Pre-cleaning

July 22, 2024

[1633]:
```
import pandas as pd
import numpy as np
from scipy import stats
from sklearn.metrics import mean_squared_error

import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split, GridSearchCV,␣
 ↪cross_val_score
from sklearn.compose import make_column_transformer, ColumnTransformer
from sklearn.pipeline import Pipeline, make_pipeline
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import OrdinalEncoder, StandardScaler, OneHotEncoder
from sklearn.model_selection import RepeatedKFold
from sklearn.metrics import mean_absolute_error
from sklearn.model_selection import GridSearchCV


from sklearn.linear_model import LinearRegression, Ridge
from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor,␣
 ↪VotingRegressor, StackingRegressor
from xgboost import XGBRegressor
from catboost import CatBoostRegressor
import lightgbm as lgb
```

[1410]:
```
pd.options.display.max_columns = 45            #just extending the number  of␣
 ↪columns that can be seen
pd.options.display.max_colwidth = 120
```

[1411]:
```
# load json as a dataframe with pandas
data = pd.read_json("data/final_dataset.json")
```

[1412]:
```
data.columns
```

[1412]:
```
Index(['Url', 'BathroomCount', 'BedroomCount', 'ConstructionYear', 'Country',
       'District', 'Fireplace', 'FloodingZone', 'Furnished', 'Garden',
       'GardenArea', 'Kitchen', 'LivingArea', 'Locality', 'MonthlyCharges',
```

```
       'NumberOfFacades', 'PEB', 'PostalCode', 'Price', 'PropertyId',
       'Province', 'Region', 'RoomCount', 'ShowerCount', 'StateOfBuilding',
       'SubtypeOfProperty', 'SurfaceOfPlot', 'SwimmingPool', 'Terrace',
       'ToiletCount', 'TypeOfProperty', 'TypeOfSale'],
      dtype='object')
```

[1413]:
```
data.head(20)
```

[1413]:
```
                                                  Url  \
2     https://www.immoweb.be/en/classified/apartment/for-
sale/zeebrugge/8380/10957010
6           https://www.immoweb.be/en/classified/house/for-
sale/tournai/7500/10956841
8      https://www.immoweb.be/en/classified/house/for-
sale/blankenberge/8370/10956807
10         https://www.immoweb.be/en/classified/house/for-sale/de-
panne/8660/10956664
11      https://www.immoweb.be/en/classified/apartment/for-
sale/hasselt/3500/10956668
14   https://www.immoweb.be/en/classified/apartment/for-
sale/schaerbeek/1030/10956614
15         https://www.immoweb.be/en/classified/house/for-
rent/waterloo/1410/10956598
18            https://www.immoweb.be/en/classified/house/for-
sale/putte/2580/10956546
22    https://www.immoweb.be/en/classified/apartment/for-
sale/vilvoorde/1800/10956452
23        https://www.immoweb.be/en/classified/apartment/for-
sale/temse/9140/10956305
24  https://www.immoweb.be/en/classified/apartment/for-
sale/middelkerke/8430/10956233
25      https://www.immoweb.be/en/classified/apartment/for-
rent/ixelles/1050/10956216
27          https://www.immoweb.be/en/classified/house/for-
sale/schilde/2970/10956210
29        https://www.immoweb.be/en/classified/apartment/for-
sale/temse/9140/10956121
30     https://www.immoweb.be/en/classified/apartment/for-
sale/westende/8434/10956060
33            https://www.immoweb.be/en/classified/house/for-
sale/ieper/8900/10956042
34            https://www.immoweb.be/en/classified/house/for-
sale/ghlin/7011/10956002
35        https://www.immoweb.be/en/classified/apartment/for-
sale/namur/5000/10955972
36        https://www.immoweb.be/en/classified/apartment/for-
sale/namur/5000/10955993
```

37 https://www.immoweb.be/en/classified/house/for-sale/oignies/5670/10955843

	BathroomCount	BedroomCount	ConstructionYear	Country	District
2	1.0	1	1969.0	Belgium	Brugge
6	6.0	13	1920.0	Belgium	Tournai
8	2.0	4	2008.0	Belgium	Brugge
10	1.0	4	NaN	Belgium	Veurne
11	0.0	2	1972.0	Belgium	Hasselt
14	1.0	1	1994.0	Belgium	Brussels
15	4.0	6	1970.0	Belgium	Nivelles
18	0.0	2	NaN	Belgium	Mechelen
22	2.0	3	2023.0	Belgium	Halle-Vilvoorde
23	NaN	2	NaN	Belgium	Sint-Niklaas
24	1.0	2	1961.0	Belgium	Oostend
25	1.0	3	NaN	Belgium	Brussels
27	3.0	5	1987.0	Belgium	Antwerp
29	NaN	1	NaN	Belgium	Sint-Niklaas
30	1.0	2	1966.0	Belgium	Oostend
33	1.0	8	1923.0	Belgium	Ieper
34	1.0	3	NaN	Belgium	Mons
35	1.0	0	1974.0	Belgium	Namur
36	1.0	0	1974.0	Belgium	Namur
37	0.0	1	1860.0	Belgium	Philippeville

	Fireplace	FloodingZone	Furnished	Garden	GardenArea	Kitchen
2	NaN	None	NaN	NaN	NaN	None
6	NaN	None	0.0	NaN	NaN	None
8	NaN	NON_FLOOD_ZONE	1.0	NaN	NaN	INSTALLED
10	NaN	None	NaN	1.0	1.0	None
11	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	None
14	NaN	None	1.0	NaN	NaN	HYPER_EQUIPPED
15	1.0	NON_FLOOD_ZONE	NaN	1.0	2519.0	INSTALLED
18	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	None
22	NaN	None	NaN	NaN	NaN	None
23	NaN	None	NaN	NaN	NaN	None
24	NaN	None	1.0	NaN	NaN	SEMI_EQUIPPED
25	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	USA_INSTALLED
27	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	INSTALLED
29	NaN	None	NaN	NaN	NaN	None
30	NaN	NON_FLOOD_ZONE	1.0	NaN	NaN	None
33	NaN	NON_FLOOD_ZONE	NaN	1.0	76.0	None
34	NaN	None	NaN	NaN	NaN	None
35	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	SEMI_EQUIPPED
36	NaN	NON_FLOOD_ZONE	0.0	NaN	NaN	NOT_INSTALLED
37	NaN	NON_FLOOD_ZONE	NaN	NaN	NaN	None

	LivingArea	Locality	MonthlyCharges	NumberOfFacades	PEB
2	29.0	Zeebrugge	NaN	NaN	None
6	391.0	Tournai	NaN	3.0	D
8	111.0	BLANKENBERGE	NaN	2.0	B
10	NaN	De Panne	NaN	2.0	F
11	92.0	Hasselt	NaN	NaN	B
14	50.0	Schaerbeek	NaN	2.0	E
15	425.0	WATERLOO	0.0	4.0	C
18	NaN	Putte	NaN	3.0	F
22	NaN	Vilvoorde	NaN	3.0	A
23	101.0	Temse	NaN	NaN	None
24	73.0	MIDDELKERKE	NaN	NaN	C
25	200.0	Ixelles	200.0	2.0	B
27	515.0	Schilde	NaN	4.0	E
29	77.0	Temse	NaN	NaN	None
30	65.0	Westende	NaN	2.0	C
33	321.0	Ieper	NaN	2.0	E
34	NaN	Ghlin	NaN	NaN	E
35	29.0	Namur	NaN	2.0	C
36	29.0	Namur	NaN	2.0	C
37	60.0	Oignies	NaN	3.0	None

	PostalCode	Price	PropertyId	Province	Region	RoomCount
2	8380	99000	10957010	West Flanders	Flanders	1.0
6	7500	765000	10956841	Hainaut	Wallonie	31.0
8	8370	399000	10956807	West Flanders	Flanders	NaN
10	8660	230000	10956664	West Flanders	Flanders	NaN
11	3500	198000	10956668	Limburg	Flanders	1.0
14	1030	215000	10956614	Brussels	Brussels	NaN
15	1410	5500	10956598	Walloon Brabant	Wallonie	NaN
18	2580	235000	10956546	Antwerp	Flanders	1.0
22	1800	485000	10956452	Flemish Brabant	Flanders	NaN
23	9140	320000	10956305	East Flanders	Flanders	NaN
24	8430	360000	10956233	West Flanders	Flanders	NaN
25	1050	2700	10956216	Brussels	Brussels	6.0
27	2970	1198000	10956210	Antwerp	Flanders	NaN
29	9140	249000	10956121	East Flanders	Flanders	NaN
30	8434	210000	10956060	West Flanders	Flanders	NaN
33	8900	285000	10956042	West Flanders	Flanders	16.0
34	7011	255000	10956002	Hainaut	Wallonie	NaN
35	5000	95000	10955972	Namur	Wallonie	NaN
36	5000	99000	10955993	Namur	Wallonie	NaN
37	5670	69000	10955843	Namur	Wallonie	NaN

	ShowerCount	StateOfBuilding	SubtypeOfProperty	SurfaceOfPlot
2	0.0	GOOD	flat_studio	NaN
6	NaN	GOOD	apartment_block	130.0

8	0.0	GOOD	house	0.0
10	NaN	TO_BE_DONE_UP	house	170.0
11	0.0	AS_NEW	apartment	NaN
14	NaN	AS_NEW	apartment	NaN
15	0.0	GOOD	villa	2519.0
18	0.0	None	house	423.0
22	0.0	None	apartment	NaN
23	0.0	None	apartment	NaN
24	0.0	GOOD	apartment	NaN
25	2.0	GOOD	apartment	NaN
27	0.0	None	house	5185.0
29	0.0	None	apartment	NaN
30	NaN	None	apartment	NaN
33	NaN	TO_RENOVATE	house	223.0
34	0.0	TO_RESTORE	house	480.0
35	1.0	GOOD	flat_studio	NaN
36	NaN	GOOD	flat_studio	NaN
37	NaN	TO_RENOVATE	house	189.0

	SwimmingPool	Terrace	ToiletCount	TypeOfProperty	\
2	NaN	1.0	1.0	2	
6	NaN	NaN	5.0	1	
8	NaN	NaN	2.0	1	
10	0.0	1.0	2.0	1	
11	NaN	1.0	1.0	2	
14	0.0	1.0	1.0	2	
15	NaN	1.0	5.0	1	
18	NaN	NaN	0.0	1	
22	0.0	NaN	NaN	2	
23	NaN	NaN	NaN	2	
24	NaN	NaN	1.0	2	
25	0.0	1.0	3.0	2	
27	NaN	NaN	3.0	1	
29	NaN	NaN	NaN	2	
30	0.0	NaN	NaN	2	
33	0.0	1.0	2.0	1	
34	NaN	NaN	2.0	1	
35	0.0	1.0	1.0	2	
36	0.0	1.0	NaN	2	
37	0.0	1.0	NaN	1	

	TypeOfSale
2	residential_sale
6	residential_sale
8	residential_sale
10	residential_sale
11	residential_sale

```
14          residential_sale
15  residential_monthly_rent
18          residential_sale
22          residential_sale
23          residential_sale
24          residential_sale
25  residential_monthly_rent
27          residential_sale
29          residential_sale
30          residential_sale
33          residential_sale
34          residential_sale
35          residential_sale
36          residential_sale
37          residential_sale
```

[1414]:
```
data.describe()
```

[1414]:

	BathroomCount	BedroomCount	ConstructionYear	Fireplace
count	109112.000000	118714.000000	68898.000000	4123.0
mean	1.232898	2.708383	1987.345496	1.0
std	1.092045	1.855343	47.311922	0.0
min	0.000000	0.000000	1753.000000	1.0
25%	1.000000	2.000000	1964.000000	1.0
50%	1.000000	3.000000	2000.000000	1.0
75%	1.000000	3.000000	2023.000000	1.0
max	145.000000	200.000000	8071.000000	1.0

	Furnished	Garden	GardenArea	LivingArea	MonthlyCharges
count	30325.000000	22503.0	2.250300e+04	104539.000000	13650.000000
mean	0.070041	1.0	4.509960e+04	167.396417	84.239853
std	0.255221	0.0	6.666220e+06	1814.592952	179.608171
min	0.000000	1.0	1.000000e+00	9.000000	0.000000
25%	0.000000	1.0	4.800000e+01	90.000000	0.000000
50%	0.000000	1.0	1.400000e+02	124.000000	30.000000
75%	0.000000	1.0	4.500000e+02	182.000000	120.000000
max	1.000000	1.0	1.000000e+09	452230.000000	5250.000000

	NumberOfFacades	PostalCode	Price	PropertyId
count	76942.000000	118714.000000	1.187140e+05	1.187140e+05
mean	2.791557	5166.113129	3.815797e+05	1.245875e+07
std	0.872792	3060.657713	4.754330e+05	3.131297e+06
min	1.000000	0.000000	1.000000e+00	1.882546e+06
25%	2.000000	2250.000000	2.000000e+05	1.114592e+07
50%	3.000000	4671.000000	3.095000e+05	1.138077e+07
75%	4.000000	8400.000000	4.390000e+05	1.146776e+07
max	24.000000	9992.000000	3.500000e+07	2.002586e+07

```
           RoomCount   ShowerCount  SurfaceOfPlot  SwimmingPool  Terrace  \
count  32916.000000  57127.000000   5.823700e+04  40358.000000  68344.0
mean       6.806538      0.696186   3.118253e+03      0.050994      1.0
std        5.458941      6.563612   4.776406e+05      0.219987      0.0
min        1.000000      0.000000   0.000000e+00      0.000000      1.0
25%        2.000000      0.000000   1.480000e+02      0.000000      1.0
50%        6.000000      0.000000   3.530000e+02      0.000000      1.0
75%       10.000000      1.000000   8.000000e+02      0.000000      1.0
max       68.000000   1120.000000   1.152500e+08      1.000000      1.0

        ToiletCount  TypeOfProperty
count  9.644100e+04   118714.000000
mean   4.120696e+01        1.509460
std    1.234059e+04        0.499913
min    0.000000e+00        1.000000
25%    1.000000e+00        1.000000
50%    1.000000e+00        2.000000
75%    2.000000e+00        2.000000
max    3.832365e+06        2.000000
```

[1415]:
```
data.shape
```

[1415]:
```
(118714, 32)
```

[1416]:
```
postal_codes_to_keep = pd.read_csv('data/postalcode_be.csv')
```

[1417]:
```
postal_codes_to_keep_list = postal_codes_to_keep['Code postal'].tolist()
```

[1418]:
```
data = data[data['PostalCode'].isin(postal_codes_to_keep_list)]
```

[1419]:
```
data.shape
```

[1419]:
```
(118707, 32)
```

[1420]:
```
data.drop_duplicates("PropertyId",inplace=True)
data.drop(data[data.ConstructionYear > 2033].index,inplace=True)
data.drop(data[data.PostalCode < 1000].index,inplace=True)
data.drop(data[data.GardenArea > 200000].index,inplace=True)
data.drop(data[data.LivingArea > 4500].index, inplace=True)
data.drop(data[data.Price > 4000000].index,inplace=True)
data.drop(data[data.NumberOfFacades > 8].index,inplace=True)
data.drop(data[data.ShowerCount > 58].index,inplace=True)
data.drop(data[data.SurfaceOfPlot > 200000].index,inplace=True)
data.drop(data[data.ToiletCount > 25].index,inplace=True)
data.drop(data[data.District == None].index,inplace=True)
data.drop(data[data.Province == None].index,inplace=True)
data.drop(data[data.Region == None].index,inplace=True)
```

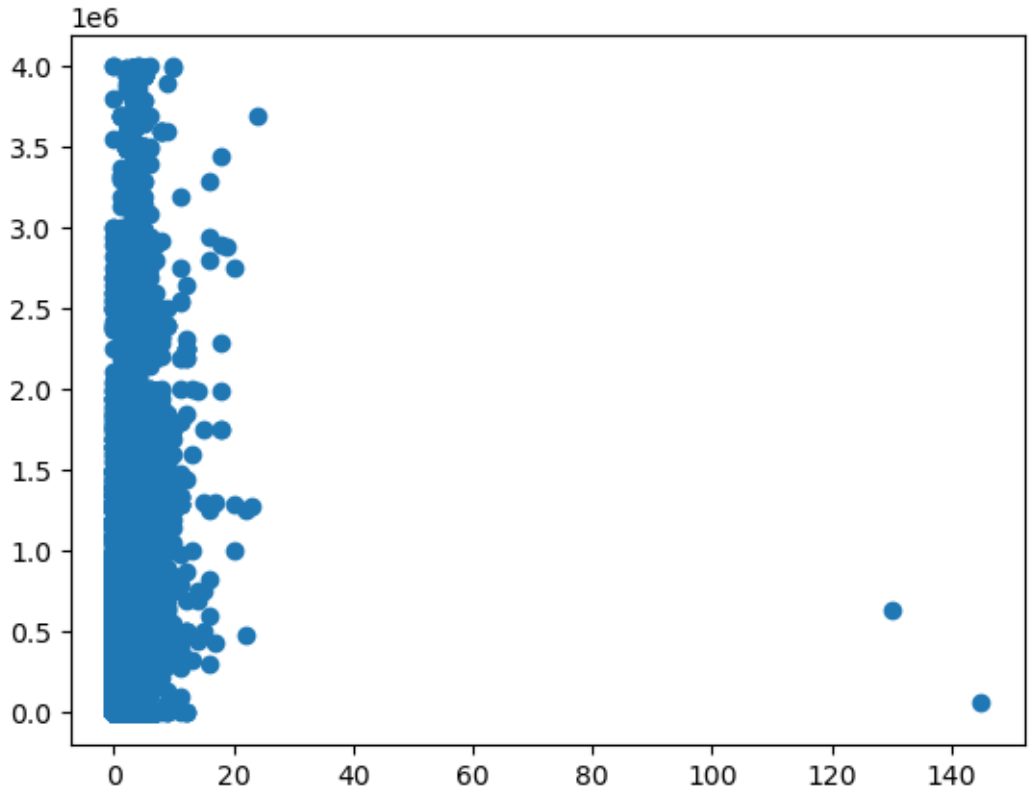
```
data.drop(data[data.Locality == None].index,inplace=True)
```

[1421]:
```
data.dtypes[data.dtypes != 'object']
```

[1421]:
```
BathroomCount       float64
BedroomCount          int64
ConstructionYear    float64
Fireplace           float64
Furnished           float64
Garden              float64
GardenArea          float64
LivingArea          float64
MonthlyCharges      float64
NumberOfFacades     float64
PostalCode            int64
Price                 int64
PropertyId            int64
RoomCount           float64
ShowerCount         float64
SurfaceOfPlot       float64
SwimmingPool        float64
Terrace             float64
ToiletCount         float64
TypeOfProperty        int64
dtype: object
```

[1422]:
```
plt.scatter(x='BathroomCount', y='Price', data=data)
```

[1422]:
```
<matplotlib.collections.PathCollection at 0x7f1057b3e4d0>
```



[1423]:
```
data.query('BathroomCount > 10')
```

[1423]:
```
        Url  \
1271         https://www.immoweb.be/en/classified/house/for-
sale/bastogne/6600/10940526
1273       https://www.immoweb.be/en/classified/house/for-
sale/fauvillers/6637/10940525
1416         https://www.immoweb.be/en/classified/apartment/for-
sale/mons/7000/10937755
3673             https://www.immoweb.be/en/classified/house/for-
sale/mons/7000/10912111
8954    https://www.immoweb.be/en/classified/apartment/for-
sale/zandhoven/2240/10890954
…
…
160622       https://www.immoweb.be/en/classified/house/for-
sale/frameries/7080/9684855
169772  https://www.immoweb.be/en/classified/apartment/for-
rent/schaerbeek/1030/8741518
170334     https://www.immoweb.be/en/classified/house/for-
sale/marcinelle/6001/10313320
```

```
171643      https://www.immoweb.be/en/classified/house/for-
sale/orchimont/5550/10484514
178037     https://www.immoweb.be/en/classified/house/for-
sale/courcelles/6180/10171746

        BathroomCount  BedroomCount  ConstructionYear  Country   District  \
1271             18.0            19            1874.0  Belgium   Bastogne
1273             18.0            19            1874.0  Belgium   Bastogne
1416             11.0            16            2013.0  Belgium       Mons
3673             11.0            16            2013.0  Belgium       Mons
8954             22.0             3               NaN  Belgium    Antwerp
…                …               …                 …       …         …
160622           11.0            11               NaN  Belgium       Mons
169772           11.0            12               NaN  Belgium   Brussels
170334           20.0            20               NaN  Belgium  Charleroi
171643           13.0            18               NaN  Belgium     Dinant
178037           15.0            18               NaN  Belgium  Charleroi

        Fireplace    FloodingZone  Furnished  Garden  GardenArea  \
1271          NaN  NON_FLOOD_ZONE        1.0     1.0     28870.0
1273          NaN  NON_FLOOD_ZONE        1.0     1.0     28870.0
1416          NaN  NON_FLOOD_ZONE        0.0     NaN         NaN
3673          NaN  NON_FLOOD_ZONE        0.0     NaN         NaN
8954          NaN  NON_FLOOD_ZONE        0.0     NaN         NaN
…             …               …         …       …           …
160622        NaN            None        0.0     NaN         NaN
169772        NaN            None        NaN     1.0        70.0
170334        NaN            None        0.0     NaN         NaN
171643        NaN  NON_FLOOD_ZONE        1.0     NaN         NaN
178037        NaN            None        0.0     NaN         NaN

               Kitchen  LivingArea    Locality  MonthlyCharges  \
1271    HYPER_EQUIPPED      1560.0    Bastogne             NaN
1273    HYPER_EQUIPPED      1560.0  Fauvillers             NaN
1416         INSTALLED         NaN        Mons             NaN
3673         INSTALLED         NaN        Mons             NaN
8954    HYPER_EQUIPPED       133.0   Zandhoven             NaN
…                  …           …           …               …
160622       INSTALLED       500.0   Frameries             NaN
169772  HYPER_EQUIPPED       450.0  Schaerbeek             0.0
170334       INSTALLED         NaN  MARCINELLE             NaN
171643            None      1500.0   Orchimont             NaN
178037            None         NaN  Courcelles             NaN

        NumberOfFacades   PEB  PostalCode    Price  PropertyId    Province  \
1271                4.0     D        6600  1750000    10940526  Luxembourg
1273                4.0     D        6637  1750000    10940525  Luxembourg
```

```
1416                4.0     B        7000  2200000    10937755     Hainaut
3673                4.0     B        7000  2200000    10912111     Hainaut
8954                4.0  None        2240   479000    10890954     Antwerp
…                   …    …           …      …         …            …
160622              2.0     D        7080  1295000     9684855     Hainaut
169772              NaN  None        1030      840     8741518    Brussels
170334              3.0     C        6001   999999    10313320     Hainaut
171643              4.0  None        5550  1600000    10484514       Namur
178037              4.0     E        6180  1300000    10171746     Hainaut

          Region  RoomCount  ShowerCount StateOfBuilding  \
1271    Wallonie        NaN         18.0            GOOD
1273    Wallonie        NaN         18.0            GOOD
1416    Wallonie        NaN          NaN            GOOD
3673    Wallonie        NaN          NaN            GOOD
8954    Flanders        NaN          NaN            GOOD
…          …          …           …              …
160622  Wallonie        NaN          NaN            None
169772  Brussels        NaN         11.0  JUST_RENOVATED
170334  Wallonie        NaN         20.0            GOOD
171643  Wallonie        NaN          0.0          AS_NEW
178037  Wallonie        NaN          NaN            GOOD

            SubtypeOfProperty  SurfaceOfPlot  SwimmingPool  Terrace  \
1271                   castle        28870.0           0.0      1.0
1273                    house        28870.0           0.0      1.0
1416                apartment            NaN           0.0      1.0
3673          apartment_block            0.0           0.0      1.0
8954                penthouse            NaN           NaN      1.0
…                       …              …             …        …
160622        apartment_block          210.0           NaN      NaN
169772            flat_studio            NaN           NaN      NaN
170334        apartment_block         1795.0           0.0      NaN
171643  exceptional_property        19958.0           NaN      NaN
178037        apartment_block         1998.0           0.0      NaN

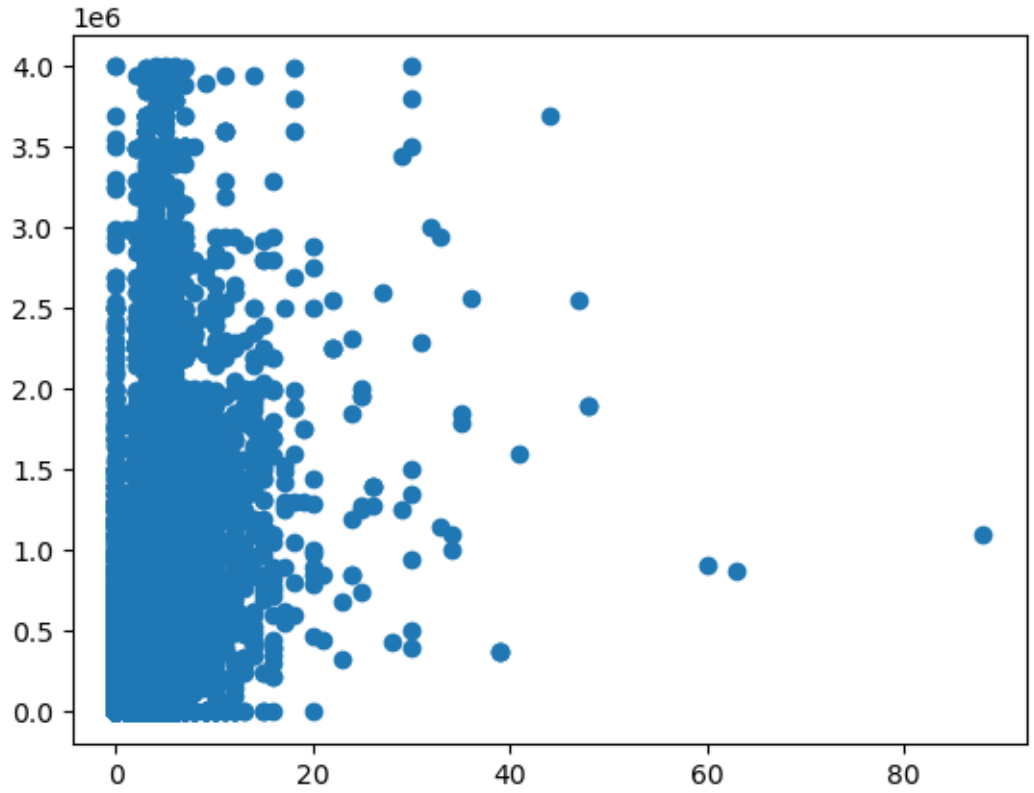
        ToiletCount  TypeOfProperty                TypeOfSale
1271           20.0               1           residential_sale
1273           20.0               1           residential_sale
1416            NaN               2           residential_sale
3673            NaN               1           residential_sale
8954            NaN               2           residential_sale
…               …                 …                         …
160622          NaN               1           residential_sale
169772          NaN               2  residential_monthly_rent
170334         20.0               1           residential_sale
171643          NaN               1           residential_sale
```

```
178037          NaN                1          residential_sale

[83 rows x 32 columns]
```

[1424]:
```
plt.scatter(x='BedroomCount', y='Price', data=data)
```

[1424]:
```
<matplotlib.collections.PathCollection at 0x7f10735bd120>
```



[1425]:
```
data.query('BedroomCount > 50')
```

[1425]:
```
Url  \
30677    https://www.immoweb.be/en/classified/house/for-
sale/brussels/1000/11490449
38018    https://www.immoweb.be/en/classified/house/for-
sale/verviers/4800/11481911
96357  https://www.immoweb.be/en/classified/house/for-
sale/schaerbeek/1030/11313431

       BathroomCount  BedroomCount  ConstructionYear  Country  District  \
30677            NaN            60               NaN  Belgium  Brussels
38018            NaN            63            1920.0  Belgium  Verviers
```

```
96357            NaN            88            1991.0  Belgium  Brussels

       Fireplace FloodingZone  Furnished  Garden  GardenArea Kitchen  \
30677        NaN         None        NaN     NaN         NaN    None
38018        NaN         None        NaN     NaN         NaN    None
96357        NaN         None        NaN     NaN         NaN    None

       LivingArea    Locality  MonthlyCharges  NumberOfFacades   PEB  \
30677         NaN    Brussels             NaN              3.0  None
38018      2378.0    Verviers             NaN              3.0  None
96357         NaN  Schaerbeek             NaN              2.0  None

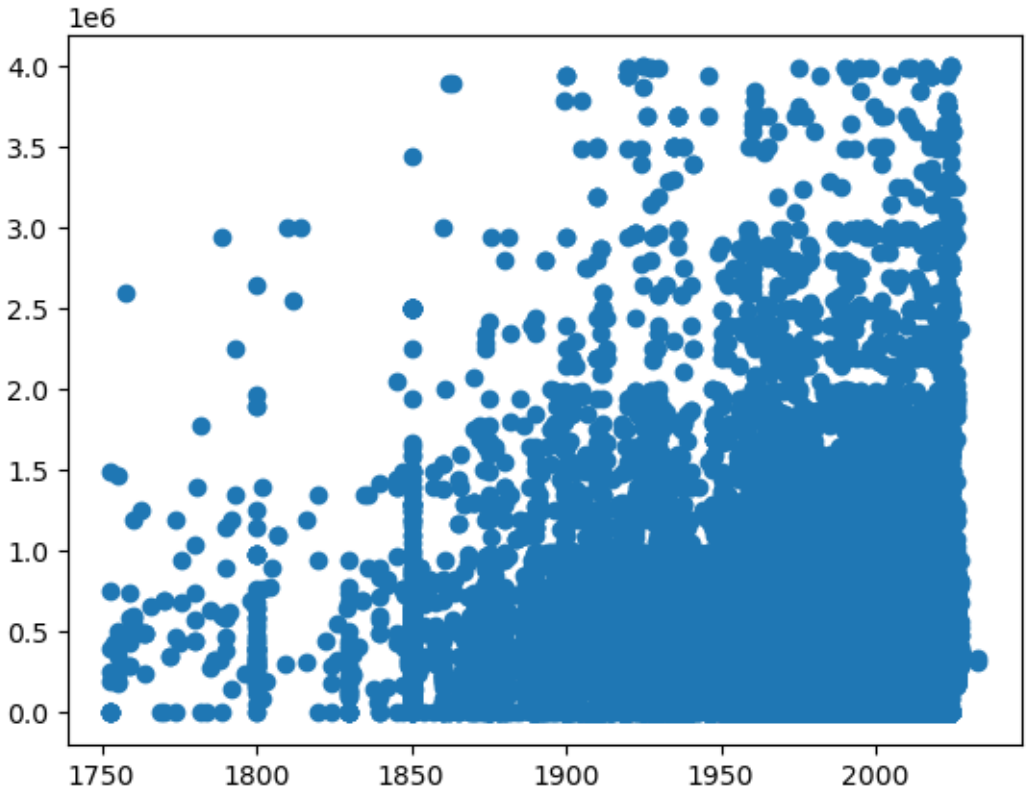
       PostalCode    Price  PropertyId  Province    Region  RoomCount  \
30677        1000   915000    11490449  Brussels  Brussels        NaN
38018        4800   875000    11481911     Liège  Wallonie        NaN
96357        1030  1100000    11313431  Brussels  Brussels        NaN

       ShowerCount StateOfBuilding SubtypeOfProperty  SurfaceOfPlot  \
30677          NaN            GOOD             house            0.0
38018          NaN   TO_BE_DONE_UP             house         1232.0
96357          NaN            None             house            0.0

       SwimmingPool  Terrace  ToiletCount  TypeOfProperty        TypeOfSale
30677           NaN      NaN          NaN               1  residential_sale
38018           0.0      1.0          NaN               1  residential_sale
96357           0.0      NaN          NaN               1  residential_sale
```

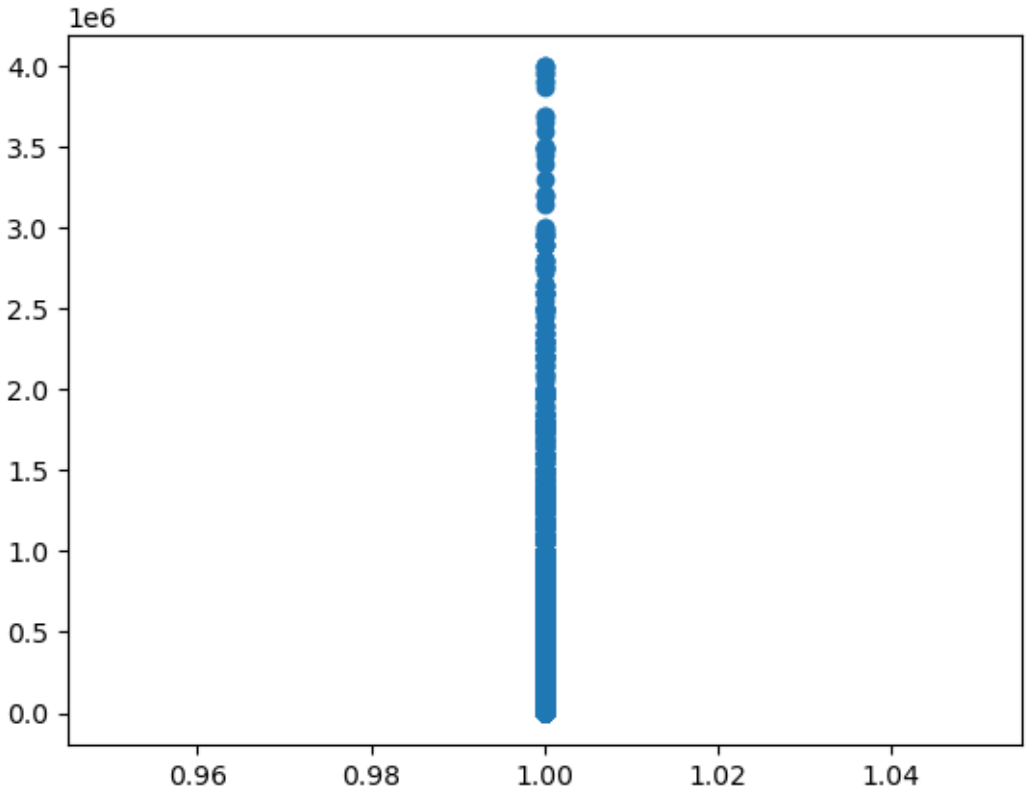
[1426]:
```
plt.scatter(x='ConstructionYear', y='Price', data=data)
```

[1426]:
```
<matplotlib.collections.PathCollection at 0x7f123bda51b0>
```



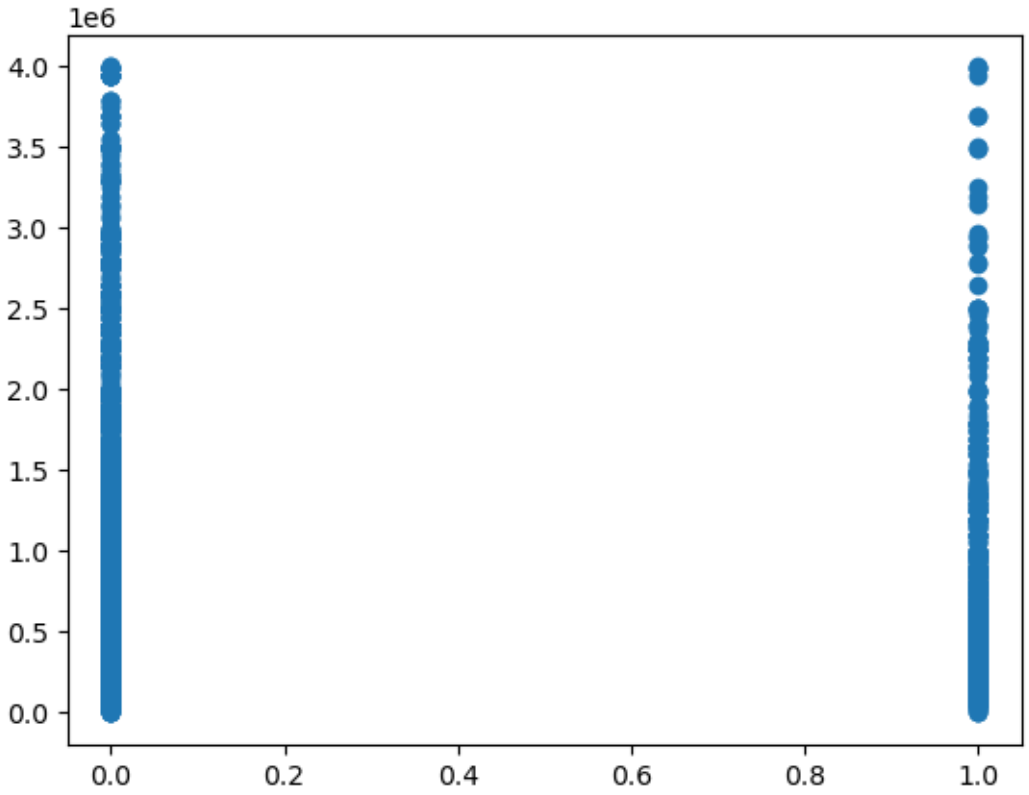
[1427]:
```
plt.scatter(x='Fireplace', y='Price', data=data)
```

[1427]:
```
<matplotlib.collections.PathCollection at 0x7f1057b77430>
```



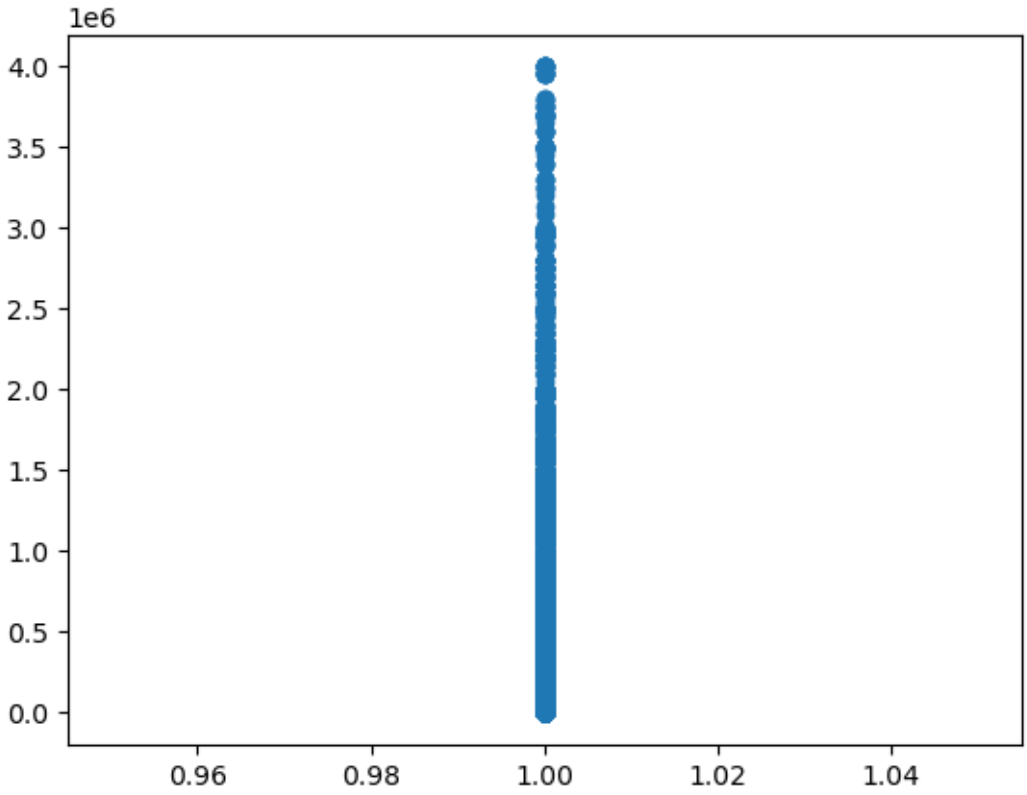
[1428]:
```
plt.scatter(x='Furnished', y='Price', data=data)
```

[1428]: <matplotlib.collections.PathCollection at 0x7f107b9532e0>



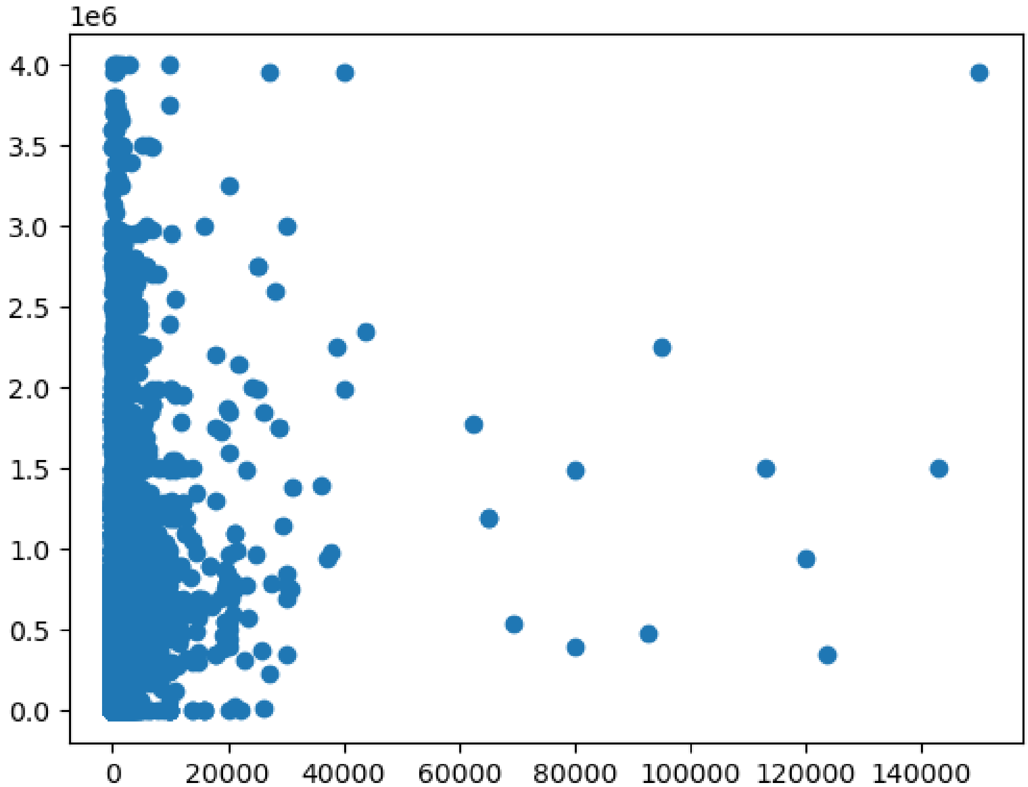
[1429]:
```
plt.scatter(x='Garden', y='Price', data=data)
```

[1429]: <matplotlib.collections.PathCollection at 0x7f123bd5de40>



[1430]:
```
plt.scatter(x='GardenArea', y='Price', data=data)
```

[1430]: <matplotlib.collections.PathCollection at 0x7f123bddfd60>



[1431]:
```
data.query('GardenArea > 40000')
```

[1431]:
```
                Url  \
25624              https://www.immoweb.be/en/classified/house/for-
sale/rijkevorsel/2310/10846568
25625                    https://www.immoweb.be/en/classified/house/for-
sale/essen/2910/10846563
27176                https://www.immoweb.be/en/classified/house/for-
sale/pondrome/5574/10815433
45286   https://www.immoweb.be/en/classified/house/for-sale/scherpenheuvel-
zichem/3270/20005790
65707       https://www.immoweb.be/en/classified/house/for-sale/marche-en-
famenne/6900/11440408
67362                 https://www.immoweb.be/en/classified/house/for-
sale/zoersel/2980/11397756
85875                    https://www.immoweb.be/en/classified/house/for-
sale/wavre/1300/11413128
90816              https://www.immoweb.be/en/classified/house/for-
sale/kasterlee/2460/11448003
117363            https://www.immoweb.be/en/classified/house/for-
sale/grimbergen/1850/11366667
```

```
123217               https://www.immoweb.be/en/classified/house/for-
sale/winksele/3020/11343599
123218               https://www.immoweb.be/en/classified/house/for-
sale/winksele/3020/11343598
150177                   https://www.immoweb.be/en/classified/house/for-
sale/asse/1730/11138877
166794     https://www.immoweb.be/en/classified/apartment/for-sale/horion-
hozemont/4460/8967721
180312               https://www.immoweb.be/en/classified/house/for-
sale/aywaille/4920/10357085

        BathroomCount  BedroomCount  ConstructionYear  Country  \
25624             4.0             6            1886.0  Belgium
25625             4.0             4            1890.0  Belgium
27176             1.0             4            1973.0  Belgium
45286             1.0             3            2024.0  Belgium
65707             0.0             3            1850.0  Belgium
67362             2.0             2               NaN  Belgium
85875             4.0             5            1977.0  Belgium
90816             2.0             4            2014.0  Belgium
117363            6.0            10               NaN  Belgium
123217            3.0             6            1927.0  Belgium
123218            3.0             6            1927.0  Belgium
150177            4.0            14               NaN  Belgium
166794            2.0             4            1850.0  Belgium
180312            3.0             3               NaN  Belgium

                District  Fireplace    FloodingZone  Furnished  Garden  \
25624           Turnhout        1.0  NON_FLOOD_ZONE        NaN     1.0
25625            Antwerp        NaN  NON_FLOOD_ZONE        NaN     1.0
27176             Dinant        NaN            None        0.0     1.0
45286             Leuven        NaN  NON_FLOOD_ZONE        0.0     1.0
65707   Marche-en-Famenne        NaN  NON_FLOOD_ZONE        0.0     1.0
67362            Antwerp        NaN            None        NaN     1.0
85875           Nivelles        1.0  NON_FLOOD_ZONE        NaN     1.0
90816           Turnhout        NaN  NON_FLOOD_ZONE        1.0     1.0
117363   Halle-Vilvoorde        NaN            None        NaN     1.0
123217            Leuven        1.0  NON_FLOOD_ZONE        NaN     1.0
123218            Leuven        1.0  NON_FLOOD_ZONE        NaN     1.0
150177   Halle-Vilvoorde        NaN  NON_FLOOD_ZONE        NaN     1.0
166794             Liège        NaN            None        NaN     1.0
180312             Liège        NaN  NON_FLOOD_ZONE        0.0     1.0

        GardenArea         Kitchen  LivingArea             Locality  \
25624      62490.0            None       585.0           Rijkevorsel
25625      43825.0            None       486.0                 Essen
27176     120000.0       INSTALLED       263.0             PONDROME
```

```
45286      92828.0  HYPER_EQUIPPED       185.0  Scherpenheuvel-Zichem
65707      69558.0   NOT_INSTALLED       400.0      Marche-en-Famenne
67362     143000.0            None       148.0                Zoersel
85875     112982.0  HYPER_EQUIPPED       392.0                  Wavre
90816     123456.0       INSTALLED        60.0              Kasterlee
117363     95000.0       INSTALLED       850.0             Grimbergen
123217     64926.0            None       856.0               WINKSELE
123218     64926.0            None       856.0               WINKSELE
150177    150000.0       INSTALLED      1240.0                   ASSE
166794     80000.0       INSTALLED       245.0        HORION-HOZÉMONT
180312     80000.0  HYPER_EQUIPPED       447.0                Aywaille

        MonthlyCharges  NumberOfFacades   PEB  PostalCode    Price  \
25624              NaN              4.0     F        2310  1775000
25625              NaN              4.0     B        2910  2350000
27176              NaN              4.0     F        5574   950000
45286              NaN              4.0  None        3270   485000
65707              NaN              4.0     G        6900   545000
67362              NaN              4.0     C        2980  1500000
85875              NaN              4.0     C        1300  1500000
90816              NaN              4.0  None        2460   350000
117363             NaN              4.0  None        1850  2250000
123217             NaN              4.0     F        3020  1200000
123218             NaN              4.0     F        3020  1200000
150177             NaN              4.0     F        1730  3950000
166794             NaN              NaN     D        4460   395000
180312             NaN              4.0     C        4920  1495000

        PropertyId         Province    Region  RoomCount  ShowerCount  \
25624     10846568          Antwerp  Flanders        NaN          0.0
25625     10846563          Antwerp  Flanders        NaN          0.0
27176     10815433            Namur  Wallonie        NaN          1.0
45286     20005790  Flemish Brabant  Flanders        NaN          NaN
65707     11440408       Luxembourg  Wallonie        NaN          1.0
67362     11397756          Antwerp  Flanders        NaN          NaN
85875     11413128  Walloon Brabant  Wallonie        NaN          NaN
90816     11448003          Antwerp  Flanders        NaN          1.0
117363    11366667  Flemish Brabant  Flanders       10.0          NaN
123217    11343599  Flemish Brabant  Flanders        NaN          0.0
123218    11343598  Flemish Brabant  Flanders        NaN          0.0
150177    11138877  Flemish Brabant  Flanders        NaN          0.0
166794     8967721            Liège  Wallonie        NaN          2.0
180312    10357085            Liège  Wallonie        NaN          NaN

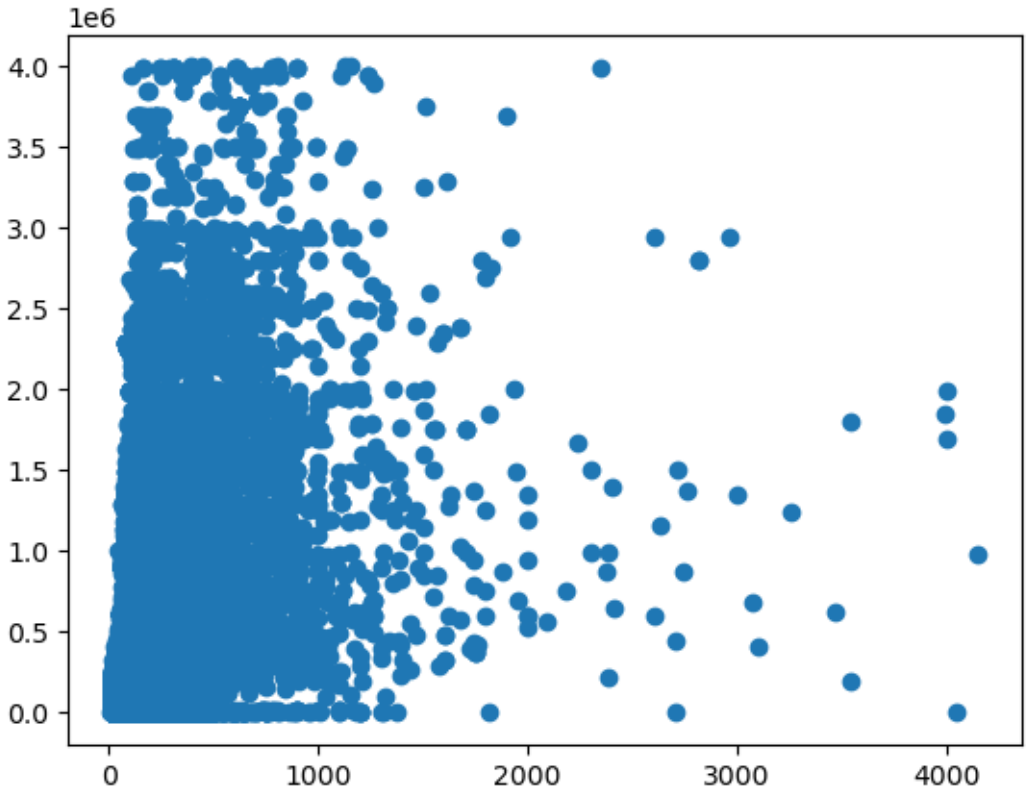
       StateOfBuilding   SubtypeOfProperty  SurfaceOfPlot  SwimmingPool  \
25624             None               villa        62490.0           NaN
25625             None               villa        43825.0           NaN
```

```
27176             None               house       129299.0          0.0
45286             GOOD               house         1019.0          NaN
65707       TO_RESTORE               house        69558.0          0.0
67362   JUST_RENOVATED               house       143179.0          NaN
85875           AS_NEW               villa        12982.0          1.0
90816           AS_NEW              chalet         8000.0          0.0
117363   TO_BE_DONE_UP              castle        95000.0          0.0
123217            None  mixed_use_building        18814.0          NaN
123218            None        manor_house        18814.0          NaN
150177            GOOD               house       153030.0          NaN
166794          AS_NEW           apartment            NaN          NaN
180312            None           farmhouse        83578.0          1.0

        Terrace  ToiletCount  TypeOfProperty        TypeOfSale
25624       1.0          7.0               1  residential_sale
25625       NaN          0.0               1  residential_sale
27176       1.0          1.0               1  residential_sale
45286       1.0          2.0               1  residential_sale
65707       1.0          1.0               1  residential_sale
67362       1.0          NaN               1  residential_sale
85875       1.0          NaN               1  residential_sale
90816       1.0          2.0               1  residential_sale
117363      1.0          NaN               1  residential_sale
123217      1.0          7.0               1  residential_sale
123218      1.0          7.0               1  residential_sale
150177      1.0          6.0               1  residential_sale
166794      1.0          2.0               2  residential_sale
180312      1.0          3.0               1  residential_sale
```

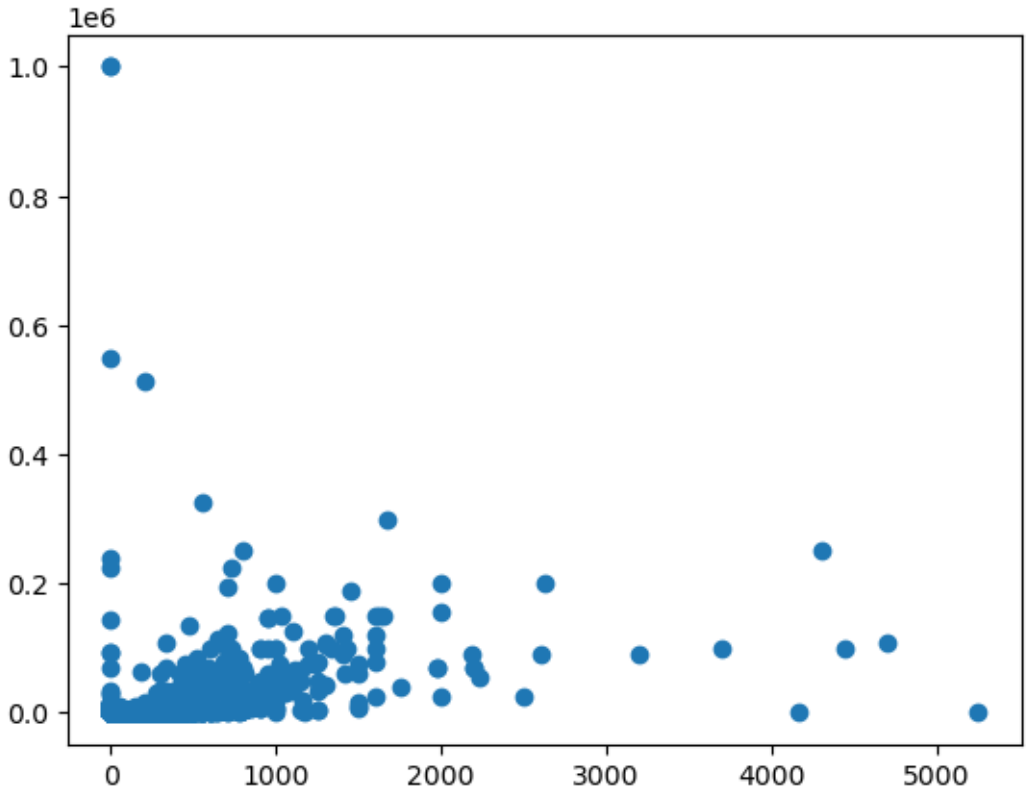
[1432]:
```
plt.scatter(x='LivingArea', y='Price', data=data)
```

[1432]:
```
<matplotlib.collections.PathCollection at 0x7f123bd456c0>
```



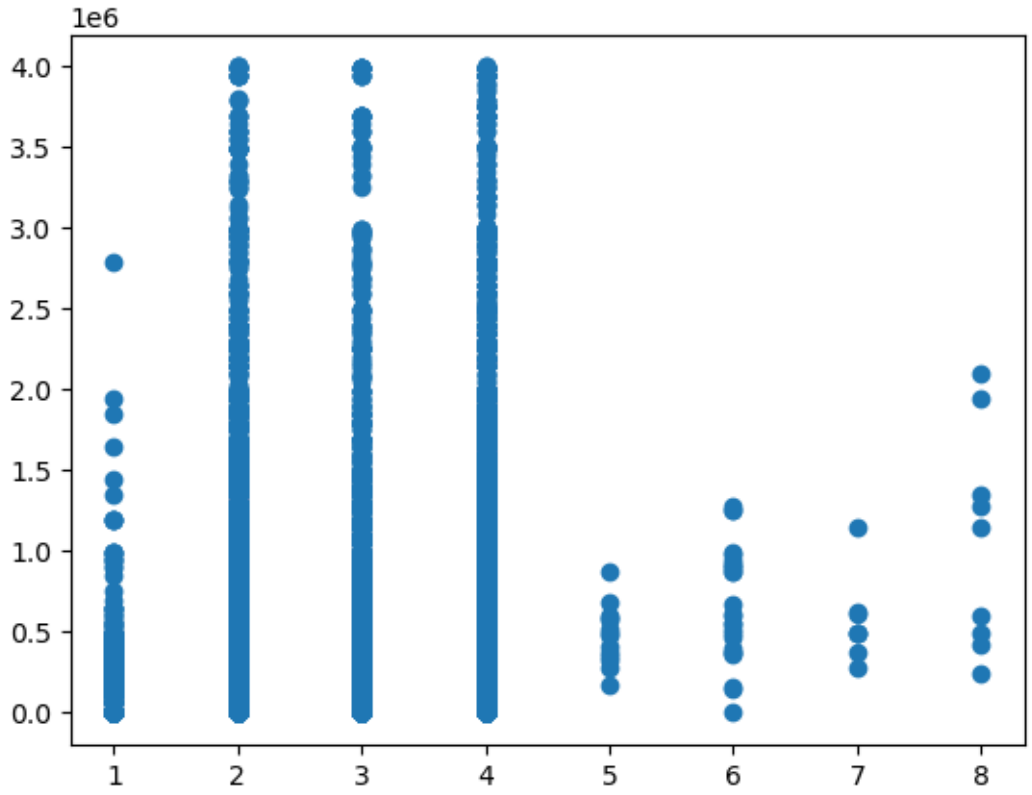
[1433]:
```
plt.scatter(x='MonthlyCharges', y='Price', data=data)
```

[1433]: <matplotlib.collections.PathCollection at 0x7f1061736d10>



[1434]:
```
plt.scatter(x='NumberOfFacades', y='Price', data=data)
```

[1434]: <matplotlib.collections.PathCollection at 0x7f10617347f0>



[1435]:
```
data.query('NumberOfFacades > 7')
```

[1435]:
```
                                                    Url  \
34957   https://www.immoweb.be/en/classified/house/for-
sale/brasschaat/2930/11484870
47554     https://www.immoweb.be/en/classified/house/for-
sale/walcourt/5651/11477545
58767       https://www.immoweb.be/en/classified/house/for-
sale/blegny/4670/11470096
69964      https://www.immoweb.be/en/classified/house/for-
sale/bocholt/3950/11388056
76112   https://www.immoweb.be/en/classified/apartment/for-
sale/neupre/4122/11430307
103669  https://www.immoweb.be/en/classified/house/for-
sale/keerbergen/3140/11214978
115672    https://www.immoweb.be/en/classified/house/for-
sale/kortrijk/8500/11191113
117839      https://www.immoweb.be/en/classified/house/for-
sale/veurne/8630/11364989
119130     https://www.immoweb.be/en/classified/house/for-
sale/kruisem/9750/11360121
```

```
        BathroomCount  BedroomCount  ConstructionYear  Country       District  \
34957             3.0             4               NaN  Belgium        Antwerp
47554             2.0             4            2004.0  Belgium  Philippeville
58767             3.0             5               NaN  Belgium          Liège
69964             1.0             4            1966.0  Belgium        Maaseik
76112             1.0             2            2024.0  Belgium          Liège
103669            3.0             5            1972.0  Belgium         Leuven
115672            0.0             3               NaN  Belgium       Kortrijk
117839            2.0             4            1890.0  Belgium         Veurne
119130            3.0             6            1875.0  Belgium     Oudenaarde

        Fireplace         FloodingZone  Furnished  Garden  GardenArea  \
34957         1.0       NON_FLOOD_ZONE        NaN     1.0      4500.0
47554         1.0       NON_FLOOD_ZONE        NaN     1.0      2000.0
58767         1.0       NON_FLOOD_ZONE        0.0     1.0     11556.0
69964         NaN       NON_FLOOD_ZONE        NaN     1.0       620.0
76112         NaN       NON_FLOOD_ZONE        NaN     1.0      1000.0
103669        1.0  POSSIBLE_FLOOD_ZONE        NaN     1.0      6620.0
115672        NaN       NON_FLOOD_ZONE        NaN     1.0        80.0
117839        NaN  POSSIBLE_FLOOD_ZONE        NaN     1.0         1.0
119130        1.0       NON_FLOOD_ZONE        NaN     NaN         NaN

                 Kitchen  LivingArea    Locality  MonthlyCharges  \
34957      HYPER_EQUIPPED       753.0  Brasschaat             NaN
47554   USA_HYPER_EQUIPPED       400.0   Walcourt              NaN
58767            INSTALLED       481.0     Blégny              NaN
69964            INSTALLED       155.0    Bocholt              NaN
76112            INSTALLED         NaN     Neupré              NaN
103669           INSTALLED       577.0  Keerbergen             NaN
115672                None       333.0   Kortrijk              NaN
117839           INSTALLED       350.0     Veurne              NaN
119130                None       582.0    Kruisem              NaN

        NumberOfFacades   PEB  PostalCode    Price  PropertyId  \
34957               8.0  None        2930  2100000    11484870
47554               8.0     C        5651   595000    11477545
58767               8.0     C        4670  1280000    11470096
69964               8.0     F        3950   249000    11388056
76112               8.0    A+        4122   420000    11430307
103669              8.0     C        3140  1348000    11214978
115672              8.0     C        8500   495000    11191113
117839              8.0     B        8630  1150000    11364989
119130              8.0     D        9750  1950000    11360121

              Province    Region  RoomCount  ShowerCount StateOfBuilding  \
34957          Antwerp  Flanders        NaN          NaN          AS_NEW
```

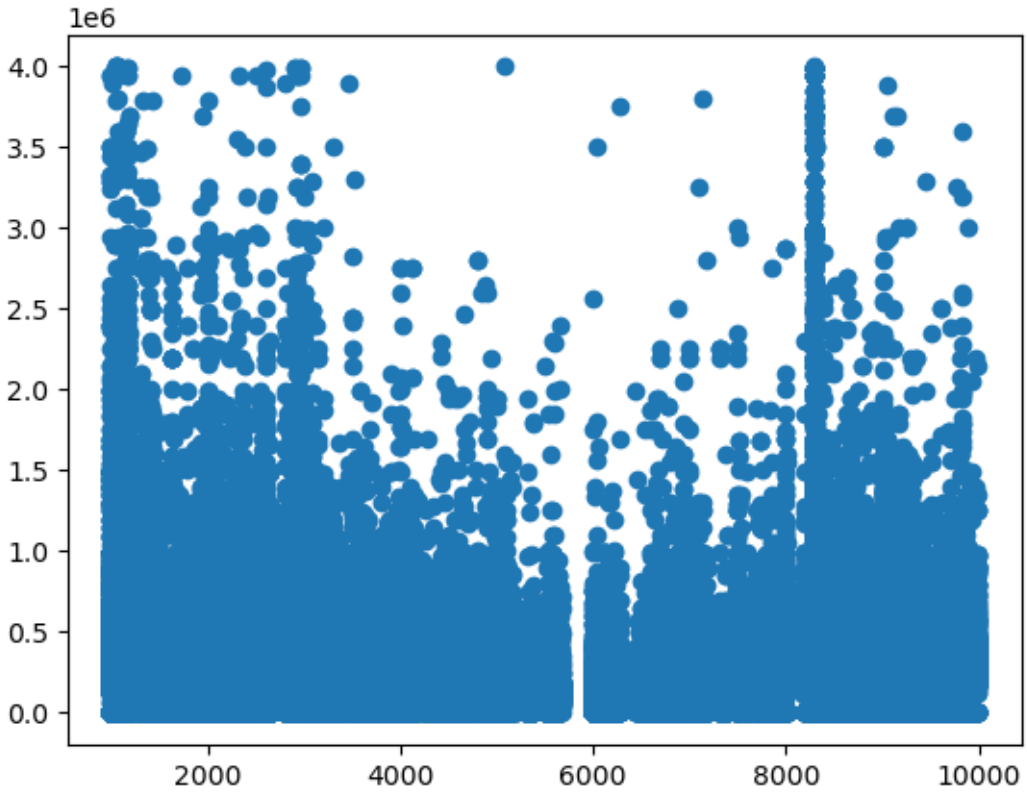
```
47554            Namur  Wallonie        NaN          NaN          AS_NEW
58767            Liège  Wallonie       31.0          NaN            GOOD
69964          Limburg  Flanders        NaN          NaN   TO_BE_DONE_UP
76112            Liège  Wallonie        5.0          1.0            None
103669  Flemish Brabant  Flanders        NaN          1.0          AS_NEW
115672    West Flanders  Flanders        1.0          0.0            None
117839    West Flanders  Flanders        NaN          2.0            GOOD
119130    East Flanders  Flanders        1.0          0.0          AS_NEW

          SubtypeOfProperty  SurfaceOfPlot  SwimmingPool  Terrace  \
34957                 villa         5335.0           1.0      1.0
47554   exceptional_property         2000.0           0.0      1.0
58767   exceptional_property        11556.0           0.0      1.0
69964                 house          770.0           0.0      1.0
76112             apartment            NaN           0.0      1.0
103669                house         6620.0           1.0      1.0
115672                house          600.0           NaN      NaN
117839      country_cottage         5657.0           1.0      1.0
119130            farmhouse         6550.0           0.0      1.0

        ToiletCount  TypeOfProperty        TypeOfSale
34957           6.0               1  residential_sale
47554           3.0               1  residential_sale
58767           4.0               1  residential_sale
69964           1.0               1  residential_sale
76112           1.0               2  residential_sale
103669          4.0               1  residential_sale
115672          0.0               1  residential_sale
117839          2.0               1  residential_sale
119130          3.0               1  residential_sale
```

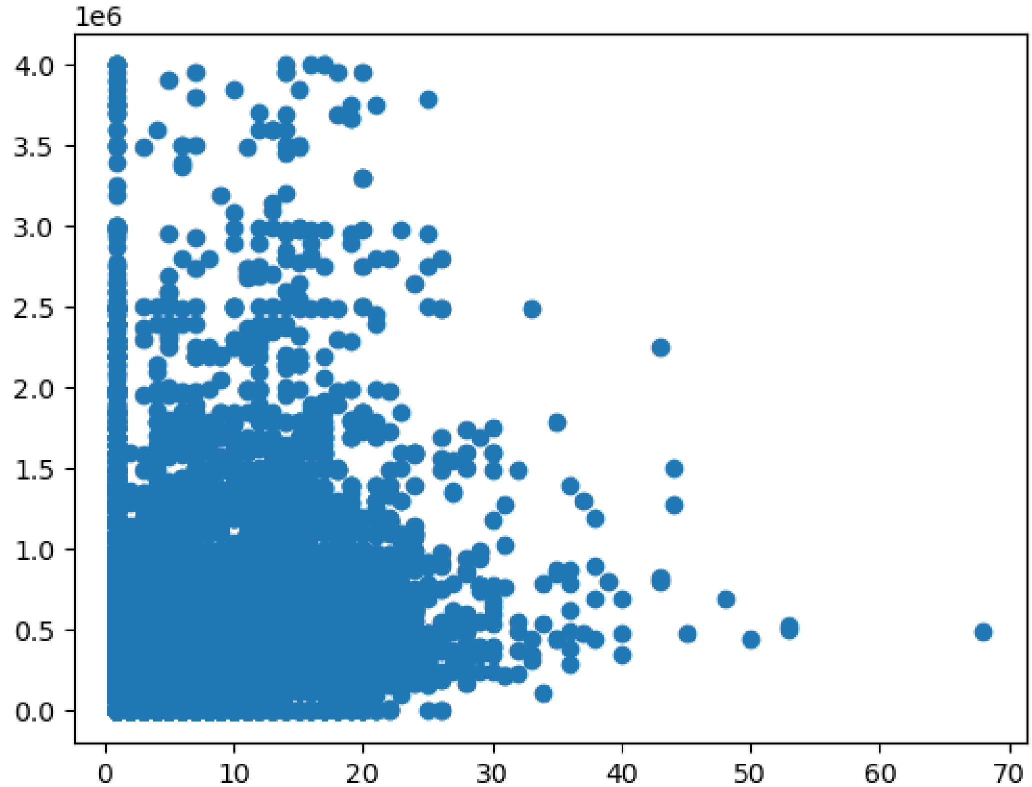
[1436]:
```
plt.scatter(x='PostalCode', y='Price', data=data)
```

[1436]:
```
<matplotlib.collections.PathCollection at 0x7f1061736ce0>
```



[1437]:
```
plt.scatter(x='RoomCount', y='Price', data=data)
```

[1437]: <matplotlib.collections.PathCollection at 0x7f108730a320>



[1438]:
```
data.query('RoomCount > 30')
```

[1438]:
```
                Url  \
6                     https://www.immoweb.be/en/classified/house/for-
sale/tournai/7500/10956841
1054            https://www.immoweb.be/en/classified/apartment/for-
sale/aywaille/4920/10943177
4764                      https://www.immoweb.be/en/classified/house/for-
sale/thon/5300/10752611
21664                 https://www.immoweb.be/en/classified/house/for-
sale/halanzy/6792/10664651
25201                  https://www.immoweb.be/en/classified/house/for-
sale/chimay/6460/10853264
29718                 https://www.immoweb.be/en/classified/house/for-
sale/malmedy/4960/10769109
30076                https://www.immoweb.be/en/classified/house/for-
sale/verviers/4800/10763700
33033        https://www.immoweb.be/en/classified/house/for-sale/corroy-le-
grand/1325/11486842
35162                https://www.immoweb.be/en/classified/house/for-
sale/sprimont/4140/11467136
```

38542 https://www.immoweb.be/en/classified/house/for-sale/olne/4877/11463965
42753 https://www.immoweb.be/en/classified/house/for-sale/anthisnes/4160/11457410
58767 https://www.immoweb.be/en/classified/house/for-sale/blegny/4670/11470096
59877 https://www.immoweb.be/en/classified/house/for-sale/liege/4000/11468635
61681 https://www.immoweb.be/en/classified/house/for-sale/marilles/1350/20009480
62736 https://www.immoweb.be/en/classified/house/for-sale/bruxelles/1000/11408092
68531 https://www.immoweb.be/en/classified/house/for-sale/grivegnee/4030/11437174
77998 https://www.immoweb.be/en/classified/house/for-sale/kapellen-2950/2950/11427986
78702 https://www.immoweb.be/en/classified/house/for-sale/braine-l-alleud/1420/11427144
79060 https://www.immoweb.be/en/classified/house/for-sale/grez-doiceau/1390/11426864
85569 https://www.immoweb.be/en/classified/house/for-sale/verviers/4800/11414150
85684 https://www.immoweb.be/en/classified/house/for-sale/grand-halleux/6698/11413864
89212 https://www.immoweb.be/en/classified/house/for-sale/grivegnee/4030/11451748
93049 https://www.immoweb.be/en/classified/house/for-sale/houtain-saint-simeon/4682/11442547
95116 https://www.immoweb.be/en/classified/house/for-sale/eeklo/9900/11281420
98204 https://www.immoweb.be/en/classified/house/for-sale/fleurus/6220/11276163
98206 https://www.immoweb.be/en/classified/house/for-sale/mellet/6211/11276161
100523 https://www.immoweb.be/en/classified/house/for-sale/brasschaat/2930/11305877
101265 https://www.immoweb.be/en/classified/apartment/for-sale/verviers/4800/11265813
102059 https://www.immoweb.be/en/classified/house/for-sale/quevy/7040/11304017
102232 https://www.immoweb.be/en/classified/house/for-sale/namur/5000/11331626
103121 https://www.immoweb.be/en/classified/house/for-sale/liege/4020/11302846
105131 https://www.immoweb.be/en/classified/house/for-sale/courcelles/6180/11211377
106332 https://www.immoweb.be/en/classified/house/for-

```
sale/verviers/4800/11250806
109012                  https://www.immoweb.be/en/classified/house/for-
sale/dour/7370/11293927
109242                 https://www.immoweb.be/en/classified/house/for-
sale/hornu/7301/11293525
111293            https://www.immoweb.be/en/classified/house/for-
sale/longchamps/6688/11237140
111552               https://www.immoweb.be/en/classified/house/for-
sale/bousval/1470/11290464
117749               https://www.immoweb.be/en/classified/house/for-
sale/corbion/6838/11365359
119404                 https://www.immoweb.be/en/classified/house/for-
sale/oreye/4360/11359140
121060                 https://www.immoweb.be/en/classified/house/for-
sale/liege/4020/11351688
124736        https://www.immoweb.be/en/classified/house/for-sale/grace-
hollogne/4460/11010296
125314                https://www.immoweb.be/en/classified/house/for-
sale/genval/1332/11089334
129727                  https://www.immoweb.be/en/classified/house/for-
sale/mons/7000/10979317
131460             https://www.immoweb.be/en/classified/house/for-
sale/grivegnee/4030/10968436
135329                 https://www.immoweb.be/en/classified/house/for-
sale/sibret/6640/11037284
144884               https://www.immoweb.be/en/classified/house/for-
sale/winenne/5570/11094016
148835              https://www.immoweb.be/en/classified/house/for-
sale/limbourg/4830/11149332
153858              https://www.immoweb.be/en/classified/house/for-
sale/hoeilaart/1560/9970172
160254               https://www.immoweb.be/en/classified/house/for-
sale/verviers/4800/9297070
181395              https://www.immoweb.be/en/classified/house/for-
sale/maldegem/9990/10105333

        BathroomCount  BedroomCount  ConstructionYear  Country  \
6                 6.0            13            1920.0  Belgium
1054              3.0             7            1900.0  Belgium
4764              1.0             6               NaN  Belgium
21664             0.0             0            1978.0  Belgium
25201             3.0             8               NaN  Belgium
29718             3.0             7            1950.0  Belgium
30076             5.0             6            1800.0  Belgium
33033             9.0            10            1972.0  Belgium
35162             4.0            11               NaN  Belgium
38542             3.0             8               NaN  Belgium
```

42753	1.0	5	1939.0	Belgium
58767	3.0	5	NaN	Belgium
59877	2.0	7	NaN	Belgium
61681	1.0	5	NaN	Belgium
62736	5.0	10	1900.0	Belgium
68531	2.0	6	NaN	Belgium
77998	3.0	6	NaN	Belgium
78702	6.0	6	2001.0	Belgium
79060	3.0	10	NaN	Belgium
85569	5.0	11	NaN	Belgium
85684	2.0	9	1800.0	Belgium
89212	2.0	6	NaN	Belgium
93049	1.0	21	1980.0	Belgium
95116	2.0	7	1979.0	Belgium
98204	2.0	7	NaN	Belgium
98206	2.0	7	NaN	Belgium
100523	2.0	7	NaN	Belgium
101265	1.0	4	NaN	Belgium
102059	1.0	9	NaN	Belgium
102232	4.0	5	NaN	Belgium
103121	4.0	8	NaN	Belgium
105131	1.0	5	NaN	Belgium
106332	3.0	4	NaN	Belgium
109012	4.0	8	NaN	Belgium
109242	2.0	5	NaN	Belgium
111293	2.0	5	1793.0	Belgium
111552	2.0	7	1998.0	Belgium
117749	12.0	13	NaN	Belgium
119404	3.0	5	1950.0	Belgium
121060	16.0	16	NaN	Belgium
124736	1.0	4	NaN	Belgium
125314	1.0	0	NaN	Belgium
129727	NaN	15	NaN	Belgium
131460	2.0	9	NaN	Belgium
135329	3.0	8	1992.0	Belgium
144884	3.0	7	1918.0	Belgium
148835	3.0	6	1887.0	Belgium
153858	6.0	13	1938.0	Belgium
160254	5.0	10	NaN	Belgium
181395	6.0	6	NaN	Belgium

	District	Fireplace	FloodingZone	Furnished	Garden	\
6	Tournai	NaN	None	0.0	NaN	
1054	Liège	NaN	NON_FLOOD_ZONE	NaN	NaN	
4764	Namur	NaN	None	NaN	NaN	
21664	Arlon	1.0	None	0.0	NaN	
25201	Thuin	NaN	None	NaN	1.0	

29718	Verviers	NaN	None	0.0	NaN
30076	Verviers	NaN	None	0.0	1.0
33033	Nivelles	NaN	None	0.0	1.0
35162	Liège	NaN	NON_FLOOD_ZONE	0.0	NaN
38542	Verviers	NaN	None	NaN	1.0
42753	Huy	NaN	NON_FLOOD_ZONE	NaN	1.0
58767	Liège	1.0	NON_FLOOD_ZONE	0.0	1.0
59877	Liège	NaN	None	NaN	NaN
61681	Nivelles	NaN	NON_FLOOD_ZONE	0.0	1.0
62736	Brussels	NaN	NON_FLOOD_ZONE	0.0	NaN
68531	Liège	NaN	NON_FLOOD_ZONE	0.0	NaN
77998	Antwerp	NaN	NON_FLOOD_ZONE	NaN	NaN
78702	Nivelles	1.0	None	0.0	NaN
79060	Nivelles	NaN	NON_FLOOD_ZONE	0.0	NaN
85569	Verviers	NaN	NON_FLOOD_ZONE	0.0	NaN
85684	Bastogne	NaN	NON_FLOOD_ZONE	0.0	1.0
89212	Liège	NaN	NON_FLOOD_ZONE	0.0	NaN
93049	Liège	1.0	None	0.0	NaN
95116	Eeklo	NaN	NON_FLOOD_ZONE	NaN	NaN
98204	Charleroi	NaN	NON_FLOOD_ZONE	0.0	NaN
98206	Charleroi	NaN	NON_FLOOD_ZONE	0.0	NaN
100523	Antwerp	NaN	NON_FLOOD_ZONE	NaN	NaN
101265	Verviers	NaN	None	NaN	NaN
102059	Mons	NaN	None	0.0	1.0
102232	Namur	NaN	None	NaN	1.0
103121	Liège	NaN	None	NaN	1.0
105131	Charleroi	NaN	None	NaN	NaN
106332	Verviers	NaN	None	0.0	NaN
109012	Mons	NaN	None	0.0	NaN
109242	Mons	NaN	None	NaN	1.0
111293	Bastogne	NaN	NON_FLOOD_ZONE	0.0	1.0
111552	Nivelles	NaN	NON_FLOOD_ZONE	NaN	NaN
117749	Neufchâteau	NaN	NON_FLOOD_ZONE	NaN	NaN
119404	Waremme	NaN	NON_FLOOD_ZONE	NaN	1.0
121060	Liège	NaN	None	1.0	NaN
124736	Liège	NaN	None	NaN	NaN
125314	Nivelles	NaN	NON_FLOOD_ZONE	NaN	NaN
129727	Mons	NaN	None	NaN	NaN
131460	Liège	NaN	NON_FLOOD_ZONE	NaN	NaN
135329	Bastogne	NaN	None	0.0	1.0
144884	Dinant	NaN	NON_FLOOD_ZONE	NaN	1.0
148835	Verviers	NaN	None	0.0	1.0
153858	Halle-Vilvoorde	1.0	None	0.0	NaN
160254	Verviers	NaN	None	0.0	NaN
181395	Eeklo	NaN	NON_FLOOD_ZONE	NaN	NaN

	GardenArea	Kitchen	LivingArea	Locality	\

6	NaN	None	391.0	Tournai
1054	NaN	INSTALLED	354.0	Aywaille
4764	NaN	None	372.0	Thon
21664	NaN	None	900.0	Halanzy
25201	90.0	None	362.0	Chimay
29718	NaN	SEMI_EQUIPPED	369.0	Malmedy
30076	300.0	SEMI_EQUIPPED	495.0	Verviers
33033	3752.0	HYPER_EQUIPPED	510.0	Corroy-le-Grand
35162	NaN	NOT_INSTALLED	401.0	Sprimont
38542	2444.0	None	653.0	Olne
42753	1368.0	INSTALLED	436.0	Anthisnes
58767	11556.0	INSTALLED	481.0	Blégny
59877	NaN	None	422.0	Liège
61681	3213.0	NOT_INSTALLED	839.0	Marilles
62736	NaN	NOT_INSTALLED	590.0	Bruxelles
68531	NaN	INSTALLED	362.0	Grivegnée
77998	NaN	HYPER_EQUIPPED	NaN	Kapellen (2950)
78702	NaN	None	700.0	Braine-l'Alleud
79060	NaN	INSTALLED	407.0	Grez-Doiceau
85569	NaN	None	407.0	Verviers
85684	1847.0	INSTALLED	422.0	Grand-halleux
89212	NaN	INSTALLED	NaN	Grivegnée
93049	NaN	INSTALLED	665.0	Houtain-Saint-Siméon
95116	NaN	INSTALLED	457.0	Eeklo
98204	NaN	INSTALLED	380.0	Fleurus
98206	NaN	INSTALLED	380.0	Mellet
100523	NaN	INSTALLED	563.0	Brasschaat
101265	NaN	None	115.0	Verviers
102059	9667.0	None	672.0	Quévy
102232	116.0	INSTALLED	210.0	Namur
103121	180.0	INSTALLED	475.0	Liège
105131	NaN	None	591.0	Courcelles
106332	NaN	NOT_INSTALLED	274.0	Verviers
109012	NaN	None	499.0	Dour
109242	629.0	None	379.0	Hornu
111293	6800.0	INSTALLED	970.0	Longchamps
111552	NaN	None	409.0	Bousval
117749	NaN	INSTALLED	737.0	Corbion
119404	2018.0	NOT_INSTALLED	434.0	Oreye
121060	NaN	None	436.0	Liège
124736	NaN	None	1680.0	Grâce-hollogne
125314	NaN	NOT_INSTALLED	610.0	Genval
129727	NaN	None	1300.0	Mons
131460	NaN	NOT_INSTALLED	543.0	Grivegnée
135329	3440.0	HYPER_EQUIPPED	482.0	Sibret
144884	4000.0	HYPER_EQUIPPED	463.0	Winenne
148835	6507.0	INSTALLED	454.0	Limbourg

153858	NaN	None	950.0		Hoeilaart
160254	NaN	INSTALLED	1090.0		Verviers
181395	NaN	INSTALLED	560.0		Maldegem

	MonthlyCharges	NumberOfFacades	PEB	PostalCode	Price	\
6	NaN	3.0	D	7500	765000	
1054	NaN	2.0	C	4920	479000	
4764	NaN	2.0	E	5300	495000	
21664	NaN	3.0	C	6792	620000	
25201	NaN	4.0	G	6460	220000	
29718	NaN	2.0	None	4960	309000	
30076	NaN	3.0	D	4800	450000	
33033	NaN	4.0	D	1325	1395000	
35162	NaN	4.0	G	4140	485000	
38542	NaN	3.0	C	4877	1275000	
42753	NaN	4.0	G	4160	495000	
58767	NaN	8.0	C	4670	1280000	
59877	NaN	2.0	B	4000	875000	
61681	NaN	4.0	F	1350	799000	
62736	NaN	2.0	G	1000	900000	
68531	NaN	2.0	D	4030	290000	
77998	NaN	NaN	C	2950	1495000	
78702	NaN	4.0	D	1420	2495000	
79060	NaN	4.0	D	1390	699000	
85569	NaN	2.0	D	4800	480000	
85684	NaN	4.0	C	6698	690000	
89212	NaN	2.0	D	4030	525000	
93049	NaN	4.0	C	4682	849000	
95116	NaN	NaN	D	9900	389000	
98204	NaN	4.0	F	6220	450000	
98206	NaN	4.0	F	6211	450000	
100523	NaN	4.0	D	2930	1195000	
101265	NaN	2.0	E	4800	110000	
102059	NaN	4.0	B	7040	535000	
102232	NaN	2.0	D	5000	349000	
103121	NaN	3.0	C	4020	450000	
105131	NaN	4.0	G	6180	375000	
106332	NaN	3.0	D	4800	225000	
109012	NaN	4.0	F	7370	350000	
109242	NaN	3.0	E	7301	235000	
111293	NaN	4.0	B	6688	2250000	
111552	NaN	4.0	D	1470	785000	
117749	NaN	2.0	F	6838	500000	
119404	NaN	4.0	C	4360	550000	
121060	NaN	3.0	D	4020	825000	
124736	NaN	3.0	E	4460	1025000	
125314	NaN	2.0	C	1332	445000	

129727	NaN	4.0	G	7000	1500000
131460	NaN	2.0	E	4030	695000
135329	NaN	4.0	B	6640	1300000
144884	NaN	4.0	A	5570	875000
148835	NaN	4.0	C	4830	799000
153858	NaN	4.0	E	1560	1795000
160254	NaN	3.0	F	4800	495000
181395	NaN	4.0	C	9990	795000

	PropertyId	Province	Region	RoomCount	ShowerCount	\
6	10956841	Hainaut	Wallonie	31.0	NaN	
1054	10943177	Liège	Wallonie	45.0	NaN	
4764	10752611	Namur	Wallonie	36.0	2.0	
21664	10664651	Luxembourg	Wallonie	36.0	0.0	
25201	10853264	Hainaut	Wallonie	31.0	NaN	
29718	10769109	Liège	Wallonie	33.0	1.0	
30076	10763700	Liège	Wallonie	50.0	4.0	
33033	11486842	Walloon Brabant	Wallonie	36.0	3.0	
35162	11467136	Liège	Wallonie	40.0	NaN	
38542	11463965	Liège	Wallonie	44.0	1.0	
42753	11457410	Liège	Wallonie	32.0	NaN	
58767	11470096	Liège	Wallonie	31.0	NaN	
59877	11468635	Liège	Wallonie	36.0	1.0	
61681	20009480	Walloon Brabant	Wallonie	43.0	NaN	
62736	11408092	Brussels	Brussels	38.0	2.0	
68531	11437174	Liège	Wallonie	36.0	1.0	
77998	11427986	Antwerp	Flanders	32.0	NaN	
78702	11427144	Walloon Brabant	Wallonie	33.0	0.0	
79060	11426864	Walloon Brabant	Wallonie	40.0	NaN	
85569	11414150	Liège	Wallonie	37.0	4.0	
85684	11413864	Luxembourg	Wallonie	38.0	2.0	
89212	11451748	Liège	Wallonie	53.0	1.0	
93049	11442547	Liège	Wallonie	35.0	0.0	
95116	11281420	East Flanders	Flanders	36.0	2.0	
98204	11276163	Hainaut	Wallonie	35.0	NaN	
98206	11276161	Hainaut	Wallonie	35.0	NaN	
100523	11305877	Antwerp	Flanders	38.0	2.0	
101265	11265813	Liège	Wallonie	34.0	NaN	
102059	11304017	Hainaut	Wallonie	34.0	5.0	
102232	11331626	Namur	Wallonie	33.0	2.0	
103121	11302846	Liège	Wallonie	33.0	NaN	
105131	11211377	Hainaut	Wallonie	32.0	NaN	
106332	11250806	Liège	Wallonie	31.0	1.0	
109012	11293927	Hainaut	Wallonie	40.0	3.0	
109242	11293525	Hainaut	Wallonie	32.0	1.0	
111293	11237140	Luxembourg	Wallonie	43.0	0.0	
111552	11290464	Walloon Brabant	Wallonie	34.0	1.0	

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117749    11365359       Luxembourg  Wallonie       53.0         11.0
119404    11359140            Liège  Wallonie       32.0          3.0
121060    11351688            Liège  Wallonie       43.0         10.0
124736    11010296            Liège  Wallonie       31.0          NaN
125314    11089334  Walloon Brabant  Wallonie       38.0          NaN
129727    10979317          Hainaut  Wallonie       44.0          NaN
131460    10968436            Liège  Wallonie       48.0          2.0
135329    11037284       Luxembourg  Wallonie       37.0          1.0
144884    11094016            Namur  Wallonie       35.0          NaN
148835    11149332            Liège  Wallonie       39.0          NaN
153858     9970172  Flemish Brabant  Flanders       35.0          0.0
160254     9297070            Liège  Wallonie       68.0          4.0
181395    10105333    East Flanders  Flanders       36.0          6.0

       StateOfBuilding     SubtypeOfProperty  SurfaceOfPlot  SwimmingPool  \
6                 GOOD       apartment_block          130.0           NaN
1054              GOOD             apartment            NaN           0.0
4764              GOOD    mixed_use_building          326.0           NaN
21664      TO_RENOVATE       apartment_block            0.0           0.0
25201    TO_BE_DONE_UP                 house          380.0           NaN
29718    TO_BE_DONE_UP                 house          122.0           0.0
30076             GOOD       apartment_block          495.0           0.0
33033           AS_NEW                 villa         3985.0           NaN
35162      TO_RENOVATE                 house         1860.0           0.0
38542           AS_NEW                 house         2940.0           1.0
42753             GOOD    mixed_use_building         1728.0           NaN
58767             GOOD  exceptional_property        11556.0           0.0
59877             GOOD       apartment_block          133.0           NaN
61681             GOOD                 house         4590.0           0.0
62736      TO_RENOVATE    mixed_use_building          200.0           0.0
68531    TO_BE_DONE_UP       apartment_block          202.0           0.0
77998           AS_NEW                 villa         2200.0           NaN
78702           AS_NEW                 villa         5000.0           0.0
79060      TO_RENOVATE                 house          720.0           0.0
85569             GOOD       apartment_block          100.0           0.0
85684             GOOD                 house         2243.0           0.0
89212    TO_BE_DONE_UP    mixed_use_building          394.0           0.0
93049    TO_BE_DONE_UP                 villa            0.0           0.0
95116             GOOD                 house          742.0           NaN
98204    TO_BE_DONE_UP                 house         5700.0           0.0
98206    TO_BE_DONE_UP                 house         5700.0           0.0
100523            GOOD                 villa         3110.0           NaN
101265            GOOD             apartment            NaN           NaN
102059            GOOD             farmhouse        10265.0           NaN
102232            GOOD       apartment_block          240.0           0.0
103121     TO_RENOVATE       apartment_block          445.0           NaN
105131     TO_RENOVATE             farmhouse            0.0           NaN
```

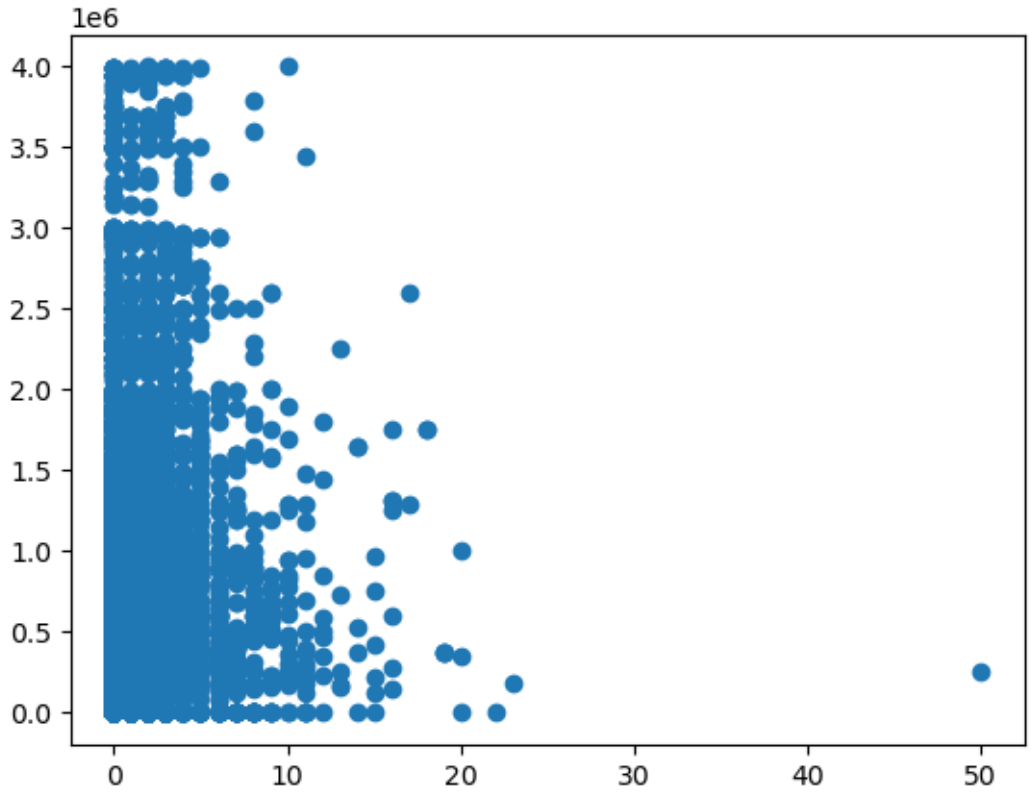
106332	TO_RENOVATE	apartment_block	170.0	0.0
109012	TO_BE_DONE_UP	mansion	2880.0	NaN
109242	TO_BE_DONE_UP	villa	970.0	NaN
111293	AS_NEW	house	7146.0	1.0
111552	GOOD	house	1704.0	NaN
117749	GOOD	mixed_use_building	429.0	0.0
119404	TO_RENOVATE	house	2362.0	0.0
121060	GOOD	apartment_block	85.0	NaN
124736	GOOD	mixed_use_building	4381.0	NaN
125314	TO_RENOVATE	mixed_use_building	920.0	0.0
129727	TO_RENOVATE	castle	154300.0	NaN
131460	GOOD	apartment_block	2455.0	0.0
135329	GOOD	house	3810.0	0.0
144884	AS_NEW	mansion	4453.0	0.0
148835	TO_BE_DONE_UP	house	6758.0	0.0
153858	GOOD	villa	10002.0	1.0
160254	TO_RENOVATE	mixed_use_building	286.0	0.0
181395	AS_NEW	house	583.0	NaN

	Terrace	ToiletCount	TypeOfProperty	TypeOfSale
6	NaN	5.0	1	residential_sale
1054	1.0	6.0	2	residential_sale
4764	1.0	3.0	1	residential_sale
21664	NaN	0.0	1	residential_sale
25201	1.0	4.0	1	residential_sale
29718	1.0	4.0	1	residential_sale
30076	1.0	5.0	1	residential_sale
33033	1.0	10.0	1	residential_sale
35162	1.0	4.0	1	residential_sale
38542	1.0	5.0	1	residential_sale
42753	1.0	3.0	1	residential_sale
58767	1.0	4.0	1	residential_sale
59877	1.0	NaN	1	residential_sale
61681	1.0	2.0	1	residential_sale
62736	1.0	5.0	1	residential_sale
68531	1.0	5.0	1	residential_sale
77998	NaN	6.0	1	residential_sale
78702	1.0	8.0	1	residential_sale
79060	1.0	NaN	1	residential_sale
85569	NaN	6.0	1	residential_sale
85684	1.0	5.0	1	residential_sale
89212	1.0	7.0	1	residential_sale
93049	NaN	2.0	1	residential_sale
95116	1.0	3.0	1	residential_sale
98204	1.0	4.0	1	residential_sale
98206	1.0	4.0	1	residential_sale
100523	NaN	4.0	1	residential_sale

101265	NaN	5.0	2	residential_sale
102059	1.0	10.0	1	residential_sale
102232	1.0	4.0	1	residential_sale
103121	1.0	4.0	1	residential_sale
105131	NaN	2.0	1	residential_sale
106332	1.0	6.0	1	residential_sale
109012	NaN	3.0	1	residential_sale
109242	1.0	2.0	1	residential_sale
111293	1.0	2.0	1	residential_sale
111552	1.0	4.0	1	residential_sale
117749	1.0	15.0	1	residential_sale
119404	1.0	2.0	1	residential_sale
121060	NaN	18.0	1	residential_sale
124736	NaN	4.0	1	residential_sale
125314	1.0	2.0	1	residential_sale
129727	1.0	NaN	1	residential_sale
131460	1.0	6.0	1	residential_sale
135329	1.0	3.0	1	residential_sale
144884	1.0	4.0	1	residential_sale
148835	1.0	4.0	1	residential_sale
153858	NaN	3.0	1	residential_sale
160254	1.0	5.0	1	residential_sale
181395	NaN	8.0	1	residential_sale

[1439]:
```
plt.scatter(x='ShowerCount', y='Price', data=data)
```

[1439]:
```
<matplotlib.collections.PathCollection at 0x7f10601ec880>
```



[1440]:
```
data.query('ShowerCount > 20')
```

[1440]:
```
Url  \
45222    https://www.immoweb.be/en/classified/house/for-
sale/herstal/4040/11479752
46953   https://www.immoweb.be/en/classified/house/for-
rent/tervuren/3080/11478080
134891   https://www.immoweb.be/en/classified/house/for-
sale/tournai/7500/10616605

        BathroomCount  BedroomCount  ConstructionYear  Country District  \
45222             1.0             2            1936.0  Belgium    Liège
46953             2.0             3               NaN  Belgium   Leuven
134891            2.0             2               NaN  Belgium  Tournai

        Fireplace    FloodingZone  Furnished  Garden  GardenArea  \
45222         NaN  NON_FLOOD_ZONE        0.0     NaN         NaN
46953         NaN            None        NaN     1.0       800.0
134891        NaN            None        0.0     NaN         NaN

                Kitchen  LivingArea  Locality  MonthlyCharges  NumberOfFacades  \
```

```
45222         INSTALLED       110.0   Herstal             NaN              2.0
46953    HYPER_EQUIPPED       178.0  Tervuren             0.0              NaN
134891        INSTALLED       134.0   Tournai             NaN              3.0

        PEB  PostalCode   Price  PropertyId         Province    Region  \
45222     C        4040  179000    11479752           Liège  Wallonie
46953     A        3080    1790    11478080  Flemish Brabant  Flanders
134891    B        7500  250000    10616605          Hainaut  Wallonie

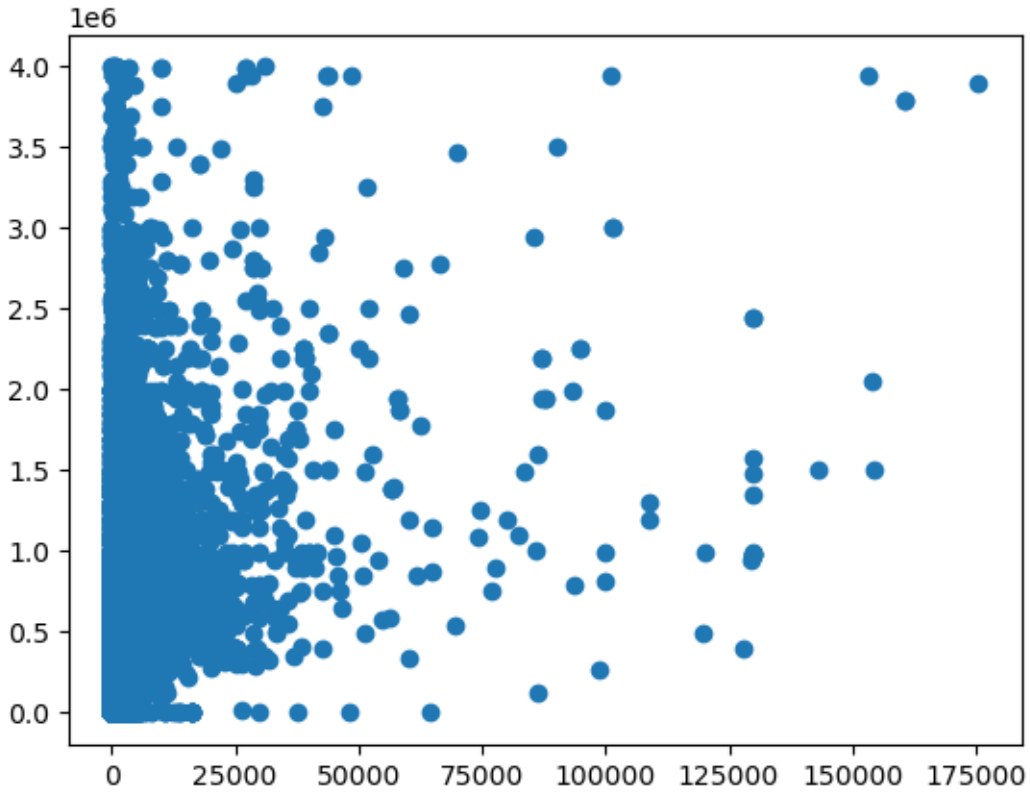
        RoomCount  ShowerCount StateOfBuilding SubtypeOfProperty  \
45222         NaN         23.0            GOOD             house
46953         9.0         22.0  JUST_RENOVATED          bungalow
134891        NaN         50.0          AS_NEW             house

        SurfaceOfPlot  SwimmingPool  Terrace  ToiletCount  TypeOfProperty  \
45222            75.0           0.0      1.0          1.0               1
46953             0.0           NaN      NaN          1.0               1
134891           63.0           0.0      NaN          NaN               1

                     TypeOfSale
45222           residential_sale
46953   residential_monthly_rent
134891          residential_sale
```

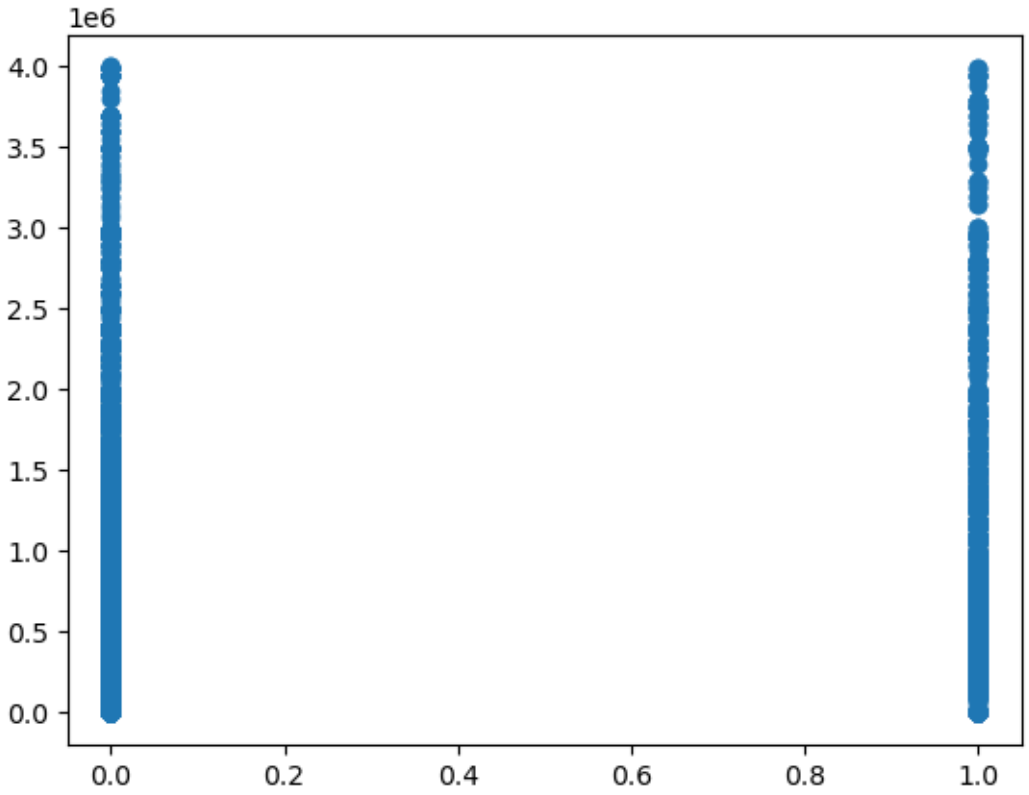
[1441]:
```
plt.scatter(x='SurfaceOfPlot', y='Price', data=data)
```

[1441]:
```
<matplotlib.collections.PathCollection at 0x7f106054c2b0>
```



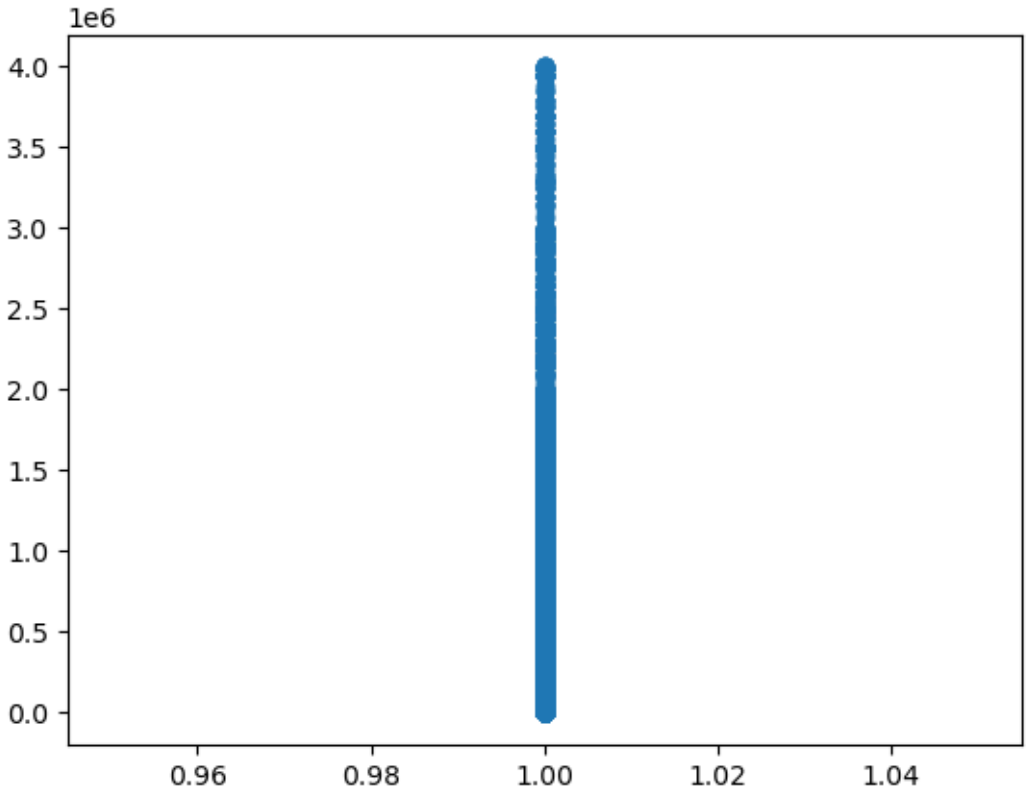
[1442]:
```
plt.scatter(x='SwimmingPool', y='Price', data=data)
```

[1442]: <matplotlib.collections.PathCollection at 0x7f106ebf7a60>



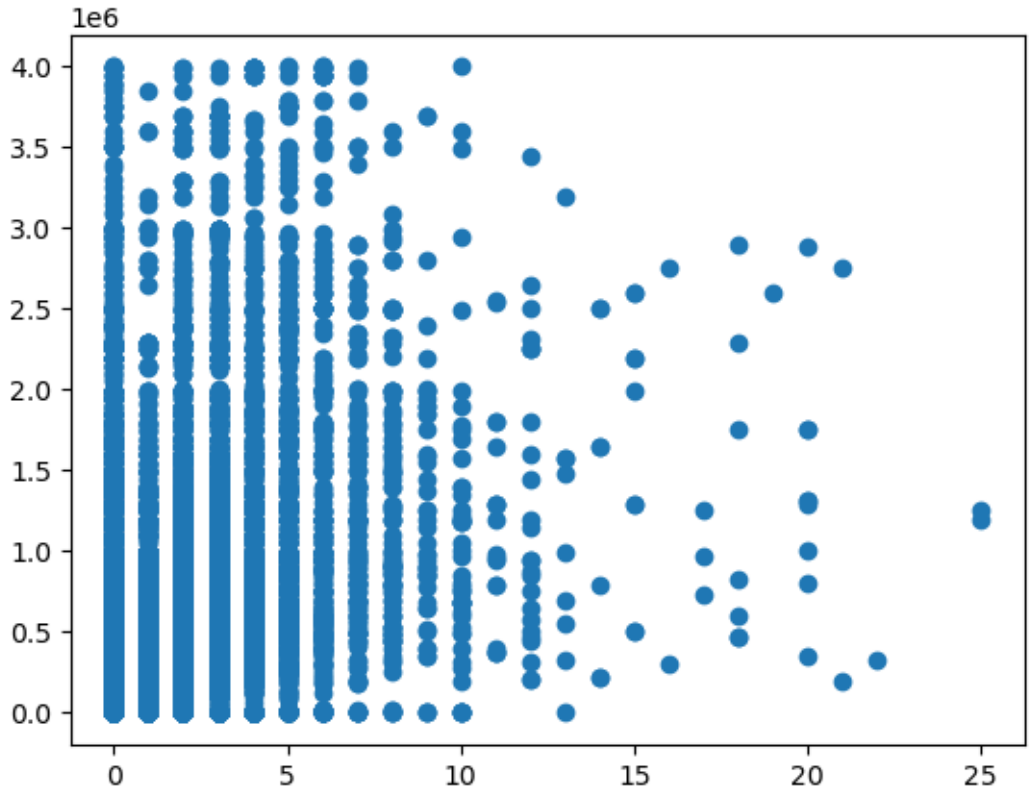
[1443]:
```
plt.scatter(x='Terrace', y='Price', data=data)
```

[1443]: <matplotlib.collections.PathCollection at 0x7f10a1b80730>



[1444]:
```
plt.scatter(x='ToiletCount', y='Price', data=data)
```

[1444]: <matplotlib.collections.PathCollection at 0x7f106086b0a0>



[1445]:
```
data.query('ToiletCount > 15')
```

[1445]:
```
                    Url  \
1271                         https://www.immoweb.be/en/classified/house/for-
sale/bastogne/6600/10940526
1273                       https://www.immoweb.be/en/classified/house/for-
sale/fauvillers/6637/10940525
25510                     https://www.immoweb.be/en/classified/apartment/for-
sale/enghien/7850/10849017
26735                       https://www.immoweb.be/en/classified/house/for-
sale/bruxelles/1000/10823525
30225                     https://www.immoweb.be/en/classified/house/for-
sale/schaerbeek/1030/11491118
72639
https://www.immoweb.be/en/classified/house/for-sale/sy/4190/11391055
72641                          https://www.immoweb.be/en/classified/house/for-
sale/durbuy/6940/11391054
77037                       https://www.immoweb.be/en/classified/house/for-
sale/antwerpen/2060/11378341
81132                        https://www.immoweb.be/en/classified/house/for-
sale/mechelen/2800/11424400
```

```
91267                        https://www.immoweb.be/en/classified/house/for-
sale/bastogne/6600/11446613
94101                          https://www.immoweb.be/en/classified/house/for-
sale/ciney/5590/11342535
99183                         https://www.immoweb.be/en/classified/house/for-
sale/liege-1/4000/11307893
107631                         https://www.immoweb.be/en/classified/house/for-
sale/jauche/1350/11247396
115473  https://www.immoweb.be/en/classified/house/for-sale/heist-op-den-berg-
wiekevorst/2222/11192577
119314                     https://www.immoweb.be/en/classified/house/for-
sale/anderlecht/1070/11359371
119733           https://www.immoweb.be/en/classified/house/for-sale/la-roche-
en-ardenne/6980/11358000
121060                         https://www.immoweb.be/en/classified/house/for-
sale/liege/4020/11351688
123234                        https://www.immoweb.be/en/classified/house/for-
sale/brussel/1020/11343564
124216                       https://www.immoweb.be/en/classified/house/for-
sale/antwerpen/2060/11017063
125917                   https://www.immoweb.be/en/classified/house/for-sale/vaux-
sur-sure/6640/11087056
133505                   https://www.immoweb.be/en/classified/apartment/for-
sale/louveigne/4141/10634220
133820                         https://www.immoweb.be/en/classified/house/for-
sale/liege/4000/11046519
139503                       https://www.immoweb.be/en/classified/house/for-
sale/erpe-mere/9420/11128591
151279                         https://www.immoweb.be/en/classified/house/for-
sale/bohan/5550/10082307
152056                        https://www.immoweb.be/en/classified/house/for-
sale/schilde/2970/10056580
170334                     https://www.immoweb.be/en/classified/house/for-
sale/marcinelle/6001/10313320
181225                       https://www.immoweb.be/en/classified/house/for-
sale/la-gleize/4987/10110132

        BathroomCount  BedroomCount  ConstructionYear  Country  \
1271             18.0            19            1874.0  Belgium
1273             18.0            19            1874.0  Belgium
25510            11.0             3               NaN  Belgium
26735            15.0            15               NaN  Belgium
30225             NaN            15               NaN  Belgium
72639             0.0            15            1875.0  Belgium
72641             0.0            15            1875.0  Belgium
77037            18.0             0            1969.0  Belgium
81132            20.0            20            1976.0  Belgium
```

```
91267            9.0            9           1950.0  Belgium
94101           18.0           31              NaN  Belgium
99183            1.0            2           1963.0  Belgium
107631           2.0            5              NaN  Belgium
115473           1.0            2           1953.0  Belgium
119314           0.0            5              NaN  Belgium
119733           9.0            9           1950.0  Belgium
121060          16.0           16              NaN  Belgium
123234          20.0           20              NaN  Belgium
124216          19.0           20           1936.0  Belgium
125917           9.0           24              NaN  Belgium
133505          16.0           18              NaN  Belgium
133820           0.0           27              NaN  Belgium
139503          22.0           25           2003.0  Belgium
151279          16.0           16           1966.0  Belgium
152056          16.0           17           1989.0  Belgium
170334          20.0           20              NaN  Belgium
181225           0.0           15              NaN  Belgium

                District  Fireplace         FloodingZone  Furnished  Garden  \
1271             Bastogne        NaN       NON_FLOOD_ZONE        1.0     1.0
1273             Bastogne        NaN       NON_FLOOD_ZONE        1.0     1.0
25510            Soignies        NaN       NON_FLOOD_ZONE        NaN     1.0
26735            Brussels        NaN                 None        0.0     NaN
30225            Brussels        NaN                 None        NaN     NaN
72639                 Huy        1.0                 None        1.0     1.0
72641   Marche-en-Famenne        1.0                 None        1.0     1.0
77037             Antwerp        NaN       NON_FLOOD_ZONE        1.0     NaN
81132            Mechelen        NaN  POSSIBLE_FLOOD_ZONE        NaN     NaN
91267            Bastogne        NaN       NON_FLOOD_ZONE        1.0     1.0
94101              Dinant        NaN                 None        NaN     NaN
99183               Liège        NaN                 None        0.0     NaN
107631           Nivelles        NaN       NON_FLOOD_ZONE        0.0     1.0
115473           Mechelen        NaN       NON_FLOOD_ZONE        1.0     NaN
119314           Brussels        NaN                 None        0.0     NaN
119733  Marche-en-Famenne        NaN       NON_FLOOD_ZONE        1.0     1.0
121060              Liège        NaN                 None        1.0     NaN
123234           Brussels        NaN                 None        NaN     NaN
124216            Antwerp        NaN                 None        1.0     NaN
125917           Bastogne        NaN                 None        NaN     NaN
133505              Liège        NaN                 None        1.0     NaN
133820              Liège        NaN                 None        NaN     NaN
139503              Aalst        NaN       NON_FLOOD_ZONE        NaN     NaN
151279             Dinant        1.0                 None        NaN     1.0
152056            Antwerp        1.0       NON_FLOOD_ZONE        NaN     1.0
170334          Charleroi        NaN                 None        0.0     NaN
181225           Verviers        NaN                 None        NaN     1.0
```

	GardenArea	Kitchen	LivingArea	Locality	\
1271	28870.0	HYPER_EQUIPPED	1560.0	Bastogne	
1273	28870.0	HYPER_EQUIPPED	1560.0	Fauvillers	
25510	150.0	None	1200.0	Enghien	
26735	NaN	None	882.0	Bruxelles	
30225	NaN	None	450.0	Schaerbeek	
72639	1287.0	INSTALLED	968.0	SY	
72641	1287.0	INSTALLED	968.0	DURBUY	
77037	NaN	INSTALLED	445.0	ANTWERPEN	
81132	NaN	HYPER_EQUIPPED	1820.0	Mechelen	
91267	9200.0	INSTALLED	485.0	Bastogne	
94101	NaN	None	1565.0	CINEY	
99183	NaN	INSTALLED	93.0	Liege 1	
107631	944.0	INSTALLED	256.0	Jauche	
115473	NaN	HYPER_EQUIPPED	718.0	Heist-op-den-Berg Wiekevorst	
119314	NaN	SEMI_EQUIPPED	NaN	ANDERLECHT	
119733	9200.0	INSTALLED	485.0	La Roche-en-Ardenne	
121060	NaN	None	436.0	Liège	
123234	NaN	SEMI_EQUIPPED	920.0	BRUSSEL	
124216	NaN	SEMI_EQUIPPED	NaN	ANTWERPEN	
125917	NaN	None	1360.0	VAUX-SUR-SÛRE	
133505	NaN	HYPER_EQUIPPED	625.0	LOUVEIGNÉ	
133820	NaN	SEMI_EQUIPPED	1529.0	LIÈGE	
139503	NaN	HYPER_EQUIPPED	1465.0	Erpe-Mere	
151279	1.0	None	NaN	Bohan	
152056	1748.0	HYPER_EQUIPPED	580.0	Schilde	
170334	NaN	INSTALLED	NaN	MARCINELLE	
181225	5000.0	SEMI_EQUIPPED	750.0	LA GLEIZE	

	MonthlyCharges	NumberOfFacades	PEB	PostalCode	Price	\
1271	NaN	4.0	D	6600	1750000	
1273	NaN	4.0	D	6637	1750000	
25510	NaN	2.0	C	7850	2750000	
26735	NaN	3.0	D	1000	1750000	
30225	NaN	2.0	D	1030	975000	
72639	NaN	4.0	None	4190	1319000	
72641	NaN	4.0	None	6940	1319000	
77037	NaN	2.0	B	2060	2895000	
81132	NaN	NaN	None	2800	2750000	
91267	NaN	4.0	None	6600	475000	
94101	NaN	4.0	D	5590	2290000	
99183	NaN	3.0	F	4000	199000	
107631	NaN	2.0	C	1350	325000	
115473	NaN	3.0	B	2222	799000	
119314	NaN	2.0	G	1070	349000	
119733	NaN	4.0	None	6980	475000	

121060	NaN	3.0	D	4020	825000
123234	NaN	NaN	F	1020	1295000
124216	NaN	2.0	E	2060	2890000
125917	NaN	4.0	None	6640	1200000
133505	NaN	3.0	G	4141	599000
133820	NaN	2.0	D	4000	2600000
139503	NaN	4.0	C	9420	1250000
151279	NaN	2.0	None	5550	305000
152056	NaN	4.0	C	2970	1250000
170334	NaN	3.0	C	6001	999999
181225	NaN	4.0	None	4987	730000

	PropertyId	Province	Region	RoomCount	ShowerCount	\
1271	10940526	Luxembourg	Wallonie	NaN	18.0	
1273	10940525	Luxembourg	Wallonie	NaN	18.0	
25510	10849017	Hainaut	Wallonie	NaN	5.0	
26735	10823525	Brussels	Brussels	NaN	16.0	
30225	11491118	Brussels	Brussels	NaN	15.0	
72639	11391055	Liège	Wallonie	NaN	16.0	
72641	11391054	Luxembourg	Wallonie	NaN	16.0	
77037	11378341	Antwerp	Flanders	NaN	0.0	
81132	11424400	Antwerp	Flanders	20.0	NaN	
91267	11446613	Luxembourg	Wallonie	NaN	9.0	
94101	11342535	Namur	Wallonie	NaN	0.0	
99183	11307893	Liège	Wallonie	NaN	NaN	
107631	11247396	Walloon Brabant	Wallonie	23.0	1.0	
115473	11192577	Antwerp	Flanders	NaN	NaN	
119314	11359371	Brussels	Brussels	5.0	2.0	
119733	11358000	Luxembourg	Wallonie	NaN	9.0	
121060	11351688	Liège	Wallonie	43.0	10.0	
123234	11343564	Brussels	Brussels	NaN	0.0	
124216	11017063	Antwerp	Flanders	NaN	0.0	
125917	11087056	Luxembourg	Wallonie	NaN	9.0	
133505	10634220	Liège	Wallonie	NaN	16.0	
133820	11046519	Liège	Wallonie	NaN	17.0	
139503	11128591	East Flanders	Flanders	NaN	NaN	
151279	10082307	Namur	Wallonie	NaN	0.0	
152056	10056580	Antwerp	Flanders	NaN	16.0	
170334	10313320	Hainaut	Wallonie	NaN	20.0	
181225	10110132	Liège	Wallonie	NaN	13.0	

	StateOfBuilding	SubtypeOfProperty	SurfaceOfPlot	SwimmingPool	\
1271	GOOD	castle	28870.0	0.0	
1273	GOOD	house	28870.0	0.0	
25510	None	apartment	NaN	NaN	
26735	GOOD	mixed_use_building	172.0	NaN	
30225	JUST_RENOVATED	house	0.0	0.0	

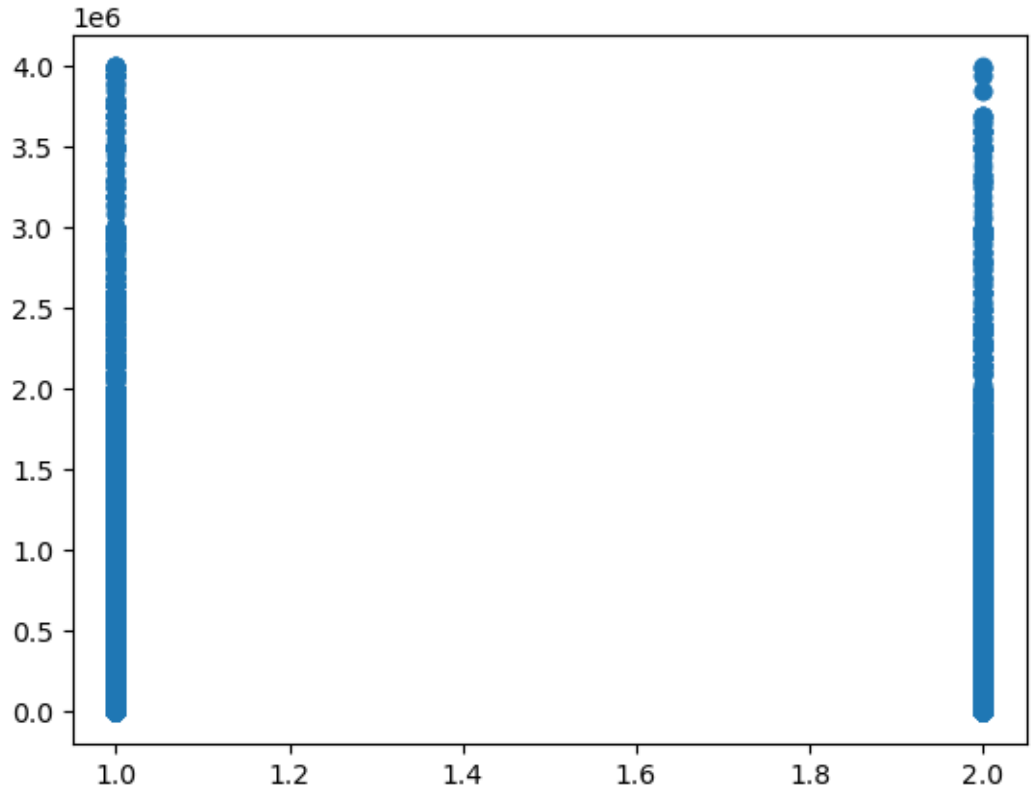
72639	GOOD	house	1287.0	1.0
72641	GOOD	house	1287.0	1.0
77037	AS_NEW	apartment_block	205.0	NaN
81132	None	mixed_use_building	58835.0	NaN
91267	TO_RENOVATE	mixed_use_building	2960.0	0.0
94101	GOOD	apartment_block	0.0	NaN
99183	None	house	297.0	NaN
107631	GOOD	house	1193.0	0.0
115473	GOOD	house	1044.0	NaN
119314	TO_RENOVATE	town_house	240.0	0.0
119733	TO_RENOVATE	mixed_use_building	2960.0	0.0
121060	GOOD	apartment_block	85.0	NaN
123234	TO_RENOVATE	apartment_block	0.0	NaN
124216	None	apartment_block	365.0	NaN
125917	None	mixed_use_building	14721.0	NaN
133505	GOOD	apartment	NaN	NaN
133820	GOOD	apartment_block	2061.0	NaN
139503	TO_BE_DONE_UP	house	4505.0	0.0
151279	GOOD	mixed_use_building	1692.0	NaN
152056	GOOD	mixed_use_building	1348.0	NaN
170334	GOOD	apartment_block	1795.0	0.0
181225	JUST_RENOVATED	apartment_block	5792.0	NaN

	Terrace	ToiletCount	TypeOfProperty	TypeOfSale
1271	1.0	20.0	1	residential_sale
1273	1.0	20.0	1	residential_sale
25510	1.0	16.0	2	residential_sale
26735	1.0	18.0	1	residential_sale
30225	1.0	17.0	1	residential_sale
72639	1.0	20.0	1	residential_sale
72641	1.0	20.0	1	residential_sale
77037	1.0	18.0	1	residential_sale
81132	NaN	21.0	1	residential_sale
91267	1.0	18.0	1	residential_sale
94101	NaN	18.0	1	residential_sale
99183	1.0	21.0	1	residential_sale
107631	1.0	22.0	1	residential_sale
115473	1.0	20.0	1	residential_sale
119314	NaN	20.0	1	residential_sale
119733	1.0	18.0	1	residential_sale
121060	NaN	18.0	1	residential_sale
123234	NaN	20.0	1	residential_sale
124216	NaN	20.0	1	residential_sale
125917	1.0	25.0	1	residential_sale
133505	1.0	18.0	2	residential_sale
133820	1.0	19.0	1	residential_sale
139503	1.0	25.0	1	residential_sale

```
151279      NaN         16.0              1  residential_sale
152056      1.0         17.0              1  residential_sale
170334      NaN         20.0              1  residential_sale
181225      1.0         17.0              1  residential_sale
```

[1446]:
```
plt.scatter(x='TypeOfProperty', y='Price', data=data)
```

[1446]:
```
<matplotlib.collections.PathCollection at 0x7f108d552c50>
```



[1447]:
```
pd.DataFrame(data.isnull().sum().sort_values(ascending=False)).head(20)
```

[1447]:
```
                     0
Fireplace       114316
MonthlyCharges  104751
GardenArea       95973
Garden           95973
Furnished        88196
RoomCount        85580
SwimmingPool     78217
ShowerCount      61454
SurfaceOfPlot    60413
```

```
FloodingZone        60236
Kitchen             51441
Terrace             50246
ConstructionYear    49731
NumberOfFacades     41718
StateOfBuilding     37046
PEB                 33562
ToiletCount         22196
LivingArea          14144
BathroomCount        9566
TypeOfProperty          0
```

[1448]:
```
data['TypeOfSale'].unique()
```

[1448]:
```
array(['residential_sale', 'residential_monthly_rent',
       'annuity_without_lump_sum', 'annuity_monthly_amount',
       'annuity_lump_sum'], dtype=object)
```

[1449]:
```
data.drop(data[data.TypeOfSale == "annuity_monthly_amount"].index,inplace=True)
data.drop(data[data.TypeOfSale == "annuity_without_lump_sum"].
 ↪index,inplace=True)
data.drop(data[data.TypeOfSale == "annuity_lump_sum"].index,inplace=True)
data.drop(data[data.TypeOfSale == "homes_to_build"].index,inplace=True)
```

[1450]:
```
data_sales = data[data.TypeOfSale == "residential_sale"]
data_rent = data[data.TypeOfSale == "residential_monthly_rent"]
```

[1451]:
```
pd.DataFrame(data_sales.isnull().sum().sort_values(ascending=False)).head(30)
```

[1451]:
```
                       0
MonthlyCharges    104638
Fireplace         101005
GardenArea         84199
Garden             84199
RoomCount          75641
Furnished          74494
SwimmingPool       71555
ShowerCount        55263
FloodingZone       51381
SurfaceOfPlot      49630
Kitchen            46981
Terrace            44213
ConstructionYear   41789
NumberOfFacades    36777
StateOfBuilding    33390
PEB                30469
ToiletCount        20117
```

```
LivingArea          11288
BathroomCount        8049
TypeOfProperty          0
SubtypeOfProperty       0
Url                     0
Region                  0
Province                0
PropertyId              0
Price                   0
PostalCode              0
Locality                0
District                0
Country                 0
```

[1452]:
```
pd.DataFrame(data_rent.isnull().sum().sort_values(ascending=False)).head(20)
```

[1452]:
```
                     0
Furnished        13447
Fireplace        13039
GardenArea       11530
Garden           11530
SurfaceOfPlot    10667
RoomCount         9649
FloodingZone      8670
ConstructionYear  7845
SwimmingPool      6411
ShowerCount       6121
Terrace           5919
NumberOfFacades   4903
Kitchen           4410
StateOfBuilding   3547
PEB               3023
LivingArea        2809
ToiletCount       2042
BathroomCount     1490
Region               0
TypeOfProperty       0
```

0.1 Data sales

[1453]:
```
data_sales.shape
```

[1453]:
```
(104638, 32)
```

[1454]:
```
pd.DataFrame(data_sales.isnull().sum().sort_values(ascending=False)).head(20)
```

[1454]:
```
                        0
MonthlyCharges     104638
Fireplace          101005
GardenArea          84199
Garden              84199
RoomCount           75641
Furnished           74494
SwimmingPool        71555
ShowerCount         55263
FloodingZone        51381
SurfaceOfPlot       49630
Kitchen             46981
Terrace             44213
ConstructionYear    41789
NumberOfFacades     36777
StateOfBuilding     33390
PEB                 30469
ToiletCount         20117
LivingArea          11288
BathroomCount        8049
TypeOfProperty          0
```

[1455]:
```
data_sales['MonthlyCharges'].unique()
```

[1455]:
```
array([nan])
```

[1456]:
```
data_sales.drop(['MonthlyCharges'], axis=1, inplace=True)
```

```
/tmp/ipykernel_5151/3118624834.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales.drop(['MonthlyCharges'], axis=1, inplace=True)
```

[1457]:
```
data_sales['Fireplace'].unique()
```

[1457]:
```
array([nan,  1.])
```

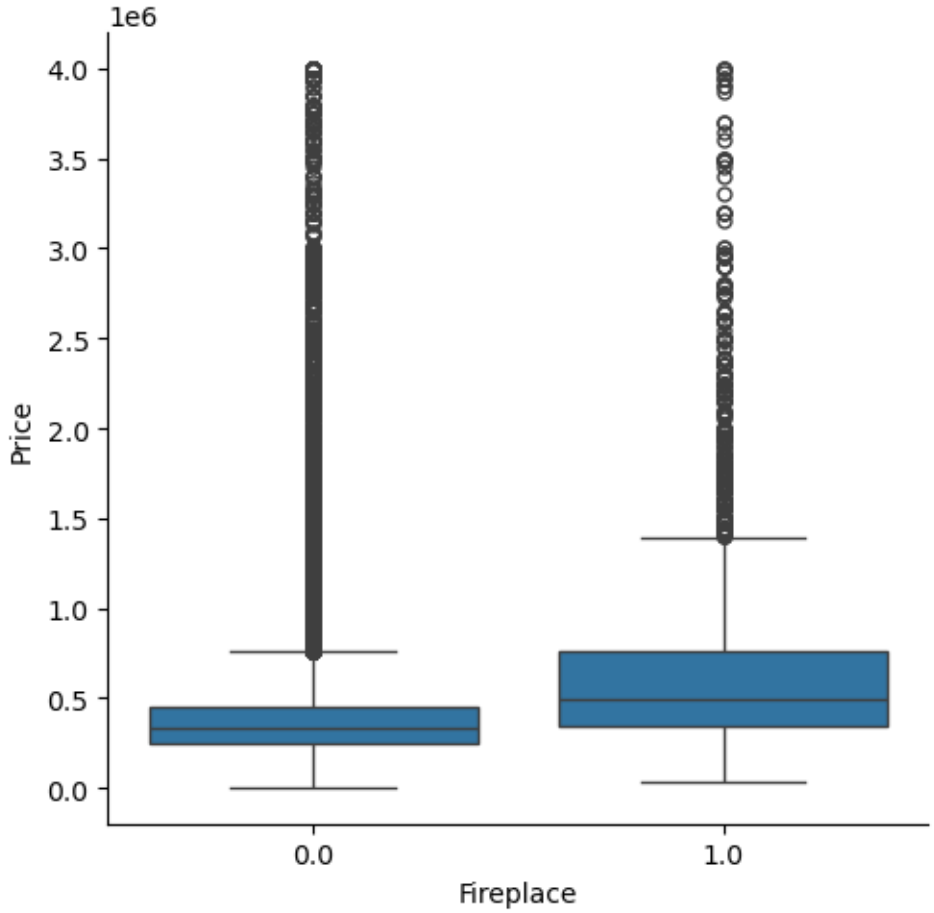
[1458]:
```
data_sales['Fireplace'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/3880146483.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['Fireplace'].fillna(0, inplace=True)
```

[1459]:
```
sns.catplot(data=data_sales, x="Fireplace", y="Price", kind="box")
```

[1459]: <seaborn.axisgrid.FacetGrid at 0x7f123bdec670>



[1460]:
```
data_sales['Garden'].unique()
```

[1460]:
```
array([nan,  1.])
```

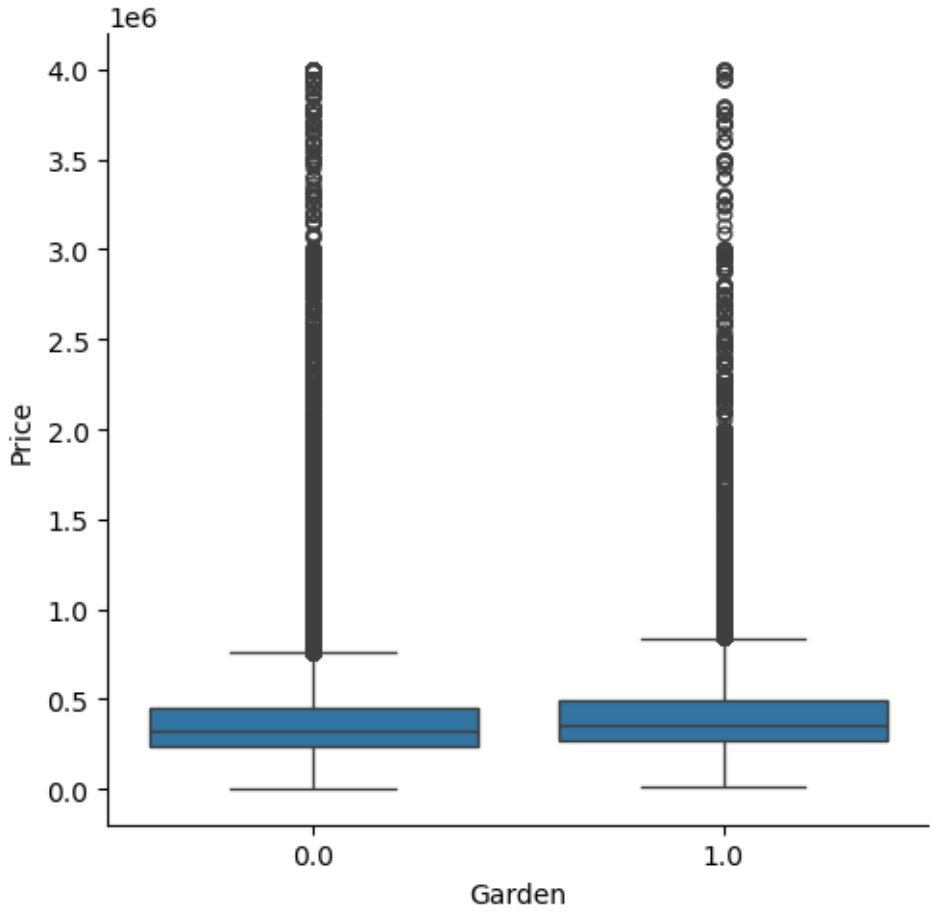
[1461]:
```
data_sales['Garden'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/937975057.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['Garden'].fillna(0, inplace=True)
```

[1462]:
```
sns.catplot(data=data_sales, x="Garden", y="Price", kind="box")
```

[1462]: <seaborn.axisgrid.FacetGrid at 0x7f106f5402e0>



[1463]:
```
data_sales['GardenArea'].unique()
```

[1463]:
```
array([      nan, 1.000e+00, 7.600e+01, …, 8.830e+02, 3.705e+03,
       4.179e+03])
```

[1464]:
```
data_sales['GardenArea'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/1579274237.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

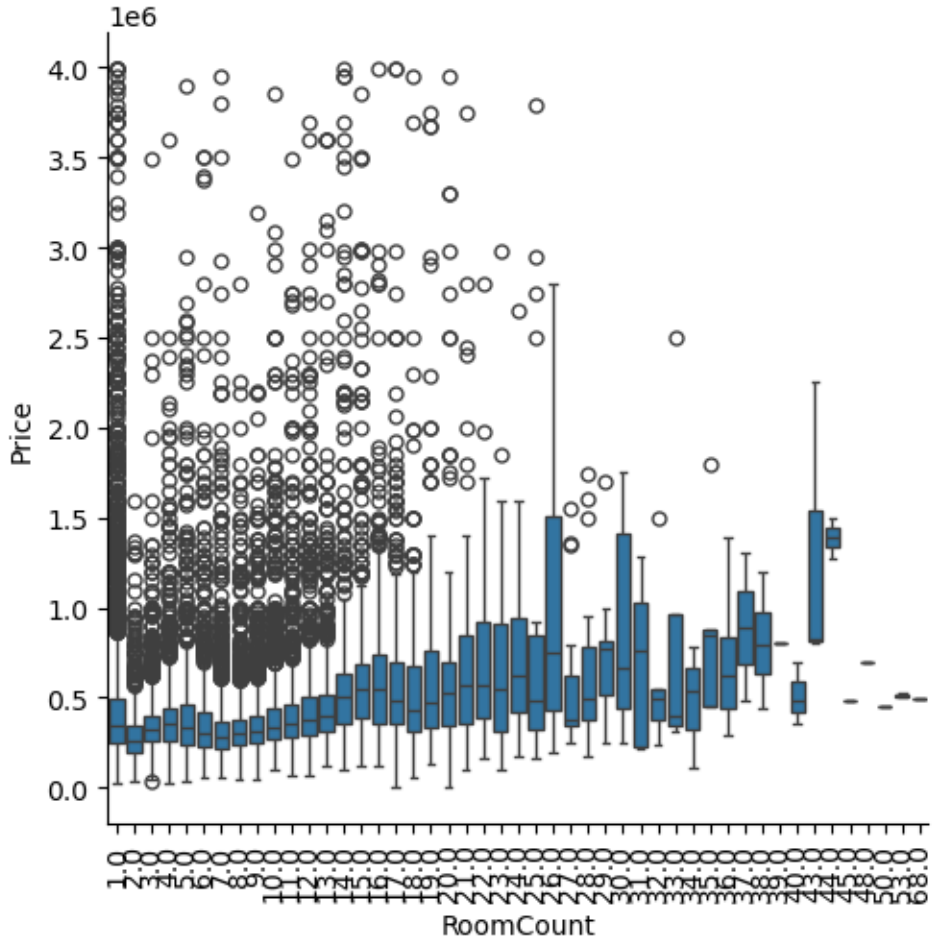
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['GardenArea'].fillna(0, inplace=True)
```

[1465]:
```
data_sales['RoomCount'].unique()
```

[1465]:
```
array([ 1., 31., nan, 16., 14.,  4.,  9., 12., 17.,  8.,  7.,  6.,  3.,
       13., 10.,  5.,  2., 19., 20., 11., 18., 23., 45., 15., 24., 22.,
       27., 28., 26., 29., 36., 21., 25., 30., 33., 50., 40., 44., 32.,
```

```
       43., 38., 37., 53., 35., 34., 48., 39., 68.])
```

[1466]:
```
sns.catplot(data=data_sales, x="RoomCount", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[ ]:
```

```

[1467]:
```
data_sales['Furnished'].unique()
```

[1467]:
```
array([nan,  0.,  1.])
```

[1468]:
```
data_sales['Furnished'].fillna(0, inplace=True)
```

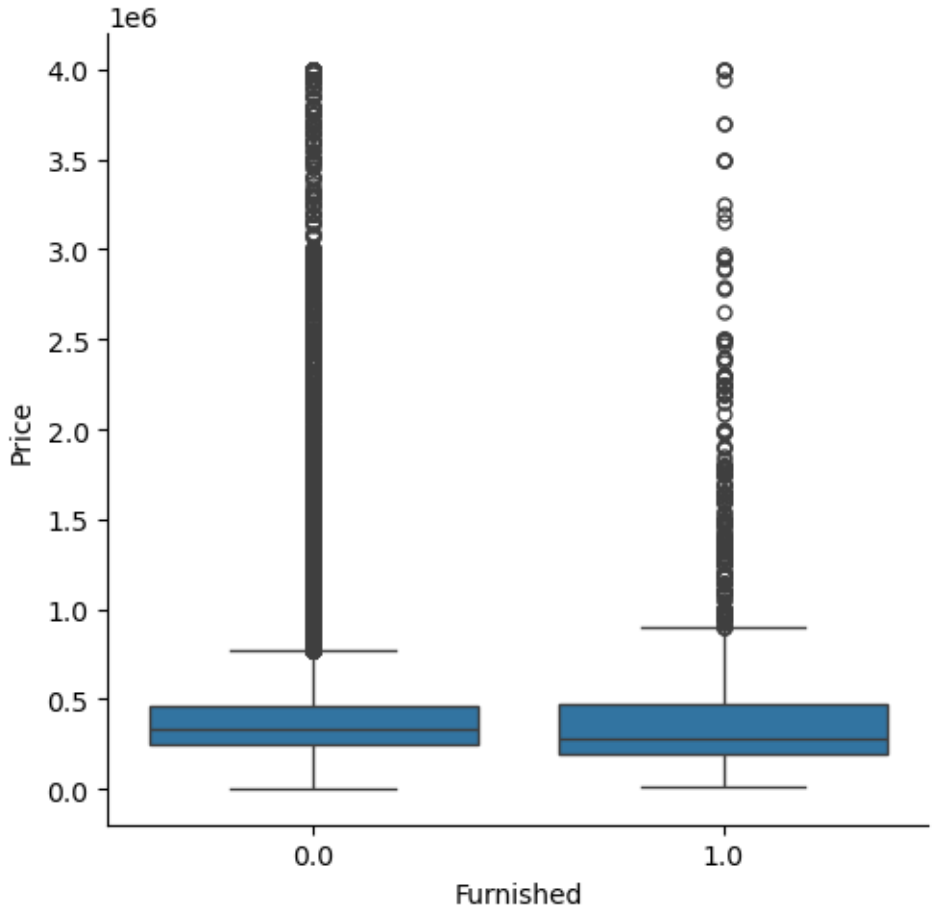
```
/tmp/ipykernel_5151/2060602967.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
```

```
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['Furnished'].fillna(0, inplace=True)
```

[1469]:
```
sns.catplot(data=data_sales, x="Furnished", y="Price", kind="box")
```

[1469]:
```
<seaborn.axisgrid.FacetGrid at 0x7f105febdf30>
```

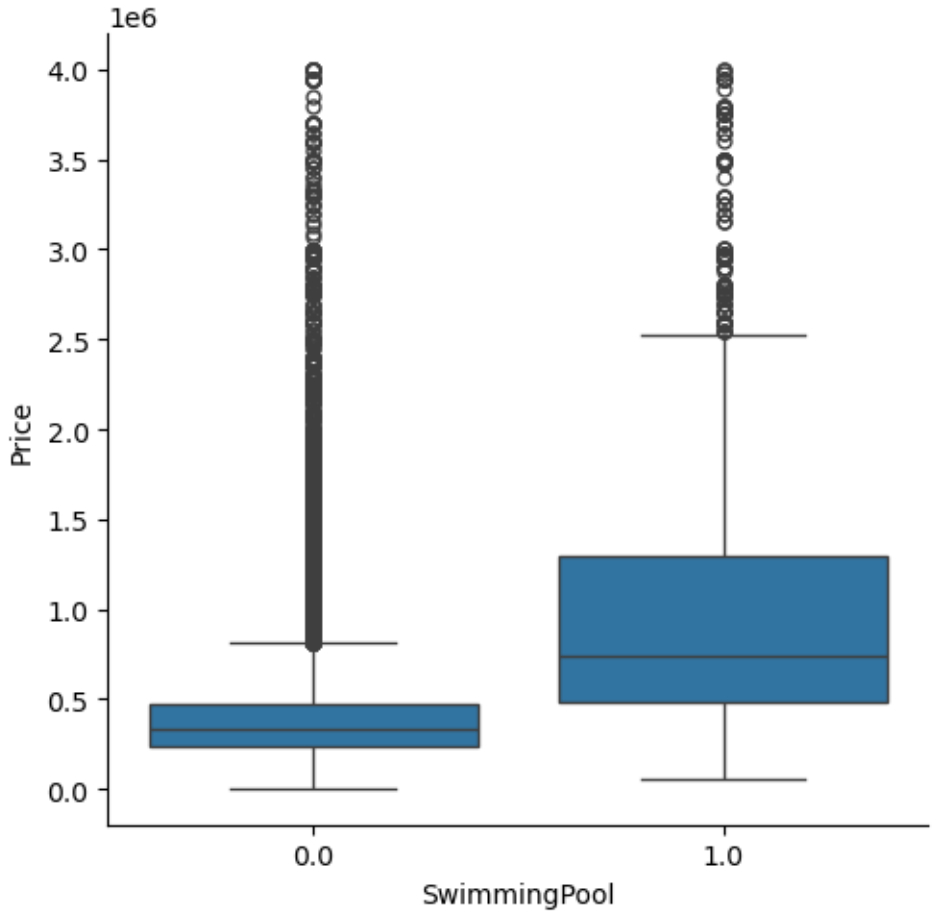


[1470]:
```
data_sales['SwimmingPool'].unique()
```

[1470]:
```
array([nan,  0.,  1.])
```

[1471]:
```
sns.catplot(data=data_sales, x="SwimmingPool", y="Price", kind="box")
```

[1471]:
```
<seaborn.axisgrid.FacetGrid at 0x7f105fe64190>
```



[1472]:
```
data_sales['SwimmingPool'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/796884055.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

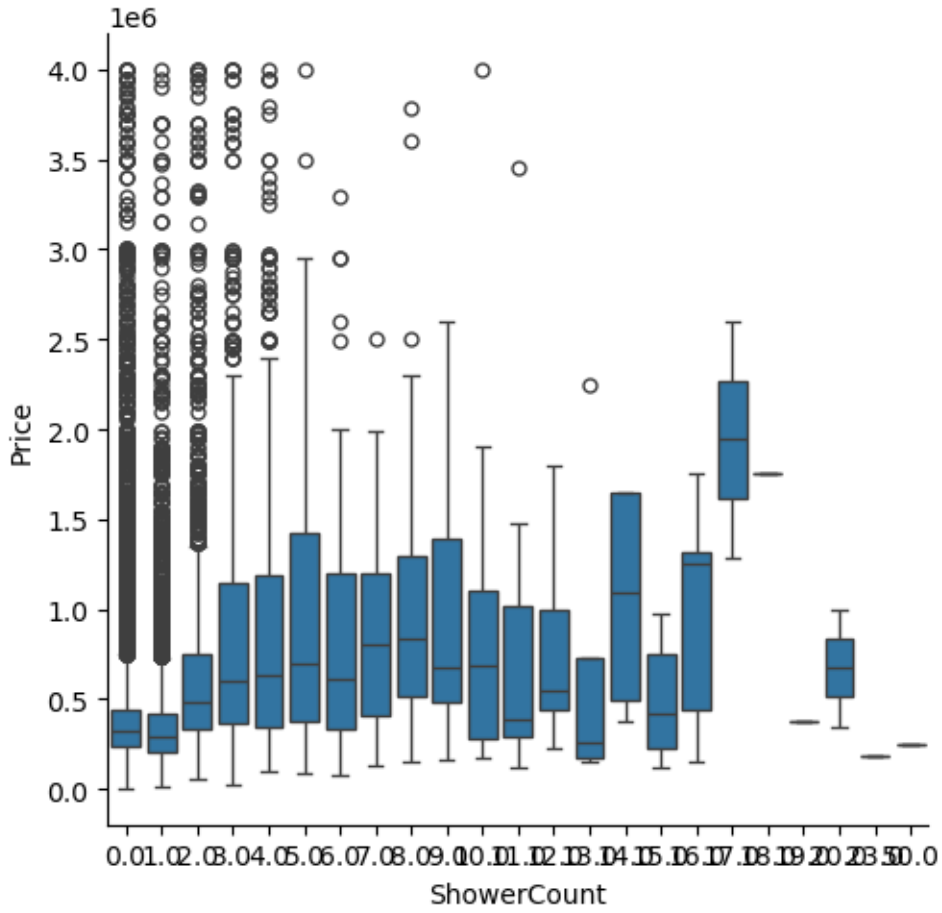
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['SwimmingPool'].fillna(0, inplace=True)
```

[1473]:
```
data_sales['ShowerCount'].unique()
```

[1473]:
```
array([ 0., nan,  1.,  3.,  2.,  4.,  5., 18.,  6.,  7.,  9., 11., 10.,
       12., 15.,  8., 16., 23., 14., 17., 13., 20., 19., 50.])
```

[1474]:
```
sns.catplot(data=data_sales, x="ShowerCount", y="Price", kind="box")
```

[1474]:
```
<seaborn.axisgrid.FacetGrid at 0x7f105f9ea1a0>
```



[1475]:
```
data_sales['ShowerCount'].fillna(0, inplace=True)
```

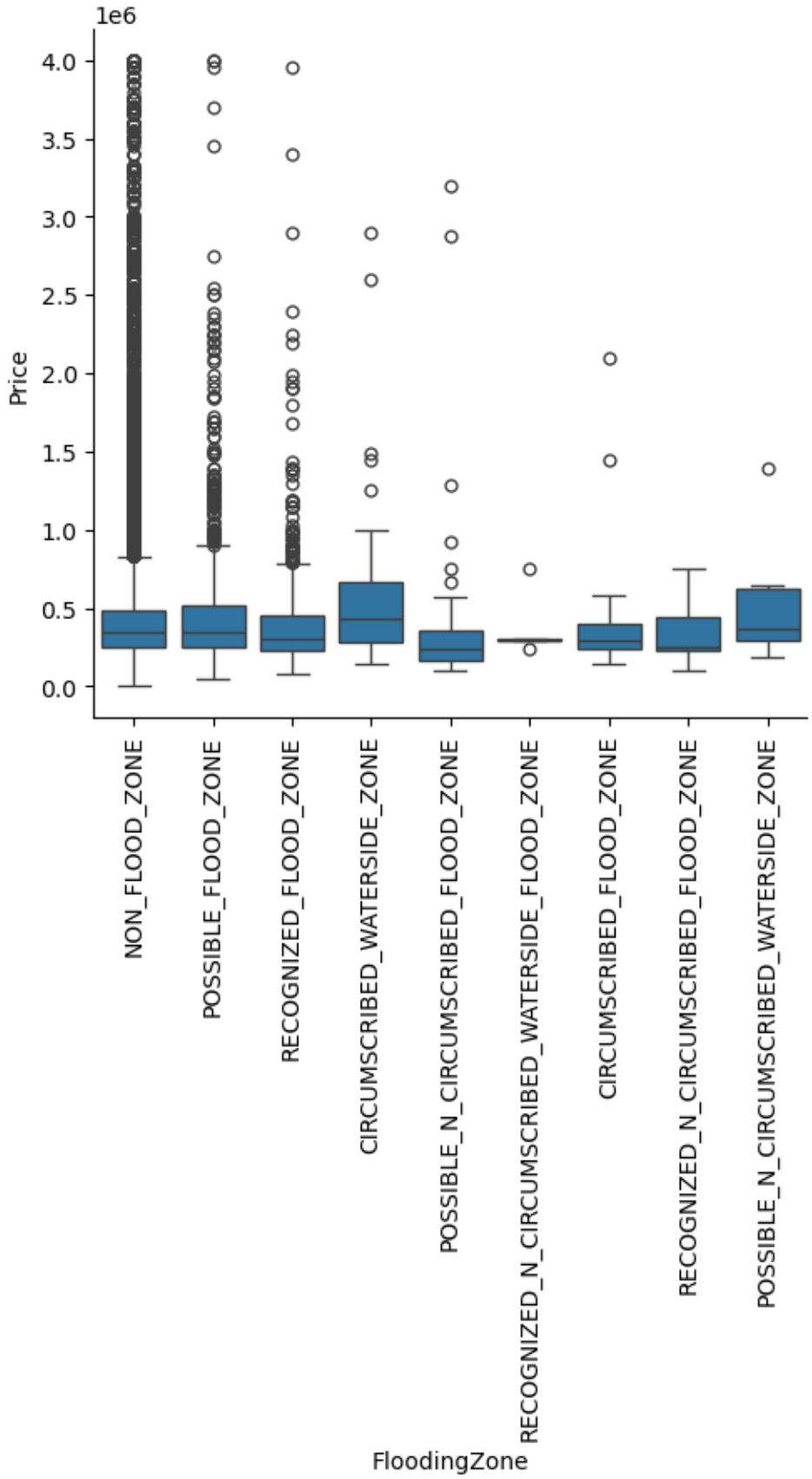
```
/tmp/ipykernel_5151/3945978582.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['ShowerCount'].fillna(0, inplace=True)
```

[1476]:
```
data_sales['FloodingZone'].unique()
```

[1476]:
```
array([None, 'NON_FLOOD_ZONE', 'POSSIBLE_FLOOD_ZONE',
       'RECOGNIZED_FLOOD_ZONE', 'CIRCUMSCRIBED_WATERSIDE_ZONE',
       'POSSIBLE_N_CIRCUMSCRIBED_FLOOD_ZONE',
       'RECOGNIZED_N_CIRCUMSCRIBED_WATERSIDE_FLOOD_ZONE',
       'CIRCUMSCRIBED_FLOOD_ZONE',
       'RECOGNIZED_N_CIRCUMSCRIBED_FLOOD_ZONE',
       'POSSIBLE_N_CIRCUMSCRIBED_WATERSIDE_ZONE'], dtype=object)
```

[1477]:
```
sns.catplot(data=data_sales, x="FloodingZone", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```


1e6
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Price
NON_FLOOD_ZONE
POSSIBLE_FLOOD_ZONE
RECOGNIZED_FLOOD_ZONE
CIRCUMSCRIBED_WATERSIDE_ZONE
POSSIBLE_N_CIRCUMSCRIBED_FLOOD_ZONE
RECOGNIZED_N_CIRCUMSCRIBED_WATERSIDE_FLOOD_ZONE
CIRCUMSCRIBED_FLOOD_ZONE
RECOGNIZED_N_CIRCUMSCRIBED_FLOOD_ZONE
POSSIBLE_N_CIRCUMSCRIBED_WATERSIDE_ZONE
FloodingZone

[1478]:
```
data_sales.groupby('FloodingZone')['FloodingZone'].agg('count')
```

[1478]:
```
FloodingZone
CIRCUMSCRIBED_FLOOD_ZONE                          32
CIRCUMSCRIBED_WATERSIDE_ZONE                      48
NON_FLOOD_ZONE                                 51042
POSSIBLE_FLOOD_ZONE                             1460
POSSIBLE_N_CIRCUMSCRIBED_FLOOD_ZONE               47
POSSIBLE_N_CIRCUMSCRIBED_WATERSIDE_ZONE            9
RECOGNIZED_FLOOD_ZONE                            593
RECOGNIZED_N_CIRCUMSCRIBED_FLOOD_ZONE             21
RECOGNIZED_N_CIRCUMSCRIBED_WATERSIDE_FLOOD_ZONE    5
Name: FloodingZone, dtype: int64
```

[1479]:
```
data_sales['FloodingZone'].fillna('NON_FLOOD_ZONE', inplace=True)
```

```
/tmp/ipykernel_5151/2404400355.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['FloodingZone'].fillna('NON_FLOOD_ZONE', inplace=True)
```

[1480]:
```
data_sales['SurfaceOfPlot'].unique()
```

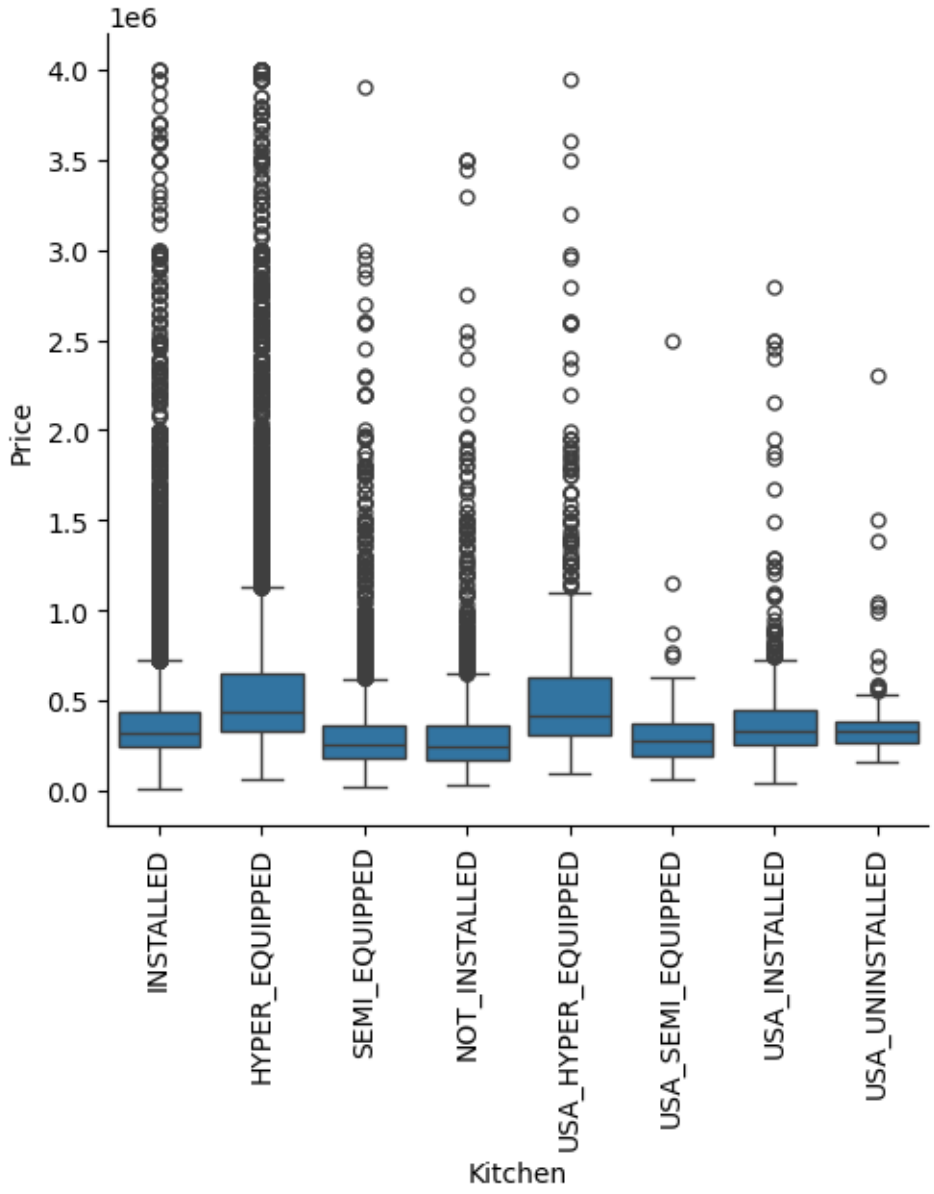
[1480]:
```
array([   nan,   130.,     0., …,  5792.,  6710., 10703.])
```

[1481]:
```
data_sales['SurfaceOfPlot'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/1081570387.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['SurfaceOfPlot'].fillna(0, inplace=True)
```

[1482]:
```
sns.catplot(data=data_sales, x="Kitchen", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[1483]:
```
data_sales.groupby('Kitchen')['Kitchen'].agg('count')
```

[1483]:
```
Kitchen
HYPER_EQUIPPED        16579
INSTALLED             28264
NOT_INSTALLED          3743
SEMI_EQUIPPED          7040
USA_HYPER_EQUIPPED      972
USA_INSTALLED           861
USA_SEMI_EQUIPPED       119
```

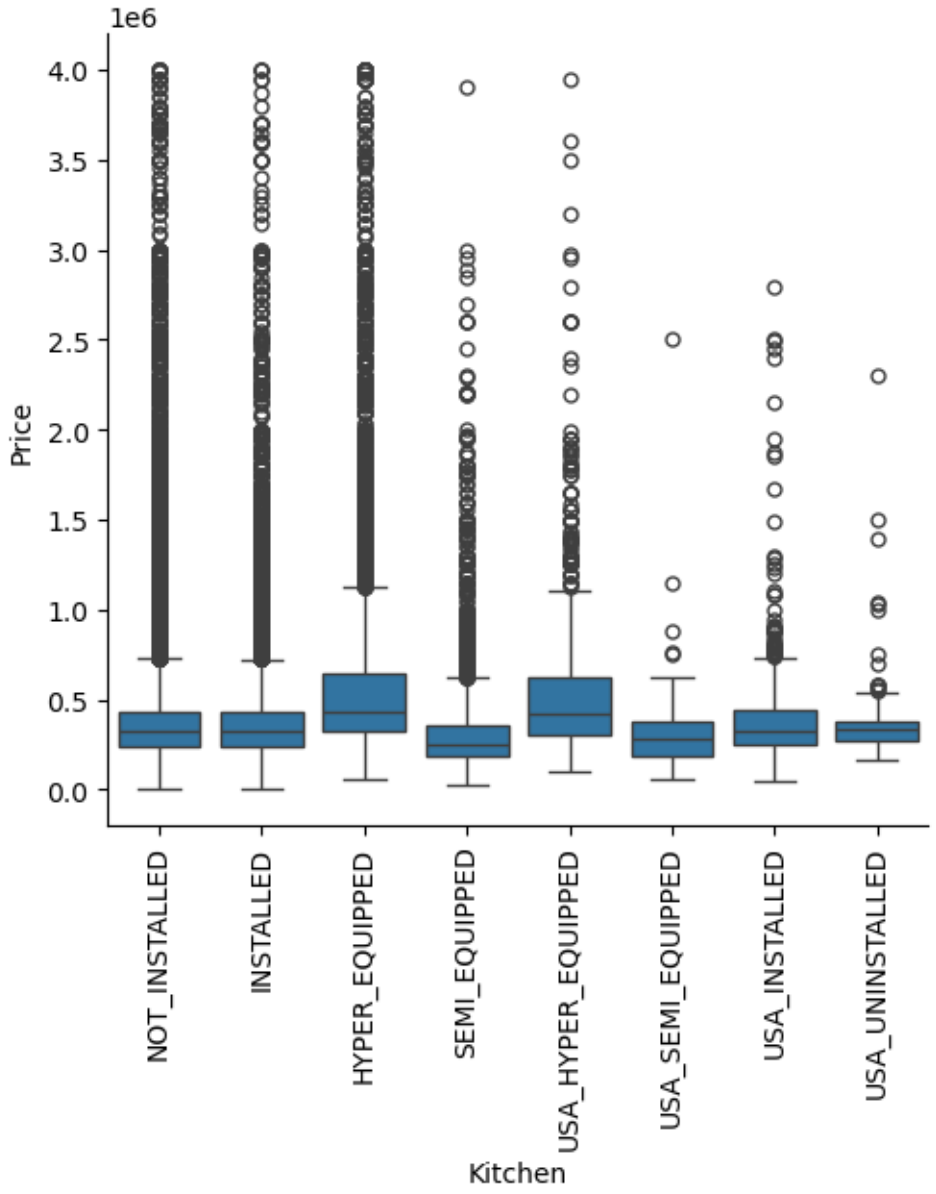
```
USA_UNINSTALLED          79
Name: Kitchen, dtype: int64
```

[1484]:
```
data_sales['Kitchen'].fillna('NOT_INSTALLED', inplace=True)
```

```
/tmp/ipykernel_5151/3107304889.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['Kitchen'].fillna('NOT_INSTALLED', inplace=True)
```

[1485]:
```
sns.catplot(data=data_sales, x="Kitchen", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[1486]:
```
data_sales['Terrace'].unique()
```

[1486]:
```
array([ 1., nan])
```

[1487]:
```
data_sales['Terrace'].fillna(0, inplace=True)
```

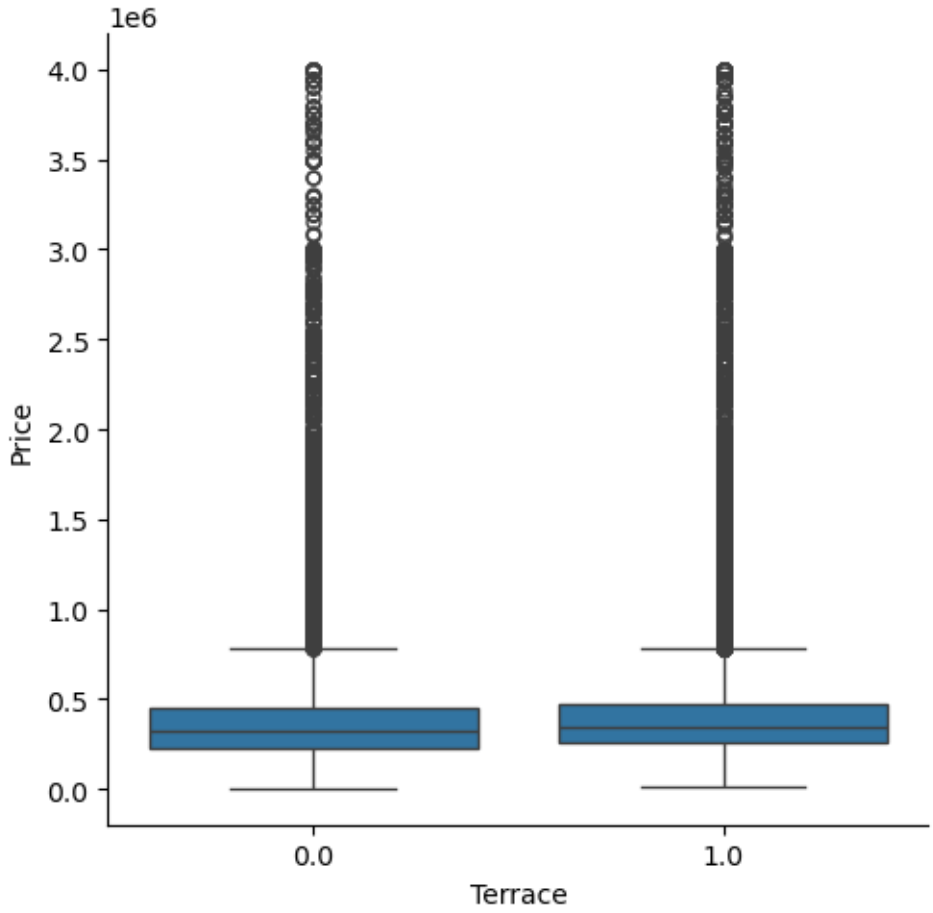
```
/tmp/ipykernel_5151/1706662363.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

```
data_sales['Terrace'].fillna(0, inplace=True)
```

[1488]:
```
sns.catplot(data=data_sales, x="Terrace", y="Price", kind="box")
```

[1488]:
```
<seaborn.axisgrid.FacetGrid at 0x7f105f022530>
```



[1489]:
```
data_sales['ConstructionYear'].unique()
```

[1489]:
```
array([1969., 1920., 2008.,   nan, 1972., 1994., 2023., 1961., 1987.,
       1966., 1923., 1974., 1860., 1950., 2015., 1968., 1965., 1935.,
       2024., 2022., 1918., 2010., 1930., 1932., 1990., 1939., 1997.,
       1993., 1952., 1962., 2020., 1963., 1992., 1946., 2006., 2019.,
       1971., 1970., 1976., 1936., 2025., 1984., 1958., 2017., 2001.,
       1977., 1996., 1900., 1988., 1790., 1931., 1951., 2016., 1947.,
       2009., 1985., 1957., 2007., 1911., 1928., 1978., 1954., 1967.,
       2004., 1915., 1973., 2021., 2005., 1850., 1979., 1986., 2012.,
       1981., 1964., 1919., 2000., 2018., 1960., 1953., 1955., 1980.,
       1910., 1937., 2014., 1999., 1874., 2011., 1899., 1949., 1934.,
```

```
       1871., 2013., 1940., 1989., 1875., 1948., 1890., 1905., 1956.,
       1983., 1925., 1938., 1982., 1912., 1975., 1991., 2003., 1959.,
       1896., 1995., 1893., 1830., 1927., 1998., 1941., 2002., 1933.,
       1873., 1901., 1909., 1942., 1870., 1758., 2026., 1902., 1776.,
       1800., 1913., 1906., 1924., 1780., 1929., 1907., 1759., 1922.,
       1908., 1889., 1812., 1879., 1878., 1943., 1868., 1944., 1945.,
       1926., 1852., 1789., 1888., 1897., 1884., 1885., 1831., 1880.,
       1904., 1921., 1914., 1760., 1802., 1849., 1886., 1903., 1882.,
       1898., 1858., 1894., 1788., 1895., 1840., 1786., 1887., 1877.,
       1867., 1862., 1917., 1864., 1872., 1916., 1869., 1772., 1876.,
       1866., 1891., 1792., 1863., 1781., 1793., 1865., 1764., 1892.,
       1766., 1824., 1755., 1853., 1753., 1836., 1881., 1845., 1803.,
       1809., 1854., 1807., 1829., 1848., 1804., 1785., 1847., 1861.,
       2033., 1763., 1774., 2027., 1826., 1833., 1842., 1814., 1822.,
       1835., 1770., 1798., 1883., 1855., 1816., 1856., 1791., 1857.,
       1810., 1838., 1782., 1834., 1851., 1754., 1859., 1796., 1820.,
       1775., 1805.])
```

[1490]:
```
data_sales['NumberOfFacades'].unique()
```

[1490]:
```
array([nan,  3.,  2.,  4.,  1.,  5.,  6.,  7.,  8.])
```

[1491]:
```
data_sales['NumberOfFacades'].fillna(2, inplace=True)
```

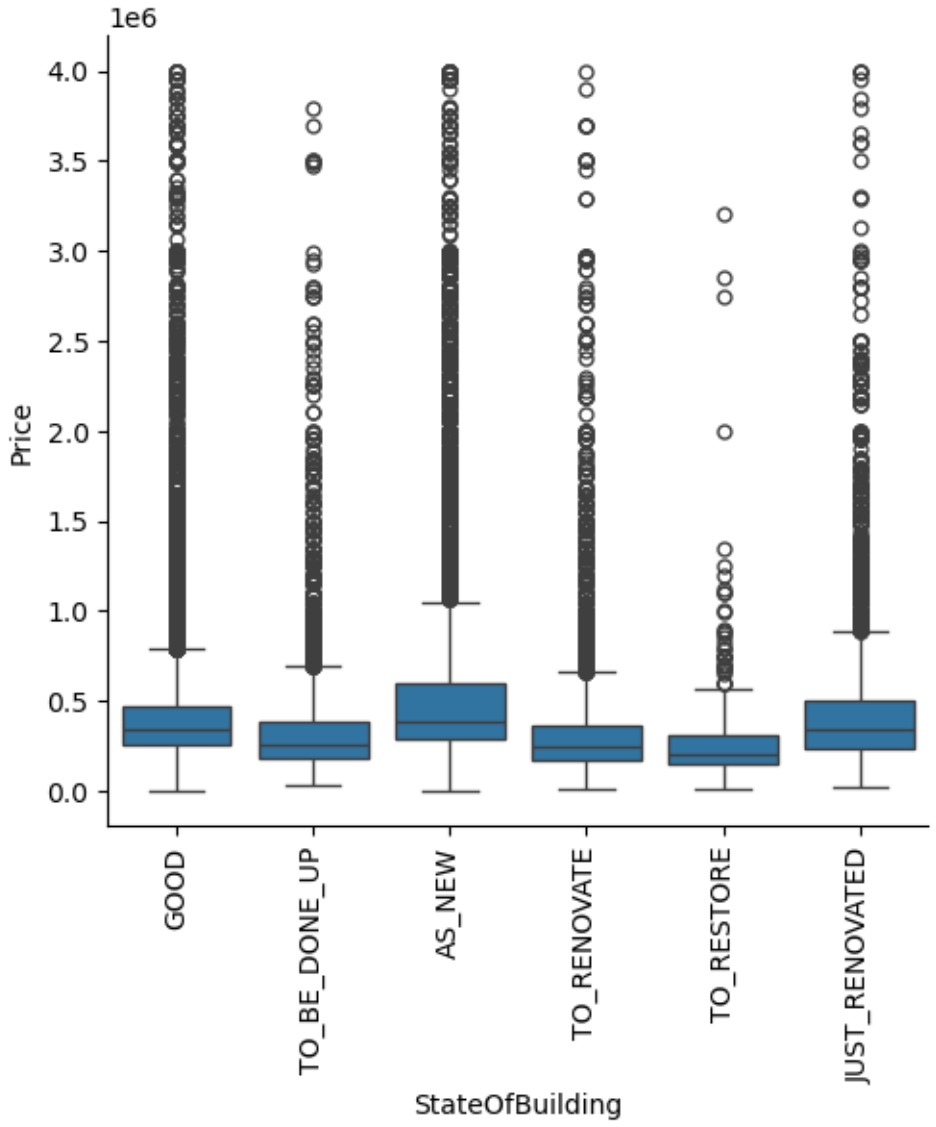
```
/tmp/ipykernel_5151/3776021179.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['NumberOfFacades'].fillna(2, inplace=True)
```

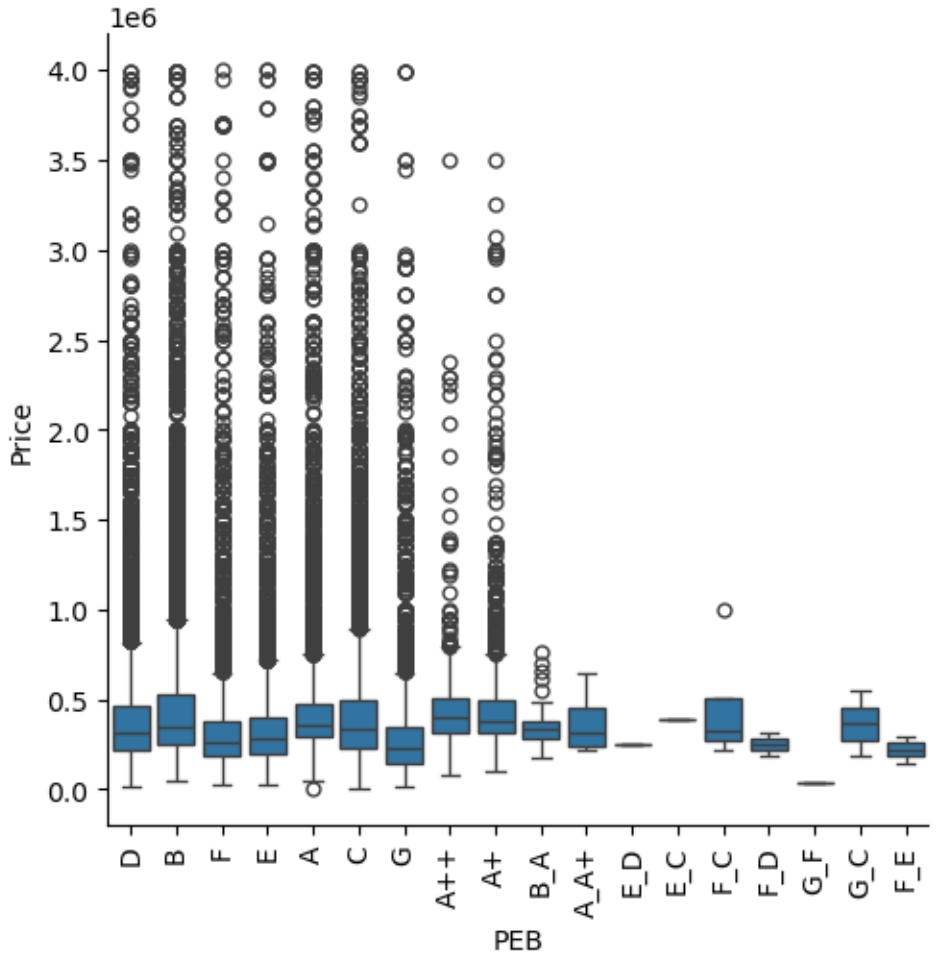
[1492]:
```
data_sales['StateOfBuilding'].unique()
```

[1492]:
```
array(['GOOD', 'TO_BE_DONE_UP', 'AS_NEW', None, 'TO_RENOVATE',
       'TO_RESTORE', 'JUST_RENOVATED'], dtype=object)
```

[1493]:
```
sns.catplot(data=data_sales, x="StateOfBuilding", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[1494]:
```
sns.catplot(data=data_sales, x="PEB", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[1495]:
```
data_sales['ToiletCount'].unique()
```

[1495]:
```
array([ 1.,  5.,  2.,  0., nan,  3.,  4.,  6., 20., 11., 10.,  8.,  7.,
        9., 14., 13., 12., 15., 16., 18., 17., 21., 22., 25., 19.])
```

[1496]:
```
data_sales['ToiletCount'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/2211876506.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['ToiletCount'].fillna(0, inplace=True)
```

[1497]:
```
data_sales['LivingArea'].unique()
```

[1497]:
```
array([  29.,  391.,  111., …,  843.,  929., 1190.])
```

[1498]:
```
data_sales['BathroomCount'].unique()
```

[1498]:
```
array([  1.,   6.,   2.,   0.,  nan,   3.,   9.,   4.,   5.,   8.,  18.,
        11.,   7.,  22., 130.,  10.,  12.,  15.,  16.,  17.,  14., 145.,
        13.,  20.,  23.,  19.,  24.])
```

[1499]:
```
data_sales['BathroomCount'].fillna(0, inplace=True)
```

```
/tmp/ipykernel_5151/307760922.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['BathroomCount'].fillna(0, inplace=True)
```

[1500]:
```
data_sales['District'].unique()
```

[1500]:
```
array(['Brugge', 'Tournai', 'Veurne', 'Hasselt', 'Brussels', 'Mechelen',
       'Halle-Vilvoorde', 'Sint-Niklaas', 'Oostend', 'Antwerp', 'Ieper',
       'Mons', 'Namur', 'Philippeville', 'Soignies', 'Leuven', 'Nivelles',
       'Charleroi', 'Liège', 'Maaseik', 'Verviers', 'Aalst', 'Tongeren',
       'Marche-en-Famenne', 'Kortrijk', 'Gent', 'Eeklo', 'Diksmuide',
       'Dendermonde', 'Waremme', 'Huy', 'Dinant', 'Neufchâteau',
       'Mouscron', 'Tielt', 'Roeselare', 'Turnhout', 'Oudenaarde',
       'Thuin', 'Arlon', 'Virton', 'Ath', 'Bastogne'], dtype=object)
```

[1501]:
```
data_sales['Province'].unique()
```

[1501]:
```
array(['West Flanders', 'Hainaut', 'Limburg', 'Brussels', 'Antwerp',
       'Flemish Brabant', 'East Flanders', 'Namur', 'Walloon Brabant',
       'Liège', 'Luxembourg'], dtype=object)
```

[1502]:
```
data_sales['Locality'].unique()
```

[1502]:
```
array(['Zeebrugge', 'Tournai', 'BLANKENBERGE', …, 'LA GLEIZE',
       'Ham-sur-Heure-Nalinnes ', 'Brasmenil'], dtype=object)
```

[1503]:
```
data_sales.shape
```

[1503]:
```
(104638, 31)
```

[1504]:
```
data_sales.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 104638 entries, 2 to 181791
Data columns (total 31 columns):
 #   Column             Non-Null Count   Dtype
---  ------             --------------   -----
 0   Url                104638 non-null  object
```

```
 1   BathroomCount       104638 non-null  float64
 2   BedroomCount        104638 non-null  int64
 3   ConstructionYear    62849 non-null   float64
 4   Country             104638 non-null  object
 5   District            104638 non-null  object
 6   Fireplace           104638 non-null  float64
 7   FloodingZone        104638 non-null  object
 8   Furnished           104638 non-null  float64
 9   Garden              104638 non-null  float64
 10  GardenArea          104638 non-null  float64
 11  Kitchen             104638 non-null  object
 12  LivingArea          93350 non-null   float64
 13  Locality            104638 non-null  object
 14  NumberOfFacades     104638 non-null  float64
 15  PEB                 74169 non-null   object
 16  PostalCode          104638 non-null  int64
 17  Price               104638 non-null  int64
 18  PropertyId          104638 non-null  int64
 19  Province            104638 non-null  object
 20  Region              104638 non-null  object
 21  RoomCount           28997 non-null   float64
 22  ShowerCount         104638 non-null  float64
 23  StateOfBuilding     71248 non-null   object
 24  SubtypeOfProperty   104638 non-null  object
 25  SurfaceOfPlot       104638 non-null  float64
 26  SwimmingPool        104638 non-null  float64
 27  Terrace             104638 non-null  float64
 28  ToiletCount         104638 non-null  float64
 29  TypeOfProperty      104638 non-null  int64
 30  TypeOfSale          104638 non-null  object
dtypes: float64(14), int64(5), object(12)
memory usage: 25.5+ MB
```

[1505]:
```
data_sales.dtypes[data_sales.dtypes == 'float64']
```

[1505]:
```
BathroomCount       float64
ConstructionYear    float64
Fireplace           float64
Furnished           float64
Garden              float64
GardenArea          float64
LivingArea          float64
NumberOfFacades     float64
RoomCount           float64
ShowerCount         float64
SurfaceOfPlot       float64
SwimmingPool        float64
```

```
Terrace             float64
ToiletCount         float64
dtype: object
```

[1506]:
```
data_sales['RoomCount'].fillna(0, inplace=True)
data_sales['ConstructionYear'].fillna(data_sales['ConstructionYear'].median(),␣
 ↪inplace=True)
data_sales['StateOfBuilding'].fillna('Unknown', inplace=True)
data_sales['PEB'].fillna('Unknown', inplace=True)
data_sales['LivingArea'].fillna(data_sales['LivingArea'].median(), inplace=True)
```

```
/tmp/ipykernel_5151/2857846457.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['RoomCount'].fillna(0, inplace=True)
/tmp/ipykernel_5151/2857846457.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['ConstructionYear'].fillna(data_sales['ConstructionYear'].median(),
inplace=True)
/tmp/ipykernel_5151/2857846457.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

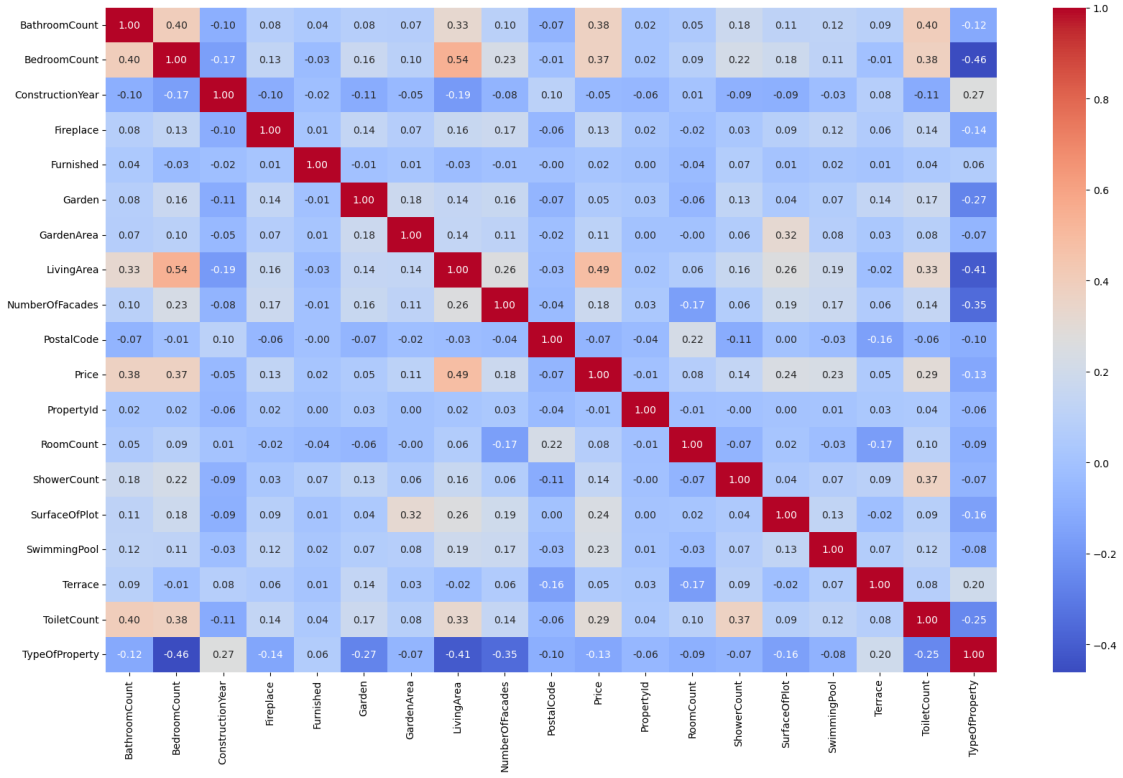
See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['StateOfBuilding'].fillna('Unknown', inplace=True)
/tmp/ipykernel_5151/2857846457.py:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['PEB'].fillna('Unknown', inplace=True)
/tmp/ipykernel_5151/2857846457.py:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['LivingArea'].fillna(data_sales['LivingArea'].median(),
inplace=True)
```

[1507]:
```
correlation_matrix = data_sales.corr()
plt.figure(figsize=(20,12))
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")
```

```
plt.show()
```



[1508]:
```
data_sales.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 104638 entries, 2 to 181791
Data columns (total 31 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   Url                 104638 non-null  object
 1   BathroomCount       104638 non-null  float64
 2   BedroomCount        104638 non-null  int64
 3   ConstructionYear    104638 non-null  float64
 4   Country             104638 non-null  object
 5   District            104638 non-null  object
 6   Fireplace           104638 non-null  float64
 7   FloodingZone        104638 non-null  object
 8   Furnished           104638 non-null  float64
 9   Garden              104638 non-null  float64
 10  GardenArea          104638 non-null  float64
 11  Kitchen             104638 non-null  object
 12  LivingArea          104638 non-null  float64
 13  Locality            104638 non-null  object
```

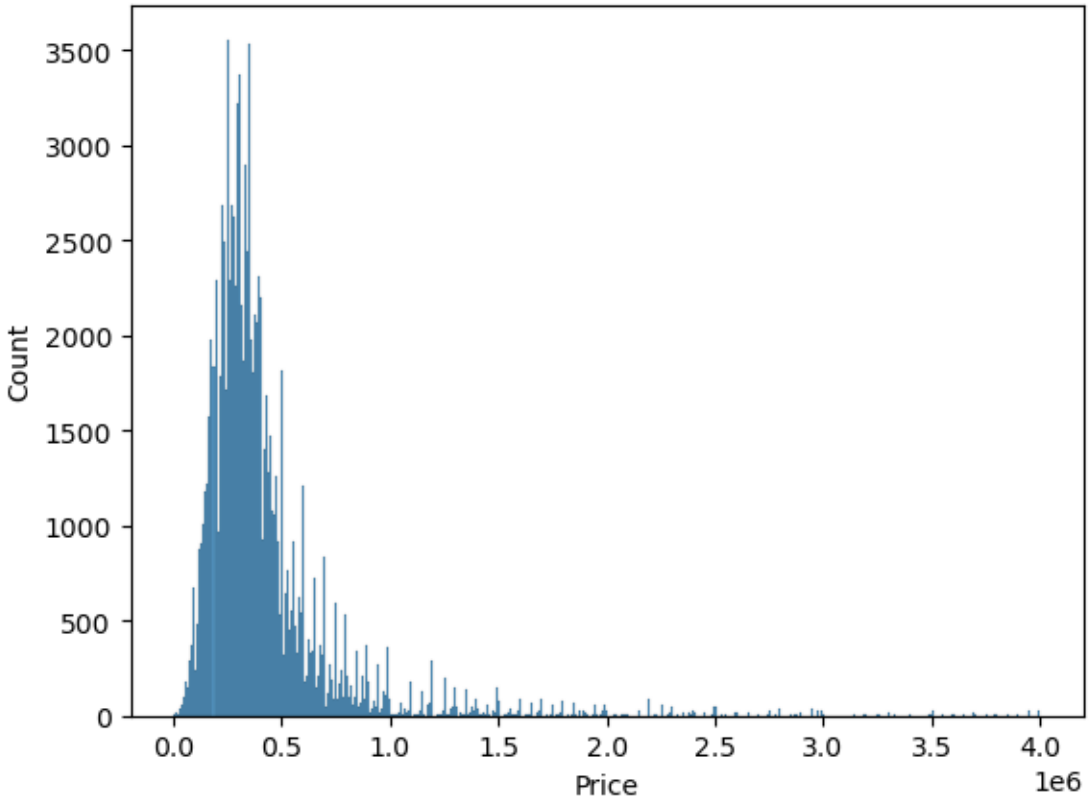
```
 14  NumberOfFacades    104638 non-null  float64
 15  PEB                104638 non-null  object
 16  PostalCode         104638 non-null  int64
 17  Price              104638 non-null  int64
 18  PropertyId         104638 non-null  int64
 19  Province           104638 non-null  object
 20  Region             104638 non-null  object
 21  RoomCount          104638 non-null  float64
 22  ShowerCount        104638 non-null  float64
 23  StateOfBuilding    104638 non-null  object
 24  SubtypeOfProperty  104638 non-null  object
 25  SurfaceOfPlot      104638 non-null  float64
 26  SwimmingPool       104638 non-null  float64
 27  Terrace            104638 non-null  float64
 28  ToiletCount        104638 non-null  float64
 29  TypeOfProperty     104638 non-null  int64
 30  TypeOfSale         104638 non-null  object
dtypes: float64(14), int64(5), object(12)
memory usage: 25.5+ MB
```

[1509]:
```
pd.DataFrame(data_sales.isnull().sum().sort_values(ascending=False)).head(20)
```

[1509]:
```
                    0
Url                 0
PostalCode          0
TypeOfProperty      0
ToiletCount         0
Terrace             0
SwimmingPool        0
SurfaceOfPlot       0
SubtypeOfProperty   0
StateOfBuilding     0
ShowerCount         0
RoomCount           0
Region              0
Province            0
PropertyId          0
Price               0
PEB                 0
BathroomCount       0
NumberOfFacades     0
Locality            0
LivingArea          0
```

[1510]:
```
sns.histplot(
    data_sales,
    x=data_sales['Price']
)
```

[1510]: <Axes: xlabel='Price', ylabel='Count'>



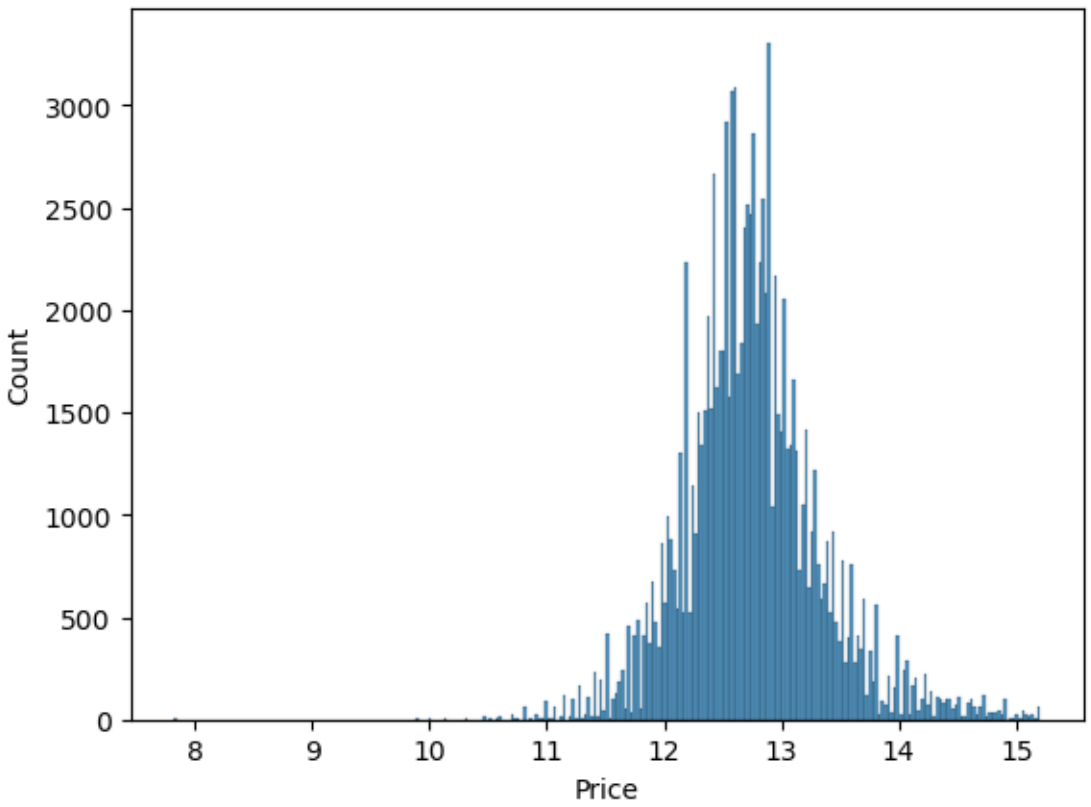
[1511]:
```
data_sales['Price'] = np.log1p(data_sales['Price'])
```

```
/tmp/ipykernel_5151/769987062.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  data_sales['Price'] = np.log1p(data_sales['Price'])
```

[1512]:
```
sns.histplot(
    data_sales,
    x=data_sales['Price']
)
```

[1512]: <Axes: xlabel='Price', ylabel='Count'>



[1513]:
```
data_sales.groupby('PEB')['PEB'].agg('count')
```

[1513]:
```
PEB
A          13313
A+          1785
A++          580
A_A+           4
B          14927
B_A           61
C          12521
D          10224
E           6971
E_C            1
E_D            1
F           9128
F_C            4
F_D            2
F_E            2
G           4642
G_C            2
G_F            1
```

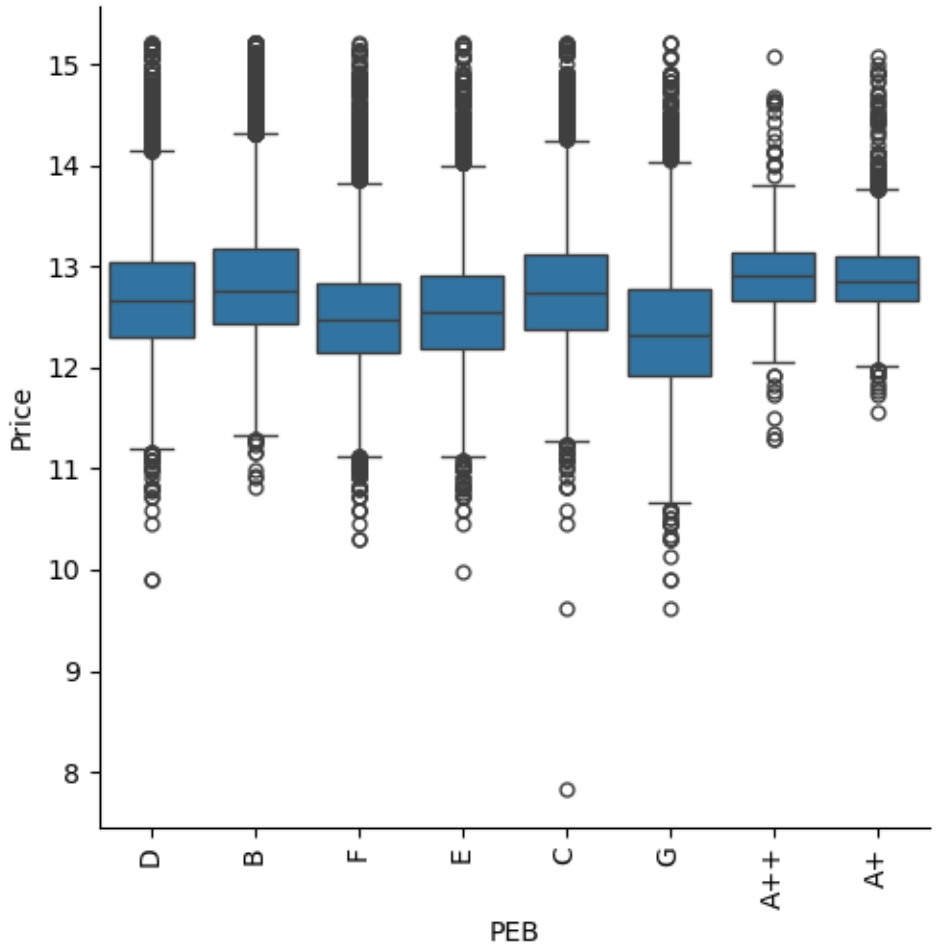
```
Unknown    30469
Name: PEB, dtype: int64
```

[1514]:
```
keep_PEB = ['A++', 'A+', 'B', 'C', 'D', 'E', 'F', 'G']
data_sales = data_sales[data_sales['PEB'].isin(keep_PEB)]
```

[1515]:
```
data_sales.groupby('PEB')['PEB'].agg('count')
```

[1515]:
```
PEB
A+      1785
A++      580
B      14927
C      12521
D      10224
E       6971
F       9128
G       4642
Name: PEB, dtype: int64
```

[1516]:
```
sns.catplot(data=data_sales, x="PEB", y="Price", kind="box")
plt.xticks(rotation=90)
plt.show()
```



[1517]:
```
data_sales.dtypes[data_sales.dtypes == 'object']
```

[1517]:
```
Url                  object
Country              object
District             object
FloodingZone         object
Kitchen              object
Locality             object
PEB                  object
Province             object
Region               object
StateOfBuilding      object
SubtypeOfProperty    object
TypeOfSale           object
dtype: object
```

[1518]:
```
data_sales.dtypes[data_sales.dtypes != 'object']
```

[1518]:
```
BathroomCount       float64
BedroomCount          int64
ConstructionYear    float64
Fireplace           float64
Furnished           float64
Garden              float64
GardenArea          float64
LivingArea          float64
NumberOfFacades     float64
PostalCode            int64
Price               float64
PropertyId            int64
RoomCount           float64
ShowerCount         float64
SurfaceOfPlot       float64
SwimmingPool        float64
Terrace             float64
ToiletCount         float64
TypeOfProperty        int64
dtype: object
```

[1519]:
```
data_sales = data_sales.drop(columns=['Url', 'Country', 'Locality',␣
↪'TypeOfSale', 'PostalCode'])
```

[1520]:
```
data_sales.dtypes[data_sales.dtypes == 'object']
```

[1520]:
```
District            object
FloodingZone        object
Kitchen             object
PEB                 object
Province            object
Region              object
StateOfBuilding     object
SubtypeOfProperty   object
dtype: object
```

[1521]:
```
data_sales.dtypes[data_sales.dtypes != 'object']
```

[1521]:
```
BathroomCount       float64
BedroomCount          int64
ConstructionYear    float64
Fireplace           float64
Furnished           float64
Garden              float64
GardenArea          float64
LivingArea          float64
NumberOfFacades     float64
```

```
Price                float64
PropertyId             int64
RoomCount            float64
ShowerCount          float64
SurfaceOfPlot        float64
SwimmingPool         float64
Terrace              float64
ToiletCount          float64
TypeOfProperty         int64
dtype: object
```

[1522]:
```
ode_cols = [
    'BathroomCount', 'BedroomCount', 'ConstructionYear', 'GardenArea',
    'LivingArea', 'NumberOfFacades', 'RoomCount',
    'ShowerCount', 'SurfaceOfPlot', 'ToiletCount'
]
```

[1523]:
```
ohe_cols = [
    'District', 'FloodingZone', 'Kitchen', 'PEB', 'Province',
    'Region', 'StateOfBuilding', 'SubtypeOfProperty', 'Fireplace',
    'Furnished', 'Garden', 'SwimmingPool', 'Terrace', 'TypeOfProperty'
]
```

[1524]:
```
num_cols = data_sales.select_dtypes(include=['int64', 'float64']).columns
num_cols = num_cols.drop('Price')
```

[1525]:
```
num_pipeline = Pipeline(steps=[
    ('impute', SimpleImputer(strategy='mean')),
    ('scaler', StandardScaler())
])
```

[1526]:
```
ode_pipeline = Pipeline(steps=[
    ('impute', SimpleImputer(strategy='most_frequent')),
    ('ode', OrdinalEncoder(handle_unknown='use_encoded_value',␣
 ↪unknown_value=-1))
])
```

[1527]:
```
ohe_pipeline = Pipeline(steps=[
    ('impute', SimpleImputer(strategy='most_frequent')),
    ('ohe', OneHotEncoder(handle_unknown='ignore', sparse_output=False))
])
```

[1528]:
```
col_trans = ColumnTransformer(transformers=[
    ('num_p', num_pipeline, num_cols),
    ('ode_p', ode_pipeline, ode_cols),
    ('ohe_p', ohe_pipeline, ohe_cols),
    ],
```

```
    remainder='passthrough',
    n_jobs=-1)
```

[1529]:
```
pipeline = Pipeline(steps=[
    ('preprocessing', col_trans)
])
```

[1530]:
```
X = data_sales.drop('Price', axis=1)
y = data_sales['Price']
```

[1531]:
```
X_preprocessed = pipeline.fit_transform(X)
```

[1532]:
```
X_train, X_test, y_train, y_test = train_test_split(X_preprocessed, y,␣
↪test_size=0.2, random_state=25)
```

[1533]:
```
#build models
```

[1534]:
```
lr = LinearRegression()
```

[1535]:
```
lr.fit(X_train, y_train)
```

[1535]:
```
LinearRegression()
```

[1536]:
```
y_pred_lr = lr.predict(X_test)
```

[1537]:
```
mean_squared_error(y_test, y_pred_lr)
```

[1537]:
```
189945927.6506543
```

[1538]:
```
lr.score(X_train, y_train)
```

[1538]:
```
0.7040428766587645
```

[1545]:
```
lr.score(X_test, y_test)
```

[1545]:
```
-457825205.56525135
```

[1603]:
```
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_lr)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  125.25650088908883
```

[1652]:
```
np.expm1(125.25650088908883)
```

[1652]:
```
2.5015383119271703e+54
```

[ ]:

[ ]:
```

```

[ ]:
```
##############################################33
```

[1546]:
```
RFR = RandomForestRegressor(random_state=13)
```

[1547]:
```
param_distributions = {
    'model__max_depth': [5, 10, 15],
    'model__n_estimators': [100, 250, 500],
    'model__min_samples_split': [3, 5, 10]
}
```

[1548]:
```
rfr_cv = GridSearchCV(RFR, param_grid_RFR, cv=5,␣
 ↪scoring='neg_mean_squared_error', n_jobs=-1)
```

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

[ ]:
```
np.sqrt(-1 * rfr_cv.best_score_)
```

[ ]:
```
rfr_cv.best_params_
```

[ ]:
```
np.sqrt(-1 * xgb_cv.best_score_)
```

[1550]:
```
######################
```

[1551]:
```
XGB = XGBRegressor(random_state=13)
```

[1552]:
```
param_grid_XGB = {
    'learning_rate': [0.05, 0.1, 0.2],
    'n_estimators': [300],
    'max_depth': [3],
    'min_child_weight': [1,2,3],
    'gamma': [0, 0.1, 0.2],
    'subsample': [0.8, 0.9, 1.0],
    'colsample_bytree': [0.8, 0.9, 1.0],
}
```

[1553]:
```
xgb_cv = GridSearchCV(XGB, param_grid_XGB, cv=3,␣
 ↪scoring='neg_mean_squared_error', n_jobs=-1)
```

[1554]:
```
xgb_cv.fit(X_train, y_train)
```

[1554]:
```
GridSearchCV(cv=3,
             estimator=XGBRegressor(base_score=None, booster=None,
                                    callbacks=None, colsample_bylevel=None,
                                    colsample_bynode=None,
                                    colsample_bytree=None, device=None,
                                    early_stopping_rounds=None,
```

```
                                   enable_categorical=False, eval_metric=None,
                                   feature_types=None, gamma=None,
                                   grow_policy=None, importance_type=None,
                                   interaction_constraints=None,
                                   learning_rate=None, m…
                                   monotone_constraints=None,
                                   multi_strategy=None, n_estimators=None,
                                   n_jobs=None, num_parallel_tree=None,
                                   random_state=13, …),
             n_jobs=-1,
             param_grid={'colsample_bytree': [0.8, 0.9, 1.0],
                         'gamma': [0, 0.1, 0.2],
                         'learning_rate': [0.05, 0.1, 0.2], 'max_depth': [3],
                         'min_child_weight': [1, 2, 3], 'n_estimators': [300],
                         'subsample': [0.8, 0.9, 1.0]},
             scoring='neg_mean_squared_error')
```

[1555]:
```
np.sqrt(-1 * xgb_cv.best_score_)
```

[1555]:
```
0.28521880968612456
```

[1608]:
```
xgb_cv.score(X_train, y_train)
```

[1608]:
```
-0.07382963200312878
```

[1609]:
```
xgb_cv.score(X_test, y_test)
```

[1609]:
```
-0.0804118810176963
```

[1606]:
```
y_pred_xgb = xgb_cv.predict(X_test)
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_xgb)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  0.2080266707592418
```

[1653]:
```
np.expm1(0.2080266707592418)
```

[1653]:
```
0.23124600737679105
```

[ ]:
```
##################################
```

[1556]:
```
ridge = Ridge()
```

[1557]:
```
param_grid_ridge = {
    'alpha': [0.05, 0.1, 1, 3, 5, 10],
    'solver': ['auto', 'svd', 'cholesky', 'lsqr', 'sparse_cg', 'sag']
}
```

[1558]:
```
ridge_cv = GridSearchCV(ridge, param_grid_ridge, cv=5,␣
↪scoring='neg_mean_squared_error', n_jobs=-1)
```

[1559]:
```
ridge_cv.fit(X_train, y_train)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
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  warnings.warn(
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  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
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reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
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  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
```

```
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
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  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
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  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/linear_model/_sag.py:349: ConvergenceWarning: The max_iter was
reached which means the coef_ did not converge
  warnings.warn(
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reached which means the coef_ did not converge
  warnings.warn(
```

[1559]:
```
GridSearchCV(cv=5, estimator=Ridge(), n_jobs=-1,
             param_grid={'alpha': [0.05, 0.1, 1, 3, 5, 10],
                         'solver': ['auto', 'svd', 'cholesky', 'lsqr',
                                    'sparse_cg', 'sag']},
             scoring='neg_mean_squared_error')
```

[1560]:
```
np.sqrt(-1 * ridge_cv.best_score_)
```

[1560]: 0.3549756656132124

[1610]:
```
ridge_cv.score(X_train, y_train)
```

[1610]: -0.12581753151916714

[1611]:
```
ridge_cv.score(X_test, y_test)
```

[1611]: -0.12312397252839238

[1607]:
```
y_pred_ridge = ridge_cv.predict(X_test)
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_ridge)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  0.2590249454555721
```

[ ]:
```
##################3
```

[1634]:
```
XGBR = XGBRegressor(tree_method='gpu_hist', use_label_encoder=False,␣
↪eval_metric='rmse')
```

[1635]:
```
params = {
    'max_depth': [5, 10, 15],
    'n_estimators': [100, 250, 500],
    'min_child_weight': [3, 5, 10]
}
```

[1636]:
```
grid_search = GridSearchCV(estimator=XGBR, param_grid=params, n_jobs=-1, cv=cv)
```

[1637]:
```
grid_search.fit(X_train, y_train)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:00] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
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split_1713397827678/work/src/common/error_msg.cc:58: Falling back to prediction
using DMatrix due to mismatched devices. This might lead to higher memory usage
and slower performance. XGBoost is running on: cuda:0, while the input data is
on: cpu.
Potential solutions:
- Use a data structure that matches the device ordinal in the booster.
- Set the device for booster before call to inplace_predict.

This warning will only be shown once.

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Potential solutions:
- Use a data structure that matches the device ordinal in the booster.
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:49] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:52] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

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/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:53] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
```

```
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:58] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:58] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:58] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:58] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:59] WARNING:
```

```
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:59] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:14:59] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:00] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:00] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:01] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:01] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:02] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:02] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:03] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"
```

```
  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:03] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:04] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:19] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:19] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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CUDA instead.

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/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:19] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:20] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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packages/xgboost/core.py:160: UserWarning: [01:15:20] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:24] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:24] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:25] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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/home/conda/feedstock_root/build_artifacts/xgboost-
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/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:35] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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packages/xgboost/core.py:160: UserWarning: [01:15:35] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:35] WARNING:
```

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/home/conda/feedstock_root/build_artifacts/xgboost-
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:35] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:35] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:40] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:40] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
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  warnings.warn(smsg, UserWarning)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:40] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
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    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:44] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:44] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:45] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:45] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"
```

```
  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py:540: FitFailedWarning:
17 fits failed out of a total of 81.
The score on these train-test partitions for these parameters will be set to
nan.
If these failures are not expected, you can try to debug them by setting
error_score='raise'.

Below are more details about the failures:
--------------------------------------------------------------------------------
1 fits failed with the following error:
Traceback (most recent call last):
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 730, in inner_f
    return func(**kwargs)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/sklearn.py", line 1090, in fit
    self._Booster = train(
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 730, in inner_f
    return func(**kwargs)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/training.py", line 181, in train
    bst.update(dtrain, i, obj)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 2050, in update
    _check_call(
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:14:52]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:14:52] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 347471872
- Requested memory: 536870912

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
sageFatal::~LogMessageFatal()+0x71) [0x7fc5e9132cf1]
```

```
  [bt] (1) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dh::detail::
ThrowOOMError(std::__cxx11::basic_string<char, std::char_traits<char>,
std::allocator<char> > const&, unsigned long)+0x466) [0x7fc5e96ed7d6]
  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(+0x2ead7c)
[0x7fc5e90ead7c]
  [bt] (3) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(thrust::deta
il::vector_base<long, dh::detail::XGBDefaultDeviceAllocatorImpl<long>
>::resize(unsigned long)+0x175) [0x7fc5e9aab5c5]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::DeviceHistogramStorage<268435456ul>::AllocateHistograms(std::vector<int,
std::allocator<int> > const&)+0x480) [0x7fc5e9aabab0]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::BuildHistLeftRight(std::vector<xgboost::tree::GPUExpandEn
try, std::allocator<xgboost::tree::GPUExpandEntry> > const&, xgboost::RegTree
const&)+0x300) [0x7fc5e9aac160]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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xgboost::RegTree*, xgboost::HostDeviceVector<int>*)+0xb99) [0x7fc5e9ab4b19]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
std::allocator<xgboost::RegTree*> > const&)+0x129) [0x7fc5e9ab84f9]
  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
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std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
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std::allocator<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7fc5e93fc1d1]



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[0x7fc5e9445673]
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  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
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  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/_ctypes.cpython-310-x86_64-linux-gnu.so(+0x12461) [0x7fc5fa8f2461]



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packages/xgboost/training.py", line 181, in train
    bst.update(dtrain, i, obj)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 2050, in update
    _check_call(
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
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```
packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:14:53]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:14:53] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 485490688
- Requested memory: 536870912

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> >,
std::allocator<std::unique_ptr<xgboost::RegTree,
```

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std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7f929c9fc1d1]



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std::default_delete<xgboost::RegTree> >,
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  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
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packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
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packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:14:59]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:14:59] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 175112192
- Requested memory: 268435456

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
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```
dynload/../../libffi.so.8(+0x6a4a) [0x7f64615c6a4a]
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- Free memory: 99614720
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```

```
  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(+0x2ead7c)
[0x7fcd962ead7c]
  [bt] (3) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(thrust::deta
il::vector_base<long, dh::detail::XGBDefaultDeviceAllocatorImpl<long>
>::resize(unsigned long)+0x175) [0x7fcd96cab5c5]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::DeviceHistogramStorage<268435456ul>::AllocateHistograms(std::vector<int,
std::allocator<int> > const&)+0x480) [0x7fcd96cabab0]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::BuildHistLeftRight(std::vector<xgboost::tree::GPUExpandEn
try, std::allocator<xgboost::tree::GPUExpandEntry> > const&, xgboost::RegTree
const&)+0x300) [0x7fcd96cac160]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::UpdateTree(xgboost::HostDeviceVector<xgboost::detail::Gra
dientPairInternal<float> >*, xgboost::DMatrix*, xgboost::ObjInfo const*,
xgboost::RegTree*, xgboost::HostDeviceVector<int>*)+0xb99) [0x7fcd96cb4b19]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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18446744073709551615ul>, std::vector<xgboost::RegTree*,
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[0x7fcd965fd58a]
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  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(XGBoosterUpd
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dynload/_ctypes.cpython-310-x86_64-linux-gnu.so(+0x12461) [0x7fcda9df2461]



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  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:15:00]
```

```
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:15:00] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 99614720
- Requested memory: 134217728

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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```
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split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
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```
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>::resize(unsigned long)+0x175) [0x7f644d2ab5c5]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::DeviceHistogramStorage<268435456ul>::AllocateHistograms(std::vector<int,
std::allocator<int> > const&)+0x480) [0x7f644d2abab0]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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try, std::allocator<xgboost::tree::GPUExpandEntry> > const&, xgboost::RegTree
const&)+0x300) [0x7f644d2ac160]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::UpdateTree(xgboost::HostDeviceVector<xgboost::detail::Gra
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xgboost::RegTree*, xgboost::HostDeviceVector<int>*)+0xb99) [0x7f644d2b4b19]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
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  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
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  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/_ctypes.cpython-310-x86_64-linux-gnu.so(+0x12461) [0x7f64603f2461]



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packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:15:01]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:15:01] /home/conda/feedstock_root/build_artifacts/xgboost-
```

```
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 146210816
- Requested memory: 134217728

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
sageFatal::~LogMessageFatal()+0x71) [0x7fcd96332cf1]
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ThrowOOMError(std::__cxx11::basic_string<char, std::char_traits<char>,
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  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(+0x2ead7c)
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  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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- Requested memory: 134217728

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std::allocator<int> > const&)+0x480) [0x7fcd96cabab0]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::BuildHistLeftRight(std::vector<xgboost::tree::GPUExpandEn
try, std::allocator<xgboost::tree::GPUExpandEntry> > const&, xgboost::RegTree
const&)+0x300) [0x7fcd96cac160]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
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xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
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std::vector<std::unique_ptr<xgboost::RegTree,
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    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:15:02]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:15:02] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
```

```
- Free memory: 129564672
- Requested memory: 268435456

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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- Free memory: 88211456
- Requested memory: 268435456

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  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
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```
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::UpdateTree(xgboost::HostDeviceVector<xgboost::detail::Gra
dientPairInternal<float> >*, xgboost::DMatrix*, xgboost::ObjInfo const*,
xgboost::RegTree*, xgboost::HostDeviceVector<int>*)+0xb99) [0x7f644d2b4b19]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMaker::Update(xgboost::tree::TrainParam const*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
std::allocator<xgboost::RegTree*> > const&)+0x129) [0x7f644d2b84f9]
  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::BoostNewTrees(xgboost::HostDeviceVector<xgboost::detail::GradientPairI
nternal<float> >*, xgboost::DMatrix*, int,
std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> >,
std::allocator<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7f644cbfc1d1]



Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
sageFatal::~LogMessageFatal()+0x71) [0x7f644c932cf1]
  [bt] (1) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMaker::Update(xgboost::tree::TrainParam const*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
std::allocator<xgboost::RegTree*> > const&)+0x3e9) [0x7f644d2b87b9]
  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::BoostNewTrees(xgboost::HostDeviceVector<xgboost::detail::GradientPairI
nternal<float> >*, xgboost::DMatrix*, int,
std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> >,
std::allocator<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7f644cbfc1d1]
  [bt] (3) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::DoBoost(xgboost::DMatrix*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::PredictionCacheEntry*, xgboost::ObjFunction const*)+0x89a)
[0x7f644cbfd58a]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::Lea
rnerImpl::UpdateOneIter(int, std::shared_ptr<xgboost::DMatrix>)+0x353)
[0x7f644cc45673]
```

```
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(XGBoosterUpd
ateOneIter+0x74) [0x7f644c915834]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/../../libffi.so.8(+0x6a4a) [0x7f64615c6a4a]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/../../libffi.so.8(+0x5fea) [0x7f64615c5fea]
  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/_ctypes.cpython-310-x86_64-linux-gnu.so(+0x12461) [0x7f64603f2461]



--------------------------------------------------------------------------------
1 fits failed with the following error:
Traceback (most recent call last):
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/model_selection/_validation.py", line 888, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 730, in inner_f
    return func(**kwargs)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/sklearn.py", line 1090, in fit
    self._Booster = train(
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 730, in inner_f
    return func(**kwargs)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/training.py", line 181, in train
    bst.update(dtrain, i, obj)
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 2050, in update
    _check_call(
  File "/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py", line 282, in _check_call
    raise XGBoostError(py_str(_LIB.XGBGetLastError()))
xgboost.core.XGBoostError: [01:15:04]
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/tree/updater_gpu_hist.cu:781: Exception in
gpu_hist: [01:15:04] /home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/c_api/../data/../common/device_helpers.cuh:431:
Memory allocation error on worker 0: std::bad_alloc: cudaErrorMemoryAllocation:
out of memory
- Free memory: 130547712
- Requested memory: 268435456

Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
sageFatal::~LogMessageFatal()+0x71) [0x7f644c932cf1]
```

```
  [bt] (1) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dh::detail::
ThrowOOMError(std::__cxx11::basic_string<char, std::char_traits<char>,
std::allocator<char> > const&, unsigned long)+0x466) [0x7f644ceed7d6]
  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(+0x2ead7c)
[0x7f644c8ead7c]
  [bt] (3) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(thrust::deta
il::vector_base<long, dh::detail::XGBDefaultDeviceAllocatorImpl<long>
>::resize(unsigned long)+0x175) [0x7f644d2ab5c5]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::DeviceHistogramStorage<268435456ul>::AllocateHistograms(std::vector<int,
std::allocator<int> > const&)+0x480) [0x7f644d2abab0]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::BuildHistLeftRight(std::vector<xgboost::tree::GPUExpandEn
try, std::allocator<xgboost::tree::GPUExpandEntry> > const&, xgboost::RegTree
const&)+0x300) [0x7f644d2ac160]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMakerDevice::UpdateTree(xgboost::HostDeviceVector<xgboost::detail::Gra
dientPairInternal<float> >*, xgboost::DMatrix*, xgboost::ObjInfo const*,
xgboost::RegTree*, xgboost::HostDeviceVector<int>*)+0xb99) [0x7f644d2b4b19]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMaker::Update(xgboost::tree::TrainParam const*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
std::allocator<xgboost::RegTree*> > const&)+0x129) [0x7f644d2b84f9]
  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::BoostNewTrees(xgboost::HostDeviceVector<xgboost::detail::GradientPairI
nternal<float> >*, xgboost::DMatrix*, int,
std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> >,
std::allocator<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7f644cbfc1d1]



Stack trace:
  [bt] (0) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(dmlc::LogMes
sageFatal::~LogMessageFatal()+0x71) [0x7f644c932cf1]
  [bt] (1) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::tre
e::GPUHistMaker::Update(xgboost::tree::TrainParam const*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::DMatrix*, xgboost::common::Span<xgboost::HostDeviceVector<int>,
18446744073709551615ul>, std::vector<xgboost::RegTree*,
std::allocator<xgboost::RegTree*> > const&)+0x3e9) [0x7f644d2b87b9]
  [bt] (2) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::BoostNewTrees(xgboost::HostDeviceVector<xgboost::detail::GradientPairI
```

```
nternal<float> >*, xgboost::DMatrix*, int,
std::vector<xgboost::HostDeviceVector<int>,
std::allocator<xgboost::HostDeviceVector<int> > >*,
std::vector<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> >,
std::allocator<std::unique_ptr<xgboost::RegTree,
std::default_delete<xgboost::RegTree> > > >*)+0x821) [0x7f644cbfc1d1]
  [bt] (3) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::gbm
::GBTree::DoBoost(xgboost::DMatrix*,
xgboost::HostDeviceVector<xgboost::detail::GradientPairInternal<float> >*,
xgboost::PredictionCacheEntry*, xgboost::ObjFunction const*)+0x89a)
[0x7f644cbfd58a]
  [bt] (4) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(xgboost::Lea
rnerImpl::UpdateOneIter(int, std::shared_ptr<xgboost::DMatrix>)+0x353)
[0x7f644cc45673]
  [bt] (5) /home/databroma/miniconda3/envs/ml_env/lib/libxgboost.so(XGBoosterUpd
ateOneIter+0x74) [0x7f644c915834]
  [bt] (6) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/../../libffi.so.8(+0x6a4a) [0x7f64615c6a4a]
  [bt] (7) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/../../libffi.so.8(+0x5fea) [0x7f64615c5fea]
  [bt] (8) /home/databroma/miniconda3/envs/ml_env/lib/python3.10/lib-
dynload/_ctypes.cpython-310-x86_64-linux-gnu.so(+0x12461) [0x7f64603f2461]



  warnings.warn(some_fits_failed_message, FitFailedWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/model_selection/_search.py:1102: UserWarning: One or more of
the test scores are non-finite: [0.7977262  0.80646336 0.8064232  0.7986292
0.80729662 0.80731748
 0.79903924 0.8066114  0.80628438 0.79883523 0.79521188 0.79296488
 0.80197914 0.79883418 0.79608378 0.80084149 0.79700615 0.79248826
 0.78583444 0.78507467        nan 0.78892417        nan        nan
        nan        nan        nan]
  warnings.warn(
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:15:45] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
```

[1637]:
```
GridSearchCV(cv=3,
             estimator=XGBRegressor(base_score=None, booster=None,
                                    callbacks=None, colsample_bylevel=None,
                                    colsample_bynode=None,
                                    colsample_bytree=None, device=None,
                                    early_stopping_rounds=None,
                                    enable_categorical=False,
                                    eval_metric='rmse', feature_types=None,
                                    gamma=None, grow_policy=None,
                                    importance_type=None,
                                    interaction_constraints=None,
                                    learning_rate=None…
                                    max_cat_threshold=None,
                                    max_cat_to_onehot=None, max_delta_step=None,
                                    max_depth=None, max_leaves=None,
                                    min_child_weight=None, missing=nan,
                                    monotone_constraints=None,
                                    multi_strategy=None, n_estimators=None,
                                    n_jobs=None, num_parallel_tree=None,
                                    random_state=None, …),
             n_jobs=-1,
             param_grid={'max_depth': [5, 10, 15],
                         'min_child_weight': [3, 5, 10],
                         'n_estimators': [100, 250, 500]})
```

[1639]:
```
np.sqrt(-1 * grid_search.best_score_)
```

```
/tmp/ipykernel_5151/3000575232.py:1: RuntimeWarning: invalid value encountered
in sqrt
  np.sqrt(-1 * grid_search.best_score_)
```

[1639]:
```
nan
```

[1640]:
```
grid_search.score(X_train, y_train)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:18:12] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:18:12] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
```

```
split_1713397827678/work/src/common/error_msg.cc:58: Falling back to prediction
using DMatrix due to mismatched devices. This might lead to higher memory usage
and slower performance. XGBoost is running on: cuda:0, while the input data is
on: cpu.
Potential solutions:
- Use a data structure that matches the device ordinal in the booster.
- Set the device for booster before call to inplace_predict.

This warning will only be shown once.

  warnings.warn(smsg, UserWarning)
```

[1640]:
```
0.9037414052621054
```

[1641]:
```
grid_search.score(X_test, y_test)
```

[1641]:
```
0.8193586481370613
```

[1642]:
```
y_pred_grid_search = grid_search.predict(X_test)
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_grid_search)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  0.19957075403653443
```

[ ]:
```
##################################33
```

[1565]:
```
lgbm_regressor = lgb.LGBMRegressor()
```

[1566]:
```
param_grid_lgbm = {
    'boosting_type': ['gbdt', 'dart'],
    'num_leaves': [20, 30, 40],
    'learning_rate': [0.01, 0.05, 0.1],
    'n_estimators': [100, 200, 300]
}
```

[1567]:
```
lgbm_cv = GridSearchCV(lgbm_regressor, param_grid_lgbm, cv=3,␣
 ↪scoring='neg_mean_squared_error', n_jobs=-1)
```

[1568]:
```
lgbm_cv.fit(X_train, y_train)
```

```
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.002403 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2618
[LightGBM] [Info] Number of data points in the train set: 48622, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697850
```

[1568]:
```
GridSearchCV(cv=3, estimator=LGBMRegressor(), n_jobs=-1,
             param_grid={'boosting_type': ['gbdt', 'dart'],
                         'learning_rate': [0.01, 0.05, 0.1],
                         'n_estimators': [100, 200, 300],
                         'num_leaves': [20, 30, 40]},
             scoring='neg_mean_squared_error')
```

[1569]:
```
np.sqrt(-1 * lgbm_cv.best_score_)
```

[1569]:
```
0.27490573414716835
```

[1612]:
```
lgbm_cv.score(X_train, y_train)
```

[1612]:
```
-0.05519101373853558
```

[1613]:
```
lgbm_cv.score(X_test, y_test)
```

[1613]:
```
-0.0744936127842746
```

[1614]:
```
y_pred_lgbm_cv = lgbm_cv.predict(X_test)
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_lgbm_cv)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  0.19952850321786045
```

[ ]:
```
##########################################3
```

[1576]:
```
catboost = CatBoostRegressor(loss_function='RMSE', verbose=False)
```

[1577]:
```
param_grid_cat ={
    'iterations': [100, 500, 1000],
    'depth': [4, 6, 8, 10],
    'learning_rate': [0.01, 0.05, 0.1, 0.5]
}
```

[1578]:
```
cat_cv = GridSearchCV(catboost, param_grid_cat, cv=3,␣
 ↪scoring='neg_mean_squared_error', n_jobs=-1)
```

[1579]:
```
cat_cv.fit(X_train, y_train)
```

```
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.014434 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
```

```
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005976 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007042 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007642 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007505 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.014388 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755

/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/joblib/externals/loky/process_executor.py:752: UserWarning: A worker
stopped while some jobs were given to the executor. This can be caused by a too
short worker timeout or by a memory leak.
  warnings.warn(

[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008036 seconds.
You can set `force_row_wise=true` to remove the overhead.
```

```
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007159 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005380 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009327 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009169 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004951 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009355 seconds.
You can set `force_row_wise=true` to remove the overhead.
```

```
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.010456 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.012845 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005836 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005719 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006607 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008844 seconds.
You can set `force_row_wise=true` to remove the overhead.
```

```
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009748 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007112 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.011563 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.011189 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.015585 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.008624 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2587
```

```
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007625 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007734 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.033778 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006278 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008323 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007288 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
```

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[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007719 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004238 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006922 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.010919 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005767 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007456 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
```

```
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007427 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007674 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007518 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007527 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004728 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007808 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
```

```
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007827 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.010701 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004157 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004045 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007253 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007823 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
```

```
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005001 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.014873 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008309 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007692 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007149 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004608 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
```

```
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006138 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.015718 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008218 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007033 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006729 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007164 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
```

```
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008214 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007987 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006157 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007679 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007720 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006601 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
```

```
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007035 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004234 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007453 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.008990 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009622 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007969 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
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[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007623 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007587 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007799 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.010746 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.009521 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004212 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
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testing was 0.007603 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.010698 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.017165 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007575 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007440 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006834 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.014669 seconds.
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You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009244 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.014485 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.017897 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007883 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.014764 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006949 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
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[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007548 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.009147 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.015154 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009815 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.015027 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007053 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
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features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005230 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007128 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007210 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005678 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007057 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007403 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
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features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008010 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.037383 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007757 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.011885 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.013989 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007475 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
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[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007082 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.006343 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007135 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007363 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007898 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007075 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
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testing was 0.007815 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007149 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007701 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006751 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.013983 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009702 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007272 seconds.
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You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007276 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007564 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009148 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004120 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005495 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006046 seconds.
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You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007204 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008057 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.014604 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005843 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007716 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007419 seconds.
You can set `force_row_wise=true` to remove the overhead.
```

```
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007634 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007137 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.004700 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007186 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007167 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006973 seconds.
You can set `force_row_wise=true` to remove the overhead.
```

```
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007230 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.011690 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.057653 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007021 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009527 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006939 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
```

```
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing col-wise multi-threading, the overhead of
testing was 0.011043 seconds.
You can set `force_col_wise=true` to remove the overhead.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007092 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007133 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007002 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007324 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007974 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
```

```
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005752 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.008053 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007907 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.009915 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006502 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.006109 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
```

```
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.007861 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2587
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 145
[LightGBM] [Info] Start training from score 12.699187
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.010342 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2581
[LightGBM] [Info] Number of data points in the train set: 32414, number of used
features: 146
[LightGBM] [Info] Start training from score 12.696755
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.005995 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 2591
[LightGBM] [Info] Number of data points in the train set: 32415, number of used
features: 146
[LightGBM] [Info] Start training from score 12.697609
```

[1579]:
```
GridSearchCV(cv=3,
             estimator=<catboost.core.CatBoostRegressor object at
0x7f107d6643d0>,
             n_jobs=-1,
             param_grid={'depth': [4, 6, 8, 10], 'iterations': [100, 500, 1000],
                         'learning_rate': [0.01, 0.05, 0.1, 0.5]},
             scoring='neg_mean_squared_error')
```

[1580]:
```
np.sqrt(-1 * cat_cv.best_score_)
```

[1580]:
```
0.2690056370086475
```

[1615]:
```
cat_cv.score(X_train, y_train)
```

[1615]:
```
-0.04453897656444072
```

[1616]:
```
cat_cv.score(X_test, y_test)
```

[1616]:
```
-0.06934034901817031
```

[1617]:
```
y_pred_cat_cv = cat_cv.predict(X_test)
# Calculer l'erreur absolue moyenne
mae = mean_absolute_error(y_test, y_pred_cat_cv)
print("Mean Absolute Error: ", mae)
```

```
Mean Absolute Error:  0.19158663294052677
```

[ ]:
```
##############################################3
```

[1643]:
```
vr = VotingRegressor([('gbr', grid_search.best_estimator_),
                      ('xgb', xgb_cv.best_estimator_),
                      ('ridge', ridge_cv.best_estimator_)],
                     weights=[2,3,1])
```

[1644]:
```
vr.fit(X_train, y_train)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:19:35] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
```

[1644]:
```
VotingRegressor(estimators=[('gbr',
                             XGBRegressor(base_score=None, booster=None,
                                          callbacks=None,
                                          colsample_bylevel=None,
                                          colsample_bynode=None,
                                          colsample_bytree=None, device=None,
                                          early_stopping_rounds=None,
                                          enable_categorical=False,
                                          eval_metric='rmse',
                                          feature_types=None, gamma=None,
                                          grow_policy=None,
                                          importance_type=None,
                                          interaction_constraints=None,
                                          learning_ra…
                                          interaction_constraints=None,
                                          learning_rate=0.2, max_bin=None,
                                          max_cat_threshold=None,
                                          max_cat_to_onehot=None,
                                          max_delta_step=None, max_depth=3,
                                          max_leaves=None, min_child_weight=1,
                                          missing=nan,
```

```
                                            monotone_constraints=None,
                                            multi_strategy=None, n_estimators=300,
                                            n_jobs=None, num_parallel_tree=None,
                                            random_state=13, …)),
                                ('ridge', Ridge(alpha=0.05, solver='sparse_cg'))],
                    weights=[2, 3, 1])
```

[1645]:
```
y_pred_vr = vr.predict(X_test)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/xgboost/core.py:160: UserWarning: [01:19:41] WARNING:
/home/conda/feedstock_root/build_artifacts/xgboost-
split_1713397827678/work/src/common/error_msg.cc:27: The tree method `gpu_hist`
is deprecated since 2.0.0. To use GPU training, set the `device` parameter to
CUDA instead.

    E.g. tree_method = "hist", device = "cuda"

  warnings.warn(smsg, UserWarning)
```

[1646]:
```
mean_squared_error(y_test, y_pred_vr, squared=False)
```

```
/home/databroma/miniconda3/envs/ml_env/lib/python3.10/site-
packages/sklearn/metrics/_regression.py:492: FutureWarning: 'squared' is
deprecated in version 1.4 and will be removed in 1.6. To calculate the root mean
squared error, use the function'root_mean_squared_error'.
  warnings.warn(
```

[1646]:
```
0.27520279502940725
```

[1648]:
```
estimators = [
    ('gbr', grid_search.best_estimator_),
    ('xgb', xgb_cv.best_estimator_),
    ('cat', cat_cv.best_estimator_),
    ('lgb', lgbm_cv.best_estimator_),
    ('rfr', rfr_cv.best_estimator_),
]
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
Cell In[1648], line 6
      1 estimators = [
      2     ('gbr', grid_search.best_estimator_),
      3     ('xgb', xgb_cv.best_estimator_),
      4     ('cat', cat_cv.best_estimator_),
      5     ('lgb', lgbm_cv.best_estimator_),
----> 6     ('rfr', rfr_cv.best_estimator_),
      7 ]
```

```
AttributeError: 'GridSearchCV' object has no attribute 'best_estimator_'
```

[1649]:
```
stackreg = StackingRegressor(
            estimators = estimators,
            final_estimator = vr
)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[1649], line 2
      1 stackreg = StackingRegressor(
----> 2             estimators = estimators,
      3             final_estimator = vr
      4 )

NameError: name 'estimators' is not defined
```

[1650]:
```
stackreg.fit(X_train, y_train)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[1650], line 1
----> 1 stackreg.fit(X_train, y_train)

NameError: name 'stackreg' is not defined
```

[ ]:
```
y_pred_stack = stackreg.predict(X_test)
```

[ ]:
```
mean_squared_error(y_test, y_pred_stack, squared=False)
```

[ ]:
```
df_test_preprocess = pipeline.transform(test_df)
```

[ ]:
```
y_stacking = np.exp(stackreg.predict(df_test_preprocess))

df_y_stacking_out = test_df[['Id']]
df_y_stacking_out['SalePrice'] = y_stacking

df_y_stacking_out.to_csv('submission.csv', index=False)
```

[ ]:

[ ]:

[ ]:

[ ]:

0.2 Data rent

[413]:
```
data_rent.shape
```

[413]:
```
(13447, 32)
```

[ ]: