In [2]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import sklearn.model_selection
from sklearn.model_selection import train_test_split
```

In [38]:
```python
!pip install xgboost
```

```
Collecting xgboost
  Downloading xgboost-1.7.1-py3-none-win_amd64.whl (89.1 MB)
Requirement already satisfied: scipy in c:\programdata\anaconda3\lib\site-packages (from xgboost) (1.7.3)
Requirement already satisfied: numpy in c:\programdata\anaconda3\lib\site-packages (from xgboost) (1.21.5)
Installing collected packages: xgboost
Successfully installed xgboost-1.7.1
```

In [39]:
```python
from sklearn.linear_model import LinearRegression
from sklearn.ensemble import StackingRegressor
from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import AdaBoostRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.tree import DecisionTreeRegressor
#neural network model
from sklearn.neural_network import MLPRegressor
from xgboost import XGBRegressor

#evaluating parameters
from sklearn.metrics import mean_absolute_error,r2_score,mean_squared_error
```

In [4]:
```python
#reading data
data=pd.read_csv("DS - Assignment Part 1 data set csv.csv")
```

In [33]:
```python
# Understanding the nature of given data
```

In [11]:
```python
data.columns
```

Out[11]:
```
Index(['Transaction date', 'House Age',
       'Distance from nearest Metro station (km)',
       'Number of convenience stores', 'latitude', 'longitude',
       'Number of bedrooms', 'House size (sqft)', 'House price of unit area'],
      dtype='object')
```

In [4]:
```python
data.head()
```

Out[4]:

	Transaction date	House Age	Distance from nearest Metro station (km)	Number of convenience stores	latitude	longitude	Number of bedrooms	House size (sqft)	House price of unit area
0	2012.917	32.0	84.87882	10	24.98298	121.54024	1	575	37.9
1	2012.917	19.5	306.59470	9	24.98034	121.53951	2	1240	42.2
2	2013.583	13.3	561.98450	5	24.98746	121.54391	3	1060	47.3
3	2013.500	13.3	561.98450	5	24.98746	121.54391	2	875	54.8
4	2012.833	5.0	390.56840	5	24.97937	121.54245	1	491	43.1

In [5]:
```python
data.describe()
```

Out[5]:

	Transaction date	House Age	Distance from nearest Metro station (km)	Number of convenience stores	latitude	longitude	Number of bedrooms	House size (sqft)	House price of unit area
count	414.000000	414.000000	414.000000	414.000000	414.000000	414.000000	414.000000	414.000000	414.000000
mean	2013.148971	17.712560	1083.885689	4.094203	24.969030	121.533361	1.987923	931.475845	37.980193
std	0.281967	11.392485	1262.109595	2.945562	0.012410	0.015347	0.818875	348.910269	13.606488
min	2012.667000	0.000000	23.382840	0.000000	24.932070	121.473530	1.000000	402.000000	7.600000
25%	2012.917000	9.025000	289.324800	1.000000	24.963000	121.528085	1.000000	548.000000	27.700000
50%	2013.167000	16.100000	492.231300	4.000000	24.971100	121.538630	2.000000	975.000000	38.450000
75%	2013.417000	28.150000	1454.279000	6.000000	24.977455	121.543305	3.000000	1234.750000	46.600000
max	2013.583000	43.800000	6488.021000	10.000000	25.014590	121.566270	3.000000	1500.000000	117.500000

In [8]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 414 entries, 0 to 413
Data columns (total 9 columns):
 #   Column                                    Non-Null Count  Dtype  
---  ------                                    --------------  -----  
 0   Transaction date                          414 non-null    float64
 1   House Age                                 414 non-null    float64
 2   Distance from nearest Metro station (km)  414 non-null    float64
 3   Number of convenience stores              414 non-null    int64  
 4   latitude                                  414 non-null    float64
 5   longitude                                 414 non-null    float64
 6   Number of bedrooms                        414 non-null    int64  
 7   House size (sqft)                         414 non-null    int64  
 8   House price of unit area                  414 non-null    float64
dtypes: float64(6), int64(3)
memory usage: 29.2 KB
```

In [9]:
```python
data.isnull()
```

Out[9]:

	Transaction date	House Age	Distance from nearest Metro station (km)	Number of convenience stores	latitude	longitude	Number of bedrooms	House size (sqft)	House price of unit area
0	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False
2	False	False	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False
...	...	...	...	...	...	...	...	...	...
409	False	False	False	False	False	False	False	False	False
410	False	False	False	False	False	False	False	False	False
411	False	False	False	False	False	False	False	False	False
412	False	False	False	False	False	False	False	False	False
413	False	False	False	False	False	False	False	False	False

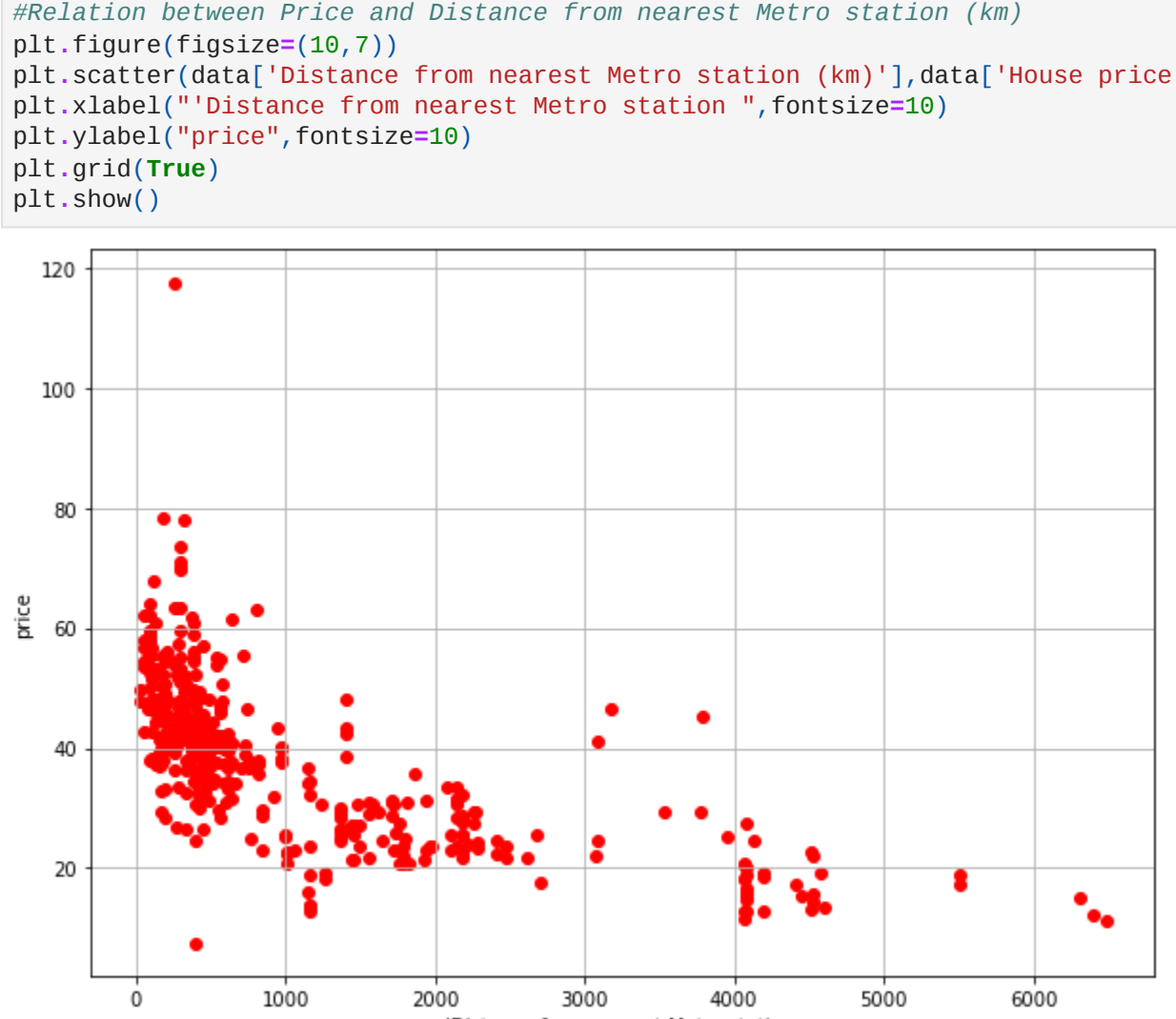
414 rows × 9 columns

In [32]:
```python
data.nunique()
```

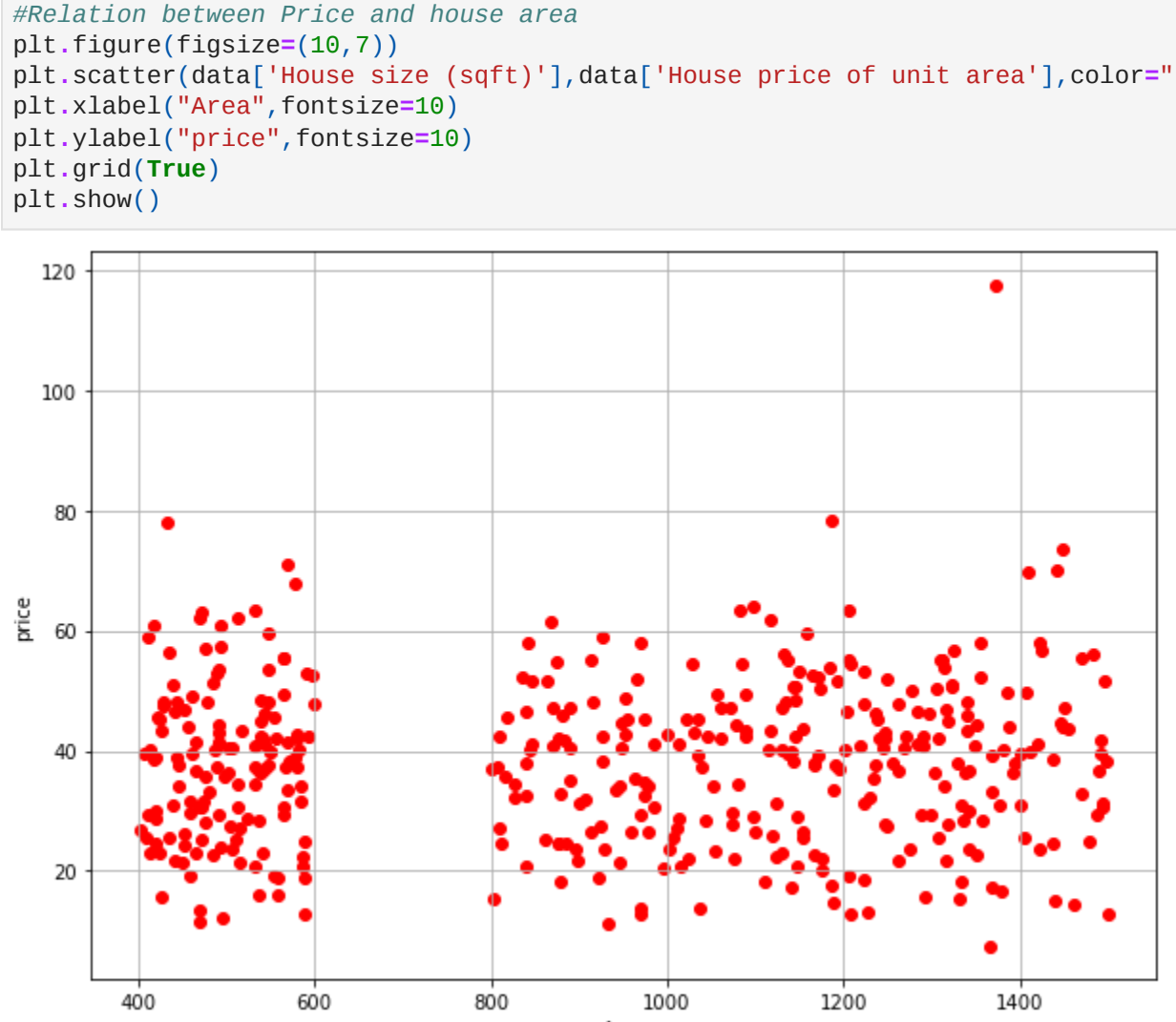
Out[32]:
```
Transaction date                             12
House Age                                   236
Distance from nearest Metro station (km)    259
Number of convenience stores                 11
latitude                                    234
longitude                                   232
Number of bedrooms                            3
House size (sqft)                           328
House price of unit area                    270
dtype: int64
```

In [35]:
```python
# Visualizing relationship between dependent and Independent features
```

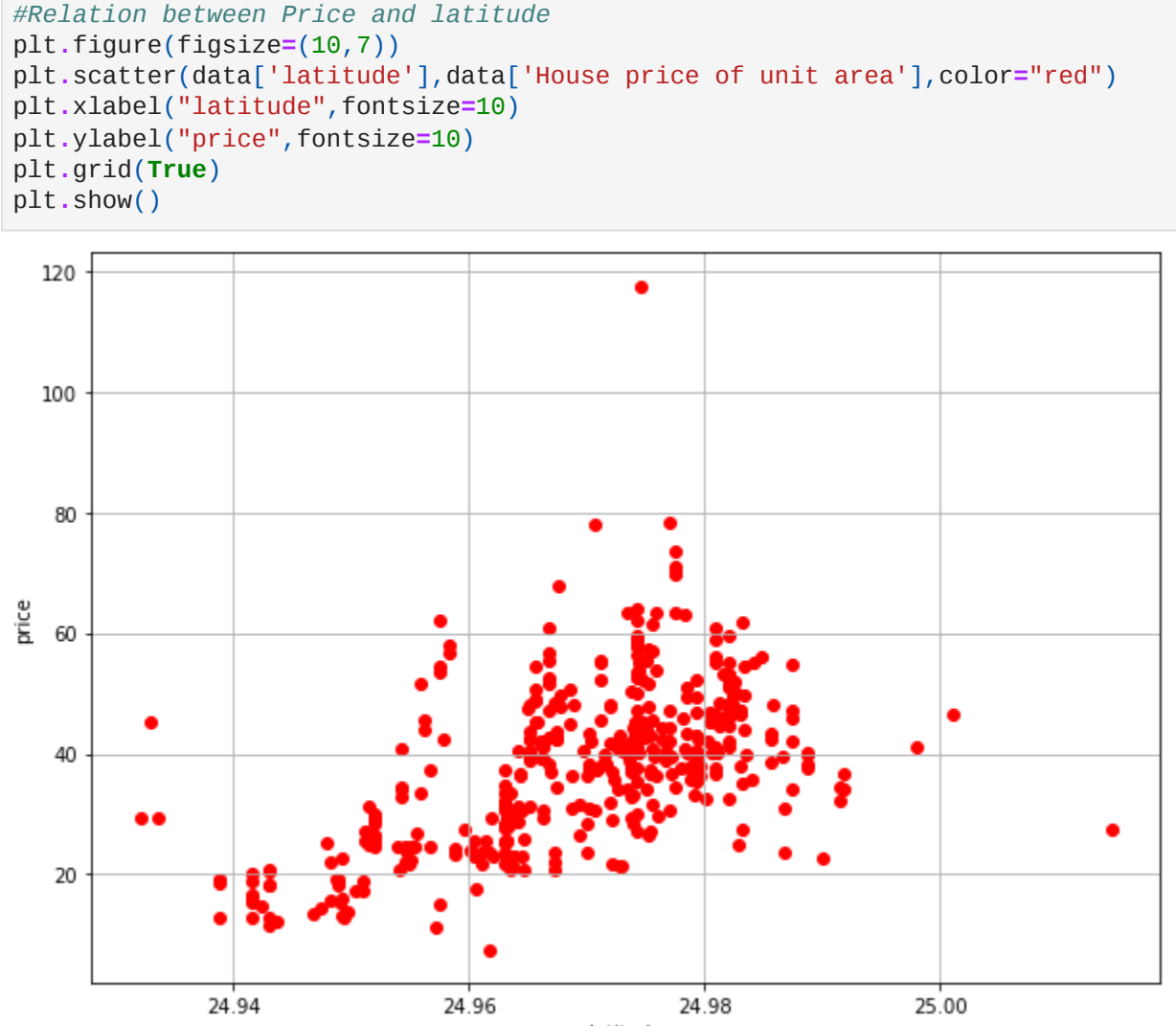
In [18]:
```python
#Relation between Price and Transaction date
plt.figure(figsize=(10,7))
plt.scatter(data['Transaction date'],data['House price of unit area'],color="red")
plt.xlabel("date",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```



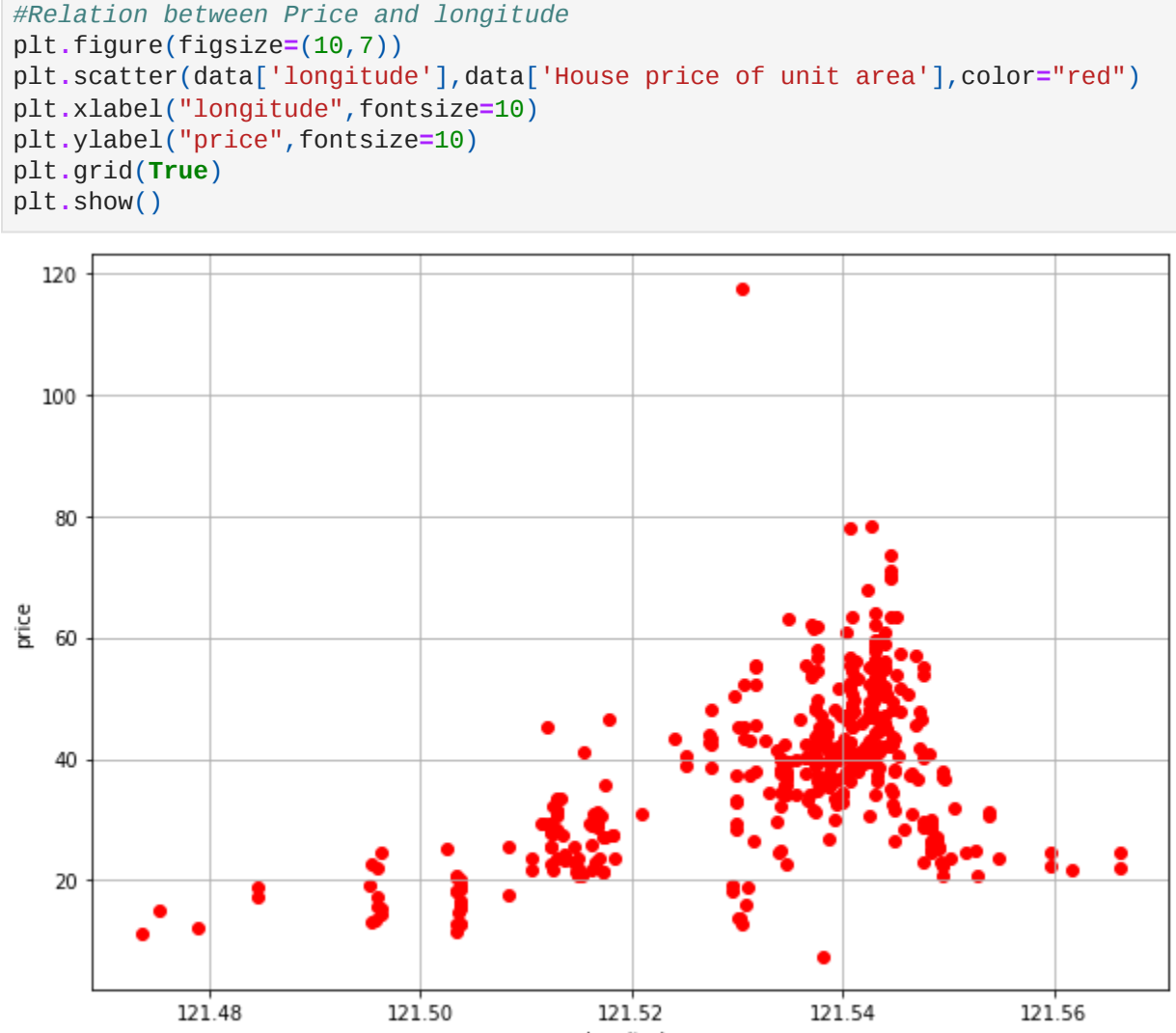
In [14]:
```python
#Relation between Price and Distance from nearest Metro station (km)
plt.figure(figsize=(10,7))
plt.scatter(data['Distance from nearest Metro station (km)'],data['House price of unit area'],color="red")
plt.xlabel("'Distance from nearest Metro station ",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```



In [36]:
```python
#Relation between Price and house area
plt.figure(figsize=(10,7))
plt.scatter(data['House size (sqft)'],data['House price of unit area'],color="red")
plt.xlabel("Area",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```



In [37]:
```python
#Relation between Price and latitude
plt.figure(figsize=(10,7))
plt.scatter(data['latitude'],data['House price of unit area'],color="red")
plt.xlabel("latitude",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```



In [38]:
```python
#Relation between Price and longitude
plt.figure(figsize=(10,7))
plt.scatter(data['longitude'],data['House price of unit area'],color="red")
plt.xlabel("longitude",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```

In [39]:
```python
#Relation between Price and bedrooms
plt.figure(figsize=(10,7))
plt.scatter(data['Number of bedrooms'],data['House price of unit area'],color="red")
plt.xlabel("Number of bedrooms",fontsize=10)
plt.ylabel("price",fontsize=10)
plt.grid(True)
plt.show()
```

In [5]:
```python
x = data.drop('House price of unit area',axis =1)
y=data['House price of unit area']
```

In [6]:
```python
xtrain,xtest,ytrain,ytest = train_test_split(x,y,test_size=.2,random_state=42)
```

In [52]:
```python
# LinearRegression
L= LinearRegression()
L.fit(xtrain,ytrain)
```

Out[52]:
```
LinearRegression()
```

In [53]:
```python
predtest=L.predict(xtest)
Lscore=L.score(xtrain,ytrain)
print(Lscore)
rmse_L=mean_squared_error(ytest,predtest,squared=False)
print(rmse_L)
```

```
0.5599600043686416
7.4543198074643335
```

In [11]:
```python
#RandomForestRegressor
rf=RandomForestRegressor(max_depth =10,n_estimators=50,criterion='mse')
rf.fit(xtrain,ytrain)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\ensemble\_forest.py:396: FutureWarning: Criterion 'mse' was deprecated in v1.0 and will be remov
ed in version 1.2. Use `criterion='squared_error'` which is equivalent.
  warn(
```

Out[11]:
```
RandomForestRegressor(criterion='mse', max_depth=10, n_estimators=50)
```

In [20]:
```python
predtest=rf.predict(xtest)
```

In [13]:
```python
rfscore=rf.score(xtrain,ytrain)
print(rfscore)
```

```
0.9422063736562449
```

In [19]:
```python
rmse=mean_squared_error(ytest,predtest,squared=False)
print(rmse)
```

```
5.991984434322764
```

In [21]:
```python
pd.DataFrame(rf.feature_importances_,index=xtest.columns).sort_values(0,ascending=False)
```

Out[21]:

	0
Distance from nearest Metro station (km)	0.532852
House Age	0.157235
latitude	0.134909
longitude	0.074192
Transaction date	0.035678
House size (sqft)	0.033227
Number of convenience stores	0.025328
Number of bedrooms	0.006579

In [22]:
```python
# most important variable is "Distance from nearest Metro station (km)". Number of bedrooms is of least importance
```

In [25]:
```python
#AdaBoostRegressor
adaboost = AdaBoostRegressor(base_estimator=DecisionTreeRegressor(max_depth =10,min_samples_split=100,random_state=42),random_state=42)
adaboost.fit(xtrain,ytrain)
```

Out[25]:
```
AdaBoostRegressor(base_estimator=DecisionTreeRegressor(max_depth=10,
                                                       min_samples_split=100,
                                                       random_state=42),
                  random_state=42)
```

In [26]:
```python
predtest=adaboost.predict(xtest)
adaboostscore=adaboost.score(xtrain,ytrain)
print(adaboostscore)
rmse_adaboost=mean_squared_error(ytest,predtest,squared=False)
print(rmse_adaboost)
```

```
0.7803649908108372
6.880893467955216
```

In [27]:
```python
#GradientBoosting
gradientboost=GradientBoostingRegressor(max_depth=10,min_samples_split=100,learning_rate=0.01,random_state=42)
gradientboost.fit(xtrain,ytrain)
```

Out[27]:
```
GradientBoostingRegressor(learning_rate=0.01, max_depth=10,
                          min_samples_split=100, random_state=42)
```

In [28]:
```python
predtest=gradientboost.predict(xtest)
gradientboostscore=gradientboost.score(xtrain,ytrain)
print(gradientboostscore)
rmse_gradientboost=mean_squared_error(ytest,predtest,squared=False)
print(rmse_gradientboost)
```

```
0.5972387243192092
7.67842493446194
```

In [29]:
```python
#r2 drops then rmse increases
```

In [ ]:
```python
mlpregressor=MLPRegressor(hidden_layer_sizes=8,activation="relu",solver="adam",verbose="True",n_iter_no_change=1000,max_iter=20000,tol=0.001,random_
mlpregressor.fit(xtrain,ytrain)
```

In [31]:
```python
predtest=mlpregressor.predict(xtest)
mlpregressorscore=mlpregressor.score(xtrain,ytrain)
print(mlpregressorscore)
rmse_mlpregressor=mean_squared_error(ytest,predtest,squared=False)
print(rmse_mlpregressor)
```

```
0.5993779066597805
7.6337458075450275
```

In [32]:
```python
# we can use other activation functions as well
```

In [41]:
```python
xgboost=XGBRegressor(max_depth =10,learning_rate=0.1,reg_alpha=1,random_state=42)
xgboost.fit(xtrain,ytrain)
```

Out[41]:
```
XGBRegressor(base_score=0.5, booster='gbtree', callbacks=None,
             colsample_bylevel=1, colsample_bynode=1, colsample_bytree=1,
             early_stopping_rounds=None, enable_categorical=False,
             eval_metric=None, feature_types=None, gamma=0, gpu_id=-1,
             grow_policy='depthwise', importance_type=None,
             interaction_constraints='', learning_rate=0.1, max_bin=256,
             max_cat_threshold=64, max_cat_to_onehot=4, max_delta_step=0,
             max_depth=10, max_leaves=0, min_child_weight=1, missing=nan,
             monotone_constraints='()', n_estimators=100, n_jobs=0,
             num_parallel_tree=1, predictor='auto', random_state=42, ...)
```

In [42]:
```python
predtest=xgboost.predict(xtest)
xgboostscore=xgboost.score(xtrain,ytrain)
print(xgboostscore)
rmse_xgboost=mean_squared_error(ytest,predtest,squared=False)
print(rmse_xgboost)
```

```
0.9996214017389085
5.8657395746949526
```

In [43]:
```python
# xgboost gave 99 percent accuracy . It is one of the best algorithm to use
```

In [44]:
```python
# stacking model - combining different algorithms
```

In [ ]:
```python
stacking = StackingRegressor(estimators=estimators,final_estimator =final_estimator ,cv=5)
stacking.fit(xtrain,ytrain)
```

In [48]:
```python
estimators = [
    ("GradientBoost",gradientboost),
    ("MLP",mlpregressor),
    ("AdaBoost",adaboost),
    ("RandomForest",rf),

]
final_estimator =XGBRegressor(max_depth =10,learning_rate=0.1,reg_alpha=1,random_state=42)
```

In [51]:
```python
predtest=stacking.predict(xtest)
stackingscore=stacking.score(xtrain,ytrain)
print(stackingscore)
rmse_stacking=mean_squared_error(ytest,predtest,squared=False)
print(rmse_stacking)
```

```
0.7241149778236378
7.046476088026656
```

In [55]:
```python
score=[]
score.extend([
    Lscore,
    xgboostscore,
    stackingscore,
    mlpregressorscore,
    gradientboostscore,
    adaboostscore,
    rfscore]

)
```

In [57]:
```python
comparison_frame=pd.DataFrame(
    {
        "Model" : [
            "LinearRegression",
            "XGBRegression",
            "StackingRegression",
            "MLPRegression",
            "GradientBoost",
            "AdaBoost",
            "RandomForestRegression"


        ],
        "Score" : score
    }
)
```

In [60]:
```python
comparison_frame.sort_values(by ="Score",ascending =True)
```

Out[60]:

	Model	Score
0	LinearRegression	0.559960
4	GradientBoost	0.597239
3	MLPRegression	0.599378
2	StackingRegression	0.724115
5	AdaBoost	0.780365
6	RandomForestRegression	0.942206
1	XGBRegression	0.999621

In [1]:
```python
# Above analysis shows that we can choose either XGB Regressor or RandomForestRegression for this model
```