) : 1 | ['Sex']
('float', []) : 7 | ['Length', 'Diameter', 'Height', 'Whole_weight', 'Shucked_weight', ...]
0.1s = Fit runtime

```

```

    8 features in original data used to generate 8 features in processed dat
a.
    Train Data (Processed) Memory Usage: 0.17 MB (0.0% of available memory)
Data preprocessing and feature engineering runtime = 0.18s ...
AutoGluon will gauge predictive performance using evaluation metric: 'mean_absolu
te_error'
    This metric's sign has been flipped to adhere to being higher_is_better.
The metric score can be multiplied by -1 to get the metric value.
    To change this, specify the eval_metric parameter of Predictor()
Automatically generating train/validation split with holdout_frac=0.1596424010217
1137, Train Rows: 2632, Val Rows: 500
User-specified model hyperparameters to be fit:
{
    'NN_TORCH': [{}],
    'GBM': [{'extra_trees': True, 'ag_args': {'name_suffix': 'XT'}}, {}, {'le
arning_rate': 0.03, 'num_leaves': 128, 'feature_fraction': 0.9, 'min_data_in_lea
f': 3, 'ag_args': {'name_suffix': 'Large', 'priority': 0, 'hyperparameter_tune_kw
args': None}}],
    'CAT': [{}],
    'XGB': [{}],
    'FASTAI': [{}],
    'RF': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'XT': [{'criterion': 'gini', 'ag_args': {'name_suffix': 'Gini', 'problem_
types': ['binary', 'multiclass']}}, {'criterion': 'entropy', 'ag_args': {'name_su
ffix': 'Entr', 'problem_types': ['binary', 'multiclass']}}, {'criterion': 'square
d_error', 'ag_args': {'name_suffix': 'MSE', 'problem_types': ['regression', 'quan
tile']}}],
    'KNN': [{'weights': 'uniform', 'ag_args': {'name_suffix': 'Unif'}}, {'wei
ghts': 'distance', 'ag_args': {'name_suffix': 'Dist'}}],
}
Fitting 11 L1 models, fit_strategy="sequential" ...
Fitting model: KNeighborsUnif ...
-1.6168 = Validation score (-mean_absolute_error)
0.02s = Training runtime
0.03s = Validation runtime
Fitting model: KNeighborsDist ...
-1.6214 = Validation score (-mean_absolute_error)
0.02s = Training runtime
0.04s = Validation runtime
Fitting model: LightGBMXT ...
-1.4938 = Validation score (-mean_absolute_error)
2.32s = Training runtime
0.02s = Validation runtime
Fitting model: LightGBM ...
-1.4945 = Validation score (-mean_absolute_error)
2.15s = Training runtime
0.01s = Validation runtime
Fitting model: RandomForestMSE ...
-1.5322 = Validation score (-mean_absolute_error)
2.99s = Training runtime
0.15s = Validation runtime
Fitting model: CatBoost ...
-1.4982 = Validation score (-mean_absolute_error)
54.42s = Training runtime
0.01s = Validation runtime
Fitting model: ExtraTreesMSE ...

```

```

-1.5175 = Validation score (-mean_absolute_error)
3.22s   = Training runtime
0.81s   = Validation runtime
Fitting model: NeuralNetFastAI ...
-1.418  = Validation score (-mean_absolute_error)
10.58s  = Training runtime
0.04s   = Validation runtime
Fitting model: XGBoost ...
-1.5331 = Validation score (-mean_absolute_error)
1.65s   = Training runtime
0.02s   = Validation runtime
Fitting model: NeuralNetTorch ...
-1.4409 = Validation score (-mean_absolute_error)
72.47s  = Training runtime
0.03s   = Validation runtime
Fitting model: LightGBMLarge ...
-1.5765 = Validation score (-mean_absolute_error)
10.66s  = Training runtime
0.02s   = Validation runtime
Fitting model: WeightedEnsemble_L2 ...
Ensemble Weights: {'NeuralNetFastAI': 0.684, 'NeuralNetTorch': 0.263, 'LightGBMXT': 0.053}
-1.4112 = Validation score (-mean_absolute_error)
0.25s   = Training runtime
0.0s    = Validation runtime
AutoGluon training complete, total runtime = 163.24s ... Best model: WeightedEnsemble_L2 | Estimated inference throughput: 5846.0 rows/s (500 batch size)
TabularPredictor saved. To load, use: predictor = TabularPredictor.load("C:\Users\준서\Desktop\Jun\3-2\테과 프\A5\AutogluonModels\ag-20250613_081951")
{'mean_absolute_error': -1.4529536962509155, 'root_mean_squared_error': -2.073709777934424, 'mean_squared_error': -4.300272464752197, 'r2': 0.5819857120513916, 'pearsonr': 0.7633699934034512, 'median_absolute_error': -0.9926595687866211}

```

In [11]: `predictor.leaderboard(test_data, silent=True)`

Out[11]:

	model	score_test	score_val	eval_metric	pred_time_test	pr
0	NeuralNetFastAI	-1.452849	-1.417994	mean_absolute_error	0.097618	
1	WeightedEnsemble_L2	-1.452954	-1.411230	mean_absolute_error	0.348891	
2	NeuralNetTorch	-1.483160	-1.440919	mean_absolute_error	0.171790	
3	LightGBMXT	-1.529341	-1.493770	mean_absolute_error	0.063688	
4	LightGBM	-1.530828	-1.494523	mean_absolute_error	0.052126	
5	CatBoost	-1.544927	-1.498244	mean_absolute_error	0.047179	
6	ExtraTreesMSE	-1.559974	-1.517540	mean_absolute_error	0.418848	
7	XGBoost	-1.571919	-1.533070	mean_absolute_error	0.991702	
8	RandomForestMSE	-1.585324	-1.532227	mean_absolute_error	0.372714	
9	LightGBMLarge	-1.593010	-1.576497	mean_absolute_error	0.053102	
10	KNeighborsDist	-1.609496	-1.621376	mean_absolute_error	0.048508	
11	KNeighborsUnif	-1.609761	-1.616800	mean_absolute_error	0.059397	

```
In [14]: X['Sex'].value_counts()
```

```
Out[14]: Sex
M      1528
I      1342
F      1307
Name: count, dtype: int64
```

```
In [15]: X.loc[:, 'Sex'] = X['Sex'].map({'M': 1, 'F': -1, 'I': 0})
```

```
In [16]: X
```

```
Out[16]:
```

	Sex	Length	Diameter	Height	Whole_weight	Shucked_weight	Viscera_weight
0	1	0.455	0.365	0.095	0.5140	0.2245	0.1010
1	1	0.350	0.265	0.090	0.2255	0.0995	0.0485
2	-1	0.530	0.420	0.135	0.6770	0.2565	0.1415
3	1	0.440	0.365	0.125	0.5160	0.2155	0.1140
4	0	0.330	0.255	0.080	0.2050	0.0895	0.0395
...
4172	-1	0.565	0.450	0.165	0.8870	0.3700	0.2390
4173	1	0.590	0.440	0.135	0.9660	0.4390	0.2145
4174	1	0.600	0.475	0.205	1.1760	0.5255	0.2875
4175	-1	0.625	0.485	0.150	1.0945	0.5310	0.2610
4176	1	0.710	0.555	0.195	1.9485	0.9455	0.3765

4177 rows × 8 columns

```
In [17]: from sklearn.model_selection import train_test_split
from sklearn.metrics import r2_score

X_train_val, X_test, y_train_val, y_test = train_test_split(X, y, random_state=4
```

```
In [18]: from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.pipeline import Pipeline
from sklearn.model_selection import KFold, GridSearchCV
from sklearn.metrics import mean_absolute_error, make_scorer
from sklearn.neural_network import MLPRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor

pipe = Pipeline([('preprocessing', None), ('regressor', RandomForestRegressor())])

# 하이퍼파라미터 그리드 정의
hyperparam_grid = [
    # MLPRegressor
    {
        'regressor': [MLPRegressor()],
```

```

        'preprocessing': [StandardScaler(), MinMaxScaler()],
        'regressor__hidden_layer_sizes': [(50,), (100,), (100, 50)],
        'regressor__learning_rate_init': [0.001, 0.01, 0.1]
    },

    # RandomForestRegressor
    {
        'regressor': [RandomForestRegressor()],
        'preprocessing': [None], # 트리 기반이므로 스케일링 불필요
        'regressor__n_estimators': [100, 300, 500],
        'regressor__max_depth': [None, 10, 30]
    },

    # KNeighborsRegressor
    {
        'regressor': [KNeighborsRegressor()],
        'preprocessing': [StandardScaler(), MinMaxScaler()],
        'regressor__n_neighbors': [3, 5, 7],
        'regressor__metric': ['minkowski'],
        'regressor__p': [1, 2],
    },
]

```

```

In [19]: #Grid Search
kfold = KFold(n_splits=5, shuffle = True, random_state=42)
grid = GridSearchCV(pipe, hyperparam_grid, scoring = 'neg_mean_absolute_error',

grid.fit(X_train_val, y_train_val)
best_model = grid.best_estimator_
best_params = grid.best_params_

#최적 모델 정보 출력
print("Best Model:", grid.best_estimator_)
print("Best param:", grid.best_params_)
print("Best performance:", grid.best_score_)

#테스트셋 예측 및 MAE 계산
y_test_pred = grid.predict(X_test)
test_mae = mean_absolute_error(y_test, y_test_pred)

print(f"\n Test Set MAE: {test_mae:.4f}")

```



```
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Best Model: Pipeline(steps=[('preprocessing', StandardScaler()),
                             ('regressor', MLPRegressor(hidden_layer_sizes=(100, 50)))]
Best param: {'preprocessing': StandardScaler(), 'regressor': MLPRegressor(), 'reg
ressor__hidden_layer_sizes': (100, 50), 'regressor__learning_rate_init': 0.001}
Best performance: -1.519460556587417

Test Set MAE: 1.5365
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