

# Advance\_house\_price\_prediction1

November 23, 2020

## 0.1 Advance House Price Prediction using regression

```
[1]: ###importing all the libraries
```

```
[2]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.preprocessing import MinMaxScaler ##used for feature scaling
scaler=MinMaxScaler()
from sklearn.ensemble import RandomForestClassifier ##used for feature selection
from sklearn.linear_model import Lasso
from sklearn.model_selection import train_test_split
from sklearn.feature_selection import SelectFromModel
from sklearn.ensemble import RandomForestRegressor
pd.pandas.set_option('display.max_columns',None)
from sklearn.model_selection import cross_val_score
```

```
[3]: df=pd.read_csv(r'a_h_p_prediction.csv')
df.head()
```

```
[3]:
```

|   | Id | MSSubClass | MSZoning | LotFrontage | LotArea | Street | Alley | LotShape | \ |
|---|----|------------|----------|-------------|---------|--------|-------|----------|---|
| 0 | 1  | 60         | RL       | 65.0        | 8450    | Pave   | NaN   | Reg      |   |
| 1 | 2  | 20         | RL       | 80.0        | 9600    | Pave   | NaN   | Reg      |   |
| 2 | 3  | 60         | RL       | 68.0        | 11250   | Pave   | NaN   | IR1      |   |
| 3 | 4  | 70         | RL       | 60.0        | 9550    | Pave   | NaN   | IR1      |   |
| 4 | 5  | 60         | RL       | 84.0        | 14260   | Pave   | NaN   | IR1      |   |

  

|   | LandContour | Utilities | LotConfig | LandSlope | Neighborhood | Condition1 | \ |
|---|-------------|-----------|-----------|-----------|--------------|------------|---|
| 0 | Lvl         | AllPub    | Inside    | Gtl       | CollgCr      | Norm       |   |
| 1 | Lvl         | AllPub    | FR2       | Gtl       | Veenker      | Feedr      |   |
| 2 | Lvl         | AllPub    | Inside    | Gtl       | CollgCr      | Norm       |   |
| 3 | Lvl         | AllPub    | Corner    | Gtl       | Crawfor      | Norm       |   |
| 4 | Lvl         | AllPub    | FR2       | Gtl       | NoRidge      | Norm       |   |

  

|   | Condition2 | BldgType | HouseStyle | OverallQual | OverallCond | YearBuilt | \ |
|---|------------|----------|------------|-------------|-------------|-----------|---|
| 0 | Norm       | 1Fam     | 2Story     | 7           | 5           | 2003      |   |
| 1 | Norm       | 1Fam     | 1Story     | 6           | 8           | 1976      |   |

|   |      |      |        |   |   |      |
|---|------|------|--------|---|---|------|
| 2 | Norm | 1Fam | 2Story | 7 | 5 | 2001 |
| 3 | Norm | 1Fam | 2Story | 7 | 5 | 1915 |
| 4 | Norm | 1Fam | 2Story | 8 | 5 | 2000 |

|   | YearRemodAdd | RoofStyle | RoofMatl | Exterior1st | Exterior2nd | MasVnrType | \ |
|---|--------------|-----------|----------|-------------|-------------|------------|---|
| 0 | 2003         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |
| 1 | 1976         | Gable     | CompShg  | MetalSd     | MetalSd     | None       |   |
| 2 | 2002         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |
| 3 | 1970         | Gable     | CompShg  | Wd Sdng     | Wd Shng     | None       |   |
| 4 | 2000         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |

|   | MasVnrArea | ExterQual | ExterCond | Foundation | BsmtQual | BsmtCond | BsmtExposure | \ |
|---|------------|-----------|-----------|------------|----------|----------|--------------|---|
| 0 | 196.0      | Gd        | TA        | PConc      | Gd       | TA       | No           |   |
| 1 | 0.0        | TA        | TA        | CBlock     | Gd       | TA       | Gd           |   |
| 2 | 162.0      | Gd        | TA        | PConc      | Gd       | TA       | Mn           |   |
| 3 | 0.0        | TA        | TA        | BrkTil     | TA       | Gd       | No           |   |
| 4 | 350.0      | Gd        | TA        | PConc      | Gd       | TA       | Av           |   |

|   | BsmtFinType1 | BsmtFinSF1 | BsmtFinType2 | BsmtFinSF2 | BsmtUnfSF | TotalBsmtSF | \ |
|---|--------------|------------|--------------|------------|-----------|-------------|---|
| 0 | GLQ          | 706        | Unf          | 0          | 150       | 856         |   |
| 1 | ALQ          | 978        | Unf          | 0          | 284       | 1262        |   |
| 2 | GLQ          | 486        | Unf          | 0          | 434       | 920         |   |
| 3 | ALQ          | 216        | Unf          | 0          | 540       | 756         |   |
| 4 | GLQ          | 655        | Unf          | 0          | 490       | 1145        |   |

|   | Heating | HeatingQC | CentralAir | Electrical | 1stFlrSF | 2ndFlrSF | LowQualFinSF | \ |
|---|---------|-----------|------------|------------|----------|----------|--------------|---|
| 0 | GasA    | Ex        | Y          | SBrkr      | 856      | 854      | 0            |   |
| 1 | GasA    | Ex        | Y          | SBrkr      | 1262     | 0        | 0            |   |
| 2 | GasA    | Ex        | Y          | SBrkr      | 920      | 866      | 0            |   |
| 3 | GasA    | Gd        | Y          | SBrkr      | 961      | 756      | 0            |   |
| 4 | GasA    | Ex        | Y          | SBrkr      | 1145     | 1053     | 0            |   |

|   | GrLivArea | BsmtFullBath | BsmtHalfBath | FullBath | HalfBath | BedroomAbvGr | \ |
|---|-----------|--------------|--------------|----------|----------|--------------|---|
| 0 | 1710      | 1            | 0            | 2        | 1        | 3            |   |
| 1 | 1262      | 0            | 1            | 2        | 0        | 3            |   |
| 2 | 1786      | 1            | 0            | 2        | 1        | 3            |   |
| 3 | 1717      | 1            | 0            | 1        | 0        | 3            |   |
| 4 | 2198      | 1            | 0            | 2        | 1        | 4            |   |

|   | KitchenAbvGr | KitchenQual | TotRmsAbvGrd | Functional | Fireplaces | FireplaceQu | \ |
|---|--------------|-------------|--------------|------------|------------|-------------|---|
| 0 | 1            | Gd          | 8            | Typ        | 0          | NaN         |   |
| 1 | 1            | TA          | 6            | Typ        | 1          | TA          |   |
| 2 | 1            | Gd          | 6            | Typ        | 1          | TA          |   |
| 3 | 1            | Gd          | 7            | Typ        | 1          | Gd          |   |
| 4 | 1            | Gd          | 9            | Typ        | 1          | TA          |   |

| GarageType | GarageYrBlt | GarageFinish | GarageCars | GarageArea | GarageQual | \ |
|------------|-------------|--------------|------------|------------|------------|---|
|------------|-------------|--------------|------------|------------|------------|---|

|   |        |        |     |   |     |    |
|---|--------|--------|-----|---|-----|----|
| 0 | Attchd | 2003.0 | RFn | 2 | 548 | TA |
| 1 | Attchd | 1976.0 | RFn | 2 | 460 | TA |
| 2 | Attchd | 2001.0 | RFn | 2 | 608 | TA |
| 3 | Detchd | 1998.0 | Unf | 3 | 642 | TA |
| 4 | Attchd | 2000.0 | RFn | 3 | 836 | TA |

  

|   | GarageCond | PavedDrive | WoodDeckSF | OpenPorchSF | EnclosedPorch | 3SsnPorch | \ |
|---|------------|------------|------------|-------------|---------------|-----------|---|
| 0 | TA         | Y          | 0          | 61          | 0             | 0         |   |
| 1 | TA         | Y          | 298        | 0           | 0             | 0         |   |
| 2 | TA         | Y          | 0          | 42          | 0             | 0         |   |
| 3 | TA         | Y          | 0          | 35          | 272           | 0         |   |
| 4 | TA         | Y          | 192        | 84          | 0             | 0         |   |

  

|   | ScreenPorch | PoolArea | PoolQC | Fence | MiscFeature | MiscVal | MoSold | YrSold | \ |
|---|-------------|----------|--------|-------|-------------|---------|--------|--------|---|
| 0 | 0           | 0        | NaN    | NaN   | NaN         | 0       | 2      | 2008   |   |
| 1 | 0           | 0        | NaN    | NaN   | NaN         | 0       | 5      | 2007   |   |
| 2 | 0           | 0        | NaN    | NaN   | NaN         | 0       | 9      | 2008   |   |
| 3 | 0           | 0        | NaN    | NaN   | NaN         | 0       | 2      | 2006   |   |
| 4 | 0           | 0        | NaN    | NaN   | NaN         | 0       | 12     | 2008   |   |

  

|   | SaleType | SaleCondition | SalePrice |
|---|----------|---------------|-----------|
| 0 | WD       | Normal        | 208500    |
| 1 | WD       | Normal        | 181500    |
| 2 | WD       | Normal        | 223500    |
| 3 | WD       | Abnorml       | 140000    |
| 4 | WD       | Normal        | 250000    |

**Missing Values** ##handling missing values ##first we find the features which consists of missing values and handle categorical and numerical missing values seperately

```
[4]: features_with_mis=[i for i in df.columns if df[i].isnull().sum()>1]
features_with_mis
```

```
[4]: ['LotFrontage',
      'Alley',
      'MasVnrType',
      'MasVnrArea',
      'BsmtQual',
      'BsmtCond',
      'BsmtExposure',
      'BsmtFinType1',
      'BsmtFinType2',
      'FireplaceQu',
      'GarageType',
      'GarageYrBlt',
      'GarageFinish',
      'GarageQual',
```

```
'GarageCond',
'PoolQC',
'Fence',
'MiscFeature']
```

```
[5]: ##categorical values with NaN values
## Handling categorical missing values
categorical_nan=[i for i in df.columns if df[i].isnull().sum()>1 and df[i].
↳dtype=='O']
for i in categorical_nan:
    df[i].fillna('missing',inplace=True)
##handling numerical features with missing variables
numerical_nan=[i for i in df.columns if df[i].isnull().sum()>1 and df[i].dtype!
↳='O']
list1=[]
for i in numerical_nan:
    a=df[i].median()
    list1.append(a)
print(list1)
for i in numerical_nan:
    median=df[i].median()
    df[i].fillna(median,inplace=True)
```

```
[69.0, 0.0, 1980.0]
```

```
[6]: df.head()
```

```
[6]:
```

|   | Id | MSSubClass | MSZoning | LotFrontage | LotArea | Street | Alley   | LotShape | \ |
|---|----|------------|----------|-------------|---------|--------|---------|----------|---|
| 0 | 1  | 60         | RL       | 65.0        | 8450    | Pave   | missing | Reg      |   |
| 1 | 2  | 20         | RL       | 80.0        | 9600    | Pave   | missing | Reg      |   |
| 2 | 3  | 60         | RL       | 68.0        | 11250   | Pave   | missing | IR1      |   |
| 3 | 4  | 70         | RL       | 60.0        | 9550    | Pave   | missing | IR1      |   |
| 4 | 5  | 60         | RL       | 84.0        | 14260   | Pave   | missing | IR1      |   |

  

|   | LandContour | Utilities | LotConfig | LandSlope | Neighborhood | Condition1 | \ |
|---|-------------|-----------|-----------|-----------|--------------|------------|---|
| 0 | Lvl         | AllPub    | Inside    | Gtl       | CollgCr      | Norm       |   |
| 1 | Lvl         | AllPub    | FR2       | Gtl       | Veenker      | Feedr      |   |
| 2 | Lvl         | AllPub    | Inside    | Gtl       | CollgCr      | Norm       |   |
| 3 | Lvl         | AllPub    | Corner    | Gtl       | Crawfor      | Norm       |   |
| 4 | Lvl         | AllPub    | FR2       | Gtl       | NoRidge      | Norm       |   |

  

|   | Condition2 | BldgType | HouseStyle | OverallQual | OverallCond | YearBuilt | \ |
|---|------------|----------|------------|-------------|-------------|-----------|---|
| 0 | Norm       | 1Fam     | 2Story     | 7           | 5           | 2003      |   |
| 1 | Norm       | 1Fam     | 1Story     | 6           | 8           | 1976      |   |
| 2 | Norm       | 1Fam     | 2Story     | 7           | 5           | 2001      |   |
| 3 | Norm       | 1Fam     | 2Story     | 7           | 5           | 1915      |   |
| 4 | Norm       | 1Fam     | 2Story     | 8           | 5           | 2000      |   |

|   | YearRemodAdd | RoofStyle | RoofMatl | Exterior1st | Exterior2nd | MasVnrType | \ |
|---|--------------|-----------|----------|-------------|-------------|------------|---|
| 0 | 2003         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |
| 1 | 1976         | Gable     | CompShg  | MetalSd     | MetalSd     | None       |   |
| 2 | 2002         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |
| 3 | 1970         | Gable     | CompShg  | Wd Sdng     | Wd Shng     | None       |   |
| 4 | 2000         | Gable     | CompShg  | VinylSd     | VinylSd     | BrkFace    |   |

|   | MasVnrArea | ExterQual | ExterCond | Foundation | BsmtQual | BsmtCond | BsmtExposure | \ |
|---|------------|-----------|-----------|------------|----------|----------|--------------|---|
| 0 | 196.0      | Gd        | TA        | PConc      | Gd       | TA       | No           |   |
| 1 | 0.0        | TA        | TA        | CBlock     | Gd       | TA       | Gd           |   |
| 2 | 162.0      | Gd        | TA        | PConc      | Gd       | TA       | Mn           |   |
| 3 | 0.0        | TA        | TA        | BrkTil     | TA       | Gd       | No           |   |
| 4 | 350.0      | Gd        | TA        | PConc      | Gd       | TA       | Av           |   |

|   | BsmtFinType1 | BsmtFinSF1 | BsmtFinType2 | BsmtFinSF2 | BsmtUnfSF | TotalBsmtSF | \ |
|---|--------------|------------|--------------|------------|-----------|-------------|---|
| 0 | GLQ          | 706        | Unf          | 0          | 150       | 856         |   |
| 1 | ALQ          | 978        | Unf          | 0          | 284       | 1262        |   |
| 2 | GLQ          | 486        | Unf          | 0          | 434       | 920         |   |
| 3 | ALQ          | 216        | Unf          | 0          | 540       | 756         |   |
| 4 | GLQ          | 655        | Unf          | 0          | 490       | 1145        |   |

|   | Heating | HeatingQC | CentralAir | Electrical | 1stFlrSF | 2ndFlrSF | LowQualFinSF | \ |
|---|---------|-----------|------------|------------|----------|----------|--------------|---|
| 0 | GasA    | Ex        | Y          | SBrkr      | 856      | 854      | 0            |   |
| 1 | GasA    | Ex        | Y          | SBrkr      | 1262     | 0        | 0            |   |
| 2 | GasA    | Ex        | Y          | SBrkr      | 920      | 866      | 0            |   |
| 3 | GasA    | Gd        | Y          | SBrkr      | 961      | 756      | 0            |   |
| 4 | GasA    | Ex        | Y          | SBrkr      | 1145     | 1053     | 0            |   |

|   | GrLivArea | BsmtFullBath | BsmtHalfBath | FullBath | HalfBath | BedroomAbvGr | \ |
|---|-----------|--------------|--------------|----------|----------|--------------|---|
| 0 | 1710      | 1            | 0            | 2        | 1        | 3            |   |
| 1 | 1262      | 0            | 1            | 2        | 0        | 3            |   |
| 2 | 1786      | 1            | 0            | 2        | 1        | 3            |   |
| 3 | 1717      | 1            | 0            | 1        | 0        | 3            |   |
| 4 | 2198      | 1            | 0            | 2        | 1        | 4            |   |

|   | KitchenAbvGr | KitchenQual | TotRmsAbvGrd | Functional | Fireplaces | FireplaceQu | \ |
|---|--------------|-------------|--------------|------------|------------|-------------|---|
| 0 | 1            | Gd          | 8            | Typ        | 0          | missing     |   |
| 1 | 1            | TA          | 6            | Typ        | 1          | TA          |   |
| 2 | 1            | Gd          | 6            | Typ        | 1          | TA          |   |
| 3 | 1            | Gd          | 7            | Typ        | 1          | Gd          |   |
| 4 | 1            | Gd          | 9            | Typ        | 1          | TA          |   |

|   | GarageType | GarageYrBlt | GarageFinish | GarageCars | GarageArea | GarageQual | \ |
|---|------------|-------------|--------------|------------|------------|------------|---|
| 0 | Attchd     | 2003.0      | RFn          | 2          | 548        | TA         |   |
| 1 | Attchd     | 1976.0      | RFn          | 2          | 460        | TA         |   |
| 2 | Attchd     | 2001.0      | RFn          | 2          | 608        | TA         |   |

|   |        |        |     |   |     |    |
|---|--------|--------|-----|---|-----|----|
| 3 | Detchd | 1998.0 | Unf | 3 | 642 | TA |
| 4 | Attchd | 2000.0 | RFn | 3 | 836 | TA |

  

|   | GarageCond | PavedDrive | WoodDeckSF | OpenPorchSF | EnclosedPorch | 3SsnPorch | \ |
|---|------------|------------|------------|-------------|---------------|-----------|---|
| 0 | TA         | Y          | 0          | 61          | 0             | 0         |   |
| 1 | TA         | Y          | 298        | 0           | 0             | 0         |   |
| 2 | TA         | Y          | 0          | 42          | 0             | 0         |   |
| 3 | TA         | Y          | 0          | 35          | 272           | 0         |   |
| 4 | TA         | Y          | 192        | 84          | 0             | 0         |   |

  

|   | ScreenPorch | PoolArea | PoolQC  | Fence   | MiscFeature | MiscVal | MoSold | \ |
|---|-------------|----------|---------|---------|-------------|---------|--------|---|
| 0 | 0           | 0        | missing | missing | missing     | 0       | 2      |   |
| 1 | 0           | 0        | missing | missing | missing     | 0       | 5      |   |
| 2 | 0           | 0        | missing | missing | missing     | 0       | 9      |   |
| 3 | 0           | 0        | missing | missing | missing     | 0       | 2      |   |
| 4 | 0           | 0        | missing | missing | missing     | 0       | 12     |   |

  

|   | YrSold | SaleType | SaleCondition | SalePrice |
|---|--------|----------|---------------|-----------|
| 0 | 2008   | WD       | Normal        | 208500    |
| 1 | 2007   | WD       | Normal        | 181500    |
| 2 | 2008   | WD       | Normal        | 223500    |
| 3 | 2006   | WD       | Abnorml       | 140000    |
| 4 | 2008   | WD       | Normal        | 250000    |

```
[7]: year_attributes=[a for a in df.columns if 'Year' in a or 'Yr' in a]
for i in ['YearBuilt', 'YearRemodAdd', 'GarageYrBlt']:
    df[i]=df['YrSold']-df[i]
```

### Encoding(frequency encoding method)

```
[8]: ##converting categorical variables to numerical variables using one hot
      →encoding using frequency
categorical_variables=[i for i in df.columns if df[i].dtype=='O']
categorical_variables
for i in categorical_variables:
    a=df[i].value_counts().to_dict()
    df[i]=df[i].map(a)
```

```
[9]: df.head()
```

```
[9]:   Id  MSSubClass  MSZoning  LotFrontage  LotArea  Street  Alley  LotShape  \
0    1           60      1151         65.0     8450   1454   1369      925
1    2           20      1151         80.0     9600   1454   1369      925
2    3           60      1151         68.0    11250   1454   1369      484
3    4           70      1151         60.0     9550   1454   1369      484
4    5           60      1151         84.0    14260   1454   1369      484
```

|   | LandContour | Utilities | LotConfig | LandSlope | Neighborhood | Condition1 | \ |
|---|-------------|-----------|-----------|-----------|--------------|------------|---|
| 0 | 1311        | 1459      | 1052      | 1382      | 150          | 1260       |   |
| 1 | 1311        | 1459      | 47        | 1382      | 11           | 81         |   |
| 2 | 1311        | 1459      | 1052      | 1382      | 150          | 1260       |   |
| 3 | 1311        | 1459      | 263       | 1382      | 51           | 1260       |   |
| 4 | 1311        | 1459      | 47        | 1382      | 41           | 1260       |   |

|   | Condition2 | BldgType | HouseStyle | OverallQual | OverallCond | YearBuilt | \ |
|---|------------|----------|------------|-------------|-------------|-----------|---|
| 0 | 1445       | 1220     | 445        | 7           | 5           | 5         |   |
| 1 | 1445       | 1220     | 726        | 6           | 8           | 31        |   |
| 2 | 1445       | 1220     | 445        | 7           | 5           | 7         |   |
| 3 | 1445       | 1220     | 445        | 7           | 5           | 91        |   |
| 4 | 1445       | 1220     | 445        | 8           | 5           | 8         |   |

|   | YearRemodAdd | RoofStyle | RoofMatl | Exterior1st | Exterior2nd | MasVnrType | \ |
|---|--------------|-----------|----------|-------------|-------------|------------|---|
| 0 | 5            | 1141      | 1434     | 515         | 504         | 445        |   |
| 1 | 31           | 1141      | 1434     | 220         | 214         | 864        |   |
| 2 | 6            | 1141      | 1434     | 515         | 504         | 445        |   |
| 3 | 36           | 1141      | 1434     | 206         | 38          | 864        |   |
| 4 | 8            | 1141      | 1434     | 515         | 504         | 445        |   |

|   | MasVnrArea | ExterQual | ExterCond | Foundation | BsmtQual | BsmtCond | \ |
|---|------------|-----------|-----------|------------|----------|----------|---|
| 0 | 196.0      | 488       | 1282      | 647        | 618      | 1311     |   |
| 1 | 0.0        | 906       | 1282      | 634        | 618      | 1311     |   |
| 2 | 162.0      | 488       | 1282      | 647        | 618      | 1311     |   |
| 3 | 0.0        | 906       | 1282      | 146        | 649      | 65       |   |
| 4 | 350.0      | 488       | 1282      | 647        | 618      | 1311     |   |

|   | BsmtExposure | BsmtFinType1 | BsmtFinSF1 | BsmtFinType2 | BsmtFinSF2 | \ |
|---|--------------|--------------|------------|--------------|------------|---|
| 0 | 953          | 418          | 706        | 1256         | 0          |   |
| 1 | 134          | 220          | 978        | 1256         | 0          |   |
| 2 | 114          | 418          | 486        | 1256         | 0          |   |
| 3 | 953          | 220          | 216        | 1256         | 0          |   |
| 4 | 221          | 418          | 655        | 1256         | 0          |   |

|   | BsmtUnfSF | TotalBsmtSF | Heating | HeatingQC | CentralAir | Electrical | \ |
|---|-----------|-------------|---------|-----------|------------|------------|---|
| 0 | 150       | 856         | 1428    | 741       | 1365       | 1334.0     |   |
| 1 | 284       | 1262        | 1428    | 741       | 1365       | 1334.0     |   |
| 2 | 434       | 920         | 1428    | 741       | 1365       | 1334.0     |   |
| 3 | 540       | 756         | 1428    | 241       | 1365       | 1334.0     |   |
| 4 | 490       | 1145        | 1428    | 741       | 1365       | 1334.0     |   |

|   | 1stFlrSF | 2ndFlrSF | LowQualFinSF | GrLivArea | BsmtFullBath | BsmtHalfBath | \ |
|---|----------|----------|--------------|-----------|--------------|--------------|---|
| 0 | 856      | 854      | 0            | 1710      | 1            | 0            |   |
| 1 | 1262     | 0        | 0            | 1262      | 0            | 1            |   |
| 2 | 920      | 866      | 0            | 1786      | 1            | 0            |   |
| 3 | 961      | 756      | 0            | 1717      | 1            | 0            |   |

|   |      |      |   |      |   |   |
|---|------|------|---|------|---|---|
| 4 | 1145 | 1053 | 0 | 2198 | 1 | 0 |
|---|------|------|---|------|---|---|

|   | FullBath | HalfBath | BedroomAbvGr | KitchenAbvGr | KitchenQual | TotRmsAbvGrd \ |
|---|----------|----------|--------------|--------------|-------------|----------------|
| 0 | 2        | 1        | 3            | 1            | 586         | 8              |
| 1 | 2        | 0        | 3            | 1            | 735         | 6              |
| 2 | 2        | 1        | 3            | 1            | 586         | 6              |
| 3 | 1        | 0        | 3            | 1            | 586         | 7              |
| 4 | 2        | 1        | 4            | 1            | 586         | 9              |

|   | Functional | Fireplaces | FireplaceQu | GarageType | GarageYrBlt | GarageFinish \ |
|---|------------|------------|-------------|------------|-------------|----------------|
| 0 | 1360       | 0          | 690         | 870        | 5.0         | 422            |
| 1 | 1360       | 1          | 313         | 870        | 31.0        | 422            |
| 2 | 1360       | 1          | 313         | 870        | 7.0         | 422            |
| 3 | 1360       | 1          | 380         | 387        | 8.0         | 605            |
| 4 | 1360       | 1          | 313         | 870        | 8.0         | 422            |

|   | GarageCars | GarageArea | GarageQual | GarageCond | PavedDrive | WoodDeckSF \ |
|---|------------|------------|------------|------------|------------|--------------|
| 0 | 2          | 548        | 1311       | 1326       | 1340       | 0            |
| 1 | 2          | 460        | 1311       | 1326       | 1340       | 298          |
| 2 | 2          | 608        | 1311       | 1326       | 1340       | 0            |
| 3 | 3          | 642        | 1311       | 1326       | 1340       | 0            |
| 4 | 3          | 836        | 1311       | 1326       | 1340       | 192          |

|   | OpenPorchSF | EnclosedPorch | 3SsnPorch | ScreenPorch | PoolArea | PoolQC \ |
|---|-------------|---------------|-----------|-------------|----------|----------|
| 0 | 61          | 0             | 0         | 0           | 0        | 1453     |
| 1 | 0           | 0             | 0         | 0           | 0        | 1453     |
| 2 | 42          | 0             | 0         | 0           | 0        | 1453     |
| 3 | 35          | 272           | 0         | 0           | 0        | 1453     |
| 4 | 84          | 0             | 0         | 0           | 0        | 1453     |

|   | Fence | MiscFeature | MiscVal | MoSold | YrSold | SaleType | SaleCondition \ |
|---|-------|-------------|---------|--------|--------|----------|-----------------|
| 0 | 1179  | 1406        | 0       | 2      | 2008   | 1267     | 1198            |
| 1 | 1179  | 1406        | 0       | 5      | 2007   | 1267     | 1198            |
| 2 | 1179  | 1406        | 0       | 9      | 2008   | 1267     | 1198            |
| 3 | 1179  | 1406        | 0       | 2      | 2006   | 1267     | 101             |
| 4 | 1179  | 1406        | 0       | 12     | 2008   | 1267     | 1198            |

|   | SalePrice |
|---|-----------|
| 0 | 208500    |
| 1 | 181500    |
| 2 | 223500    |
| 3 | 140000    |
| 4 | 250000    |



### 0.1.1 Feature Scaling

```
[10]: ##feature scaling
      ##first remove dependent and unique features to apply feature scaling and
      ↪perform scaling on features
      feature_to_scale=[i for i in df.columns if i not in ['Id','SalePrice']]
      scaler.fit(df[feature_to_scale])
```

```
[10]: MinMaxScaler()
```

```
[11]: df2=pd.DataFrame(scaler.
      ↪transform(df[feature_to_scale]),columns=feature_to_scale)
      df2
```

```
[11]: MSSubClass  MSZoning  LotFrontage  LotArea  Street  Alley  LotShape  \
0      0.235294      1.0      0.150685  0.033420      1.0      1.0  1.000000
1      0.000000      1.0      0.202055  0.038795      1.0      1.0  1.000000
2      0.235294      1.0      0.160959  0.046507      1.0      1.0  0.518033
3      0.294118      1.0      0.133562  0.038561      1.0      1.0  0.518033
4      0.235294      1.0      0.215753  0.060576      1.0      1.0  0.518033
...      ...      ...      ...      ...      ...      ...
1455    0.235294      1.0      0.140411  0.030929      1.0      1.0  1.000000
1456    0.000000      1.0      0.219178  0.055505      1.0      1.0  1.000000
1457    0.294118      1.0      0.154110  0.036187      1.0      1.0  1.000000
1458    0.000000      1.0      0.160959  0.039342      1.0      1.0  1.000000
1459    0.000000      1.0      0.184932  0.040370      1.0      1.0  1.000000

      LandContour  Utilities  LotConfig  LandSlope  Neighborhood  Condition1  \
0              1.0          1.0    1.000000          1.0      0.663677      1.000000
1              1.0          1.0    0.041031          1.0      0.040359      0.062798
2              1.0          1.0    1.000000          1.0      0.663677      1.000000
3              1.0          1.0    0.247137          1.0      0.219731      1.000000
4              1.0          1.0    0.041031          1.0      0.174888      1.000000
...      ...      ...      ...      ...      ...      ...
1455          1.0          1.0    1.000000          1.0      0.345291      1.000000
1456          1.0          1.0    1.000000          1.0      0.318386      1.000000
1457          1.0          1.0    1.000000          1.0      0.219731      1.000000
1458          1.0          1.0    1.000000          1.0      1.000000      1.000000
1459          1.0          1.0    1.000000          1.0      0.439462      1.000000

      Condition2  BldgType  HouseStyle  OverallQual  OverallCond  YearBuilt  \
0              1.0          1.0    0.608635    0.666667          0.500    0.036765
1              1.0          1.0    1.000000    0.555556          0.875    0.227941
2              1.0          1.0    0.608635    0.666667          0.500    0.051471
3              1.0          1.0    0.608635    0.666667          0.500    0.669118
4              1.0          1.0    0.608635    0.777778          0.500    0.058824
...      ...      ...      ...      ...      ...      ...
```

|      |     |     |          |          |       |          |
|------|-----|-----|----------|----------|-------|----------|
| 1455 | 1.0 | 1.0 | 0.608635 | 0.555556 | 0.500 | 0.058824 |
| 1456 | 1.0 | 1.0 | 1.000000 | 0.555556 | 0.625 | 0.235294 |
| 1457 | 1.0 | 1.0 | 0.608635 | 0.666667 | 1.000 | 0.507353 |
| 1458 | 1.0 | 1.0 | 1.000000 | 0.444444 | 0.625 | 0.441176 |
| 1459 | 1.0 | 1.0 | 1.000000 | 0.444444 | 0.625 | 0.316176 |

|      | YearRemodAdd | RoofStyle | RoofMatl | Exterior1st | Exterior2nd | MasVnrType | \ |
|------|--------------|-----------|----------|-------------|-------------|------------|---|
| 0    | 0.098361     | 1.000000  | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |
| 1    | 0.524590     | 1.000000  | 1.0      | 0.426070    | 0.423459    | 1.000000   |   |
| 2    | 0.114754     | 1.000000  | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |
| 3    | 0.606557     | 1.000000  | 1.0      | 0.398833    | 0.073559    | 1.000000   |   |
| 4    | 0.147541     | 1.000000  | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |
| ...  | ...          | ...       | ...      | ...         | ...         | ...        |   |
| 1455 | 0.131148     | 1.000000  | 1.0      | 1.000000    | 1.000000    | 1.000000   |   |
| 1456 | 0.377049     | 1.000000  | 1.0      | 0.208171    | 0.280318    | 0.140187   |   |
| 1457 | 0.081967     | 1.000000  | 1.0      | 0.116732    | 0.117296    | 1.000000   |   |
| 1458 | 0.245902     | 0.249342  | 1.0      | 0.426070    | 0.423459    | 1.000000   |   |
| 1459 | 0.721311     | 1.000000  | 1.0      | 0.429961    | 0.409543    | 1.000000   |   |

|      | MasVnrArea | ExterQual | ExterCond | Foundation | BsmtQual | BsmtCond | \ |
|------|------------|-----------|-----------|------------|----------|----------|---|
| 0    | 0.122500   | 0.531390  | 1.000000  | 1.000000   | 0.949511 | 1.000000 |   |
| 1    | 0.000000   | 1.000000  | 1.000000  | 0.979814   | 0.949511 | 1.000000 |   |
| 2    | 0.101250   | 0.531390  | 1.000000  | 1.000000   | 0.949511 | 1.000000 |   |
| 3    | 0.000000   | 1.000000  | 1.000000  | 0.222050   | 1.000000 | 0.048128 |   |
| 4    | 0.218750   | 0.531390  | 1.000000  | 1.000000   | 0.949511 | 1.000000 |   |
| ...  | ...        | ...       | ...       | ...        | ...      | ...      |   |
| 1455 | 0.000000   | 1.000000  | 1.000000  | 1.000000   | 0.949511 | 1.000000 |   |
| 1456 | 0.074375   | 1.000000  | 1.000000  | 0.979814   | 0.949511 | 1.000000 |   |
| 1457 | 0.000000   | 0.042601  | 0.113193  | 0.004658   | 1.000000 | 0.048128 |   |
| 1458 | 0.000000   | 1.000000  | 1.000000  | 0.979814   | 1.000000 | 1.000000 |   |
| 1459 | 0.000000   | 0.531390  | 1.000000  | 0.979814   | 1.000000 | 1.000000 |   |

|      | BsmtExposure | BsmtFinType1 | BsmtFinSF1 | BsmtFinType2 | BsmtFinSF2 | \ |
|------|--------------|--------------|------------|--------------|------------|---|
| 0    | 1.000000     | 0.969466     | 0.125089   | 1.000000     | 0.000000   |   |
| 1    | 0.104918     | 0.465649     | 0.173281   | 1.000000     | 0.000000   |   |
| 2    | 0.083060     | 0.969466     | 0.086109   | 1.000000     | 0.000000   |   |
| 3    | 1.000000     | 0.465649     | 0.038271   | 1.000000     | 0.000000   |   |
| 4    | 0.200000     | 0.969466     | 0.116052   | 1.000000     | 0.000000   |   |
| ...  | ...          | ...          | ...        | ...          | ...        |   |
| 1455 | 1.000000     | 1.000000     | 0.000000   | 1.000000     | 0.000000   |   |
| 1456 | 1.000000     | 0.465649     | 0.139972   | 0.032206     | 0.110583   |   |
| 1457 | 1.000000     | 0.969466     | 0.048724   | 1.000000     | 0.000000   |   |
| 1458 | 0.083060     | 0.969466     | 0.008682   | 0.032206     | 0.698100   |   |
| 1459 | 1.000000     | 0.282443     | 0.147059   | 0.025765     | 0.196744   |   |

|   | BsmtUnfSF | TotalBsmtSF | Heating | HeatingQC | CentralAir | Electrical | \ |
|---|-----------|-------------|---------|-----------|------------|------------|---|
| 0 | 0.064212  | 0.140098    | 1.0     | 1.000000  | 1.0        | 1.000000   |   |

|      |          |          |     |          |     |          |
|------|----------|----------|-----|----------|-----|----------|
| 1    | 0.121575 | 0.206547 | 1.0 | 1.000000 | 1.0 | 1.000000 |
| 2    | 0.185788 | 0.150573 | 1.0 | 1.000000 | 1.0 | 1.000000 |
| 3    | 0.231164 | 0.123732 | 1.0 | 0.324324 | 1.0 | 1.000000 |
| 4    | 0.209760 | 0.187398 | 1.0 | 1.000000 | 1.0 | 1.000000 |
| ...  | ...      | ...      | ... | ...      | ... | ...      |
| 1455 | 0.407962 | 0.155974 | 1.0 | 1.000000 | 1.0 | 1.000000 |
| 1456 | 0.252140 | 0.252373 | 1.0 | 0.577027 | 1.0 | 1.000000 |
| 1457 | 0.375428 | 0.188543 | 1.0 | 1.000000 | 1.0 | 1.000000 |
| 1458 | 0.000000 | 0.176432 | 1.0 | 0.324324 | 1.0 | 0.069767 |
| 1459 | 0.058219 | 0.205565 | 1.0 | 0.324324 | 1.0 | 1.000000 |

|      | 1stFlrSF | 2ndFlrSF | LowQualFinSF | GrLivArea | BsmtFullBath | BsmtHalfBath | \ |
|------|----------|----------|--------------|-----------|--------------|--------------|---|
| 0    | 0.119780 | 0.413559 | 0.0          | 0.259231  | 0.333333     | 0.0          |   |
| 1    | 0.212942 | 0.000000 | 0.0          | 0.174830  | 0.000000     | 0.5          |   |
| 2    | 0.134465 | 0.419370 | 0.0          | 0.273549  | 0.333333     | 0.0          |   |
| 3    | 0.143873 | 0.366102 | 0.0          | 0.260550  | 0.333333     | 0.0          |   |
| 4    | 0.186095 | 0.509927 | 0.0          | 0.351168  | 0.333333     | 0.0          |   |
| ...  | ...      | ...      | ...          | ...       | ...          | ...          |   |
| 1455 | 0.142038 | 0.336077 | 0.0          | 0.247362  | 0.000000     | 0.0          |   |
| 1456 | 0.399036 | 0.000000 | 0.0          | 0.327619  | 0.333333     | 0.0          |   |
| 1457 | 0.195961 | 0.557869 | 0.0          | 0.377920  | 0.000000     | 0.0          |   |
| 1458 | 0.170721 | 0.000000 | 0.0          | 0.140166  | 0.333333     | 0.0          |   |
| 1459 | 0.211565 | 0.000000 | 0.0          | 0.173700  | 0.333333     | 0.0          |   |

|      | FullBath | HalfBath | BedroomAbvGr | KitchenAbvGr | KitchenQual | \ |
|------|----------|----------|--------------|--------------|-------------|---|
| 0    | 0.666667 | 0.5      | 0.375        | 0.333333     | 0.78592     |   |
| 1    | 0.666667 | 0.0      | 0.375        | 0.333333     | 1.00000     |   |
| 2    | 0.666667 | 0.5      | 0.375        | 0.333333     | 0.78592     |   |
| 3    | 0.333333 | 0.0      | 0.375        | 0.333333     | 0.78592     |   |
| 4    | 0.666667 | 0.5      | 0.500        | 0.333333     | 0.78592     |   |
| ...  | ...      | ...      | ...          | ...          | ...         |   |
| 1455 | 0.666667 | 0.5      | 0.375        | 0.333333     | 1.00000     |   |
| 1456 | 0.666667 | 0.0      | 0.375        | 0.333333     | 1.00000     |   |
| 1457 | 0.666667 | 0.0      | 0.500        | 0.333333     | 0.78592     |   |
| 1458 | 0.333333 | 0.0      | 0.250        | 0.333333     | 0.78592     |   |
| 1459 | 0.333333 | 0.5      | 0.375        | 0.333333     | 1.00000     |   |

|      | TotRmsAbvGrd | Functional | Fireplaces | FireplaceQu | GarageType | \ |
|------|--------------|------------|------------|-------------|------------|---|
| 0    | 0.500000     | 1.000000   | 0.000000   | 1.000000    | 1.000000   |   |
| 1    | 0.333333     | 1.000000   | 0.333333   | 0.437313    | 1.000000   |   |
| 2    | 0.333333     | 1.000000   | 0.333333   | 0.437313    | 1.000000   |   |
| 3    | 0.416667     | 1.000000   | 0.333333   | 0.537313    | 0.440972   |   |
| 4    | 0.583333     | 1.000000   | 0.333333   | 0.437313    | 1.000000   |   |
| ...  | ...          | ...        | ...        | ...         | ...        |   |
| 1455 | 0.416667     | 1.000000   | 0.333333   | 0.437313    | 1.000000   |   |
| 1456 | 0.416667     | 0.022075   | 0.666667   | 0.437313    | 1.000000   |   |
| 1457 | 0.583333     | 1.000000   | 0.666667   | 0.537313    | 1.000000   |   |

|      |          |          |          |          |          |
|------|----------|----------|----------|----------|----------|
| 1458 | 0.250000 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |
| 1459 | 0.333333 | 1.000000 | 0.000000 | 1.000000 | 1.000000 |

|      | GarageYrBlt | GarageFinish | GarageCars | GarageArea | GarageQual | \ |
|------|-------------|--------------|------------|------------|------------|---|
| 0    | 0.046729    | 0.650763     | 0.50       | 0.386460   | 1.0        |   |
| 1    | 0.289720    | 0.650763     | 0.50       | 0.324401   | 1.0        |   |
| 2    | 0.065421    | 0.650763     | 0.50       | 0.428773   | 1.0        |   |
| 3    | 0.074766    | 1.000000     | 0.75       | 0.452750   | 1.0        |   |
| 4    | 0.074766    | 0.650763     | 0.75       | 0.589563   | 1.0        |   |
| ...  | ...         | ...          | ...        | ...        | ...        |   |
| 1455 | 0.074766    | 0.650763     | 0.50       | 0.324401   | 1.0        |   |
| 1456 | 0.299065    | 1.000000     | 0.50       | 0.352609   | 1.0        |   |
| 1457 | 0.644860    | 0.650763     | 0.25       | 0.177715   | 1.0        |   |
| 1458 | 0.560748    | 1.000000     | 0.25       | 0.169252   | 1.0        |   |
| 1459 | 0.401869    | 0.517176     | 0.25       | 0.194640   | 1.0        |   |

|      | GarageCond | PavedDrive | WoodDeckSF | OpenPorchSF | EnclosedPorch | \ |
|------|------------|------------|------------|-------------|---------------|---|
| 0    | 1.0        | 1.0        | 0.000000   | 0.111517    | 0.000000      |   |
| 1    | 1.0        | 1.0        | 0.347725   | 0.000000    | 0.000000      |   |
| 2    | 1.0        | 1.0        | 0.000000   | 0.076782    | 0.000000      |   |
| 3    | 1.0        | 1.0        | 0.000000   | 0.063985    | 0.492754      |   |
| 4    | 1.0        | 1.0        | 0.224037   | 0.153565    | 0.000000      |   |
| ...  | ...        | ...        | ...        | ...         | ...           |   |
| 1455 | 1.0        | 1.0        | 0.000000   | 0.073126    | 0.000000      |   |
| 1456 | 1.0        | 1.0        | 0.407235   | 0.000000    | 0.000000      |   |
| 1457 | 1.0        | 1.0        | 0.000000   | 0.109689    | 0.000000      |   |
| 1458 | 1.0        | 1.0        | 0.427071   | 0.000000    | 0.202899      |   |
| 1459 | 1.0        | 1.0        | 0.858810   | 0.124314    | 0.000000      |   |

|      | 3SsnPorch | ScreenPorch | PoolArea | PoolQC | Fence    | MiscFeature | \ |
|------|-----------|-------------|----------|--------|----------|-------------|---|
| 0    | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 1    | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 2    | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 3    | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 4    | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| ...  | ...       | ...         | ...      | ...    | ...      | ...         |   |
| 1455 | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 1456 | 0.0       | 0.0         | 0.0      | 1.0    | 0.125000 | 1.000000    |   |
| 1457 | 0.0       | 0.0         | 0.0      | 1.0    | 0.041096 | 0.034164    |   |
| 1458 | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |
| 1459 | 0.0       | 0.0         | 0.0      | 1.0    | 1.000000 | 1.000000    |   |

|   | MiscVal | MoSold   | YrSold | SaleType | SaleCondition |
|---|---------|----------|--------|----------|---------------|
| 0 | 0.00000 | 0.090909 | 0.50   | 1.0      | 1.00000       |
| 1 | 0.00000 | 0.363636 | 0.25   | 1.0      | 1.00000       |
| 2 | 0.00000 | 0.727273 | 0.50   | 1.0      | 1.00000       |
| 3 | 0.00000 | 0.090909 | 0.00   | 1.0      | 0.08124       |

|      |         |          |      |     |         |
|------|---------|----------|------|-----|---------|
| 4    | 0.00000 | 1.000000 | 0.50 | 1.0 | 1.00000 |
| ...  | ...     | ...      | ...  | ... | ...     |
| 1455 | 0.00000 | 0.636364 | 0.25 | 1.0 | 1.00000 |
| 1456 | 0.00000 | 0.090909 | 1.00 | 1.0 | 1.00000 |
| 1457 | 0.16129 | 0.363636 | 1.00 | 1.0 | 1.00000 |
| 1458 | 0.00000 | 0.272727 | 1.00 | 1.0 | 1.00000 |
| 1459 | 0.00000 | 0.454545 | 0.50 | 1.0 | 1.00000 |

[1460 rows x 79 columns]

```
[12]: df3=df[['Id','SalePrice']]
x_data=pd.concat([df['Id'],df2],axis=1)
x_data.head()
```

```
[12]:
```

|   | Id | MSSubClass | MSZoning | LotFrontage | LotArea  | Street | Alley | LotShape | \ |
|---|----|------------|----------|-------------|----------|--------|-------|----------|---|
| 0 | 1  | 0.235294   | 1.0      | 0.150685    | 0.033420 | 1.0    | 1.0   | 1.000000 |   |
| 1 | 2  | 0.000000   | 1.0      | 0.202055    | 0.038795 | 1.0    | 1.0   | 1.000000 |   |
| 2 | 3  | 0.235294   | 1.0      | 0.160959    | 0.046507 | 1.0    | 1.0   | 0.518033 |   |
| 3 | 4  | 0.294118   | 1.0      | 0.133562    | 0.038561 | 1.0    | 1.0   | 0.518033 |   |
| 4 | 5  | 0.235294   | 1.0      | 0.215753    | 0.060576 | 1.0    | 1.0   | 0.518033 |   |

|   | LandContour | Utilities | LotConfig | LandSlope | Neighborhood | Condition1 | \ |
|---|-------------|-----------|-----------|-----------|--------------|------------|---|
| 0 | 1.0         | 1.0       | 1.000000  | 1.0       | 0.663677     | 1.000000   |   |
| 1 | 1.0         | 1.0       | 0.041031  | 1.0       | 0.040359     | 0.062798   |   |
| 2 | 1.0         | 1.0       | 1.000000  | 1.0       | 0.663677     | 1.000000   |   |
| 3 | 1.0         | 1.0       | 0.247137  | 1.0       | 0.219731     | 1.000000   |   |
| 4 | 1.0         | 1.0       | 0.041031  | 1.0       | 0.174888     | 1.000000   |   |

|   | Condition2 | BldgType | HouseStyle | OverallQual | OverallCond | YearBuilt | \ |
|---|------------|----------|------------|-------------|-------------|-----------|---|
| 0 | 1.0        | 1.0      | 0.608635   | 0.666667    | 0.500       | 0.036765  |   |
| 1 | 1.0        | 1.0      | 1.000000   | 0.555556    | 0.875       | 0.227941  |   |
| 2 | 1.0        | 1.0      | 0.608635   | 0.666667    | 0.500       | 0.051471  |   |
| 3 | 1.0        | 1.0      | 0.608635   | 0.666667    | 0.500       | 0.669118  |   |
| 4 | 1.0        | 1.0      | 0.608635   | 0.777778    | 0.500       | 0.058824  |   |

|   | YearRemodAdd | RoofStyle | RoofMatl | Exterior1st | Exterior2nd | MasVnrType | \ |
|---|--------------|-----------|----------|-------------|-------------|------------|---|
| 0 | 0.098361     | 1.0       | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |
| 1 | 0.524590     | 1.0       | 1.0      | 0.426070    | 0.423459    | 1.000000   |   |
| 2 | 0.114754     | 1.0       | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |
| 3 | 0.606557     | 1.0       | 1.0      | 0.398833    | 0.073559    | 1.000000   |   |
| 4 | 0.147541     | 1.0       | 1.0      | 1.000000    | 1.000000    | 0.510514   |   |

|   | MasVnrArea | ExterQual | ExterCond | Foundation | BsmtQual | BsmtCond | \ |
|---|------------|-----------|-----------|------------|----------|----------|---|
| 0 | 0.12250    | 0.53139   | 1.0       | 1.000000   | 0.949511 | 1.000000 |   |
| 1 | 0.00000    | 1.00000   | 1.0       | 0.979814   | 0.949511 | 1.000000 |   |
| 2 | 0.10125    | 0.53139   | 1.0       | 1.000000   | 0.949511 | 1.000000 |   |
| 3 | 0.00000    | 1.00000   | 1.0       | 0.222050   | 1.000000 | 0.048128 |   |

|   |         |         |     |          |          |          |
|---|---------|---------|-----|----------|----------|----------|
| 4 | 0.21875 | 0.53139 | 1.0 | 1.000000 | 0.949511 | 1.000000 |
|---|---------|---------|-----|----------|----------|----------|

|   | BsmtExposure | BsmtFinType1 | BsmtFinSF1 | BsmtFinType2 | BsmtFinSF2 | \ |
|---|--------------|--------------|------------|--------------|------------|---|
| 0 | 1.000000     | 0.969466     | 0.125089   | 1.0          | 0.0        |   |
| 1 | 0.104918     | 0.465649     | 0.173281   | 1.0          | 0.0        |   |
| 2 | 0.083060     | 0.969466     | 0.086109   | 1.0          | 0.0        |   |
| 3 | 1.000000     | 0.465649     | 0.038271   | 1.0          | 0.0        |   |
| 4 | 0.200000     | 0.969466     | 0.116052   | 1.0          | 0.0        |   |

|   | BsmtUnfSF | TotalBsmtSF | Heating | HeatingQC | CentralAir | Electrical | \ |
|---|-----------|-------------|---------|-----------|------------|------------|---|
| 0 | 0.064212  | 0.140098    | 1.0     | 1.000000  | 1.0        | 1.0        |   |
| 1 | 0.121575  | 0.206547    | 1.0     | 1.000000  | 1.0        | 1.0        |   |
| 2 | 0.185788  | 0.150573    | 1.0     | 1.000000  | 1.0        | 1.0        |   |
| 3 | 0.231164  | 0.123732    | 1.0     | 0.324324  | 1.0        | 1.0        |   |
| 4 | 0.209760  | 0.187398    | 1.0     | 1.000000  | 1.0        | 1.0        |   |

|   | 1stFlrSF | 2ndFlrSF | LowQualFinSF | GrLivArea | BsmtFullBath | BsmtHalfBath | \ |
|---|----------|----------|--------------|-----------|--------------|--------------|---|
| 0 | 0.119780 | 0.413559 | 0.0          | 0.259231  | 0.333333     | 0.0          |   |
| 1 | 0.212942 | 0.000000 | 0.0          | 0.174830  | 0.000000     | 0.5          |   |
| 2 | 0.134465 | 0.419370 | 0.0          | 0.273549  | 0.333333     | 0.0          |   |
| 3 | 0.143873 | 0.366102 | 0.0          | 0.260550  | 0.333333     | 0.0          |   |
| 4 | 0.186095 | 0.509927 | 0.0          | 0.351168  | 0.333333     | 0.0          |   |

|   | FullBath | HalfBath | BedroomAbvGr | KitchenAbvGr | KitchenQual | TotRmsAbvGrd | \ |
|---|----------|----------|--------------|--------------|-------------|--------------|---|
| 0 | 0.666667 | 0.5      | 0.375        | 0.333333     | 0.78592     | 0.500000     |   |
| 1 | 0.666667 | 0.0      | 0.375        | 0.333333     | 1.00000     | 0.333333     |   |
| 2 | 0.666667 | 0.5      | 0.375        | 0.333333     | 0.78592     | 0.333333     |   |
| 3 | 0.333333 | 0.0      | 0.375        | 0.333333     | 0.78592     | 0.416667     |   |
| 4 | 0.666667 | 0.5      | 0.500        | 0.333333     | 0.78592     | 0.583333     |   |

|   | Functional | Fireplaces | FireplaceQu | GarageType | GarageYrBlt | GarageFinish | \ |
|---|------------|------------|-------------|------------|-------------|--------------|---|
| 0 | 1.0        | 0.000000   | 1.000000    | 1.000000   | 0.046729    | 0.650763     |   |
| 1 | 1.0        | 0.333333   | 0.437313    | 1.000000   | 0.289720    | 0.650763     |   |
| 2 | 1.0        | 0.333333   | 0.437313    | 1.000000   | 0.065421    | 0.650763     |   |
| 3 | 1.0        | 0.333333   | 0.537313    | 0.440972   | 0.074766    | 1.000000     |   |
| 4 | 1.0        | 0.333333   | 0.437313    | 1.000000   | 0.074766    | 0.650763     |   |

|   | GarageCars | GarageArea | GarageQual | GarageCond | PavedDrive | WoodDeckSF | \ |
|---|------------|------------|------------|------------|------------|------------|---|
| 0 | 0.50       | 0.386460   | 1.0        | 1.0        | 1.0        | 0.000000   |   |
| 1 | 0.50       | 0.324401   | 1.0        | 1.0        | 1.0        | 0.347725   |   |
| 2 | 0.50       | 0.428773   | 1.0        | 1.0        | 1.0        | 0.000000   |   |
| 3 | 0.75       | 0.452750   | 1.0        | 1.0        | 1.0        | 0.000000   |   |
| 4 | 0.75       | 0.589563   | 1.0        | 1.0        | 1.0        | 0.224037   |   |

|   | OpenPorchSF | EnclosedPorch | 3SsnPorch | ScreenPorch | PoolArea | PoolQC | \ |
|---|-------------|---------------|-----------|-------------|----------|--------|---|
| 0 | 0.111517    | 0.000000      | 0.0       | 0.0         | 0.0      | 1.0    |   |
| 1 | 0.000000    | 0.000000      | 0.0       | 0.0         | 0.0      | 1.0    |   |

|   |          |          |     |     |     |     |
|---|----------|----------|-----|-----|-----|-----|
| 2 | 0.076782 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |
| 3 | 0.063985 | 0.492754 | 0.0 | 0.0 | 0.0 | 1.0 |
| 4 | 0.153565 | 0.000000 | 0.0 | 0.0 | 0.0 | 1.0 |

  

|   | Fence | MiscFeature | MiscVal | MoSold   | YrSold | SaleType | SaleCondition |
|---|-------|-------------|---------|----------|--------|----------|---------------|
| 0 | 1.0   | 1.0         | 0.0     | 0.090909 | 0.50   | 1.0      | 1.00000       |
| 1 | 1.0   | 1.0         | 0.0     | 0.363636 | 0.25   | 1.0      | 1.00000       |
| 2 | 1.0   | 1.0         | 0.0     | 0.727273 | 0.50   | 1.0      | 1.00000       |
| 3 | 1.0   | 1.0         | 0.0     | 0.090909 | 0.00   | 1.0      | 0.08124       |
| 4 | 1.0   | 1.0         | 0.0     | 1.000000 | 0.50   | 1.0      | 1.00000       |

```
[13]: y_data=df['SalePrice']
```

### 0.1.2 Feature Selection

#### Feature selection using Random Forest

```
[16]: X_train,X_test,Y_train,Y_test=train_test_split(x_data,y_data,test_size=0.2)
```

```
[17]: sel=SelectFromModel(RandomForestClassifier(n_estimators=10))
sel.fit(X_train,Y_train)
```

```
[17]: SelectFromModel(estimator=RandomForestClassifier(n_estimators=10))
```

```
[18]: sel.get_support()
select_features=X_train.columns[(sel.get_support())]
len(select_features)
```

```
[18]: 30
```

```
[19]: print(select_features)
```

```
Index(['Id', 'MSSubClass', 'LotFrontage', 'LotArea', 'Neighborhood',
       'OverallQual', 'OverallCond', 'YearBuilt', 'YearRemodAdd',
       'Exterior1st', 'Exterior2nd', 'MasVnrType', 'MasVnrArea',
       'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1', 'BsmtUnfSF',
       'TotalBsmtSF', '1stFlrSF', '2ndFlrSF', 'GrLivArea', 'BedroomAbvGr',
       'TotRmsAbvGrd', 'FireplaceQu', 'GarageYrBlt', 'GarageArea',
       'WoodDeckSF', 'OpenPorchSF', 'MoSold', 'YrSold'],
      dtype='object')
```

```
[20]: x_train1=X_train[select_features]
x_test1=X_test[select_features]
```

#### Using Random Forest Algorithm to deploy the model

```
[21]: from sklearn.ensemble import RandomForestRegressor
regressor=RandomForestRegressor(n_estimators=200,random_state=42)
regressor.fit(x_train1,Y_train)
```

```
[21]: RandomForestRegressor(n_estimators=200, random_state=42)
```

```
[ ]:
```

```
[22]: y_pred=regressor.predict(x_test1)
      y_pred
```

```
[22]: array([157859.5 , 157990.35 , 143567.735, 215034.685, 206662.85 ,
        228253.89 , 124774.13 , 176289.375, 140628.095, 186542.12 ,
        156779.365, 124935.54 ,  95116.11 , 157080.465,  95094.665,
        332159.83 , 151043.45 , 349179.87 , 146170.   , 131320.95 ,
        104609.57 , 126786.72 , 213400.68 , 148905.18 , 143979.15 ,
        382251.92 , 205817.4  , 226157.06 , 131811.39 , 140684.375,
        123069.985, 149004.72 , 306478.955, 134688.215, 160489.7  ,
        256906.305, 153955.845, 124693.26 , 255854.69 , 102664.97 ,
        256636.325, 336135.155, 277724.305, 112734.755,  80117.965,
        183993.28 ,  96494.185, 129038.975, 145941.99 , 174757.45 ,
        197674.55 , 176417.96 , 135508.7  , 230571.29 , 104129.195,
        112107.92 , 223306.4  , 246892.825, 268877.58 , 192034.675,
        204723.915, 117809.78 , 282504.45 , 178410.625, 160688.24 ,
        137087.27 , 220329.395, 261814.265, 178520.58 , 121381.4  ,
        86832.405, 135052.605, 212331.25 , 183535.975, 122210.18 ,
        146720.85 , 130446.275, 249074.815, 150984.25 , 274374.07 ,
        125374.58 , 106014.145, 168706.935, 185781.945, 234819.72 ,
        116315.46 , 128868.13 , 128148.885, 276280.61 ,  88722.885,
        133722.215, 307252.745,  93257.345, 113428.7  , 348252.725,
        191992.155,  98420.215, 396053.44 , 140887.535, 295860.94 ,
        213175.35 , 157084.   , 213336.4  , 147134.815, 204692.265,
        127097.   , 124236.235, 426826.65 , 121330.235, 112995.135,
        108966.195, 114856.66 , 150424.24 , 195266.785,  93821.955,
        264261.02 , 151185.305, 143770.145, 421585.94 , 179511.755,
        155633.   , 266946.405, 177571.225, 189470.125, 278613.835,
        147744.865, 182174.345, 145214.45 , 139158.25 ,  58746.74 ,
        139540.03 , 150358.345, 203876.265, 320657.835, 167520.795,
        144794.17 , 171098.72 , 149596.785, 126440.4  , 196068.175,
        349905.155, 190919.95 , 119943.875, 149273.45 , 510958.195,
        331651.47 , 203258.79 , 179721.075, 198472.75 , 182307.27 ,
        114960.485, 146902.67 , 195566.49 , 226449.135, 166102.02 ,
        250841.205, 158552.035, 141996.76 , 240985.245, 275289.85 ,
        316943.915, 313881.79 , 190392.675, 200326.17 , 156346.115,
        244208.63 ,  92002.35 , 153864.15 , 204236.485, 217441.455,
        289003.445, 143143.275, 135474.635, 219240.25 , 178622.38 ,
        163203.31 , 127540.85 , 171535.675,  80668.08 , 189192.775,
        172381.435, 205254.96 , 239280.415, 105408.095, 144323.545,
        273533.745,  95286.33 , 113844.44 , 124093.91 , 129465.74 ,
        230420.39 , 274630.435, 111971.31 , 119464.785, 126633.49 ,
        177997.475,  92499.355, 139553.105, 215974.73 , 159178.305,
```



```

84062.22 , 478516.295, 105426.69 , 390090.575, 113829.46 ,
218847.4 , 166039.71 , 136031.16 , 175325.64 , 137428.29 ,
221588.01 , 163594.785, 139186.33 , 164819.985, 142333.3 ,
164016.9 , 221882.27 , 151633.65 , 157980.85 , 129043.005,
259521.12 , 114588.95 , 94809.895, 149389.915, 113372.45 ,
195777.74 , 129571.23 , 134624.1 , 198809.595, 140443.59 ,
318693.165, 230461.17 , 119251.775, 121601.54 , 122750.52 ,
239638.3 , 194945.465, 243453.665, 195131.205, 253009.49 ,
309005.005, 170772.05 , 192607.805, 114212.26 , 139301.85 ,
99462.125, 194523.7 , 176174.375, 197208.065, 182138.385,
201238.45 , 227011.765, 189050.875, 176459.41 , 141579.825,
311609.895, 289644.84 , 154211.97 , 116654.75 , 131918.915,
158553.075, 83666.045, 114026.315, 89943.885, 113389.545,
197640.195, 174933.985, 403001.865, 190666.555, 339760.13 ,
118658.6 , 263186.18 , 135412.065, 122699.205, 217544.74 ,
104580.325, 122972.25 , 109575.605, 111860.42 , 145307.98 ,
179132.76 , 322148.785, 170505.15 , 211312.77 , 161332.715,
233446.41 , 131388.83 , 152890.265, 142519.205, 136533.235,
190287.955, 166159.085])

```

### 0.1.3 Accuracy score using different metrics

```

[23]: from sklearn.metrics import mean_absolute_error
      from sklearn.metrics import mean_squared_error
      print('mean absolute error:',mean_absolute_error(Y_test,y_pred))
      print('mean squared error:',mean_squared_error(Y_test,y_pred))

```

```

mean absolute error: 19155.878510273975
mean squared error: 1011138714.8946253

```

```

[24]: scores=cross_val_score(regressor,x_data[select_features],y_data,cv=5)
      scores

```

```

[24]: array([0.8577374 , 0.87291288, 0.87425541, 0.87836803, 0.81036536])

```

```

[ ]:

```