```python
#房屋优势特征管道
def house_advantage_ext(X):
    """
    房屋优势特征提取函数
    将房屋优势字符串编码为四维向量 [装修，房本满五年，地铁，房本满两年]
    每有一个特征就记为1，例如"装修、房本满五年" -> [1,1,0,0]
    """
```

```python
from sklearn.pipeline import make_pipeline
from sklearn.impute import SimpleImputer
from sklearn.preprocessing import FunctionTransformer

FACILITY_FEATURES = ['冰箱', '天然', '天然气', '宽带', '床', '暖气', '洗衣机', '热水器', '电视', '空调', '衣柜']

def facility_ext(X):
    """
    从配套设施字符串中提取特征向量

    参数:
    X: 输入数据，可以是Series、DataFrame或二维数组

    返回:
    numpy数组，形状为(n_samples, n_features)，其中n_features=11
    """
```

```python
#房屋户型处理管道
import re
class HouseTypeEncoder2(BaseEstimator, TransformerMixin):
    """房屋户型编码器 - 将'3室1厅1厨1卫'格式编码为四维数值特征"""
```

```python
def direction_ext(X):
    """
    房屋朝向编码函数
    将房屋朝向字符串编码为四维向量 [东，南，西，北]
    每有一个方向字符就记为1，例如"东南" -> [1,1,0,0]
    """
```

| Model | In_sample_MAE | Out_of_sample_MAE | CV_MAE | Kaggle |
|---|---|---|---|---|
| OLS | 107418.6739 | 107258.4649 | 107593.1324 | 59.51 |
| LASSO_Grid | 110589.8347 | 110584.7792 | 110745.0865 | 56.15 |
| RIDGE_Grid | 107418.6908 | 107258.5021 | 107593.1213 | 57.9 |
| | | | | |
| OLS | 539620.1426 | 546830.373 | 540624.8751 | |
| LASSO_Grid | 549402.8018 | 555203.9157 | 550135.6885 | |
| RIDGE_Grid | 539619.97 | 546830.424 | 540624.5991 | |
| | | | | |
| best model | | | | 59.51 |

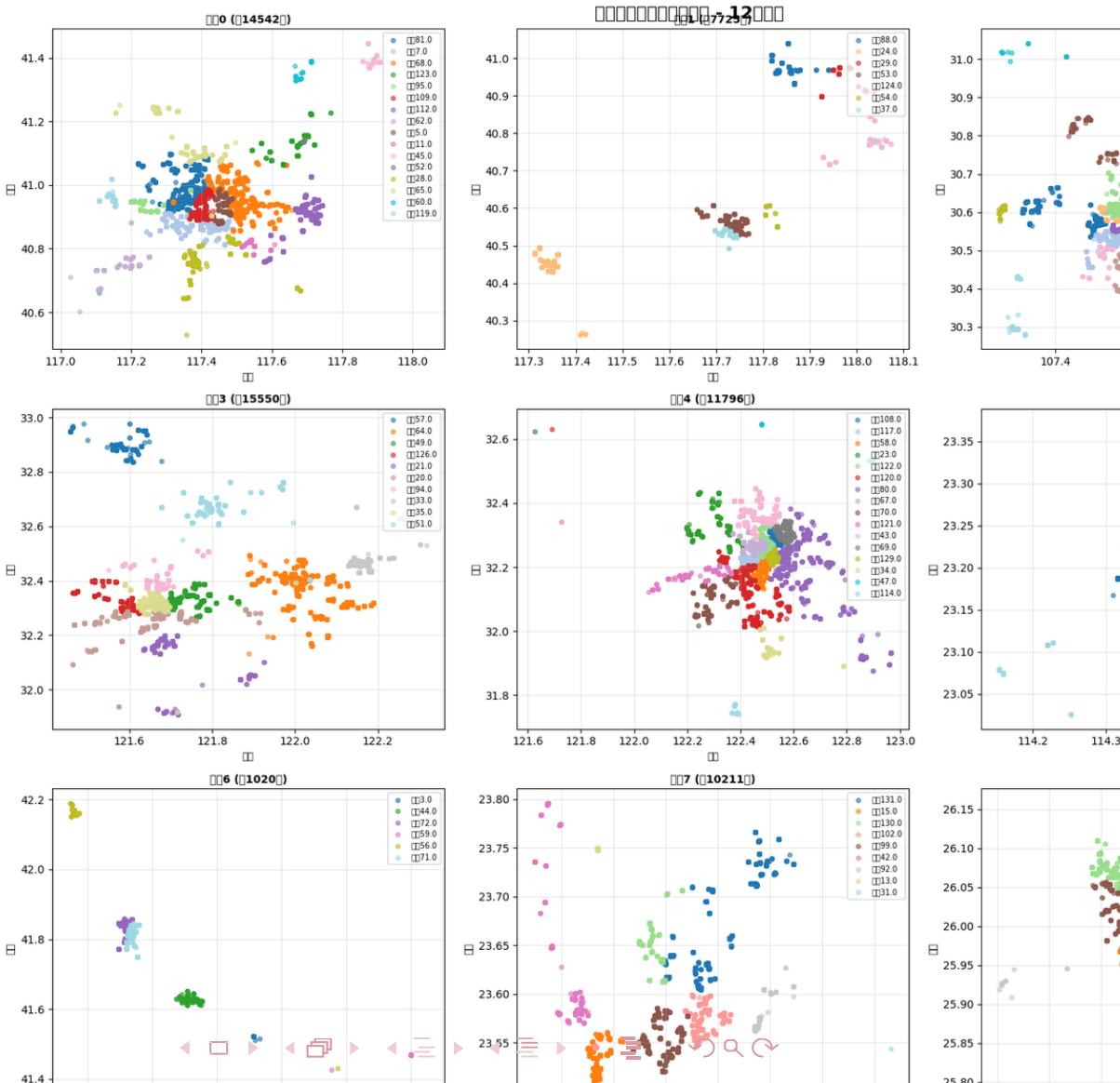
```python
X_train, X_test, y_train, y_test = train_test_split(
    cleaned_rent.drop('Price', axis=1),
    np.log(cleaned_rent['Price']),
    test_size=0.2,
    random_state=111
)
```

```python
from sklearn.compose import ColumnTransformer

rent_preprocessing=ColumnTransformer([
    ('poly',poly_pipeline2,['面积','绿化率_小数','物业费_提取','燃气费_提取','log_面积','log_绿化率','log_物业费','log_燃气费']),
    ('cat',cat_pipeline,['城市','付款方式','租赁方式','电梯','用水','用电','燃气','建筑结构','供水','供电']),
    ('fq',cat_frequency,['产权描述','租期','区县','板块','物业类别']),
    ('facility',facility_pipeline,['配套设施']),
    ('geo',cluster_simil,['lon','lat']),
    ('type',house_type_pipeline2,['户型']),
    ('floor',floor_pipeline2,['楼层']),
    ('direction',direction_pipeline,['朝向'])
])
```

- 使用正则表达式分解有效信息
- 文本数据赋分
- 类别特征编码
- 分层级的缺失值补全方法
- 特殊城市的差异化处理

| 指标 | 样本内 | 样本外 | 交叉验证 | Kaggle |
|---|---|---|---|---|
| OLS | 320582.07 | 319596.14 | 328584.51 | 73.5 |
| Ridge | 601814.70 | 605654.64 | 621220.14 | 62.3 |
| 最佳线性模型 | 320582.07 | 319596.14 | 328584.51 | 73.5 |
| | | | | |
| 指标 | 样本内 | 样本外 | 交叉验证 | Kaggle |
| OLS | 85179.74 | 88370.71 | 87848.58 | 73.5 |
| Ridge | 85174.49 | 88369.65 | 87640.89 | 62.3 |
| 最佳线性模型 | 85174.49 | 88369.65 | 87640.89 | 62.3 |



| PRICE_Model | In sample MAE | Out of sample MAE | CV MAE | Kaggle Score |
|---|---|---|---|---|
| OLS | 738418.52 | 726924.67 | 739022.16 | 54.31 |
| LASSO | 739308.43 | 727820.67 | 739856.26 | 54.33 |
| Ridge | 738418.52 | 726924.67 | 739022.16 | 54.31 |
| ElasticNet | 738621.47 | 727139.84 | 739215.67 | 54.31 |
| SGD | 740125.89 | 729320.10 | 745567.55 | 54.31 |
| Huber | 739523.46 | 729386.15 | 740130.92 | 54.04 |

| RENT_Model | In sample MAE | Out of sample MAE | CV MAE |
|---|---|---|---|
| OLS | 156664.86 | 157723.88 | 156845.09 |
| LASSO | 157715.75 | 158718.22 | 157893.30 |
| Ridge | 156664.88 | 157723.90 | 156845.11 |
| ElasticNet | 157609.73 | 158620.36 | 157788.61 |
| SGD | 159805.71 | 161424.36 | 158015.11 |
| Huber | 157479.68 | 158959.46 | 157748.79 |

## ①一次提取数值信息

→一次处理多列减少工作量

```
def extract_numeric_features(df):
    """提取数字特征"""
```

| 房屋总数 | 楼栋总数 |
|---|---|
| 1317户 | 19栋 |
| 2317户 | 40栋 |
| 1554户 | 20栋 |
| 66户 | 27栋 |

→ *房屋总数 1317*

| 物 业 费 |
|---|
| 1.3-1.65元/月/㎡ |
| 0.65元/月/㎡ |
| 1.98-2.98元/月/㎡ |

→ *(1.3+1.65)/2*

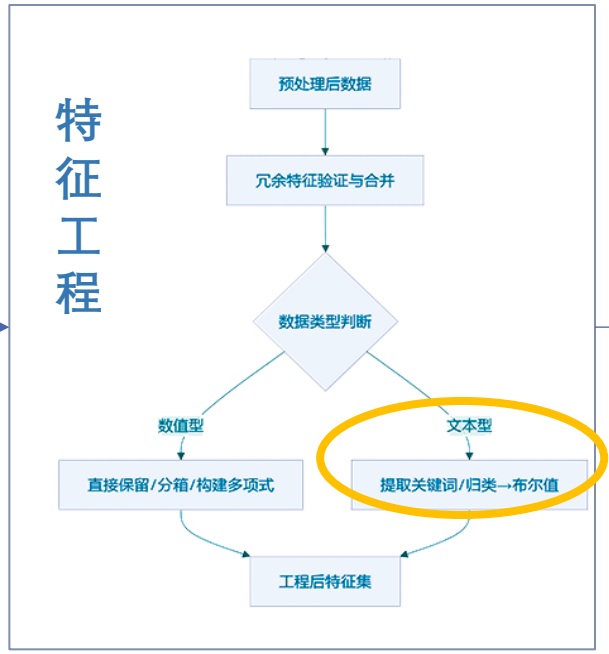
| 建筑年代 |
|---|
| 1955-2000年 |
| 2005年 |
| 2011-2012年 |
| 2009-2011年 |

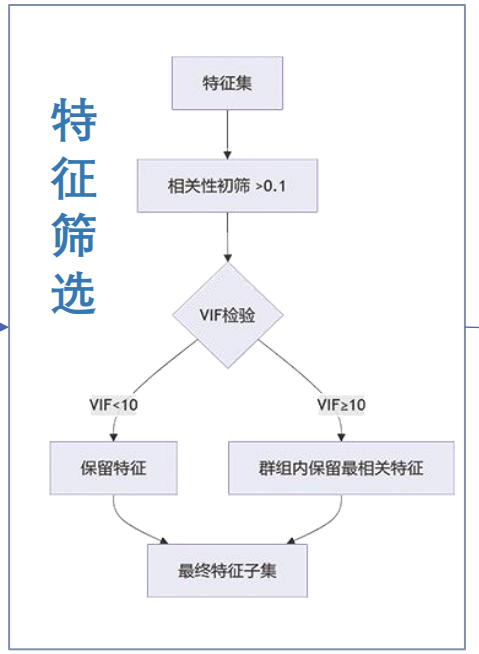
→ *建筑年代（1955+2000）/2*

```
def create_binning_features(df):
    """创建分箱特征"""
    # 建筑年代分箱
    if '建筑年代' in df.columns:
        df['建筑年代分箱'] = pd.cut(df['建筑年代'],
                                bins=[0, 1980, 1990, 2000, 2010, 2020, 2030],
                                labels=['老旧', '80年代', '90年代', '00年代', '10年代', '新建筑'])
```

*建筑年代_老旧：True*

数据输入


投入模型

## ②单列文字信息→更多的可用特征

| 房屋户型 |
|---|
| 2室1厅1厨1卫 |
| 3室1厅1厨1卫 |
| 3室2厅1厨2卫 |
| 6室3厅1厨3卫 |
| 1房间1卫 |

→ *室 厅 厨 卫*
*2 1 1 1*

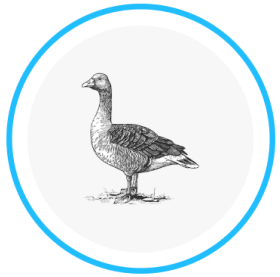
| 房屋朝向 |
|---|
| 南 北 |
| 南 北 |
| 东南 |
| 东 南 西 北 |

→ *南 北*
*True True*

→ *朝向个数：2*

→ *南北通透：True*

何宣晓 2023200184



mialex2005

**Alex Wong**

黄之杰 2023200251

| Metrics (Price) | In sample | out of sample | Cross-validation | Kaggle Score |
|---|---|---|---|---|
| OLS | 521784.319 | 517497.624 | 526609.124 | 64.85 |
| LASSO L1:0.01 | 751114.486 | 734893.989 | 753207.844 | 57.65 |
| Ridge L2:100 | 522947.226 | 518393.887 | 527682.534 | 64.63 |
| ElasticNet Alpha:0.2 L1:0.01 | 755031.273 | 738051.991 | 716246.446 | 59.67 |

```
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=15; total time=   3.4s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=15; total time=   3.5s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   6.0s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   5.9s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   5.8s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   5.9s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   6.3s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=39; total time=   5.6s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  20.5s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  21.9s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  20.2s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  19.9s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  19.1s
[CV] END regressor__poly__degree=2, regressor__poly__interaction_only=True, regressor__selector__k=78; total time=  19.2s

=== 完成 ===
最佳参数:  {'regressor__poly__degree': 2, 'regressor__poly__interaction_only': False, 'regressor__selector__k': 39}
最佳 CV R^2:  0.8092377075284357

最佳 pipeline（已拟合）:
Pipeline(memory=Memory(location=C:\Users\lldlu\AppData\Local\Temp\sklearn_cache_9slgpdv1\joblib),
         steps=[('preprocessor',
                 ColumnTransformer(transformers=[('geo_cluster',
                                                  LonLatClusterTransformer(n_clusters=40),
                                                  ['lon', 'lat']),
                                                 ('log_cols',
                                                  Pipeline(steps=[('imputer',
                                                                   SimpleImputer(strategy='median')),
                                                                  ('log',
                                                                   FunctionTransformer(func=<ufunc 'log'>)),
                                                                  ('winsor...
                                                  TargetEncoder(cols=['district'],
                                                                smoothing=50),
                                                  ['district']),
                                                 ('plate_cluster',
                                                  PlateClusterTransformer(),
                                                  ['plate'])])),
                ('selector',
                 SelectKBest(k=39,
                             score_func=<function f_regressi...0x000001E0B0A90D60>)),
                ('poly', PolynomialFeatures(include_bias=F...),
                ('to_float32',
                 FunctionTransformer(accept_sparse=True,
                                     func=<function <lam... at 0x000001E0B0A939C0>)),
                ('model', LinearRegression())])
```

| | geo_n_clusters | district_smoothing | plate_n_clusters | fit_intercept | ...se | split1_rmse | split2_rmse | split3_rmse | split4_rmse | split5_rmse | mean_rmse |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 58 | 54 | 11 | True | 1120875 | 1102661 | 1145309 | 1081226 | 1105161 | 1050595 | 1100971 |
| 7 | 55 | 49 | 14 | False | 1117016 | 1093939 | 1146632 | 1083601 | 1109300 | 1057088 | 1101263 |
| 1 | 47 | 50 | 12 | True | 1120709 | 1081657 | 1147435 | 1087470 | 1106980 | 1063888 | 1101356 |
| 6 | 56 | 51 | 10 | True | 1122280 | 1090218 | 1145742 | 1083719 | 1110580 | 1056044 | 1101430 |
| 18 | 51 | 57 | 9 | False | 1123103 | 1090309 | 1144040 | 1085405 | 1105165 | 1062312 | 1101722 |

```
---  ------            --------------  -----
 0   city              98899 non-null  int64
 1   Price             98899 non-null  float64
 2   area              98899 non-null  float64
 3   way2rent          98899 non-null  object
 4   elevator          98895 non-null  float64
 5   wat_sup           81159 non-null  float64
 6   ele_sup           81575 non-null  float64
 7   gas               94317 non-null  float64
 8   period2rent       51966 non-null  object
 9   lon               98899 non-null  float64
 10  lat               98899 non-null  float64
 11  year              98899 non-null  float64
 12  district          94222 non-null  float64
 13  plate             93755 non-null  float64
 14  built_year        72750 non-null  float64
 15  greening_rate     74497 non-null  float64
 16  plot_ratio        74819 non-null  float64
 17  property_fee      76740 non-null  float64
 18  build_struc       78158 non-null  object
 19  gas_feenum        73842 non-null  float64
 20  park_area         73420 non-null  float64
 21  floor             98635 non-null  float64
 22  room              93849 non-null  float64
 23  hall              93871 non-null  float64
 24  kitchen           0 non-null      float64
 25  bathroom          34765 non-null  float64
 26  east              98899 non-null  int64
 27  south             98899 non-null  int64
 28  west              98899 non-null  int64
 29  north             98899 non-null  int64
 30  transaction_year  98899 non-null  int64
 31  bed               98899 non-null  float64
 32  wardrobe          98899 non-null  float64
 33  air_condi         98899 non-null  float64
 34  wash_mach         98899 non-null  float64
 35  water_heat        98899 non-null  float64
 36  dwelling          98899 non-null  float64
 37  ground_comm       98899 non-null  float64
 38  commerce          98899 non-null  float64
 39  carport           98899 non-null  float64
 40  apart             98899 non-null  float64
 41  villa             98899 non-null  float64
 42  density_ratio     94268 non-null  float64
 43  reflect_sentiment 98899 non-null  float64
```

```
Pipeline(steps=[('preprocessor',
                 ColumnTransformer(transformers=[('geo_cluster',
                                                  LonLatClusterTransformer(n_clusters=25),
                                                  ['lon', 'lat']),
                                                 ('log_cols',
                                                  Pipeline(steps=[('imputer',
                                                                   SimpleImputer(strategy='median')),
                                                                  ('log',
                                                                   FunctionTransformer(func=<ufunc 'log'>)),
                                                                  ('winsor',
                                                                   Winsorizer()),
                                                                  ('scaler',
                                                                   StandardScaler())]),
                                                  ['gas_feenum', 'park_area']),
                                                 ('log1p_num',
                                                  P...
                                                                                 sparse_output=False))]),
                                                  ['city', 'way2rent', 'floor',
                                                   'wat_sup', 'ele_sup',
                                                   'build_struc']),
                                                 ('district_target',
                                                  TargetEncoder(cols=['district'],
                                                                smoothing=15),
                                                  ['district']),
                                                 ('period2rent',
                                                  TargetEncoder(smoothing=15,
                                                                verbose='period2rent'),
                                                  ['period2rent']),
                                                 ('plate_cluster',
                                                  PlateClusterTransformer(),
                                                  ['plate'])])),
                ('scaler', StandardScaler()),
                ('regressor', LinearRegression())])
```