HOUSE PRICES ADVANCED REGRESSION TECHNIQUES

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import preprocessing
from sklearn import metrics
```

In [48]:

```
# Fix random seed for reproducibility
np.random.seed(10)
plt.rcParams["figure.figsize"]=(10,5)
```

IMPORT DATA

In [51]:

```
# Train Data
train=pd.read_csv("C:/Users/Me/Desktop/Data Science/Houses/house-prices-advanced-regression-techni
ques/train.csv")
```

In [3]:

```
#Test Data
test=pd.read_csv("C:/Users/Me/Desktop/Data Science/Houses/house-prices-advanced-regression-techniq
ues/test.csv")
```

In [4]:

```
#DATA SHAPE
```

In [5]:

```
train.shape
```

Out[5]:

```
(1460, 81)
```

In [6]:

```
test.shape
```

Out[6]:

```
(1459, 80)
```

In [7]:

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1460 entries, 0 to 1459
Data columns (total 81 columns):
Id               1460 non-null int64
MSSubClass       1460 non-null int64
MSZoning         1460 non-null object
LotFrontage      1201 non-null float64
LotArea          1460 non-null int64
Street           1460 non-null object
Alley            91 non-null object
```

```
LotShape         1460 non-null object
LandContour      1460 non-null object
Utilities        1460 non-null object
LotConfig        1460 non-null object
LandSlope        1460 non-null object
Neighborhood     1460 non-null object
Condition1       1460 non-null object
Condition2       1460 non-null object
BldgType         1460 non-null object
HouseStyle       1460 non-null object
OverallQual      1460 non-null int64
OverallCond      1460 non-null int64
YearBuilt        1460 non-null int64
YearRemodAdd     1460 non-null int64
RoofStyle        1460 non-null object
RoofMatl         1460 non-null object
Exterior1st      1460 non-null object
Exterior2nd      1460 non-null object
MasVnrType       1452 non-null object
MasVnrArea       1452 non-null float64
ExterQual        1460 non-null object
ExterCond        1460 non-null object
Foundation       1460 non-null object
BsmtQual         1423 non-null object
BsmtCond         1423 non-null object
BsmtExposure     1422 non-null object
BsmtFinType1     1423 non-null object
BsmtFinSF1       1460 non-null int64
BsmtFinType2     1422 non-null object
BsmtFinSF2       1460 non-null int64
BsmtUnfSF        1460 non-null int64
TotalBsmtSF      1460 non-null int64
Heating          1460 non-null object
HeatingQC        1460 non-null object
CentralAir       1460 non-null object
Electrical       1459 non-null object
1stFlrSF         1460 non-null int64
2ndFlrSF         1460 non-null int64
LowQualFinSF     1460 non-null int64
GrLivArea        1460 non-null int64
BsmtFullBath     1460 non-null int64
BsmtHalfBath     1460 non-null int64
FullBath         1460 non-null int64
HalfBath         1460 non-null int64
BedroomAbvGr     1460 non-null int64
KitchenAbvGr     1460 non-null int64
KitchenQual      1460 non-null object
TotRmsAbvGrd     1460 non-null int64
Functional       1460 non-null object
Fireplaces       1460 non-null int64
FireplaceQu      770 non-null object
GarageType       1379 non-null object
GarageYrBlt      1379 non-null float64
GarageFinish     1379 non-null object
GarageCars       1460 non-null int64
GarageArea       1460 non-null int64
GarageQual       1379 non-null object
GarageCond       1379 non-null object
PavedDrive       1460 non-null object
WoodDeckSF       1460 non-null int64
OpenPorchSF      1460 non-null int64
EnclosedPorch    1460 non-null int64
3SsnPorch        1460 non-null int64
ScreenPorch      1460 non-null int64
PoolArea         1460 non-null int64
PoolQC           7 non-null object
Fence            281 non-null object
MiscFeature      54 non-null object
MiscVal          1460 non-null int64
MoSold           1460 non-null int64
YrSold           1460 non-null int64
SaleType         1460 non-null object
SaleCondition    1460 non-null object
SalePrice        1460 non-null int64
dtypes: float64(3), int64(35), object(43)
memory usage: 924.0+ KB
```

In [8]:

```
# MISSING VALUES
```

In [9]:

```
train.isnull().sum()
```

Out[9]:

```
Id                0
MSSubClass        0
MSZoning          0
LotFrontage     259
LotArea           0
                 ...
MoSold            0
YrSold            0
SaleType          0
SaleCondition     0
SalePrice         0
Length: 81, dtype: int64
```

In [10]:

```
test.isnull().sum()
```

Out[10]:

```
Id                0
MSSubClass        0
MSZoning          4
LotFrontage     227
LotArea           0
                 ...
MiscVal           0
MoSold            0
YrSold            0
SaleType          1
SaleCondition     0
Length: 80, dtype: int64
```

#Fill NA values

In [52]:

```
train.fillna(method="bfill", inplace=True)
test.fillna(method="bfill", inplace=True)
```

In [55]:

```
train.fillna(method="ffill", inplace=True)
test.fillna(method="ffill", inplace=True)
```

In [57]:

```
#Check remaining NA values
train.info()
```

Out[57]:

```
Id              0
MSSubClass      0
MSZoning        0
LotFrontage     0
LotArea         0
                ..
MoSold          0
YrSold          0
SaleType        0
SaleCondition   0
```

```
SalePrice        0
Length: 81, dtype: int64
```

In [ ]:

```
```

TOP 6 OF DATA

In [13]:

```
train.head()
```

Out[13]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	PoolArea	PoolQC	Fence	M
0	1	60	RL	65.0	8450	Pave	Grvl	Reg	Lvl	AllPub	...	0	Ex	MnPrv	
1	2	20	RL	80.0	9600	Pave	Grvl	Reg	Lvl	AllPub	...	0	Ex	MnPrv	
2	3	60	RL	68.0	11250	Pave	Grvl	IR1	Lvl	AllPub	...	0	Ex	MnPrv	
3	4	70	RL	60.0	9550	Pave	Grvl	IR1	Lvl	AllPub	...	0	Ex	MnPrv	
4	5	60	RL	84.0	14260	Pave	Grvl	IR1	Lvl	AllPub	...	0	Ex	MnPrv	

5 rows × 81 columns

In [14]:

```
test.head()
```

Out[14]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	ScreenPorch	PoolArea	P
0	1461	20	RH	80.0	11622	Pave	Pave	Reg	Lvl	AllPub	...	120	0	
1	1462	20	RL	81.0	14267	Pave	Pave	IR1	Lvl	AllPub	...	0	0	
2	1463	60	RL	74.0	13830	Pave	Pave	IR1	Lvl	AllPub	...	0	0	
3	1464	60	RL	78.0	9978	Pave	Pave	IR1	Lvl	AllPub	...	0	0	
4	1465	120	RL	43.0	5005	Pave	Pave	IR1	HLS	AllPub	...	144	0	

5 rows × 80 columns

In [15]:

```
# COLUMNS IN THE DATA
train.columns
```

Out[15]:

```
Index(['Id', 'MSSubClass', 'MSZoning', 'LotFrontage', 'LotArea', 'Street',
       'Alley', 'LotShape', 'LandContour', 'Utilities', 'LotConfig',
       'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType',
       'HouseStyle', 'OverallQual', 'OverallCond', 'YearBuilt', 'YearRemodAdd',
       'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType',
       'MasVnrArea', 'ExterQual', 'ExterCond', 'Foundation', 'BsmtQual',
       'BsmtCond', 'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1',
       'BsmtFinType2', 'BsmtFinSF2', 'BsmtUnfSF', 'TotalBsmtSF', 'Heating',
       'HeatingQC', 'CentralAir', 'Electrical', '1stFlrSF', '2ndFlrSF',
       'LowQualFinSF', 'GrLivArea', 'BsmtFullBath', 'BsmtHalfBath', 'FullBath',
       'HalfBath', 'BedroomAbvGr', 'KitchenAbvGr', 'KitchenQual',
       'TotRmsAbvGrd', 'Functional', 'Fireplaces', 'FireplaceQu', 'GarageType',
       'GarageYrBlt', 'GarageFinish', 'GarageCars', 'GarageArea', 'GarageQual',
       'GarageCond', 'PavedDrive', 'WoodDeckSF', 'OpenPorchSF',
       'EnclosedPorch', '3SsnPorch', 'ScreenPorch', 'PoolArea', 'PoolQC',
       'Fence', 'MiscFeature', 'MiscVal', 'MoSold', 'YrSold', 'SaleType',
       'SaleCondition', 'SalePrice'],
      dtype='object')
```

In [ ]:

```
```

Encoding

In [16]:

```
label_encode=preprocessing.LabelEncoder()
```

In [17]:

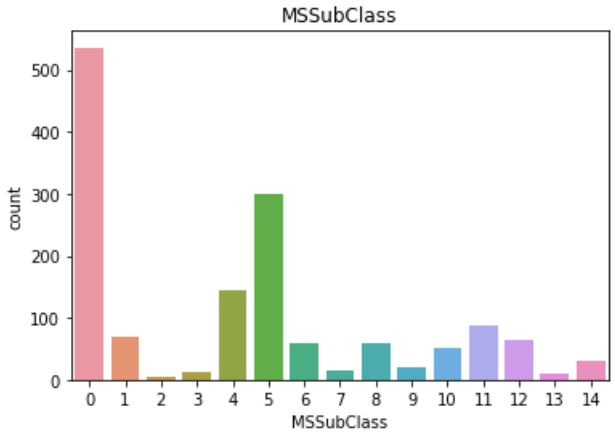
```
columns=['MSSubClass','MSZoning','Street','Alley', 'LotShape', 'LandContour',
'Utilities','LotConfig',
           'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType','HouseStyle','Overal
lQual',
            'OverallCond','RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd','MasVnrType','Exter
Qual',
            'ExterCond', 'Foundation', 'BsmtQual','BsmtCond', 'BsmtExposure', 'BsmtFinType1','BsmtF
inType2',
            'Heating','HeatingQC', 'CentralAir', 'Electrical', 'KitchenQual','Functional','Fireplac
eQu', 'GarageType',
            'GarageFinish','GarageQual','GarageCond','PavedDrive','PoolQC','Fence', 'MiscFeature','
SaleType','SaleCondition']
```

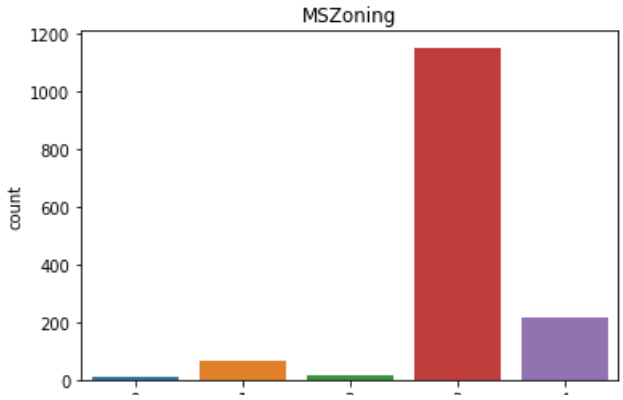
In [24]:

```
# Changing data type to category
for i in columns:
    train[i]=train[i].astype("category")
    test[i]=test[i].astype("category")
```

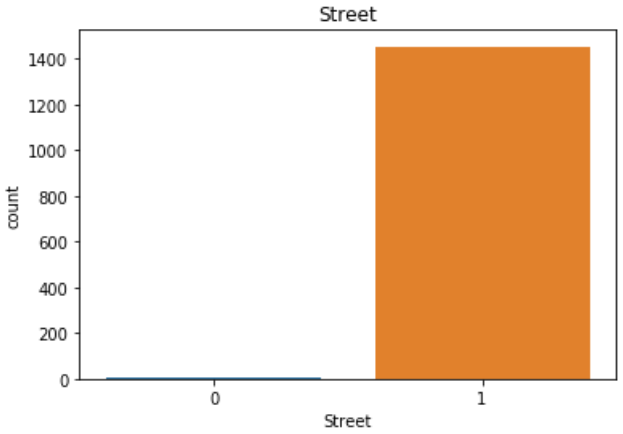
In [31]:

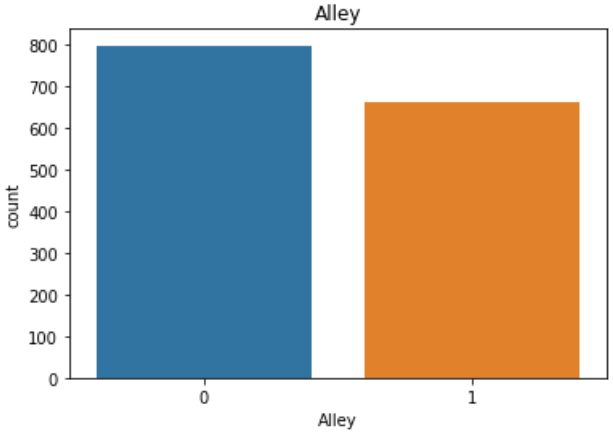
```
# Counting and plotting counts of attributes
for i in columns:
    plt.title(i)
    sns.countplot(i,data=train)
    plt.show()
```

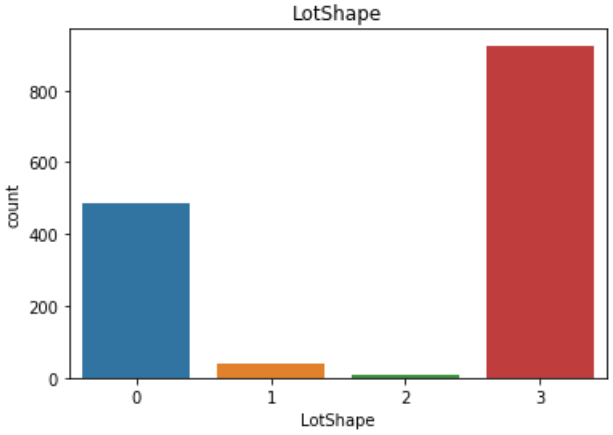


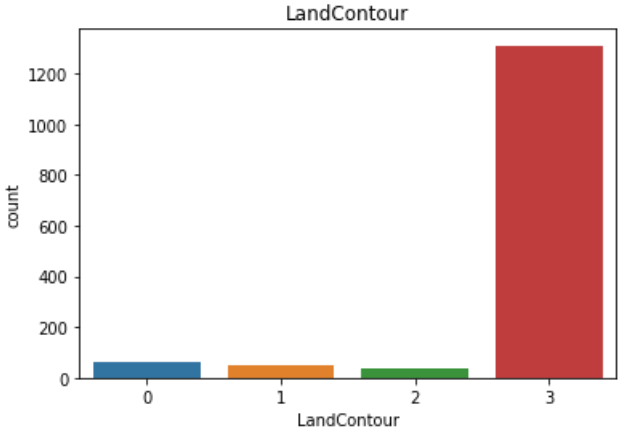


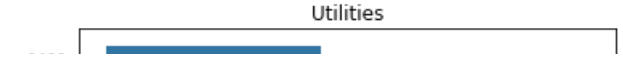

0
1
2
3
4
MSZoning

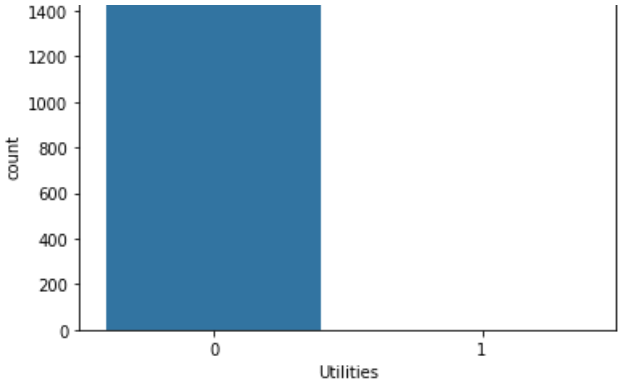

Street
1400
1200
1000
800
600
400
200
0
count
0
1
Street

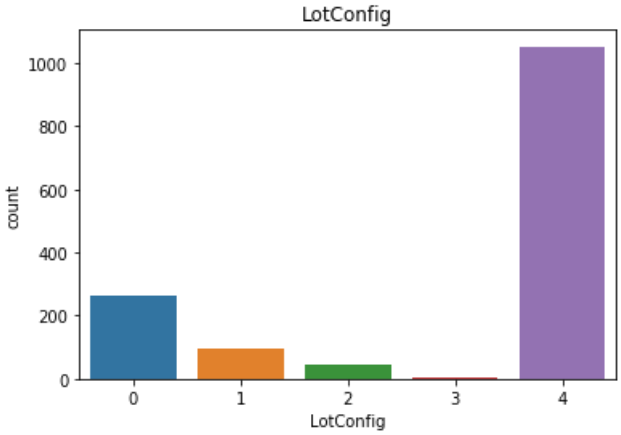

Alley
800
700
600
500
400
300
200
100
0
count
0
1
Alley

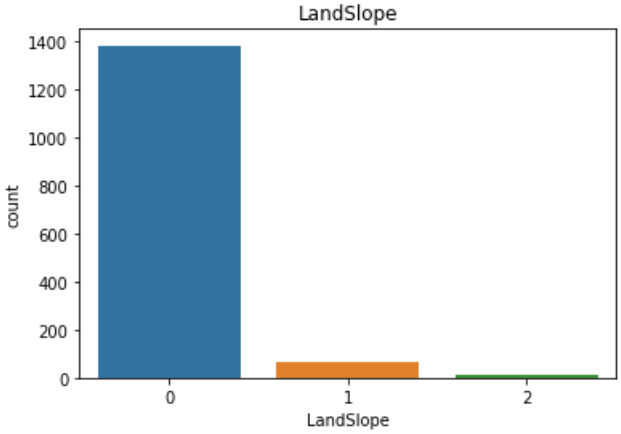

LotShape
800
600
400
200
0
count
0
1
2
3
LotShape

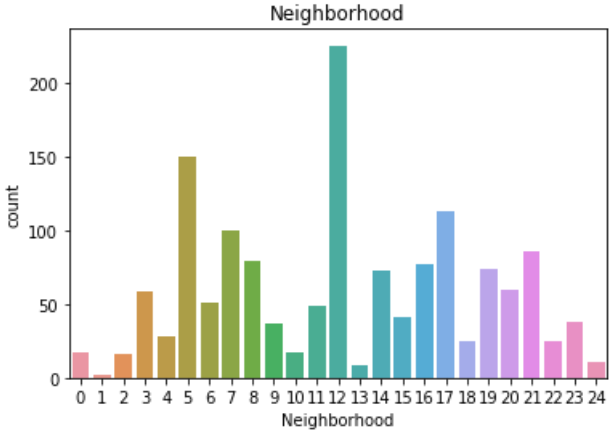

LandContour
1200
1000
800
600
400
200
0
count
0
1
2
3
LandContour


Utilities

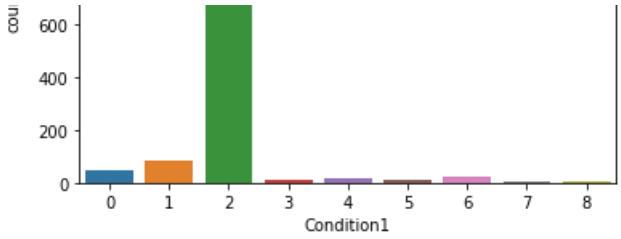

count
Utilities

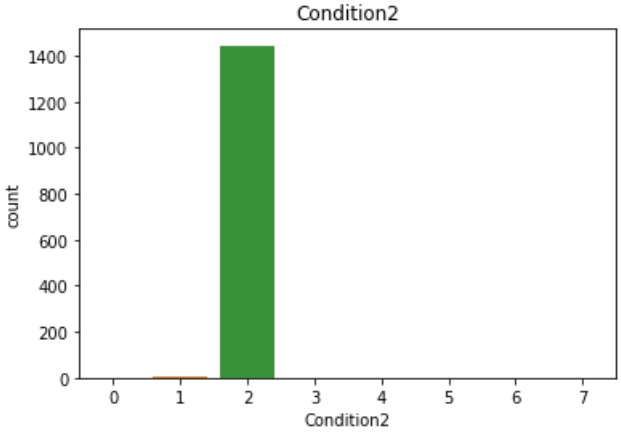

LotConfig
count
LotConfig

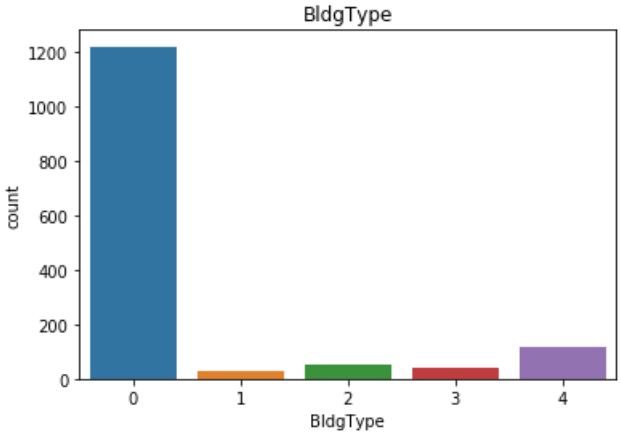

LandSlope
count
LandSlope

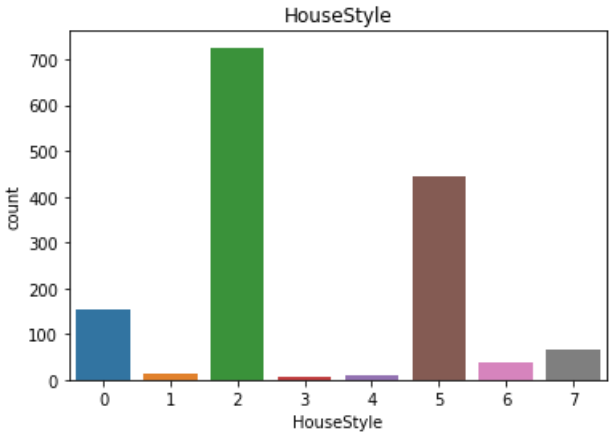

Neighborhood
count
Neighborhood

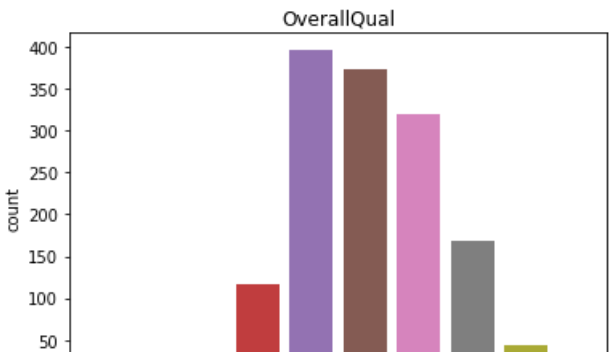

Condition1

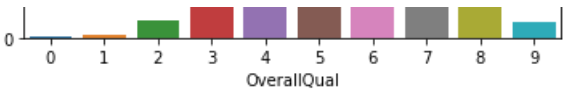

cou
600
400
200
0
0 1 2 3 4 5 6 7 8
Condition1

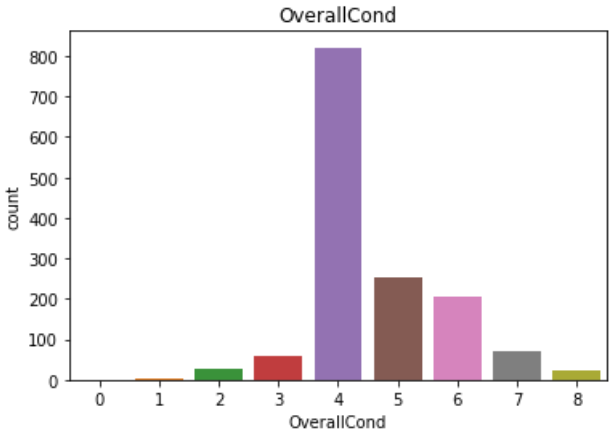

Condition2
count
1400
1200
1000
800
600
400
200
0
0 1 2 3 4 5 6 7
Condition2

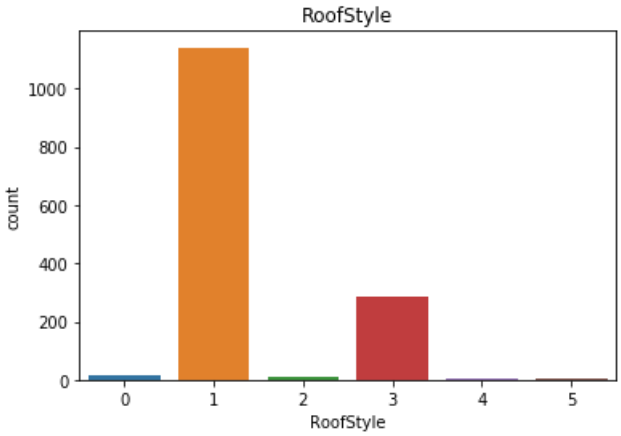

BldgType
count
1200
1000
800
600
400
200
0
0 1 2 3 4
BldgType

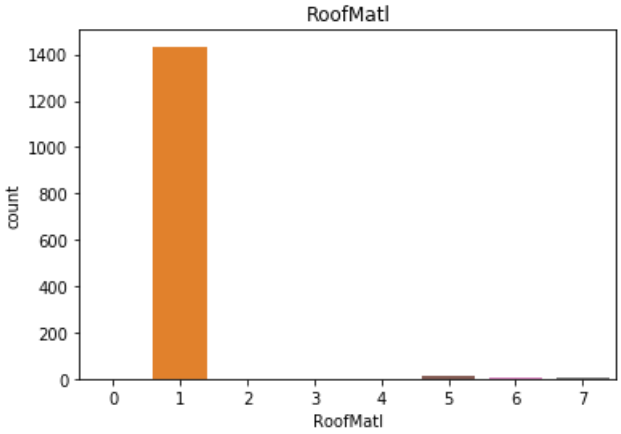

HouseStyle
count
700
600
500
400
300
200
100
0
0 1 2 3 4 5 6 7
HouseStyle

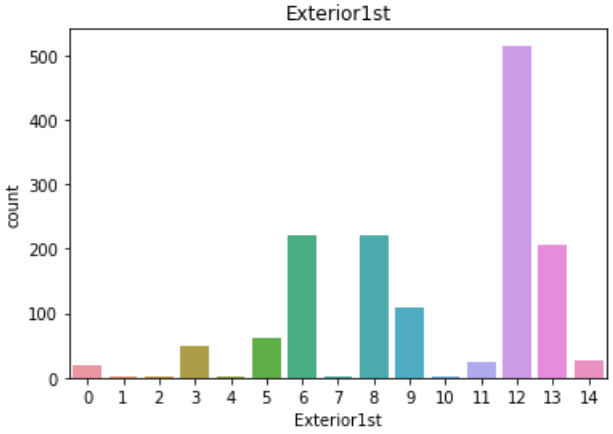

OverallQual
count
400
350
300
250
200
150
100
50

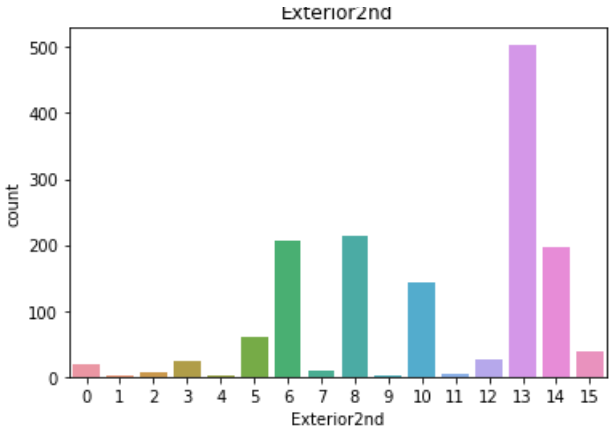

0
0 1 2 3 4 5 6 7 8 9
OverallQual

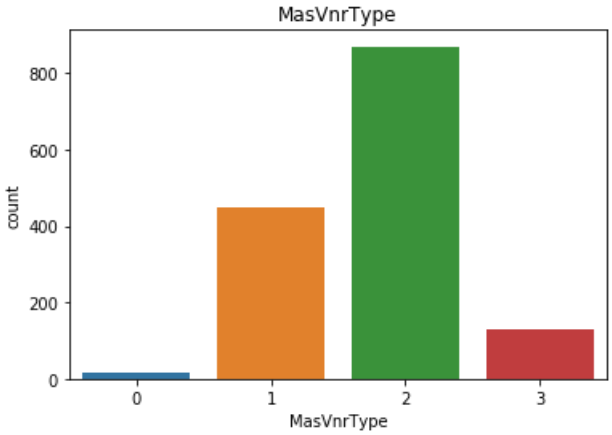

OverallCond
count
800
700
600
500
400
300
200
100
0
0 1 2 3 4 5 6 7 8
OverallCond

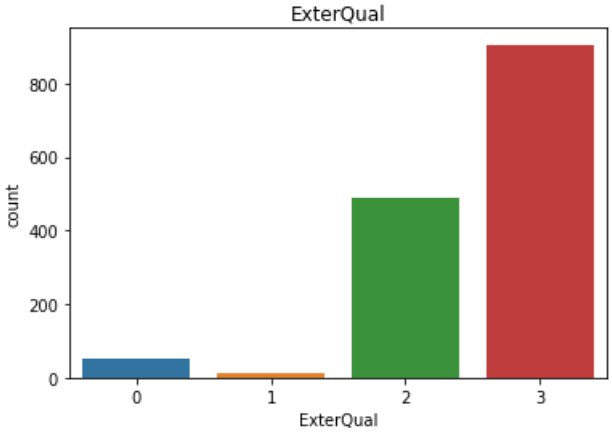

RoofStyle
count
1000
800
600
400
200
0
0 1 2 3 4 5
RoofStyle

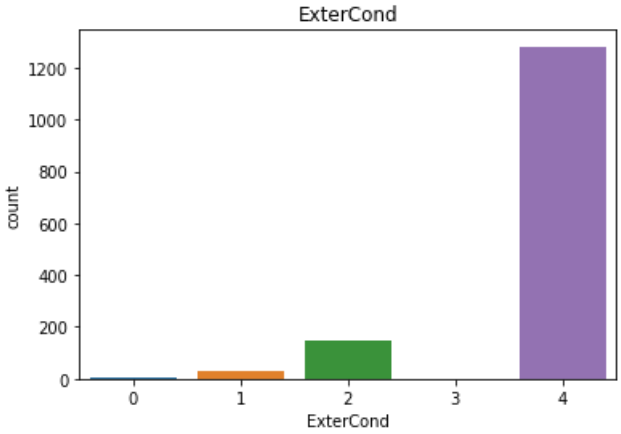

RoofMatl
count
1400
1200
1000
800
600
400
200
0
0 1 2 3 4 5 6 7
RoofMatl


Exterior1st
count
500
400
300
200
100
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Exterior1st

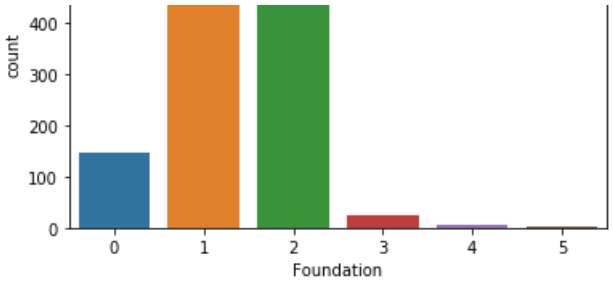

Exterior2nd
count
Exterior2nd

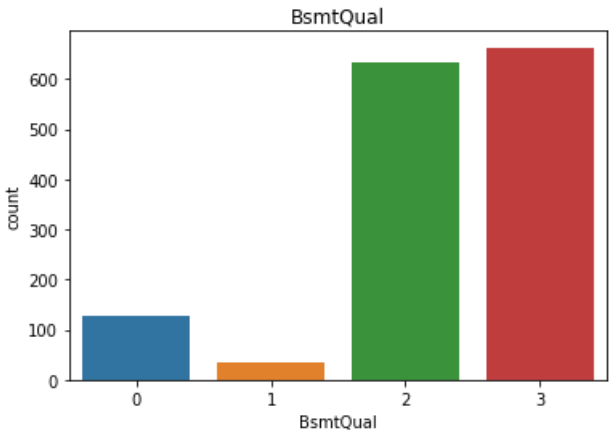

MasVnrType
count
MasVnrType

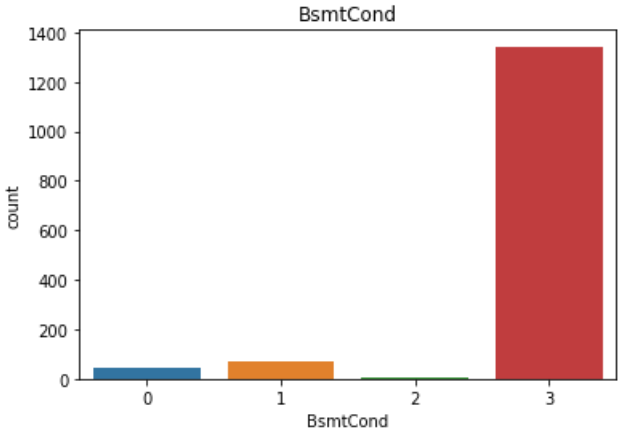

ExterQual
count
ExterQual

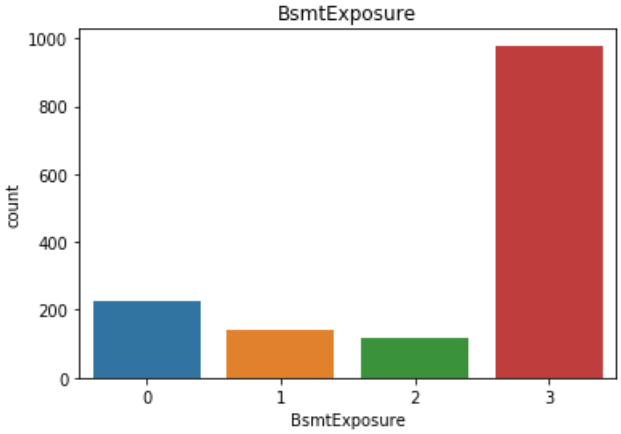

ExterCond
count
ExterCond

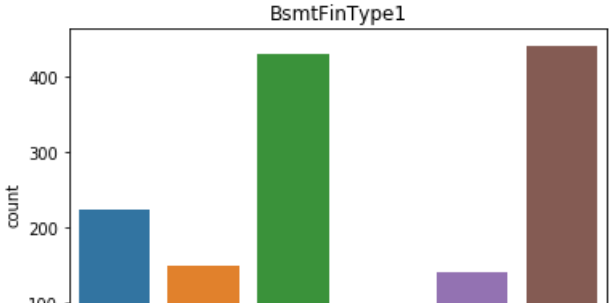

Foundation

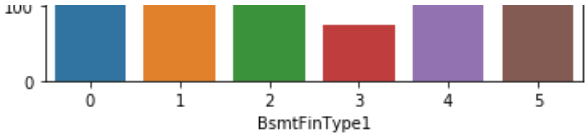

count
400
300
200
100
0
0
1
2
3
4
5
Foundation

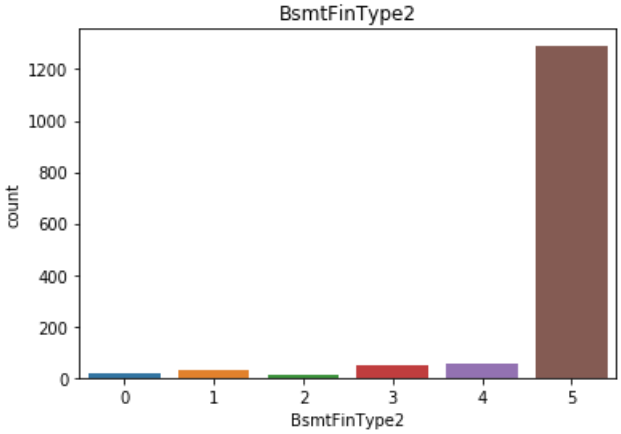

BsmtQual
count
600
500
400
300
200
100
0
0
1
2
3
BsmtQual

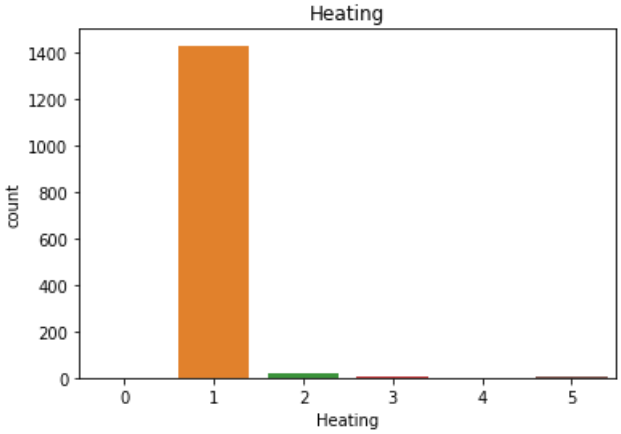

BsmtCond
count
1400
1200
1000
800
600
400
200
0
0
1
2
3
BsmtCond

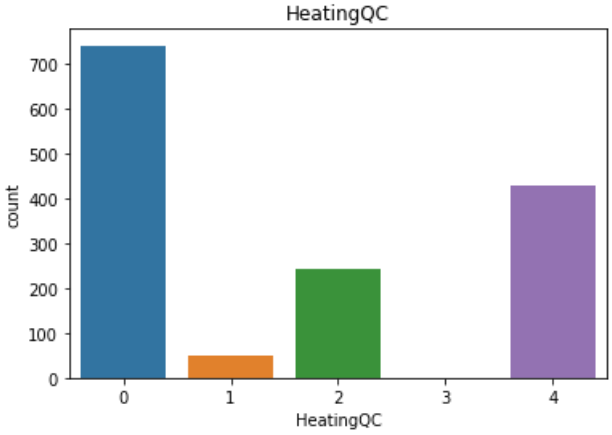

BsmtExposure
count
1000
800
600
400
200
0
0
1
2
3
BsmtExposure

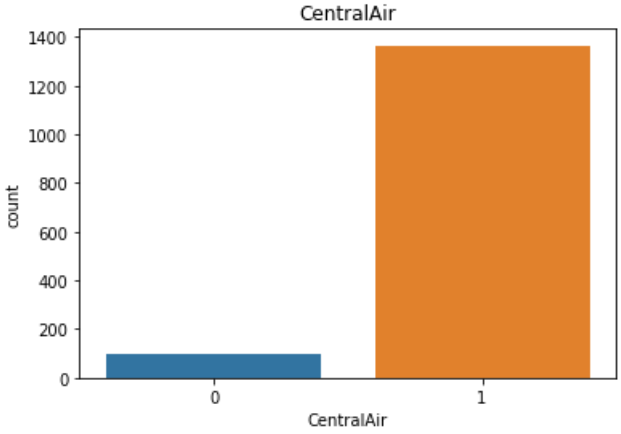

BsmtFinType1
count
400
300
200

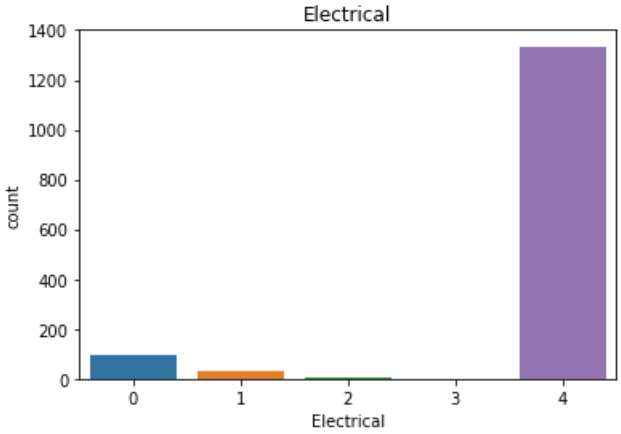

0
1
2
3
4
5
BsmtFinType1

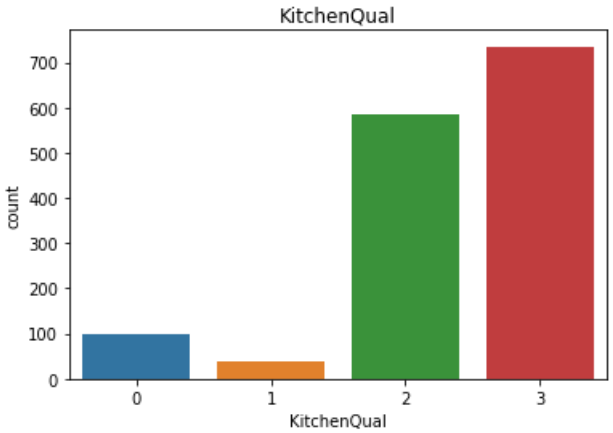

BsmtFinType2
count
0
200
400
600
800
1000
1200
0
1
2
3
4
5
BsmtFinType2

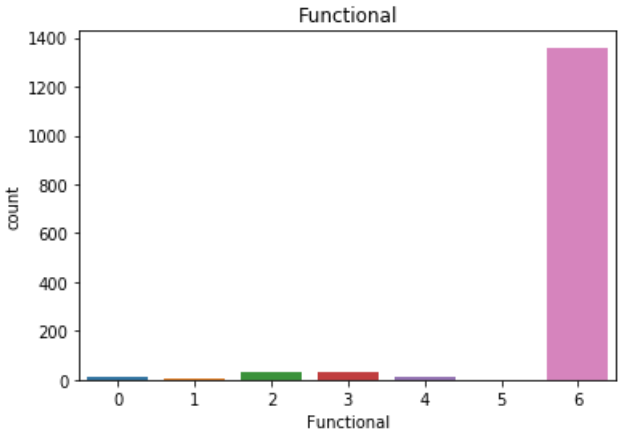

Heating
count
0
200
400
600
800
1000
1200
1400
0
1
2
3
4
5
Heating

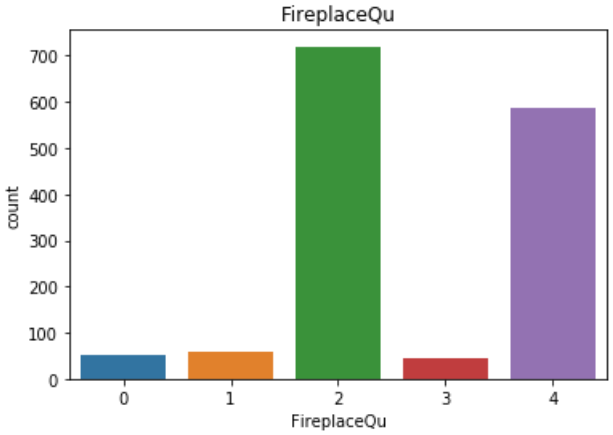

HeatingQC
count
0
100
200
300
400
500
600
700
0
1
2
3
4
HeatingQC

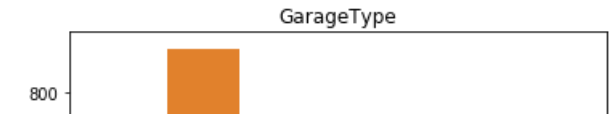

CentralAir
count
0
200
400
600
800
1000
1200
1400
0
1
CentralAir

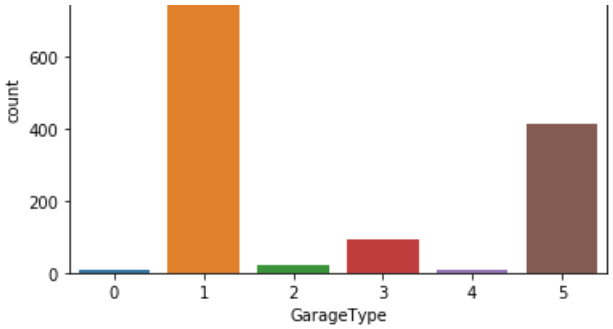

Electrical
count
Electrical

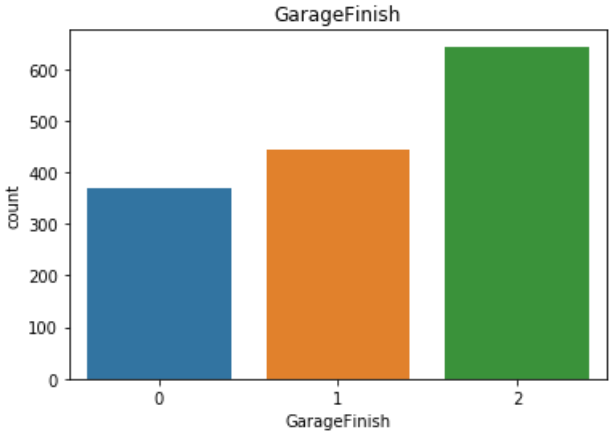

KitchenQual
count
KitchenQual

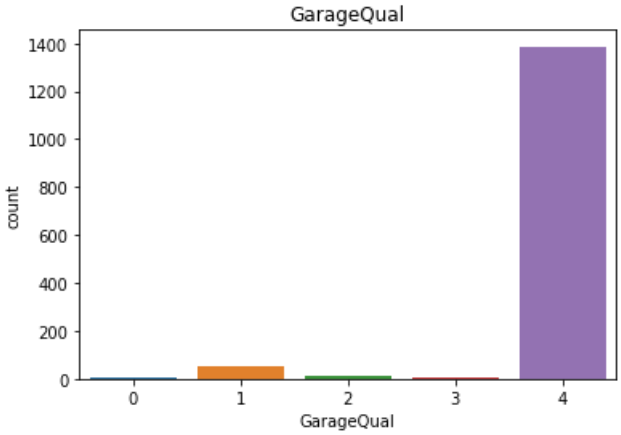

Functional
count
Functional

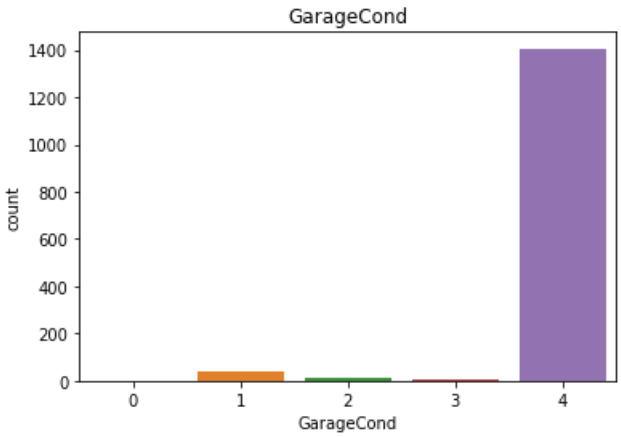

FireplaceQu
count
FireplaceQu

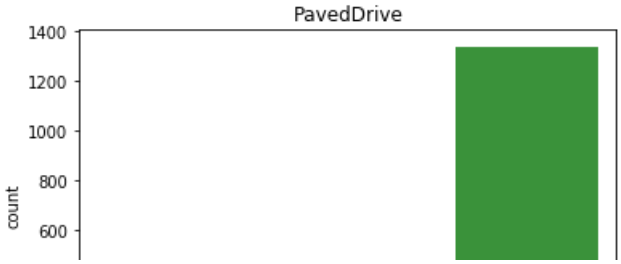

GarageType

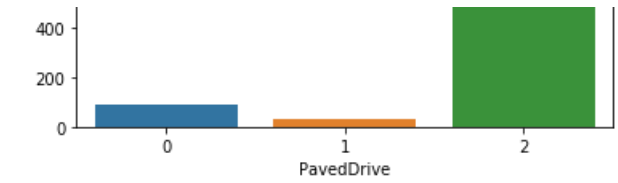

count
600
400
200
0
0
1
2
3
4
5
GarageType

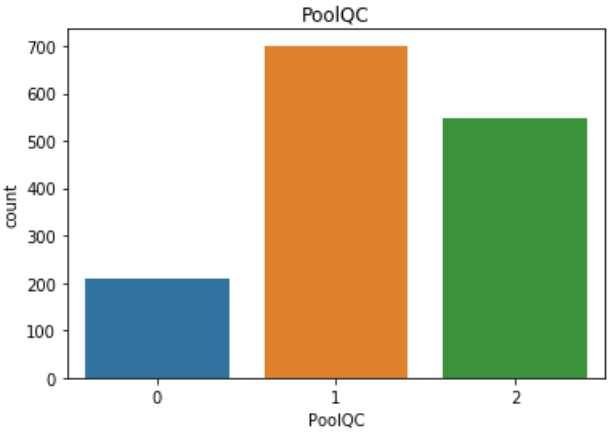

GarageFinish
count
600
500
400
300
200
100
0
0
1
2
GarageFinish

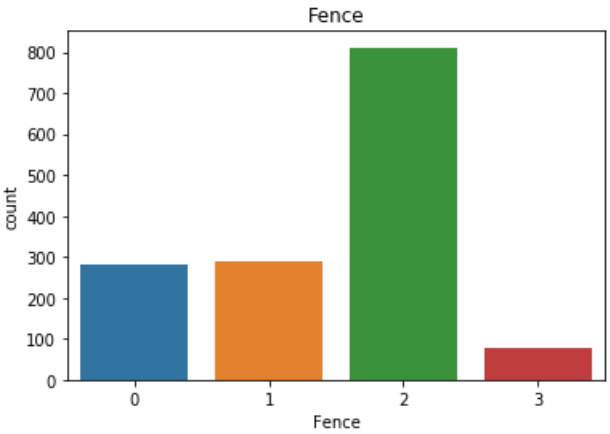

GarageQual
count
1400
1200
1000
800
600
400
200
0
0
1
2
3
4
GarageQual

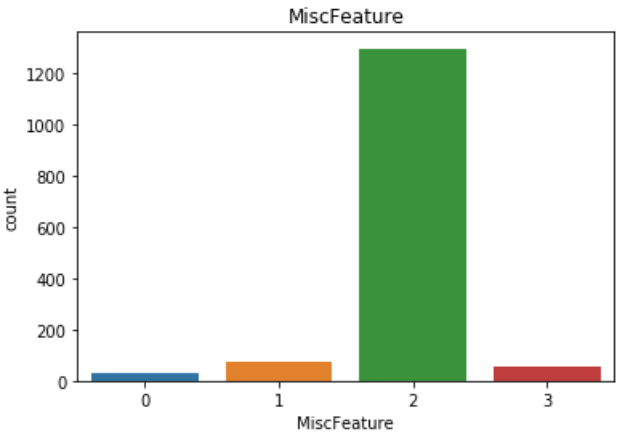

GarageCond
count
1400
1200
1000
800
600
400
200
0
0
1
2
3
4
GarageCond

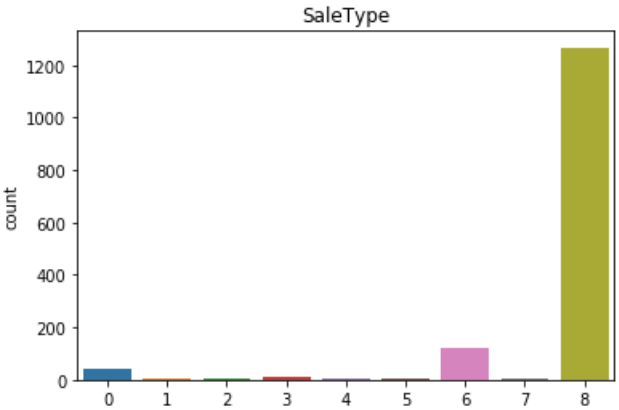

PavedDrive
count
1400
1200
1000
800
600

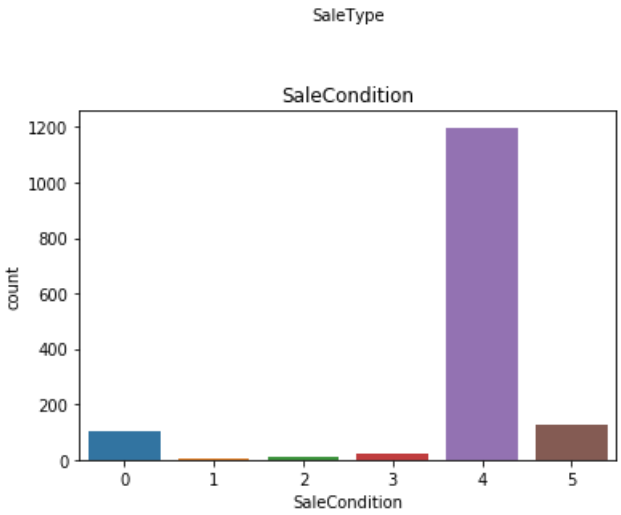

400
200
0
0
1
2
PavedDrive


PoolQC
700
600
500
400
300
200
100
0
count
0
1
2
PoolQC


Fence
800
700
600
500
400
300
200
100
0
count
0
1
2
3
Fence


MiscFeature
1200
1000
800
600
400
200
0
count
0
1
2
3
MiscFeature


SaleType
1200
1000
800
600
400
200
0
count
0
1
2
3
4
5
6
7
8



In [25]:

```
# Label encoding for test and train data
for i in columns:
    train[i]=label_encode.fit_transform(train[i])
    test[i]=label_encode.fit_transform(test[i])
```

In [26]:

```
train
```

Out[26]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	PoolArea	PoolQC	Fe
0	1	5	3	65.0	8450	1	0	3	3	0	...	0	0	
1	2	0	3	80.0	9600	1	0	3	3	0	...	0	0	
2	3	5	3	68.0	11250	1	0	0	3	0	...	0	0	
3	4	6	3	60.0	9550	1	0	0	3	0	...	0	0	
4	5	5	3	84.0	14260	1	0	0	3	0	...	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
1455	1456	5	3	62.0	7917	1	1	3	3	0	...	0	2	
1456	1457	0	3	85.0	13175	1	1	3	3	0	...	0	2	
1457	1458	6	3	66.0	9042	1	1	3	3	0	...	0	2	
1458	1459	0	3	68.0	9717	1	1	3	3	0	...	0	2	
1459	1460	0	3	75.0	9937	1	1	3	3	0	...	0	2	

1460 rows × 81 columns

In [27]:

```
test
```

Out[27]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	ScreenPorch	PoolArea
0	1461	0	2	80.0	11622	1	1	3	3	0	...	120	0
1	1462	0	3	81.0	14267	1	1	0	3	0	...	0	0
2	1463	5	3	74.0	13830	1	1	0	3	0	...	0	0
3	1464	5	3	78.0	9978	1	1	0	3	0	...	0	0
4	1465	11	3	43.0	5005	1	1	0	1	0	...	144	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
1454	2915	13	4	21.0	1936	1	0	3	3	0	...	0	0

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	ScreenPorch	PoolArea
1455	2916	13	4	21.0	1894	1	0	3	3	0	...	0	0
1456	2917	0	3	160.0	20000	1	0	3	3	0	...	0	0
1457	2918	9	3	62.0	10441	1	0	3	3	0	...	0	0
1458	2919	5	3	74.0	9627	1	0	3	3	0	...	0	0

1459 rows × 80 columns

Descriptive Statistics

In [28]:

```
train.describe()
```

Out[28]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	
count	1460.000000	1460.000000	1460.000000	1460.000000	1460.000000	1460.000000	1460.000000	1460.000000	1460.000000	1460
mean	730.500000	4.166438	3.028767	70.306164	10516.828082	0.995890	0.453425	1.942466	2.777397	0
std	421.610009	4.161951	0.632017	23.945565	9981.264932	0.063996	0.497997	1.409156	0.707666	0
min	1.000000	0.000000	0.000000	21.000000	1300.000000	0.000000	0.000000	0.000000	0.000000	0
25%	365.750000	0.000000	3.000000	59.000000	7553.500000	1.000000	0.000000	0.000000	3.000000	0
50%	730.500000	4.000000	3.000000	70.000000	9478.500000	1.000000	0.000000	3.000000	3.000000	0
75%	1095.250000	6.000000	3.000000	80.000000	11601.500000	1.000000	1.000000	3.000000	3.000000	0
max	1460.000000	14.000000	4.000000	313.000000	215245.000000	1.000000	1.000000	3.000000	3.000000	1

8 rows × 81 columns

In [29]:

```
#Correlation of Attributes of the data
correlation=train.corr(method="spearman")
correlation
```

Out[29]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	...	Po
Id	1.000000	0.019226	-0.023256	-0.029631	-0.005364	0.008916	0.022942	0.029786	-0.016388	0.013324	...	0.0
MSSubClass	0.019226	1.000000	0.127902	-0.273617	-0.269570	-0.017276	0.009256	0.070499	-0.003433	-0.029594	...	0.0
MSZoning	-0.023256	0.127902	1.000000	-0.211224	-0.219857	0.036386	-0.082901	0.146903	0.005214	-0.005542	...	0.0
LotFrontage	-0.029631	-0.273617	-0.211224	1.000000	0.523980	-0.041278	0.028328	-0.128586	0.012951	0.036942	...	0.0
LotArea	-0.005364	-0.269570	-0.219857	0.523980	1.000000	-0.053676	-0.011124	-0.310579	-0.080551	0.036246	...	0.0
...	...	...	...	...	...	...	...	...	...	...	...	
MoSold	0.019018	0.018403	-0.035685	0.010191	0.006423	0.002495	0.001799	-0.035617	-0.030269	-0.043864	...	0.0
YrSold	0.001526	-0.027401	-0.016242	0.014633	-0.027473	-0.023701	-0.000329	0.037071	0.022947	0.024530	...	0.0
SaleType	0.026916	0.047649	0.130390	-0.079732	-0.055284	0.008380	0.011871	0.019892	-0.013105	-0.074835	...	0.0
SaleCondition	-0.013279	-0.062102	-0.094488	0.106834	0.080913	0.022390	0.019516	-0.054651	0.021831	-0.063162	...	0.0
SalePrice	-0.018546	0.007192	-0.334909	0.343535	0.456461	0.045814	0.066146	-0.305923	-0.010234	-0.016710	...	0.0

81 rows × 81 columns

In [30]:

```
#Heatmap of correlation between features in train data
correlation.style.background_gradient(cmap='viridis').set_precision(2)
```

Out[30]:

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig
Id	1	0.019	-0.023	-0.03	-0.0054	0.0089	0.023	0.03	-0.016	0.013	0.047
MSSubClass	0.019	1	0.13	-0.27	-0.27	-0.017	0.0093	0.07	-0.0034	-0.03	0.045
MSZoning	-0.023	0.13	1	-0.21	-0.22	0.036	-0.083	0.15	0.0052	-0.0055	0.018
LotFrontage	-0.03	-0.27	-0.21	1	0.52	-0.041	0.028	-0.13	0.013	0.037	-0.14
LotArea	-0.0054	-0.27	-0.22	0.52	1	-0.054	-0.011	-0.31	-0.081	0.036	-0.2
Street	0.0089	-0.017	0.036	-0.041	-0.054	1	-0.006	-0.011	0.12	0.0017	0.012
Alley	0.023	0.0093	-0.083	0.028	-0.011	-0.006	1	-0.063	-0.018	0.029	-0.024
LotShape	0.03	0.07	0.15	-0.13	-0.31	-0.011	-0.063	1	0.12	-0.036	0.22
LandContour	-0.016	-0.0034	0.0052	0.013	-0.081	0.12	-0.018	0.12	1	0.0088	-0.022
Utilities	0.013	-0.03	-0.0055	0.037	0.036	0.0017	0.029	-0.036	0.0088	1	-0.033
LotConfig	0.047	0.045	0.018	-0.14	-0.2	0.012	-0.024	0.22	-0.022	-0.033	1
LandSlope	0.019	-0.02	-0.028	0.0033	0.12	-0.18	0.017	-0.093	-0.52	-0.0062	0.012
Neighborhood	-0.012	-0.0091	-0.21	0.12	0.093	-0.01	0.036	-0.03	0.038	0.044	-0.034
Condition1	-0.012	-0.013	-0.069	0.0085	0.088	-0.037	0.049	-0.11	0.028	0.003	0.062
Condition2	0.03	-0.03	0.016	0.0069	0.047	-0.00044	0.02	0.0092	-0.00049	0.00018	0.056
BldgType	0.019	0.65	0.1	-0.36	-0.43	-0.049	0.061	0.14	0.029	-0.012	0.1
HouseStyle	0.017	0.53	-0.12	0.082	0.061	0.022	0.01	-0.11	0.07	0.047	-0.035
OverallQual	-0.029	0.11	-0.21	0.21	0.23	0.059	0.055	-0.2	0.017	-0.00032	-0.032
OverallCond	0.0036	-0.072	0.19	-0.052	-0.047	0.049	-0.0037	0.02	-0.033	0.021	-0.039
YearBuilt	-0.0051	0.036	-0.35	0.16	0.1	0.032	0.065	-0.21	0.12	-0.018	0.0084
YearRemodAdd	-0.012	0.0068	-0.2	0.096	0.075	0.063	0.059	-0.13	0.062	-0.03	0.0021
RoofStyle	0.036	-0.14	-0.028	0.16	0.14	-0.02	-0.028	0.0093	0.0079	-0.013	-0.011
RoofMatl	-0.028	-0.019	-0.014	0.064	0.14	0.008	0.011	-0.075	-0.083	-0.0033	-0.07
Exterior1st	-0.037	-0.063	0.013	0.015	0.066	-0.0025	0.01	0.003	-0.014	-0.031	0.02
Exterior2nd	-0.041	-0.086	0.028	0.031	0.049	0.00038	-0.0016	0.0092	-0.036	-0.033	0.0049
MasVnrType	0.051	-0.056	0.019	-0.078	-0.067	0.0092	0.01	0.014	-0.089	-0.035	0.0025
MasVnrArea	-0.039	0.025	-0.088	0.2	0.18	0.013	0.013	-0.11	0.088	0.047	-0.0094
ExterQual	-0.0078	-0.052	0.24	-0.16	-0.13	0.035	-0.035	0.18	-0.018	0.02	0.0061
ExterCond	0.025	0.013	-0.12	0.077	0.033	0.0081	-0.017	-0.019	0.0075	0.0097	0.038
Foundation	0.0043	0.075	-0.26	0.096	0.051	0.045	0.046	-0.14	0.045	-0.018	-0.01
BsmtQual	0.04	-0.11	0.19	-0.12	-0.13	-0.031	-0.062	0.18	-2.3e-05	0.027	0.026
BsmtCond	0.0044	-0.029	-0.014	0.1	0.011	-0.019	0.017	-0.0063	0.018	0.0077	0.031
BsmtExposure	-0.03	-0.066	0.072	-0.11	-0.18	0.07	-0.014	0.15	0.11	0.018	0.026
BsmtFinType1	0.01	0.07	0.089	-0.058	-0.047	-0.015	-0.02	0.077	-0.053	-0.0091	0.029
BsmtFinSF1	-0.013	-0.11	-0.13	0.13	0.17	-0.013	0.03	-0.13	-0.018	-0.013	-0.01
BsmtFinType2	0.014	0.08	0.00079	-0.047	-0.073	0.047	-0.023	0.025	-0.03	-0.066	-0.0067
BsmtFinSF2	-0.0067	-0.084	-0.0055	0.049	0.072	-0.044	0.023	-0.033	0.026	0.073	0.0038
BsmtUnfSF	-0.0095	-0.12	-0.024	0.092	0.078	0.037	0.01	-0.0027	0.034	-0.011	-0.0044
TotalBsmtSF	-0.033	-0.32	-0.2	0.33	0.37	0.0096	0.063	-0.18	0.014	-0.02	-0.035
Heating	0.026	0.062	0.099	-0.047	-0.0035	0.009	-0.0052	0.08	0.017	-0.0037	-0.0042
HeatingQC	0.00045	0.0012	0.15	-0.059	-0.069	-0.052	-0.015	0.1	-0.062	0.012	-0.0042
CentralAir	0.0098	-0.11	-0.12	0.099	0.11	0.07	0.023	-0.11	0.082	0.0069	-0.0092

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandContour	Utilities	LotConfig
Electrical	0.009	0.043	-0.12	0.082	0.077	0.019	-0.015	-0.1	0.068	-0.087	-0.012
1stFlrSF	-0.00062	-0.28	-0.17	0.36	0.44	0.0087	0.026	-0.17	-0.036	0.02	-0.044
2ndFlrSF	0.0095	0.49	-0.012	0.028	0.12	0.042	-0.0053	-0.047	-0.022	-0.022	-0.043
LowQualFinSF	-0.028	0.076	0.036	-0.014	-0.02	0.0086	-0.019	0.043	-0.046	-0.0035	-0.0048
GrLivArea	0.0028	0.2	-0.16	0.3	0.45	0.049	0.0094	-0.18	-0.047	-0.0085	-0.069
BsmtFullBath	0.0047	-0.042	-0.071	0.066	0.096	-0.041	0.022	-0.081	-0.018	-0.022	-0.018
BsmtHalfBath	-0.021	0.0025	-0.011	-0.019	0.046	0.016	-0.00071	-0.026	-0.0021	0.11	-0.012
FullBath	0.0073	0.19	-0.24	0.17	0.24	0.048	0.052	-0.16	0.049	-0.028	-0.01
HalfBath	0.0026	0.28	-0.14	0.074	0.14	0.028	-0.0097	-0.12	0.034	-0.02	-0.031
BedroomAbvGr	0.042	0.069	-0.083	0.25	0.34	0.035	-0.014	-0.074	0.0057	0.0059	-0.06
KitchenAbvGr	0.0076	0.28	0.05	0.0021	-0.023	0.014	0.014	0.092	-0.036	-0.0056	0.0028
KitchenQual	-0.011	-0.03	0.18	-0.15	-0.13	-0.034	-0.047	0.15	0.028	-0.021	-0.0042
TotRmsAbvGrd	0.026	0.17	-0.095	0.3	0.41	0.052	-0.031	-0.12	-0.017	0.014	-0.041
Functional	-0.0022	0.031	-0.093	0.028	-0.037	-0.017	0.024	-0.025	0.034	0.0071	-0.019
Fireplaces	-0.014	0.019	-0.09	0.21	0.35	0.0058	0.023	-0.21	-0.063	0.02	-0.054
FireplaceQu	0.031	0.07	-0.008	-0.017	-0.035	0.024	-0.065	-0.039	0.067	-0.018	0.0053
GarageType	-0.004	0.12	0.2	-0.23	-0.22	-0.017	-0.026	0.16	-0.061	0.015	0.00049
GarageYrBlt	0.011	0.067	-0.26	0.088	0.038	0.03	0.082	-0.16	0.074	-0.026	-0.005
GarageFinish	-0.011	-0.025	0.22	-0.2	-0.17	-0.011	-0.069	0.22	-0.05	-0.0091	0.021
GarageCars	0.013	0.024	-0.21	0.29	0.34	-0.028	0.025	-0.2	0.0074	0.0092	-0.076
GarageArea	0.0065	-0.047	-0.25	0.32	0.37	-0.031	0.044	-0.19	0.016	0.01	-0.079
GarageQual	-0.0012	-0.031	-0.18	0.062	0.041	0.033	0.057	-0.1	-0.0015	0.006	0.011
GarageCond	-0.021	-0.04	-0.11	0.053	0.032	-0.013	0.047	-0.071	0.0078	0.0051	0.037
PavedDrive	0.00058	-0.06	-0.18	0.13	0.067	0.021	0.051	-0.12	0.13	0.0078	-0.055
WoodDeckSF	-0.043	0.023	-0.074	0.11	0.18	0.014	0.051	-0.17	-0.017	-0.023	-0.02
OpenPorchSF	-0.0032	0.032	-0.18	0.14	0.18	0.013	0.022	-0.12	0.058	0.036	-0.043
EnclosedPorch	-0.0068	0.011	0.19	-0.1	-0.067	0.026	-0.042	0.11	-0.057	-0.011	-0.045
3SsnPorch	-0.037	-0.036	-0.015	0.056	0.062	0.0083	0.044	-0.036	-0.06	-0.0034	-0.018
ScreenPorch	0.006	-0.022	-0.0096	0.039	0.092	-0.023	0.00034	-0.047	-0.0082	0.094	0.0097
PoolArea	0.056	0.033	-0.015	0.078	0.084	0.0045	-0.023	-0.024	-0.011	-0.0018	-0.048
PoolQC	0.77	0.016	-0.042	-0.05	-0.00037	-0.011	0.012	0.042	0.0055	0.031	0.046
Fence	-0.11	-0.018	0.02	0.0017	-0.044	-0.031	-0.12	-0.0019	0.023	0.048	0.018
MiscFeature	0.16	-0.019	0.03	0.026	0.009	-0.0066	0.044	-0.021	-0.032	0.0027	-0.029
MiscVal	-0.043	-0.033	0.0027	0.017	0.059	-0.16	-0.07	-0.023	0.006	-0.005	-0.022
MoSold	0.019	0.018	-0.036	0.01	0.0064	0.0025	0.0018	-0.036	-0.03	-0.044	0.024
YrSold	0.0015	-0.027	-0.016	0.015	-0.027	-0.024	-0.00033	0.037	0.023	0.025	-0.0045
SaleType	0.027	0.048	0.13	-0.08	-0.055	0.0084	0.012	0.02	-0.013	-0.075	-0.0068
SaleCondition	-0.013	-0.062	-0.094	0.11	0.081	0.022	0.02	-0.055	0.022	-0.063	0.05
SalePrice	-0.019	0.0072	-0.33	0.34	0.46	0.046	0.066	-0.31	-0.01	-0.017	-0.074

In [32]:

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for column in columns:
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    sns.scatterplot(column,"SalePrice",data=train)
    plt.show()
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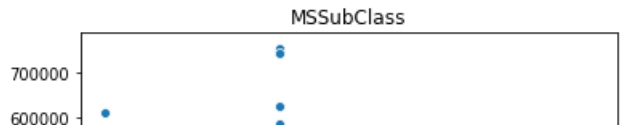

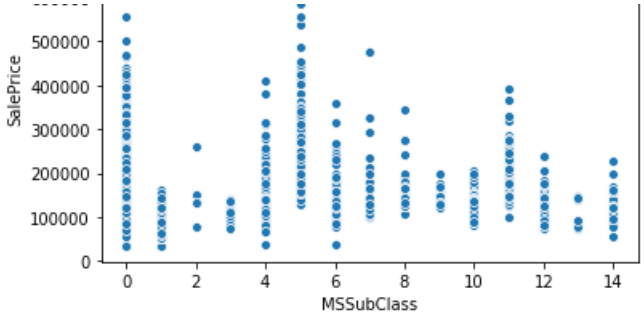
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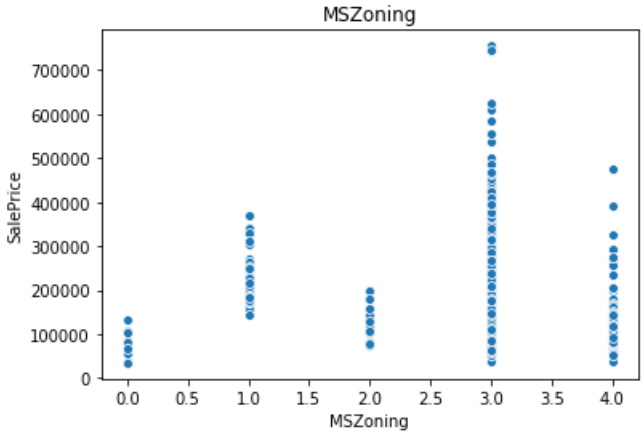
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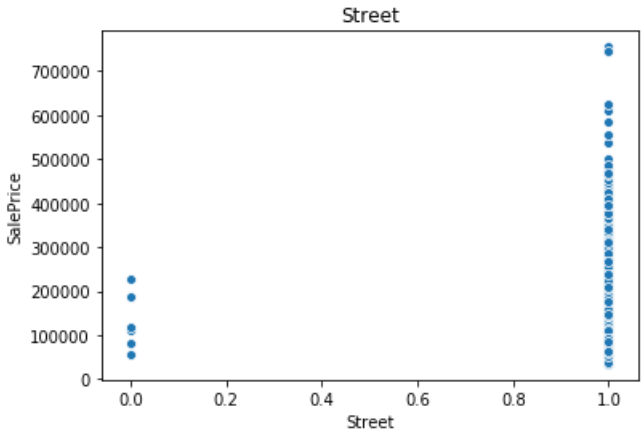
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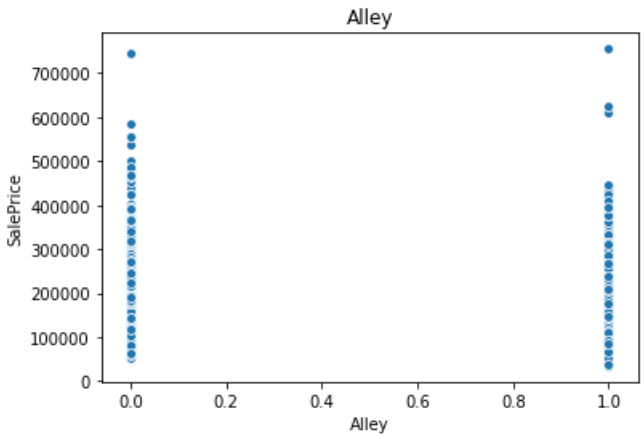
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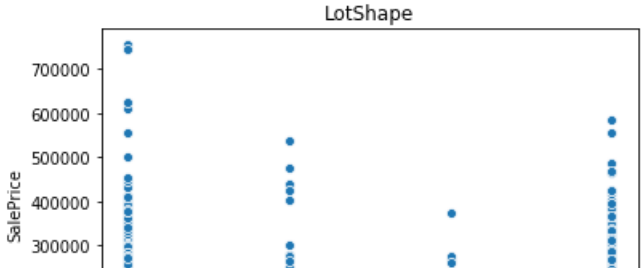
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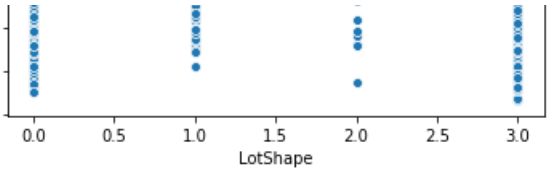
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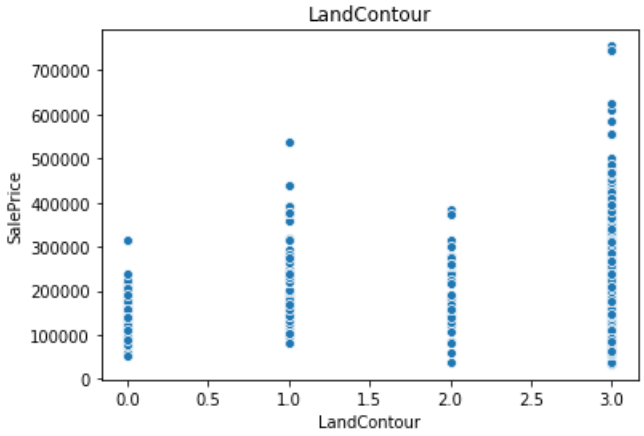
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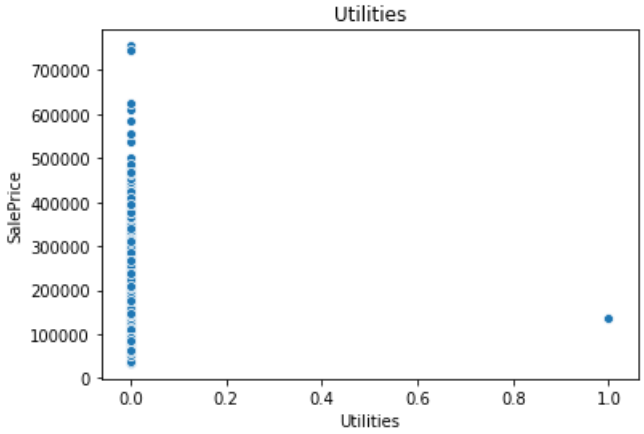
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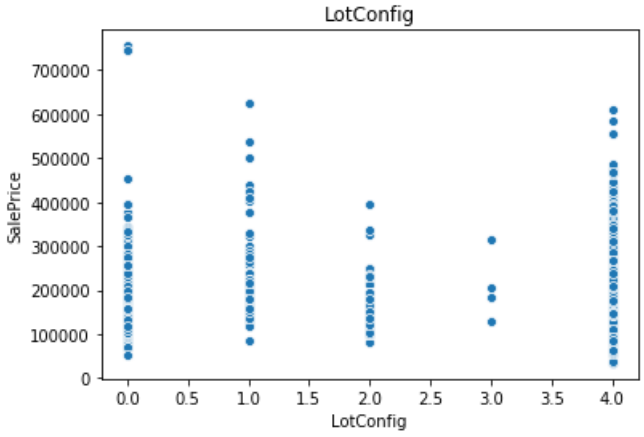
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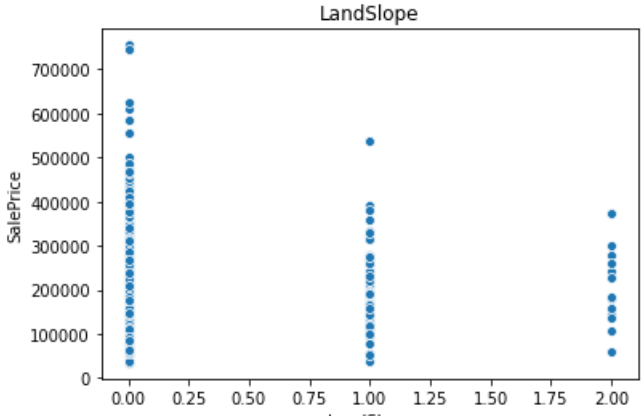
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LandSlope

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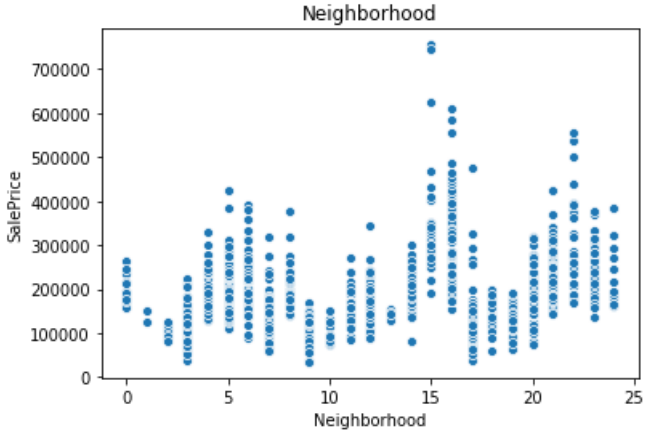

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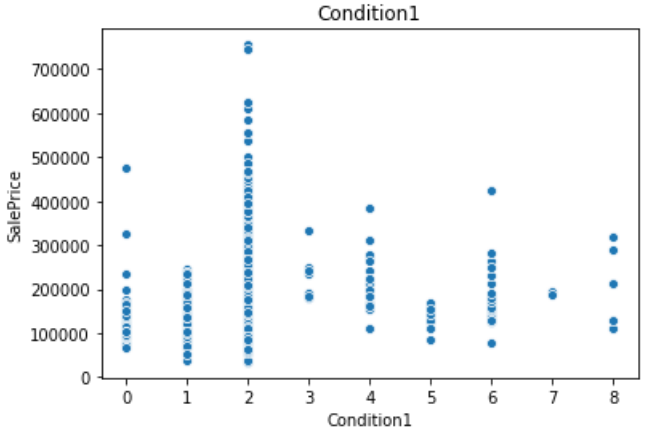

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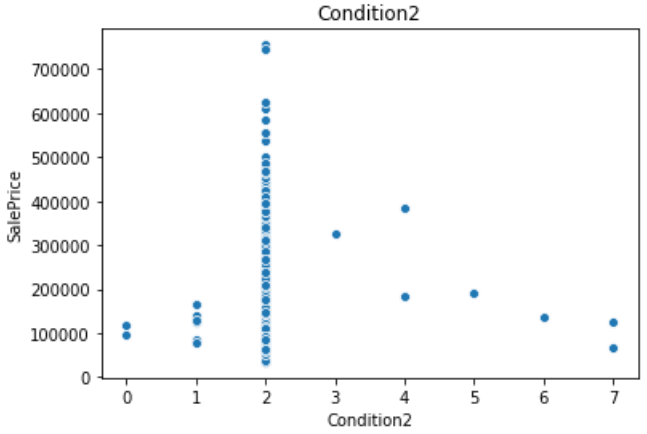

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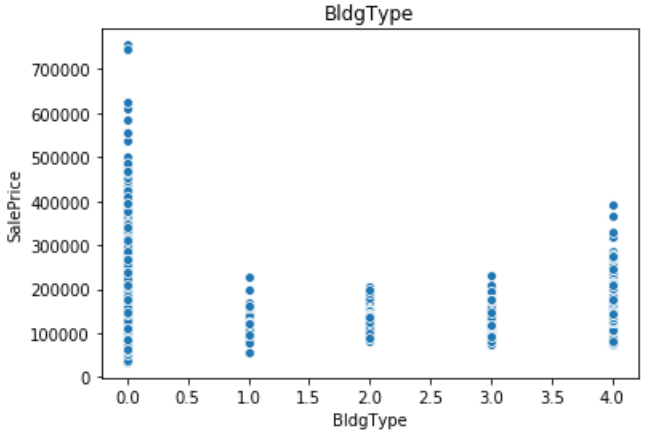

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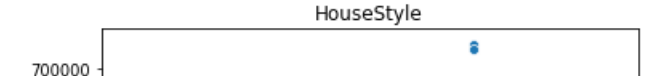

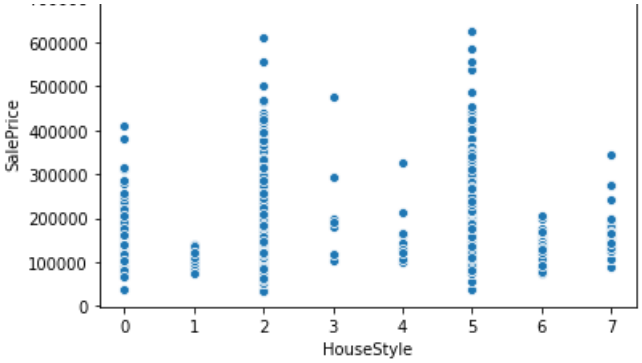
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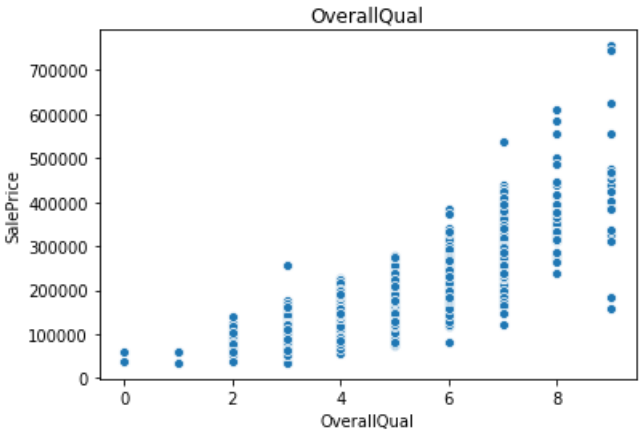
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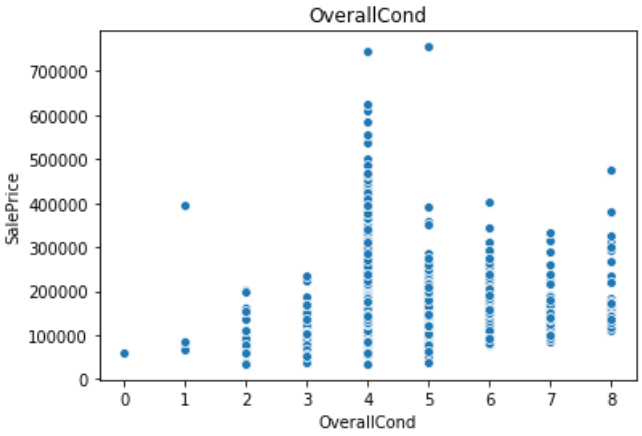
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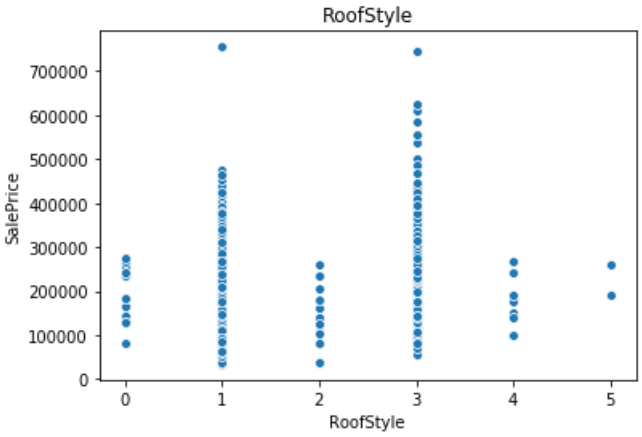
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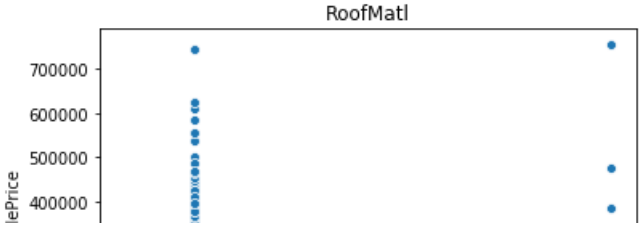
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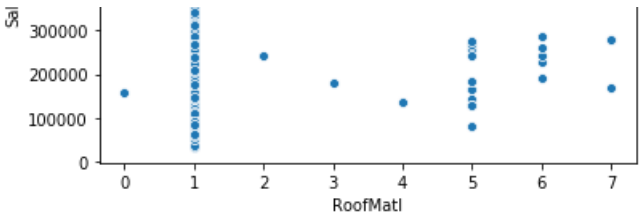
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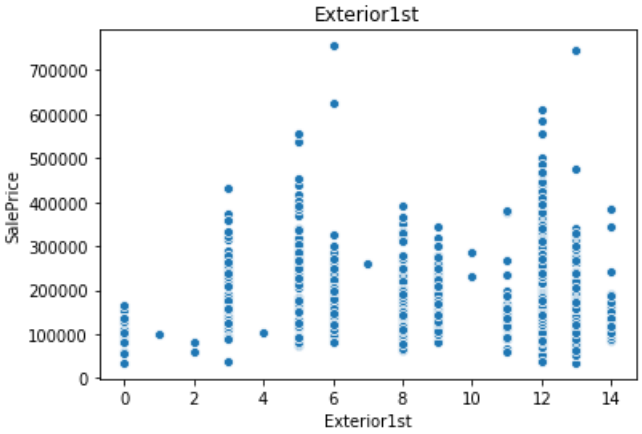
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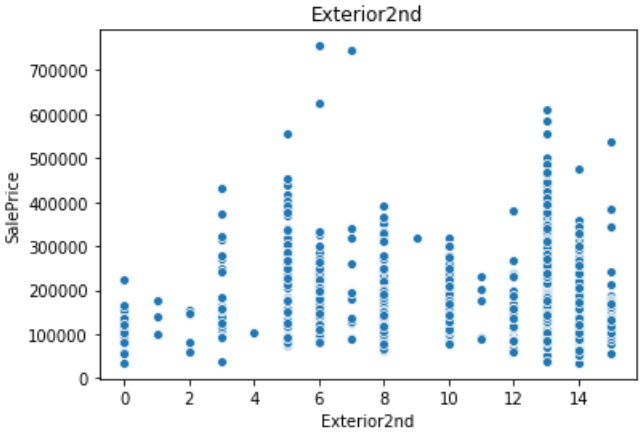
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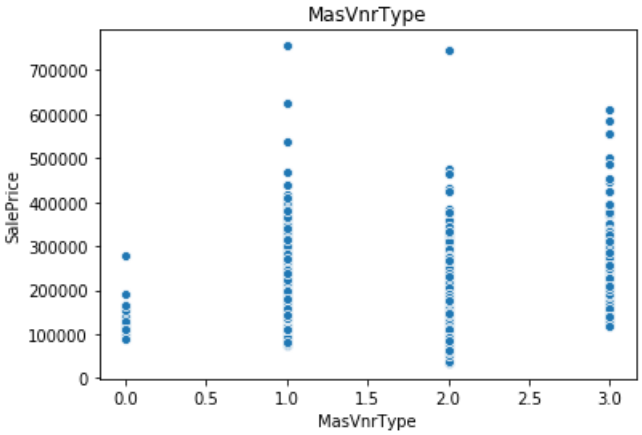
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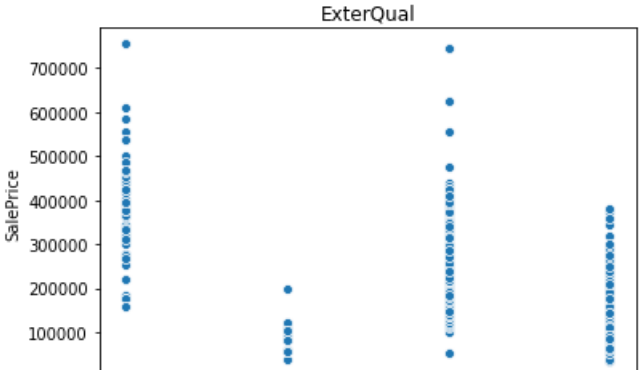
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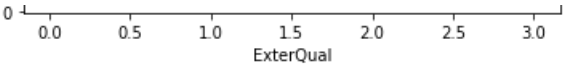
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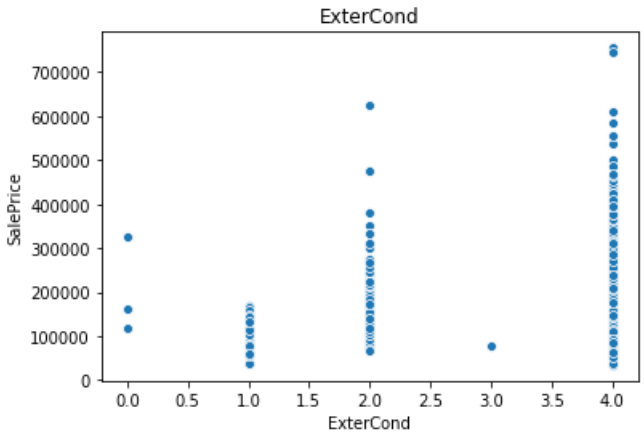
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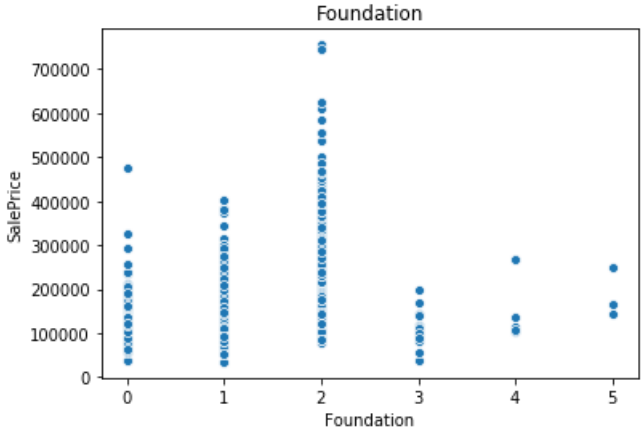
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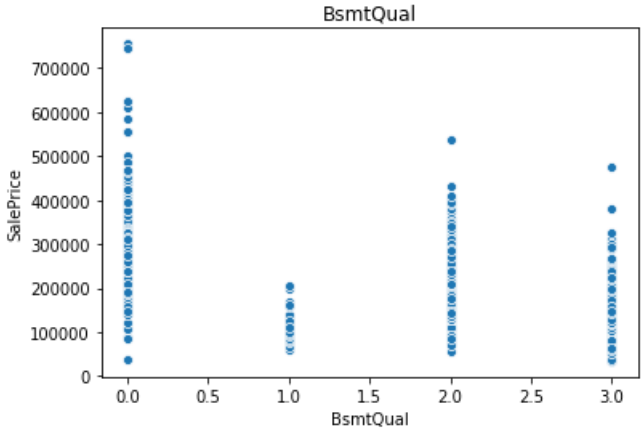
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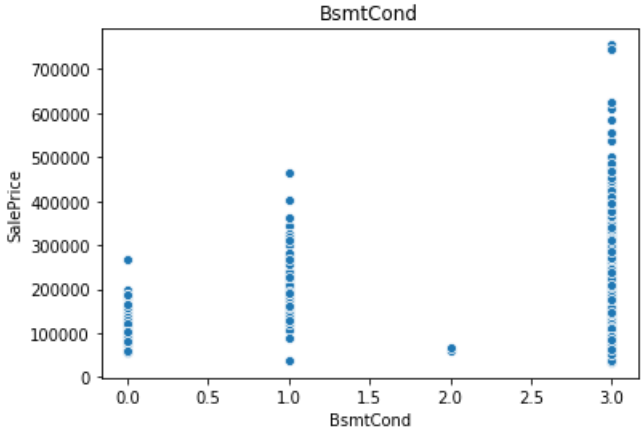
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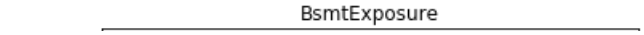
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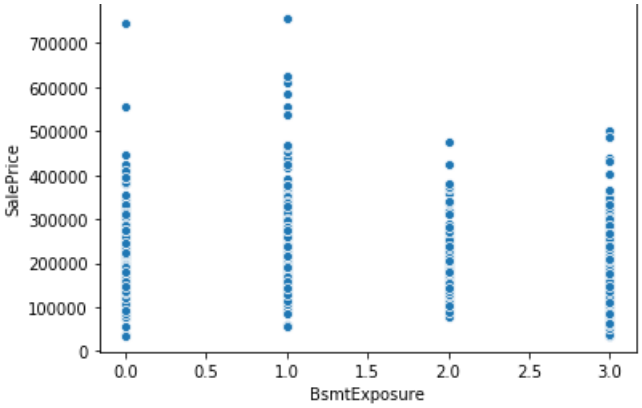
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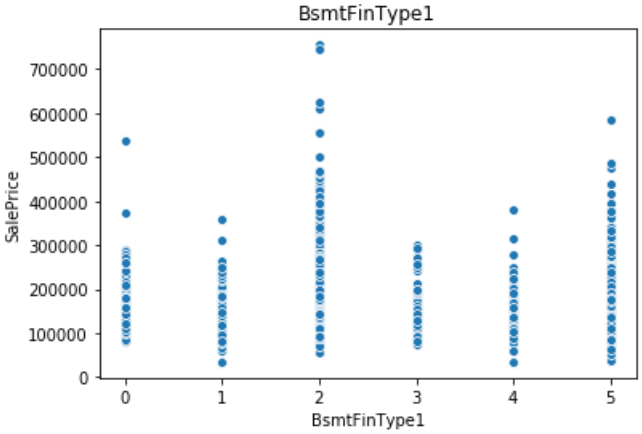
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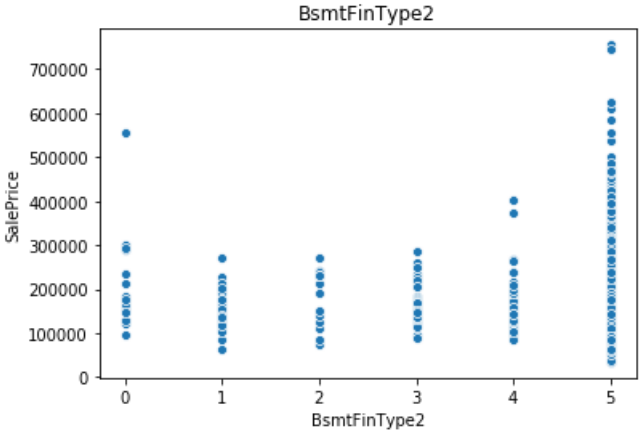
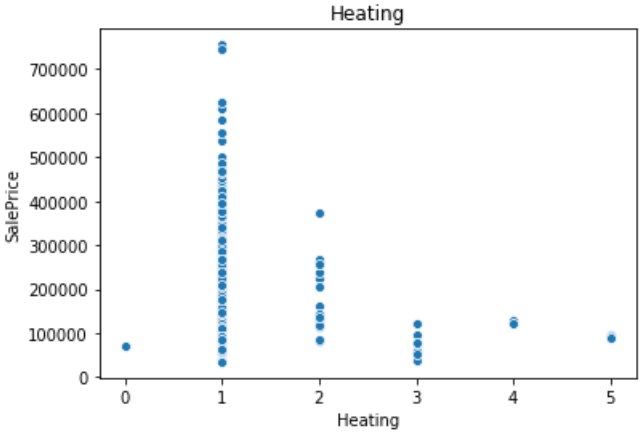
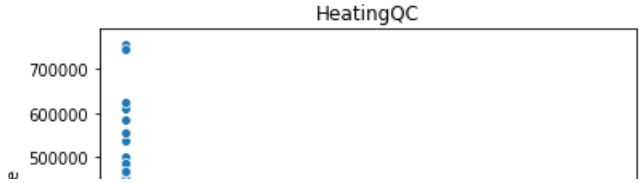
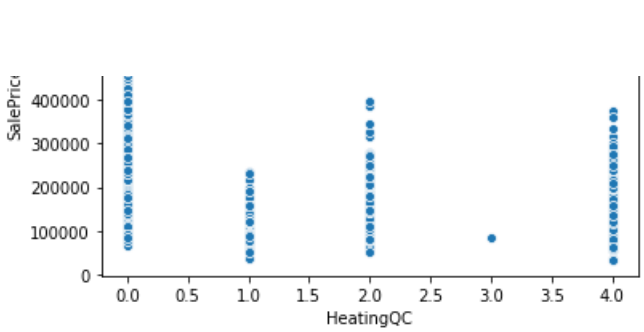
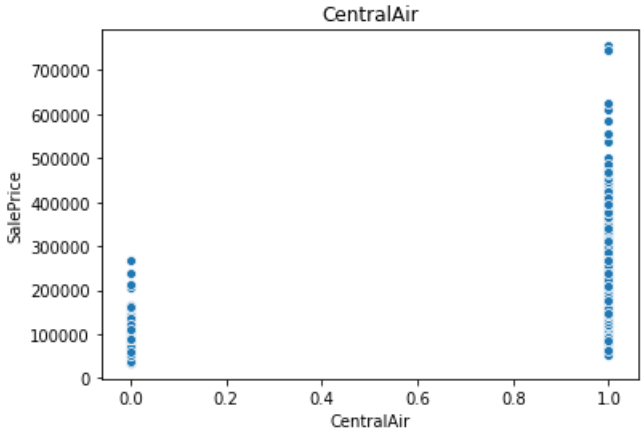
SalePrice
BsmtFinType1

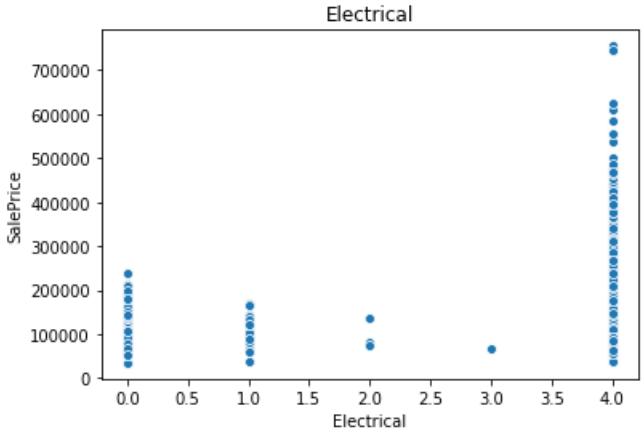

BsmtFinType2
SalePrice
BsmtFinType2

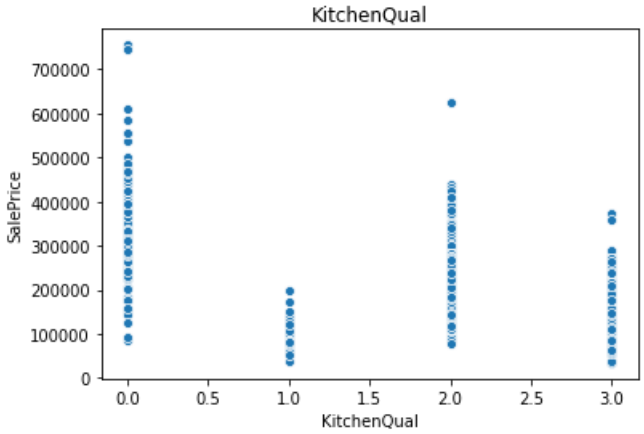

Heating
SalePrice
Heating

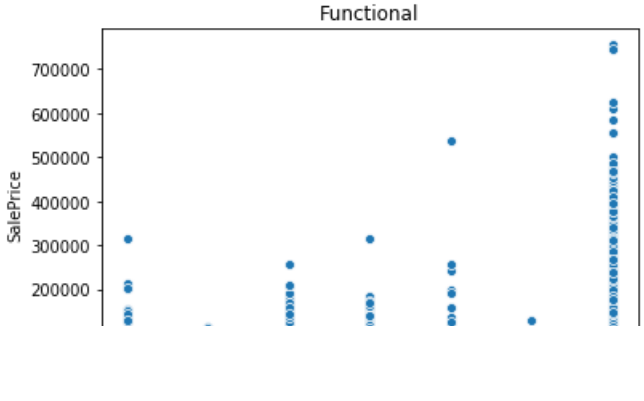

HeatingQC

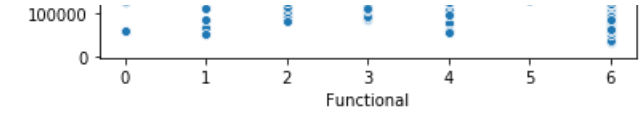

SalePrice
400000
300000
200000
100000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
HeatingQC

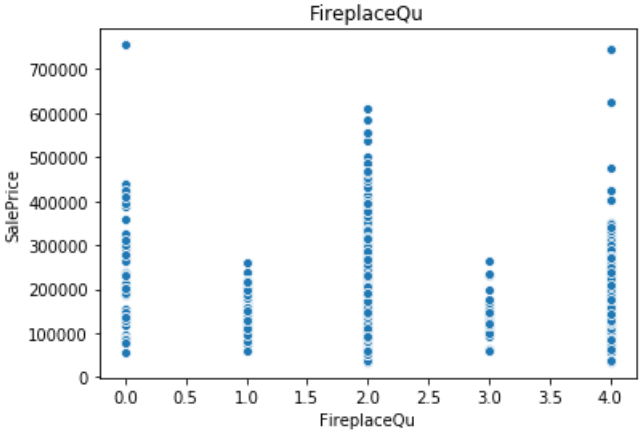

CentralAir
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.0
0.2
0.4
0.6
0.8
1.0
CentralAir

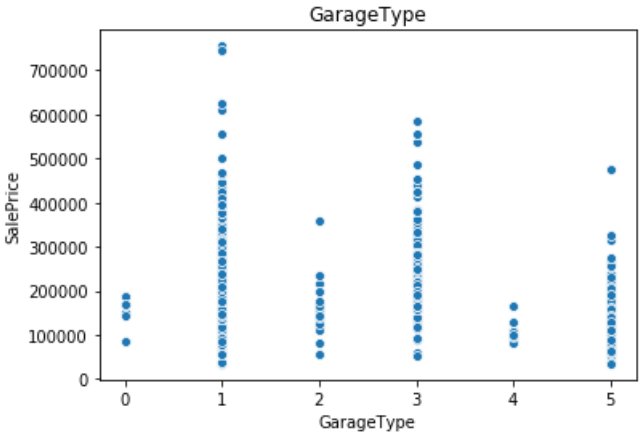

Electrical
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Electrical

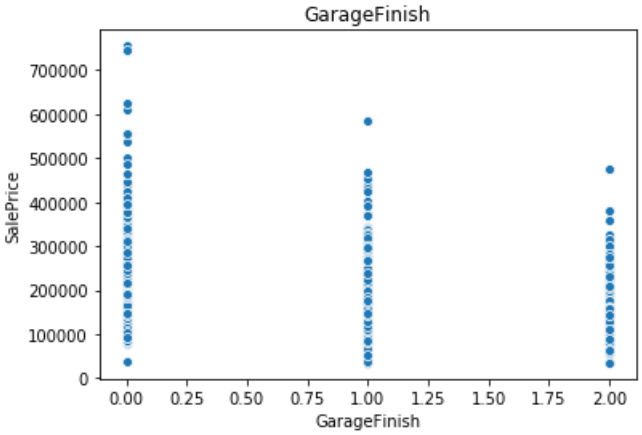

KitchenQual
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
KitchenQual

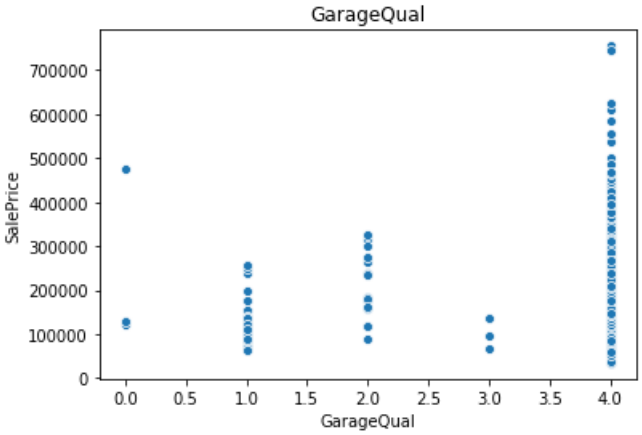

Functional
SalePrice
700000
600000
500000
400000
300000
200000

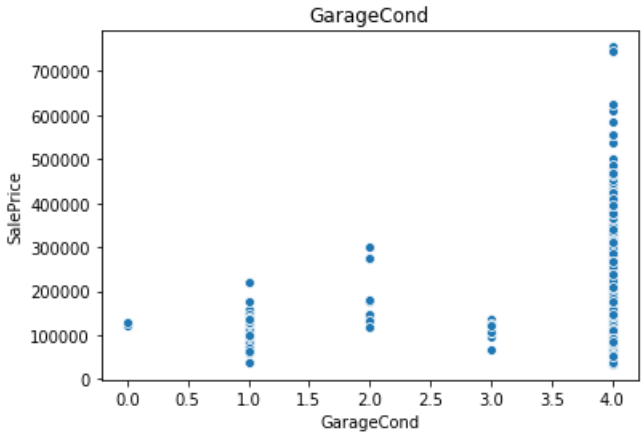

100000
0
0
1
2
3
4
5
6
Functional

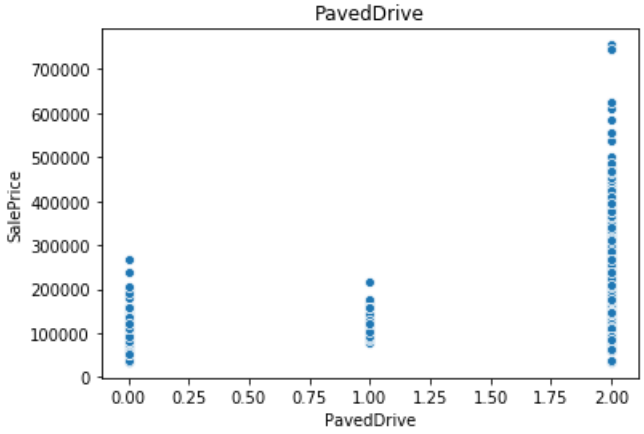

FireplaceQu
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
FireplaceQu

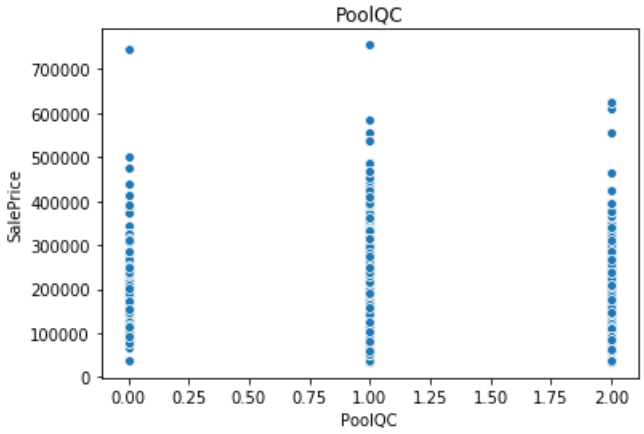

GarageType
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0
1
2
3
4
5
GarageType

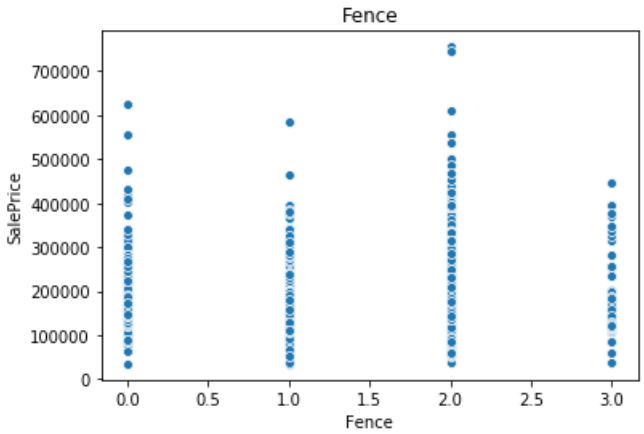

GarageFinish
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
GarageFinish

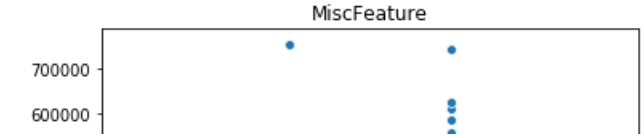

GarageQual
SalePrice
700000
600000
500000
400000
300000
200000
100000
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
GarageQual

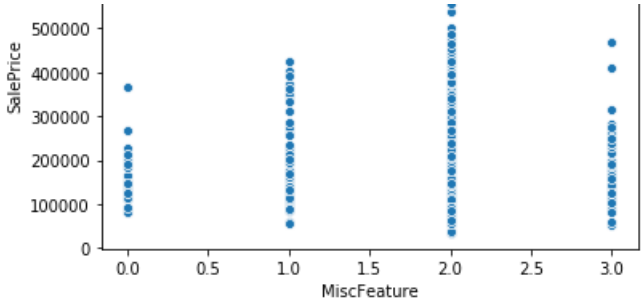

GarageCond
SalePrice
GarageCond

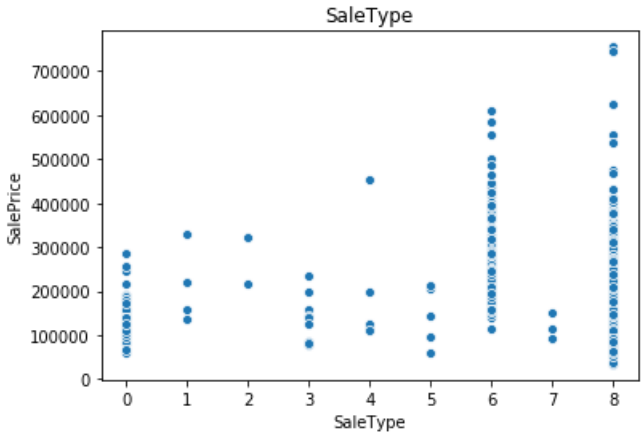

PavedDrive
SalePrice
PavedDrive

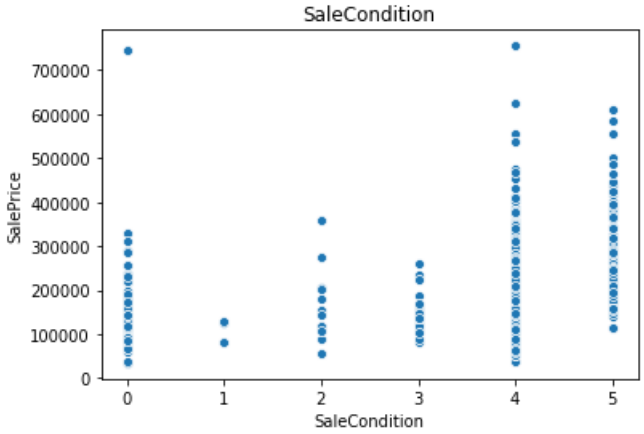

PoolQC
SalePrice
PoolQC


Fence
SalePrice
Fence


MiscFeature

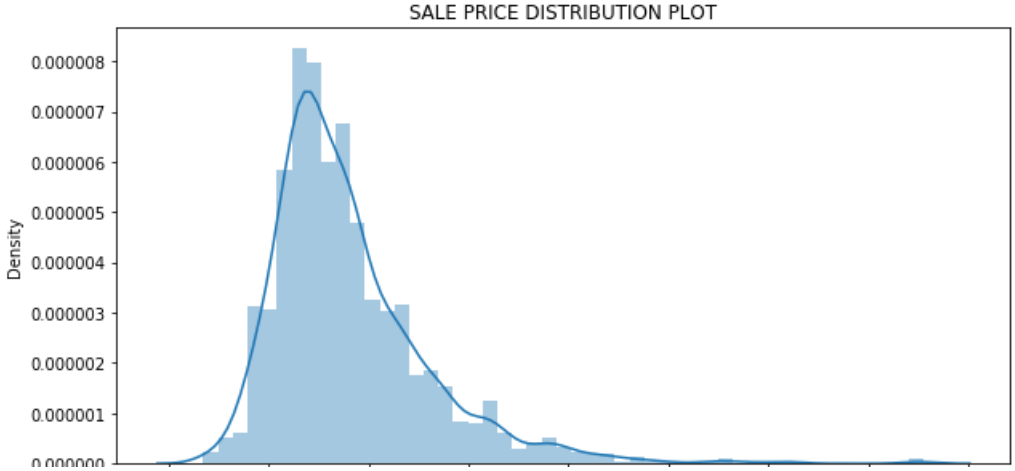






In [49]:

```
# Distribution plot for sales
sns.distplot(train["SalePrice"])
plt.title("SALE PRICE DISTRIBUTION PLOT")
plt.ylabel("Density")
plt.xlabel("Sale Price")
plt.xticks(rotation=90)
plt.show()
```



MODEL

In [34]:

```
x_train=pd.DataFrame(train[['MSSubClass', 'MSZoning', 'LotFrontage', 'LotArea', 'Street',
       'Alley', 'LotShape', 'LandContour', 'Utilities', 'LotConfig',
       'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType',
       'HouseStyle', 'OverallQual', 'OverallCond', 'YearBuilt', 'YearRemodAdd',
       'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType',
       'MasVnrArea', 'ExterQual', 'ExterCond', 'Foundation', 'BsmtQual',
       'BsmtCond', 'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1',
       'BsmtFinType2', 'BsmtFinSF2', 'BsmtUnfSF', 'TotalBsmtSF', 'Heating',
       'HeatingQC', 'CentralAir', 'Electrical', '1stFlrSF', '2ndFlrSF',
       'LowQualFinSF', 'GrLivArea', 'BsmtFullBath', 'BsmtHalfBath', 'FullBath',
       'HalfBath', 'BedroomAbvGr', 'KitchenAbvGr', 'KitchenQual',
       'TotRmsAbvGrd', 'Functional', 'Fireplaces', 'FireplaceQu', 'GarageType',
       'GarageYrBlt', 'GarageFinish', 'GarageCars', 'GarageArea', 'GarageQual',
       'GarageCond', 'PavedDrive', 'WoodDeckSF', 'OpenPorchSF',
       'EnclosedPorch', '3SsnPorch', 'ScreenPorch', 'PoolArea', 'PoolQC',
       'Fence', 'MiscFeature', 'MiscVal', 'MoSold', 'YrSold', 'SaleType',
       'SaleCondition']])
y_train=pd.DataFrame(train.iloc[:,-1])
```

In [35]:

```
x_test=pd.DataFrame(test[['MSSubClass', 'MSZoning', 'LotFrontage', 'LotArea', 'Street',
       'Alley', 'LotShape', 'LandContour', 'Utilities', 'LotConfig',
       'LandSlope', 'Neighborhood', 'Condition1', 'Condition2', 'BldgType',
       'HouseStyle', 'OverallQual', 'OverallCond', 'YearBuilt', 'YearRemodAdd',
       'RoofStyle', 'RoofMatl', 'Exterior1st', 'Exterior2nd', 'MasVnrType',
       'MasVnrArea', 'ExterQual', 'ExterCond', 'Foundation', 'BsmtQual',
       'BsmtCond', 'BsmtExposure', 'BsmtFinType1', 'BsmtFinSF1',
       'BsmtFinType2', 'BsmtFinSF2', 'BsmtUnfSF', 'TotalBsmtSF', 'Heating',
       'HeatingQC', 'CentralAir', 'Electrical', '1stFlrSF', '2ndFlrSF',
       'LowQualFinSF', 'GrLivArea', 'BsmtFullBath', 'BsmtHalfBath', 'FullBath',
       'HalfBath', 'BedroomAbvGr', 'KitchenAbvGr', 'KitchenQual',
       'TotRmsAbvGrd', 'Functional', 'Fireplaces', 'FireplaceQu', 'GarageType',
       'GarageYrBlt', 'GarageFinish', 'GarageCars', 'GarageArea', 'GarageQual',
       'GarageCond', 'PavedDrive', 'WoodDeckSF', 'OpenPorchSF',
       'EnclosedPorch', '3SsnPorch', 'ScreenPorch', 'PoolArea', 'PoolQC',
       'Fence', 'MiscFeature', 'MiscVal', 'MoSold', 'YrSold', 'SaleType',
       'SaleCondition']])
```

In [36]:

```
#FIT AND PREDICT SALE PRICE
```

In [37]:

```
# Import and use random forest
from sklearn.ensemble import RandomForestRegressor as RF
```

In [38]:

```
# Model Fit and Predict
regressor = RF(n_estimators=100,
               criterion='mse',
               max_features= None,
               max_depth = 14,bootstrap=True)
regressor=regressor.fit(x_train, y_train.values.ravel())
regressor.fit(x_train, y_train.values.ravel())
y_pred = regressor.predict(x_test)
```

In [39]:

```
y_train.values.ravel()
```

Out[39]:

```
array([208500, 181500, 223500, ..., 266500, 142125, 147500], dtype=int64)
```

In [40]:

```
# Make predicted values as DataFrame
y_pred=pd.DataFrame(y_pred)
```

In [41]:

```
y_pred.rename(columns={0:"SalePrice"},inplace=True)
```

In [42]:

```
y_pred["Id"]=test["Id"]
```

In [43]:

```
# values for submission
final=y_pred[["Id","SalePrice"]]
```

In [50]:

```
final.head()
```

Out[50]:

	Id	SalePrice
0	1461	124437.154544
1	1462	152514.897412
2	1463	181226.686719
3	1464	180756.510065
4	1465	200426.302265

In [ ]:

```
#Submission
final.to_csv("PriceSubmission.csv",index=False)
```

In [ ]:

```

```