```
# This Python 3 environment comes with many helpful analytics libr
# It is defined by the kaggle/python docker image: https://github
# For example, here's several helpful packages to load in

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_

# Input data files are available in the "../input/" directory.
# For example, running this (by clicking run or pressing Shift+Ent

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# Any results you write to the current directory are saved as outp
```

```
/kaggle/input/house-prices-advanced-regression-technique
/kaggle/input/house-prices-advanced-regression-technique
/kaggle/input/house-prices-advanced-regression-technique
/kaggle/input/house-prices-advanced-regression-technique
```

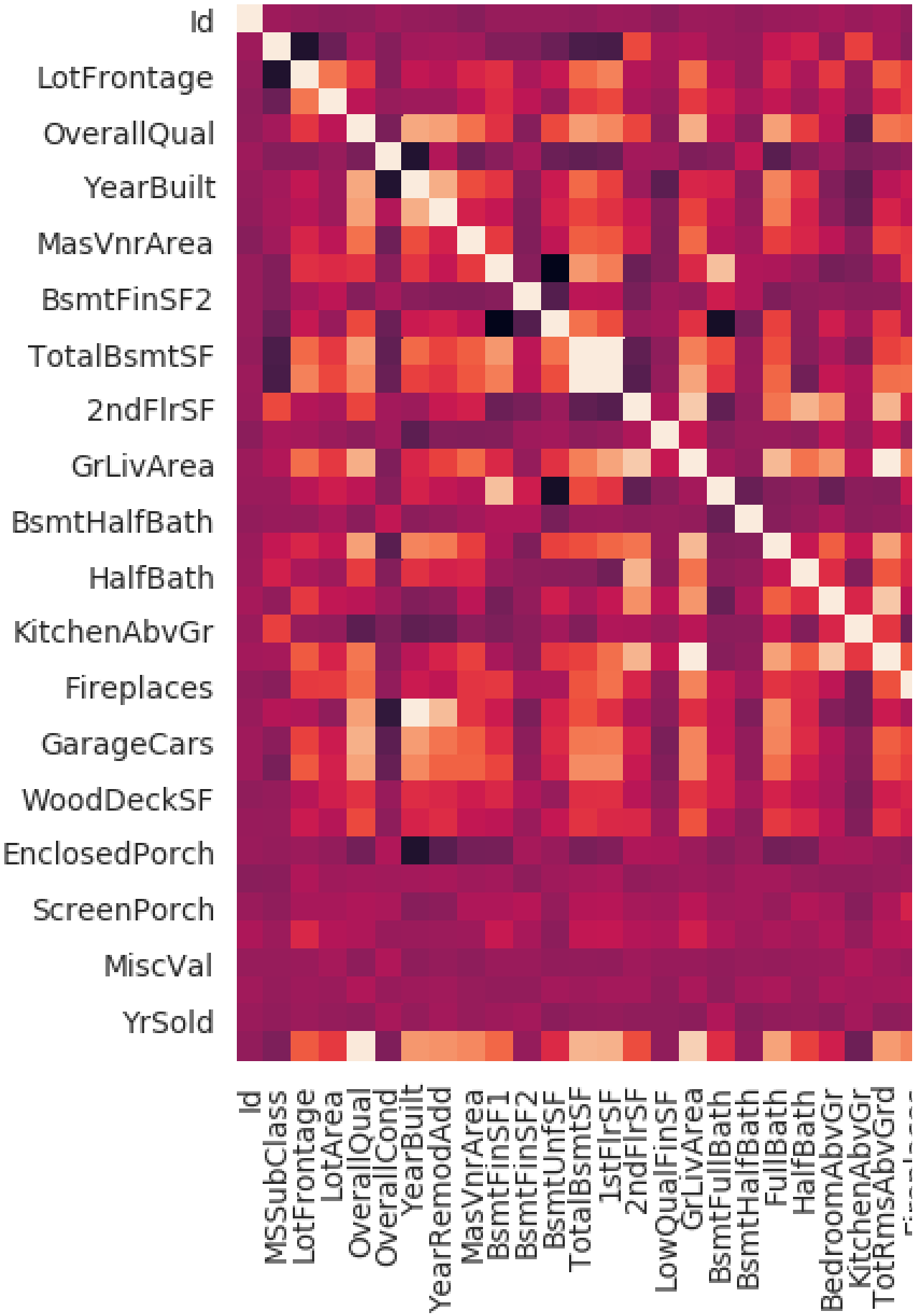
Homework 3 - Ames Housing Dataset

For all parts below, answer all parts as shown in the Google document for H
answer as well as text to answer the questions. We also ask that code be cc

Part 1 - Pairwise Correlations

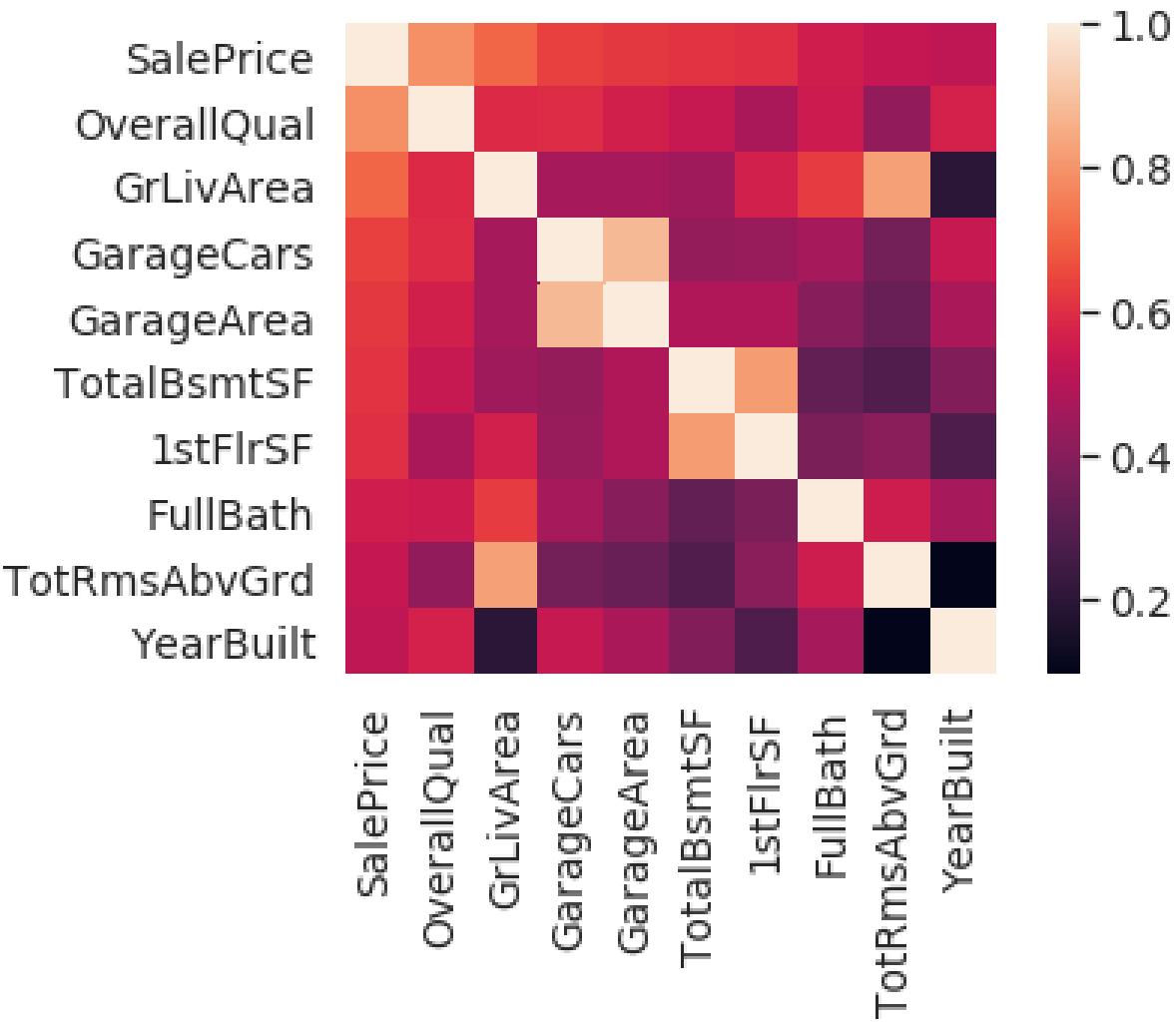
```
# TODO: show visualization
```

```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np


df1 = pd.read_csv('/kaggle/input/house-prices-advanced-regression-


corrmat = df1.corr(method = 'pearson')
f, ax = plt.subplots(figsize=(12, 9))
sns.heatmap(corrmat, vmax=.8, square=True);
```


Id
LotFrontage
OverallQual
YearBuilt
MasVnrArea
BsmtFinSF2
TotalBsmtSF
2ndFlrSF
GrLivArea
BsmtHalfBath
HalfBath
KitchenAbvGr
Fireplaces
GarageCars
WoodDeckSF
EnclosedPorch
ScreenPorch
MiscVal
YrSold
Id
MSSubClass
LotFrontage
LotArea
OverallQual
OverallCond
YearBuilt
YearRemodAdd
MasVnrArea
BsmtFinSF1
BsmtFinSF2
BsmtUnfSF
TotalBsmtSF
1stFlrSF
2ndFlrSF
LowQualFinSF
GrLivArea
BsmtFullBath
BsmtHalfBath
FullBath
HalfBath
BedroomAbvGr
KitchenAbvGr
TotRmsAbvGrd

This heatmap shows an overview of all the values and how do are they corre of what is happening, it does give us an overall view and we can see some p Enclosed Porch are inversely correlated. This might be due to the increase i allowed for each home to be made gets lesser and hence the dip. We also s Ground Live Area are highly correlated.

```
#saleprice correlation matrix
k = 10 #number of variables for heatmap
cols = corrmat.nlargest(k, 'SalePrice')['SalePrice'].index
cm = np.corrcoef(df1[cols].values.T)
sns.set(font_scale=1.25)
hm = sns.heatmap(cm, cbar=True, square=True, fmt='.2f', yticklabe
plt.show()
```



This heatmap provides a much thorough view of the 10 most correlated valu
built have a negative correlation whereas GarageCars i.e. the number of car
total area of the garage are highly correlated.

```
print (corrmat['SalePrice'].sort_values(ascending=False)[:10], '\r
print ('----------------------')
print (corrmat['SalePrice'].sort_values(ascending=False)[-10:]) #
```

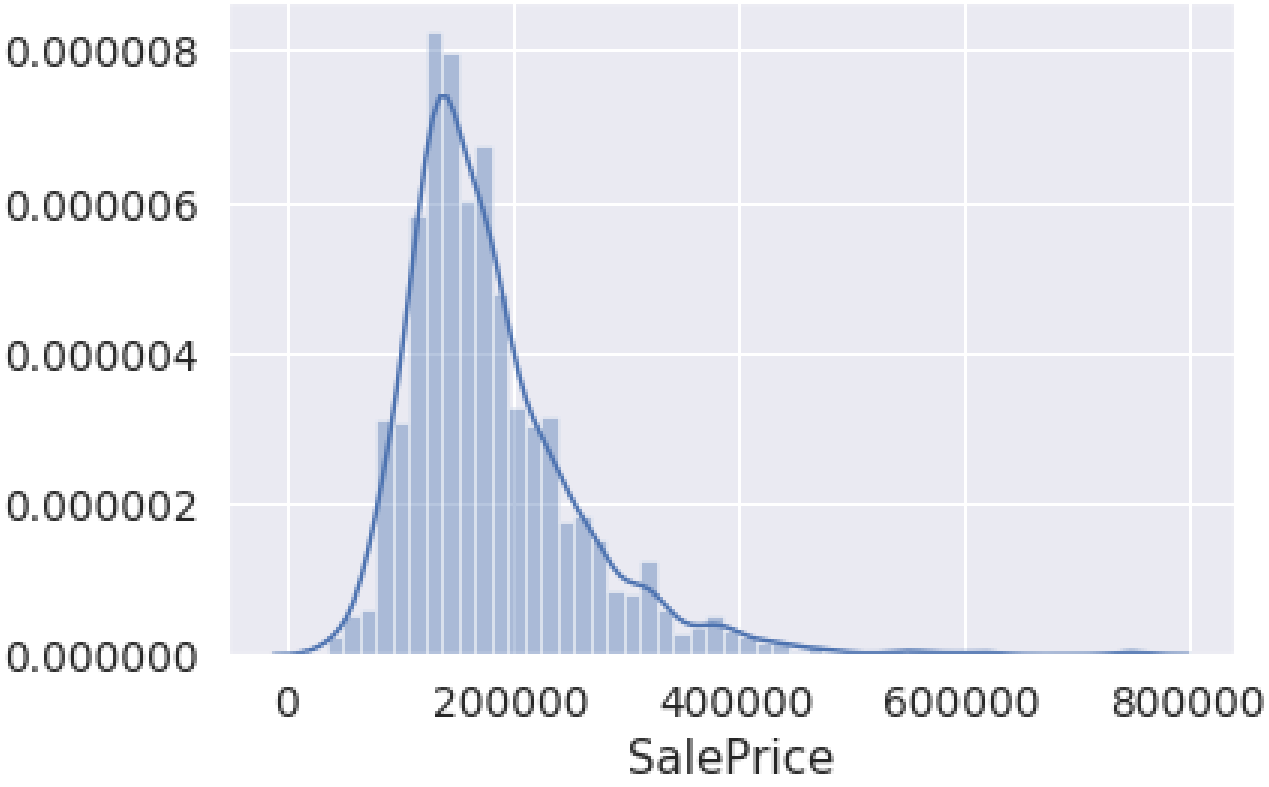
```
SalePrice       1.000000
OverallQual     0.790982
GrLivArea       0.708624
GarageCars      0.640409
GarageArea      0.623431
TotalBsmtSF     0.613581
1stFlrSF        0.605852
FullBath        0.560664
TotRmsAbvGrd    0.533723
YearBuilt       0.522897
Name: SalePrice, dtype: float64

----------------------
BsmtFinSF2      -0.011378
BsmtHalfBath    -0.016844
MiscVal         -0.021190
Id              -0.021917
LowQualFinSF    -0.025606
YrSold          -0.028923
OverallCond     -0.077856
MSSubClass      -0.084284
EnclosedPorch   -0.128578
KitchenAbvGr    -0.135907
Name: SalePrice, dtype: float64
```

Here, we want to show the negative correlation with our target variable whic
relevant as the decreased porch means that the area is crowded one hence

Part 2 - Informative Plots

```
# TODO: code to generate Plot 1
sns.distplot(df1['SalePrice'])
```

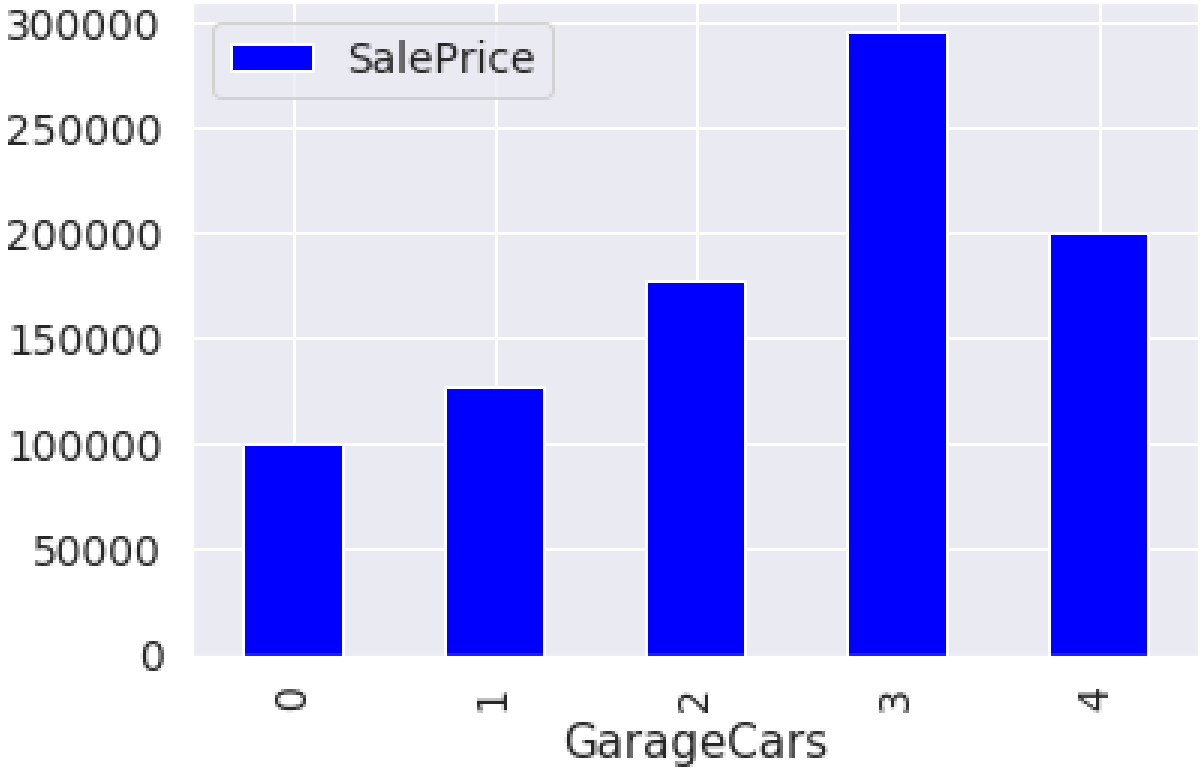
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f547815c940
```



This plot shows us the SalePrice which is skewed. This means that the norn
much cheaper than anywhere here in NY.

```
# TODO: code to generate Plot 2
pivot = df1.pivot_table(index='GarageCars', values='SalePrice', a
pivot.plot(kind='bar', color='blue')
```

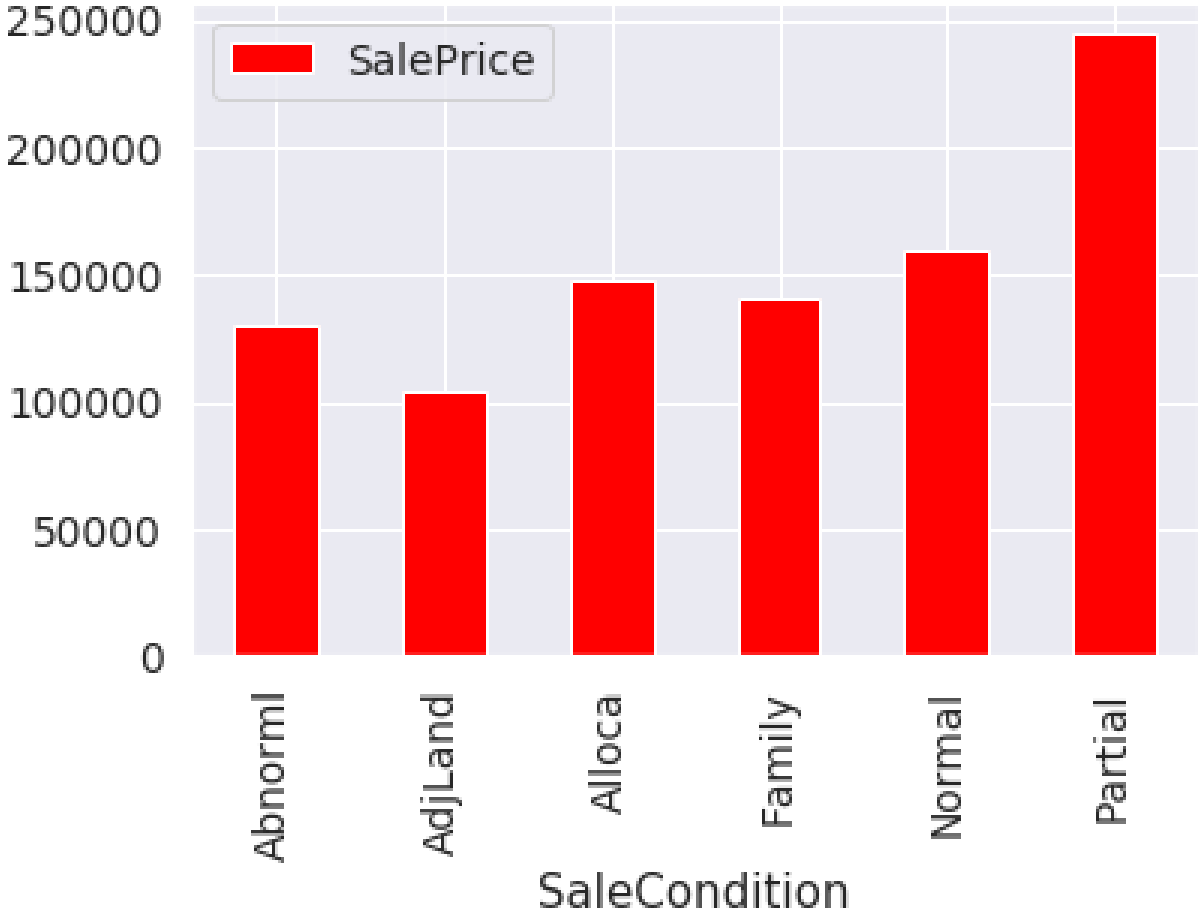
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5471c8a8d0
```



This plot tells us that a house which has place for 3 cars cost more than a p
due to the fact that when the capacity of the car space increases, the living
decrease, making the place go down in price.

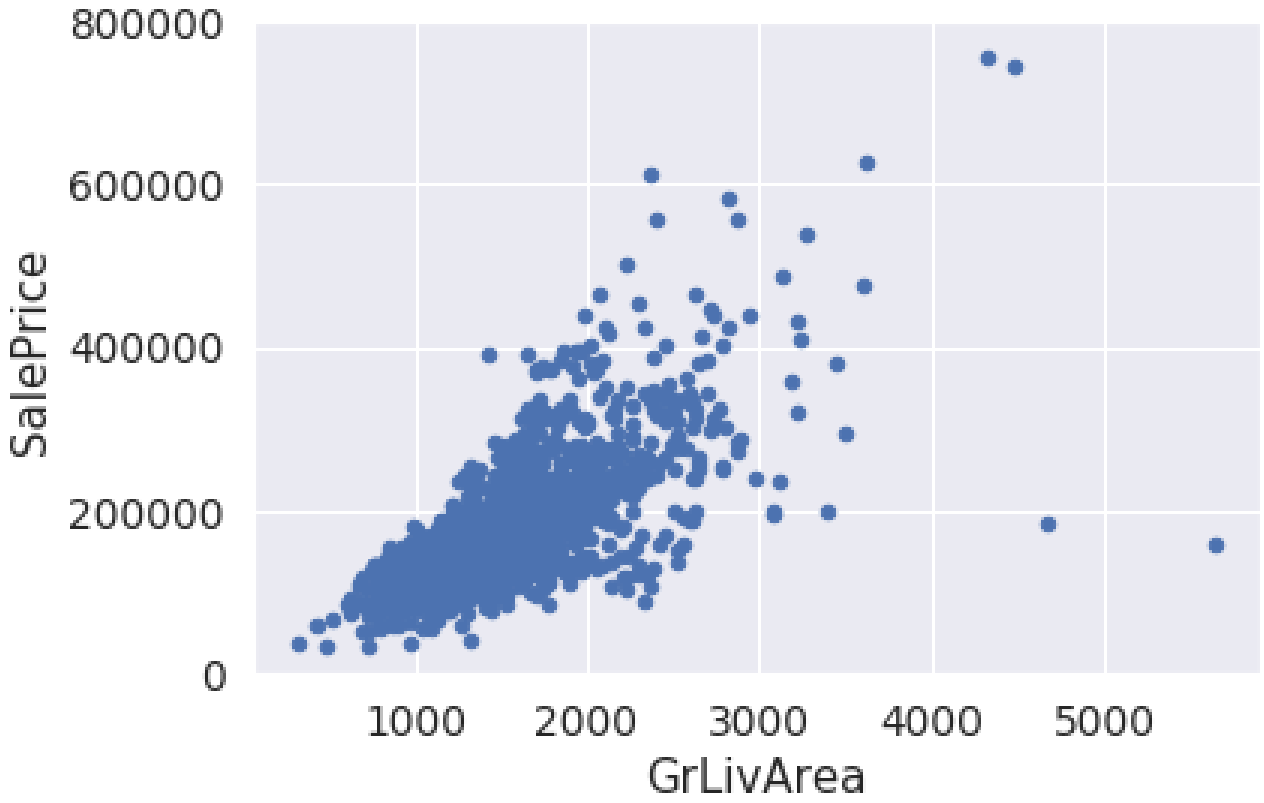
```
# TODO: code to generate Plot 3
sp_pivot = df1.pivot_table(index='SaleCondition', values='SalePri
sp_pivot.plot(kind='bar', color='red')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f54710cfeb8
```



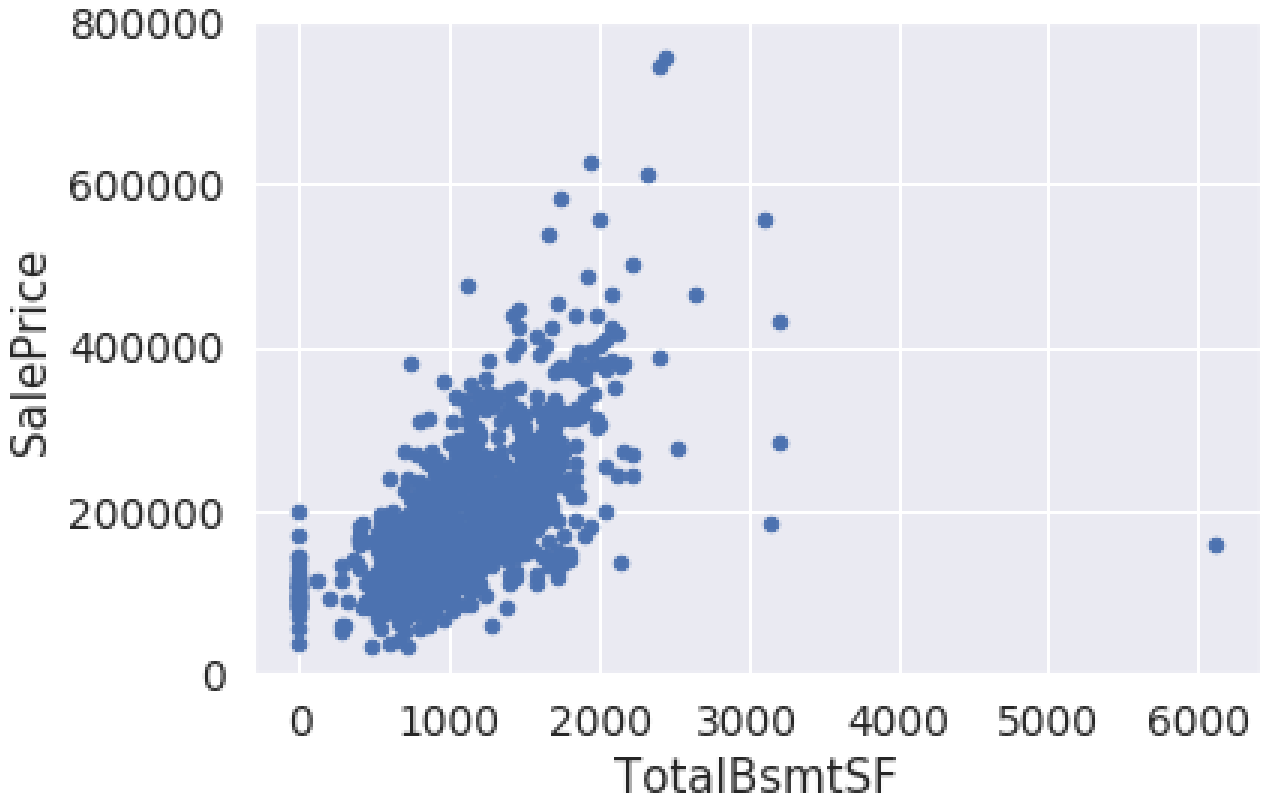
It seems that people love Partial housing. They dont want the whole thing.

```
# TODO: code to generate Plot 4
data = pd.concat([df1['SalePrice'], df1['GrLivArea']], axis=1)
data.plot.scatter(x='GrLivArea', y='SalePrice', ylim=(0,800000));
```



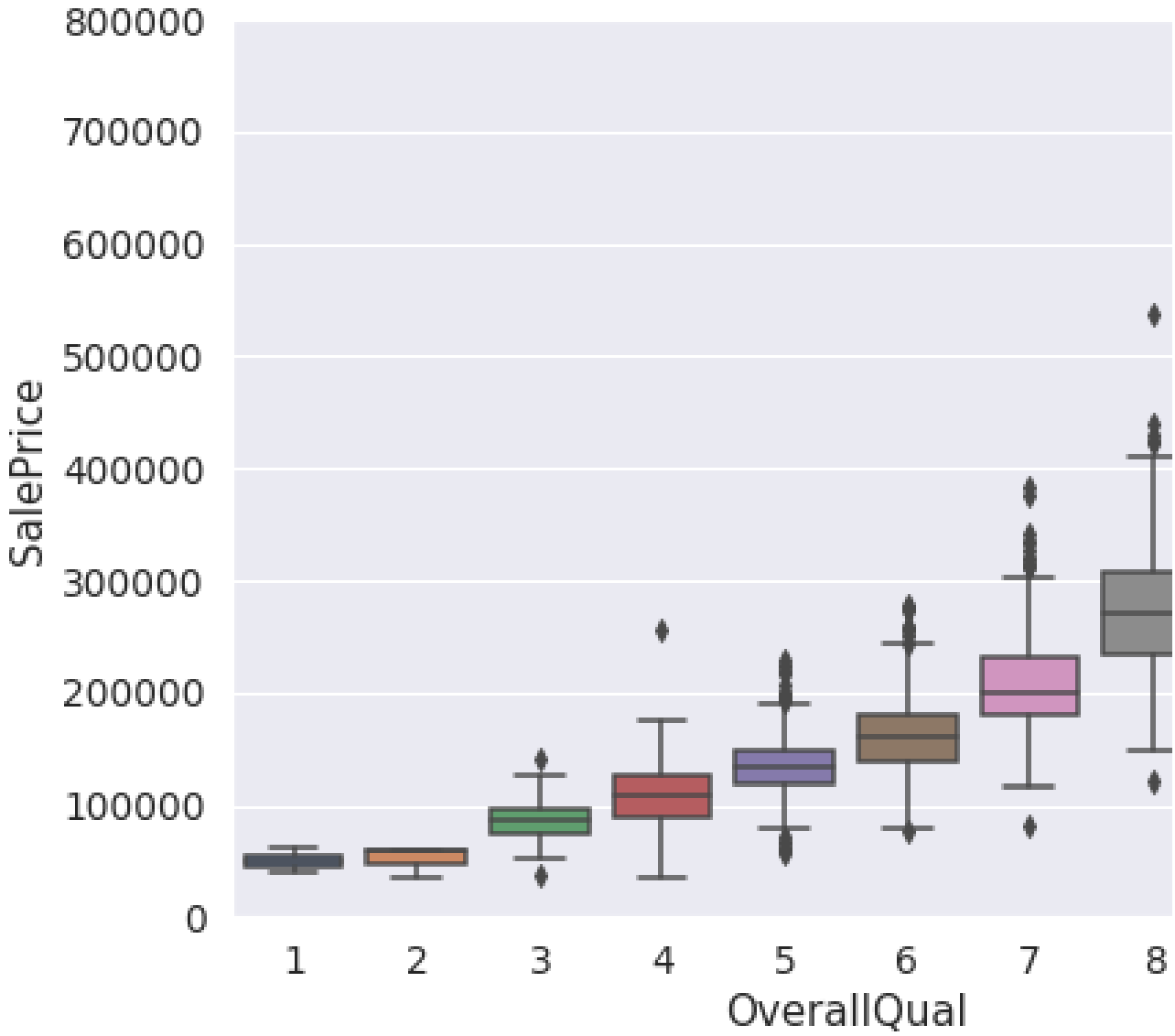
This graph shows that GrLivArea, i.e. Ground Live Area is highly correlated t
actually very self explanatory. But, we also see some outliers in the data. We
which seems odd and might be an outlier or faulty entry.

```
# TODO: code to generate Plot 5
data = pd.concat([df1['SalePrice'], df1['TotalBsmtSF']], axis=1)
data.plot.scatter(x='TotalBsmtSF', y='SalePrice', ylim=(0,800000)
```



This is also a very intutive graph and shows that the more the area, more is

```
var = 'OverallQual'
data = pd.concat([df1['SalePrice'], df1[var]], axis=1)
f, ax = plt.subplots(figsize=(8, 6))
fig = sns.boxplot(x=var, y="SalePrice", data=data)
fig.axis(ymin=0, ymax=800000);
```



This again shows a linear relation. This essentially means that as the quality intuitive and is also inherently true.

Data Cleaning

```
test = pd.read_csv('/kaggle/input/house-prices-advanced-regressior
ntrain = df1.shape[0]
ntest = test.shape[0]
y_train = df1.SalePrice.values
all_data = pd.concat((df1, test), sort=False).reset_index(drop=Tru
```

```
all_data.drop(['SalePrice'], axis=1, inplace=True)
print("all_data size is : {}".format(all_data.shape))
```

```
all_data size is : (2919, 80)
```

```
total = all_data.isnull().sum().sort_values(ascending=False)
percent = (all_data.isnull().sum()/all_data.isnull().count()).sort
missing_data = pd.concat([total, percent], axis=1, keys=['Total',
missing_data.head(35)
```

	Total	Percent
PoolQC	2909	0.996574
MiscFeature	2814	0.964029
Alley	2721	0.932169
Fence	2348	0.804385
FireplaceQu	1420	0.486468
LotFrontage	486	0.166495
GarageCond	159	0.054471
GarageQual	159	0.054471
GarageYrBlt	159	0.054471
GarageFinish	159	0.054471
GarageType	157	0.053786
BsmtCond	82	0.028092
BsmtExposure	82	0.028092
BsmtQual	81	0.027749
BsmtFinType2	80	0.027407
BsmtFinType1	79	0.027064
MasVnrType	24	0.008222
MasVnrArea	23	0.007879
MSZoning	4	0.001370
BsmtHalfBath	2	0.000685

Utilities	2	0.000685
Functional	2	0.000685
BsmtFullBath	2	0.000685
BsmtFinSF1	1	0.000343
Exterior1st	1	0.000343
Exterior2nd	1	0.000343
BsmtFinSF2	1	0.000343
BsmtUnfSF	1	0.000343
TotalBsmtSF	1	0.000343
SaleType	1	0.000343
Electrical	1	0.000343
KitchenQual	1	0.000343
GarageArea	1	0.000343
GarageCars	1	0.000343
HouseStyle	0	0.000000

Here, we see that PoolQC is the mostly missing data which might be correct house.Similar for Alley,MiscFetaure,FirePlaceQu. We can see that these feat Garage values have same missing values and hence that can also be delete have 1 missing values which might mean that there is 1 row that has all thes

```
all_data = all_data.drop((missing_data[missing_data['Total'] > 1]
all_data = all_data.drop((missing_data[missing_data['Total'] == 1
all_data.isnull().sum().max()
```

```
0
```

```
train = all_data[:ntrain]
test = all_data[ntrain:]
```

```
train['Neighborhood']
```

```
0       CollgCr
1       Veenker
2       CollgCr
3       Crawfor
4       NoRidge
         ...
1455    Gilbert
1456     NWAmes
1457    Crawfor
1458      NAmes
1459    Edwards
Name: Neighborhood, Length: 1460, dtype: object
```

Part 3 - Handcrafted Scoring Function

```
# TODO: code for scoring function
df2 = train
f = df2.groupby(['GrLivArea']).mean()
# g = f.rank(1,'SalePrice')
g1 = df1.groupby('Neighborhood').mean()['SalePrice'].rank(ascendi
g2 = df1.groupby('GrLivArea').mean()['SalePrice'].rank(ascending=
g3 = df1.groupby('OverallQual').mean()['SalePrice'].rank(ascendin
g4 = df1.groupby('GarageCars').mean()['SalePrice'].rank(ascending=
g5 = df1.groupby('GarageArea').mean()['SalePrice'].rank(ascending=
g6 = df1.groupby('TotalBsmtSF').mean()['SalePrice'].rank(ascendin
g7 = df1.groupby('1stFlrSF').mean()['SalePrice'].rank(ascending=Tr
g8 = df1.groupby('FullBath').mean()['SalePrice'].rank(ascending=Tr
```

```
g9 = df1.groupby('TotRmsAbvGrd').mean()['SalePrice'].rank(ascendi
g10 = df1.groupby('YearBuilt').mean()['SalePrice'].rank(ascending=

t1 = g1.to_dict()
t2 = g2.to_dict()
t3 = g3.to_dict()
t4 = g4.to_dict()
t5 = g5.to_dict()
t6 = g6.to_dict()
t7 = g7.to_dict()
t8 = g8.to_dict()
t9 = g9.to_dict()
t10 = g10.to_dict()

train1 = pd.DataFrame()

cols = ['Neighborhood','OverallQual','GrLivArea','GarageCars','Ga
        'TotRmsAbvGrd','YearBuilt']
for x in cols:
    train1[x] = df1[x]
train1.head()
```

	Neighborhood	OverallQual	GrLivArea	GarageCars	Gar
0	CollgCr	7	1710	2	
1	Veenker	6	1262	2	
2	CollgCr	7	1786	2	
3	Crawfor	7	1717	3	
4	NoRidge	8	2198	3	

```
t90 = pd.DataFrame()
def score_fn():
    c = train1['Neighborhood'].count()
    lst = list(range(c))
    print(train1)
    for i in lst:
        j = int(i)
        t = train1.iloc[j]['Neighborhood']
```

```
        f = t1[t]
        train1.set_value(j, 'Neighborhood', f)
    t90 = train1
    print(t90)
    train1['Sum'] = train1.sum(axis=1)
    #train1['Neighborhood']
    t3 = train1.nlargest(10, ['Sum'])
    t5 = train1.nsmallest(10, ['Sum'])
    for index, row in train1.iterrows():
        x1 = row['Neighborhood']
        for item in g1.items():
            if item[1] == x1:
                t3.set_value(index, 'Neighborhood', item[0])

    for index, row in train1.iterrows():
        x1 = row['Neighborhood']
        for item in g1.items():
            if item[1] == x1:
                t5.set_value(index, 'Neighborhood', item[0])
    t4 = t3.nlargest(10, ['Sum'])
    t6 = t5.nlargest(10, ['Sum'])
    return t4,t6
```

What is the ten most desirable houses?

```
t4,t6 = score_fn()
t4
```

```
     Neighborhood  OverallQual  GrLivArea  GarageCars  G
0         CollgCr            7       1710           2
1         Veenker            6       1262           2
2         CollgCr            7       1786           2
3         Crawfor            7       1717           3
4         NoRidge            8       2198           3
...           ...          ...        ...         ...
1455      Gilbert            6       1647           2
1456       NWAmes            6       2073           2
1457      Crawfor            7       2340           1
1458        NAmes            5       1078           1
1459      Edwards            5       1256           1

      TotalBsmtSF  1stFlrSF  FullBath  TotRmsAbvGrd  Yea
0             856       856         2             8
1            1262      1262         2             6
2             920       920         2             6
3             756       961         1             7
4            1145      1145         2             9
...           ...       ...       ...           ...
1455          953       953         2             7
1456         1542      2073         2             7
1457         1152      1188         2             9
1458         1078      1078         1             5
1459         1256      1256         1             6

[1460 rows x 10 columns]
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
  # Remove the CWD from sys.path while we load stuff.
     Neighborhood  OverallQual  GrLivArea  GarageCars  G
0              17            7       1710           2
1              21            6       1262           2
2              17            7       1786           2
3              18            7       1717           3
4              25            8       2198           3
...           ...          ...        ...         ...
1455           15            6       1647           2
1456           14            6       2073           2
```

```
1457           18            7       2340           1
1458           11            5       1078           1
1459            5            5       1256           1

      TotalBsmtSF  1stFlrSF  FullBath  TotRmsAbvGrd  Yea
0             856       856         2             8
1            1262      1262         2             6
2             920       920         2             6
3             756       961         1             7
4            1145      1145         2             9
...           ...       ...       ...           ...
1455          953       953         2             7
1456         1542      2073         2             7
1457         1152      1188         2             9
1458         1078      1078         1             5
1459         1256      1256         1             6

[1460 rows x 10 columns]
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
```

	Neighborhood	OverallQual	GrLivArea	GarageCars
1298	Edwards	10.0	5642.0	2.0
523	Edwards	10.0	4676.0	3.0
496	NoRidge	8.0	3228.0	2.0
1182	NoRidge	10.0	4476.0	3.0
691	NoRidge	10.0	4316.0	3.0
1373	NoRidge	10.0	2633.0	3.0
440	NridgHt	10.0	2402.0	3.0
1169	NoRidge	10.0	3627.0	3.0
224	NridgHt	10.0	2392.0	3.0

1044	NWAmes	8.0	2524.0	2.0

What is the ten least desirable houses?

```
t90
```

—

```
t6
```

	Neighborhood	OverallQual	GrLivArea	GarageCars
125	IDOTRR	6.0	754.0	0.0
29	BrkSide	4.0	520.0	1.0
916	IDOTRR	2.0	480.0	1.0
1321	BrkSide	3.0	720.0	1.0
710	BrkSide	3.0	729.0	0.0
528	Edwards	4.0	605.0	0.0
1218	BrkSide	4.0	912.0	0.0
705	IDOTRR	4.0	1092.0	0.0
1100	SWISU	2.0	438.0	1.0
533	BrkSide	1.0	334.0	0.0

I have selected items that have the highest correlation with the SalePrice. To values and made a score for each one of them. The neighborhood has been has been given the highest value. The rest being integer values were added house of area 3000>2000 and hence will give more weight to overall score.

Part 4 - Pairwise Distance Function

```
# TODO: code for distance function
cols = ['Neighborhood','OverallQual','GrLivArea','1stFlrSF','FullB
        'TotRmsAbvGrd','YearBuilt']
for x in cols:
    train1[x] = train[x]
train1.head()
```

	Neighborhood	OverallQual	GrLivArea	GarageCars	Gar
0	CollgCr	7	1710	2	
1	Veenker	6	1262	2	
2	CollgCr	7	1786	2	
3	Crawfor	7	1717	3	
4	NoRidge	8	2198	3	

```
train['Neighborhood'].unique()
```

```
      array(['CollgCr', 'Veenker', 'Crawfor', 'NoRidge', 'Mitc
             'NWAmes', 'OldTown', 'BrkSide', 'Sawyer', 'NridgH
             'SawyerW', 'IDOTRR', 'MeadowV', 'Edwards', 'Timbe
             'StoneBr', 'ClearCr', 'NPkVill', 'Blmngtn', 'BrDa
```

```
from sklearn.preprocessing import LabelEncoder
train3 = train
cols = ('Street','LotShape','LandContour','LotConfig','LandSlope',
        'HouseStyle','RoofStyle','RoofMatl','ExterQual','ExterCond
        'PavedDrive','SaleCondition')

# process columns, apply LabelEncoder to categorical features
for c in cols:
    lbl = LabelEncoder()
    lbl.fit(list(train3[c].values))
    train3[c] = lbl.transform(list(train3[c].values))

# shape
print('Shape all_data: {}'.format(train3.shape))
```

```
Shape all_data: (1460, 46)
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
A value is trying to be set on a copy of a slice from a
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pyda
  # This is added back by InteractiveShellApp.init_path(
```

```
#train90 = train1
def pairwise(a,b):
    #print(np.linalg.norm(a-b))
    return np.linalg.norm(a-b)
```

```
train90 = train1
```

```
train90.rename(columns={ train90.columns[0]: "Neighborhood" }, inp
c = train90['Neighborhood'].count()
lst = list(range(c))
print(train90)
for i in lst:
    j = int(i)
    t = train90.iloc[j]['Neighborhood']
    f = t1[t]
    train90.set_value(j, 'Neighborhood', f)

train90
```

```
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
  # Remove the CWD from sys.path while we load stuff.
     Neighborhood  OverallQual  GrLivArea  GarageCars  G
0         CollgCr            7       1710           2
1         Veenker            6       1262           2
2         CollgCr            7       1786           2
3         Crawfor            7       1717           3
4         NoRidge            8       2198           3
...           ...          ...        ...         ...
1455      Gilbert            6       1647           2
1456       NWAmes            6       2073           2
1457      Crawfor            7       2340           1
1458        NAmes            5       1078           1
1459      Edwards            5       1256           1

      TotalBsmtSF  1stFlrSF  FullBath  TotRmsAbvGrd  Yea
0             856       856         2             8
1            1262      1262         2             6
2             920       920         2             6
3             756       961         1             7
4            1145      1145         2             9
...           ...       ...       ...           ...
1455          953       953         2             7
1456         1542      2073         2             7
1457         1152      1188         2             9
1458         1078      1078         1             5
1459         1256      1256         1             6

[1460 rows x 11 columns]
```

	Neighborhood	OverallQual	GrLivArea	GarageCars
0	17	7	1710	2
1	21	6	1262	2
2	17	7	1786	2
3	18	7	1717	3

```
train3 = train
from sklearn.preprocessing import LabelEncoder
cols = ('Street','LotShape','LandContour','LotConfig','LandSlope',
        'HouseStyle','RoofStyle','RoofMatl','ExterQual','ExterCond
        'PavedDrive','SaleCondition')

# process columns, apply LabelEncoder to categorical features
for c in cols:
    lbl = LabelEncoder()
    lbl.fit(list(train3[c].values))
    train3[c] = lbl.transform(list(train3[c].values))

# shape
print('Shape all_data: {}'.format(train3.shape))
```

```
Shape all_data: (1460, 46)
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
A value is trying to be set on a copy of a slice from a
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pyda
  # This is added back by InteractiveShellApp.init_path(
```

How well does the distance function work? When does it do well/badly?

```
train3 = train
```

Part 5 - Clustering

```
from sklearn.cluster import DBSCAN
clustering = DBSCAN(eps=280, min_samples=2, metric = pairwise).fit
clust = clustering.labels_
clust
```

How well do the clusters reflect neighborhood boundaries? Write a discussi

```
clust1 = pd.DataFrame(clust)
clust1[0].unique()
```

```
array([ 0,  1,  2, -1,  3,  4,  5,  6,  7,  8,  9, 10, 1
```

```
ytrain_pca = pd.DataFrame(clust)
```

```
from sklearn.decomposition import PCA
pca = PCA(n_components=2)
principalComponents = pca.fit_transform(train90)
principalDf = pd.DataFrame(data = principalComponents
             , columns = ['principal component 1', 'principal comp
finalDf = pd.concat([principalDf, ytrain_pca], axis = 1)
print(type(finalDf))
finalDf.rename(columns={ finalDf.columns[2]: "target" }, inplace =
finalDf
```

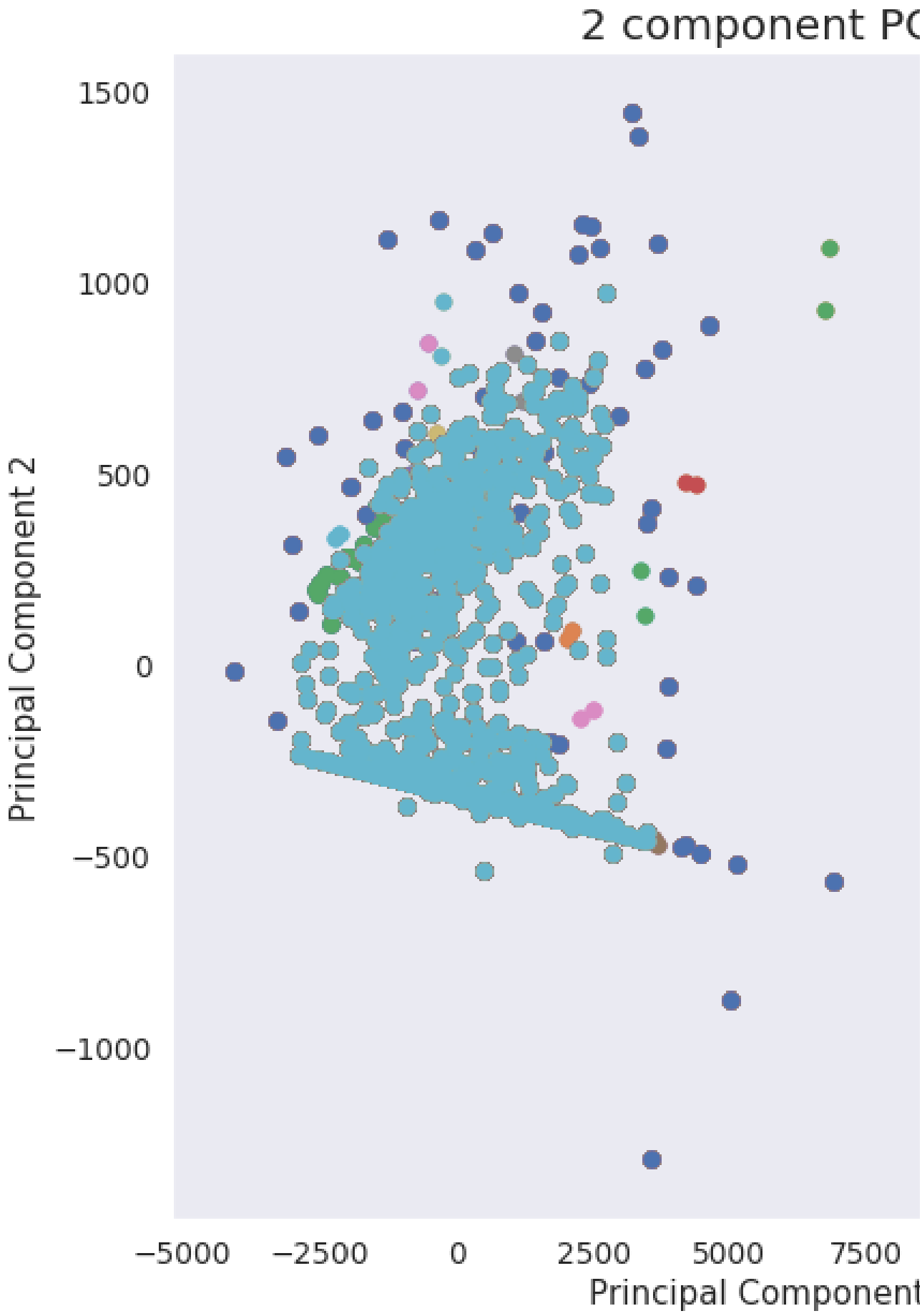
```
<class 'pandas.core.frame.DataFrame'>
```

	principal component 1	principal component 2	tar
0	-235.736040	355.674021	
1	44.762207	-340.774393	
2	53.978297	354.994340	
3	-210.277845	384.773229	

```
type(clust)
```

```
numpy.ndarray
```

```
fig = plt.figure(figsize = (10,10))
ax = fig.add_subplot(1,1,1)
ax.set_xlabel('Principal Component 1', fontsize = 15)
ax.set_ylabel('Principal Component 2', fontsize = 15)
ax.set_title('2 component PCA', fontsize = 20)

targets = clust
#colors = ['r', 'g', 'b']
for target in targets:
    indicesToKeep = finalDf['target'] == target
    ax.scatter(finalDf.loc[indicesToKeep, 'principal component 1']
               , finalDf.loc[indicesToKeep, 'principal component 2']
               , s = 50)
ax.legend(clust1[0].unique())
ax.grid()
```


2 component PC
1500
1000
500
0
−500
−1000
Principal Component 2
−5000
−2500
0
2500
5000
7500
Principal Component

As can be seen from the figure, the clusters are based on the distance and u
used PCA to decrease the number of components and hence view it in a 2D

Part 6 - Linear Regression

```
from sklearn.preprocessing import LabelEncoder
cols = ('Street','LotShape','LandContour','LotConfig','LandSlope',
        'HouseStyle','RoofStyle','RoofMatl','ExterQual','ExterCond
        'PavedDrive','SaleCondition')

# process columns, apply LabelEncoder to categorical features
for c in cols:
    lbl = LabelEncoder()
    lbl.fit(list(test[c].values))
    test[c] = lbl.transform(list(test[c].values))
```

```
# shape
print('Shape all_data: {}'.format(test.shape))
```

```
Shape all_data: (1459, 46)
/opt/conda/lib/python3.6/site-packages/ipykernel_launche
A value is trying to be set on a copy of a slice from a
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pyda
  # Remove the CWD from sys.path while we load stuff.
```

```
# TODO: code for linear regression
train3 = train
from sklearn.linear_model import LinearRegression
model1 = LinearRegression()
model1.fit(train3,y_train)
predict1 = model1.predict(train3)
predict = model1.predict(test)
from sklearn.metrics import mean_squared_error
from math import sqrt
rms = sqrt(mean_squared_error(y_train, predict1))

coeff_df = pd.DataFrame(model1.coef_, train3.columns, columns=['Co
```

```
y_train.shape
```

```
(1460,)
```

```
rms
```

```
34302.96425845283
```

```
coeff_df
```

	Coefficient
Id	-1.566255
MSSubClass	-60.696718
LotArea	0.442976
Street	29152.318379
LotShape	-1126.725301
LandContour	3081.166099
LotConfig	3.040278
LandSlope	10423.086793
Neighborhood	619.297191
Condition1	-1055.019868
Condition2	-8359.690266
BldgType	-3289.645623
HouseStyle	-434.117981
OverallQual	15521.969041
OverallCond	5388.537397
YearBuilt	469.921419
YearRemodAdd	30.138755
RoofStyle	2615.396384
RoofMatl	3398.248784
ExterQual	-17192.187405

ExterCond	986.247012
Foundation	371.686816
Heating	-1179.238785
HeatingQC	-904.423645
CentralAir	-3488.791818
1stFlrSF	37.144754
2ndFlrSF	19.588481
LowQualFinSF	-26.787338
GrLivArea	29.945898
FullBath	-312.409458
HalfBath	-867.346692
BedroomAbvGr	-8654.721697
KitchenAbvGr	-12488.826981
TotRmsAbvGrd	3824.038355
Fireplaces	4639.057311
PavedDrive	1543.345223
WoodDeckSF	30.795121
OpenPorchSF	-10.273531
EnclosedPorch	10.708368
3SsnPorch	19.840339
ScreenPorch	62.689786

PoolArea	-18.343098
MiscVal	-1.594904
MoSold	-220.891501
YrSold	-1154.313793
SaleCondition	2736.791333

How well/badly does it work? Which are the most important variables?

It gives a RMSE of 34302. We can see that it gives a lot f weightage to Stree KitchenAbvGrd and also ExterQual. Here, the theta denote the amount of we

Part 7 - External Dataset

```
# TODO: code to import external dataset and test
import random


lst =[]
for i in range(1460):
    lst.append(random.randint(1,5))
i = pd.DataFrame(lst)
i.rename(columns={ i.columns[0]: "Schools" }, inplace = True)
i
# random.randint(3,4)
```

	Schools
0	2
1	4
2	4
3	3
4	4
...	...
1455	3
1456	5
1457	5

```
train4 = train
len(train4.columns)
train4.shape
ext1 = np.ones(1460)
ext1 = ext1*3
ext1 = np.transpose(ext1)
ext1 = np.reshape(ext1, (1460,1))
ext1
ext1 = pd.DataFrame(ext1)
#ext1
#ext1.rename(columns={ ext1.columns[0]: "Schools" }, inplace = Tru
# train4 = pd.concat([train4,ext1],axis=1)
train4 = pd.concat([train4,i],axis=1)
y_train = pd.DataFrame(y_train)
y_train.rename(columns={ y_train.columns[0]: "Y" }, inplace = True
train4 = pd.concat([train4,y_train],axis=1)
from scipy.stats import pearsonr
corr, _ = pearsonr(train4['Schools'], train4['Y'])
corr
#train4['Schools'].isnull().sum()
```

```
0.030610303498988183
```

```
train['Neighborhood'].unique()
```

```
array([ 5, 24,  6, 15, 11, 21, 14, 17,  3, 19, 16, 12, 2
        8, 22,  4, 13,  0,  2, 18,  1])
```

The dataset chosen here in of how many schools are present in the vincinity schools around the area, there are a limited choices they have and hence a r still it shows some correlation if not 0. Under exact and correct circumstane might lead to a better prediction

Part 8 - Permutation Test

```
# TODO: code for all permutation tests
train4 = pd.DataFrame()
train4['OverallQual'] = train['OverallQual']
train5 = pd.DataFrame()
train5['GrLivArea'] = train['GrLivArea']
train6 = pd.DataFrame()
train6['Street'] = train['Street']
train7 = pd.DataFrame()
train7['KitchenAbvGr'] = train['KitchenAbvGr']
train8 = pd.DataFrame()
train8['SaleCondition'] = train['SaleCondition']
train9 = pd.DataFrame()
train9['YrSold'] = train['YrSold']
train10 = pd.DataFrame()
train10['LotArea'] = train['LotArea']
train11 = pd.DataFrame()
train11['CentralAir'] = train['CentralAir']
train12 = pd.DataFrame()
train12['FullBath'] = train['FullBath']
train13 = pd.DataFrame()
train13['HalfBath'] = train['HalfBath']
```

```
model2 = LinearRegression()
model3 = LinearRegression()
model4 = LinearRegression()
model5 = LinearRegression()
model6 = LinearRegression()
model7 = LinearRegression()
model8 = LinearRegression()
model9 = LinearRegression()
model10 = LinearRegression()
model11 = LinearRegression()


model2.fit(train4,y_train)
model3.fit(train5,y_train)
model4.fit(train6,y_train)
model5.fit(train7,y_train)
model6.fit(train8,y_train)
model7.fit(train9,y_train)
model8.fit(train10,y_train)
model9.fit(train11,y_train)
model10.fit(train12,y_train)
model11.fit(train13,y_train)


test1 = pd.DataFrame()
test1['OverallQual'] = test['OverallQual']
test2 = pd.DataFrame()
test2['GrLivArea'] = test['GrLivArea']
test3 = pd.DataFrame()
test3['Street'] = test['Street']
test3 = pd.get_dummies(test3)
test4 = pd.DataFrame()
test4['KitchenAbvGr'] = test['KitchenAbvGr']
test5 = pd.DataFrame()
test5['SaleCondition'] = test['SaleCondition']
test5 = pd.get_dummies(test5)
test6 = pd.DataFrame()
test6['YrSold'] = test['YrSold']
test7 = pd.DataFrame()
test7['LotArea'] = test['LotArea']
test8 = pd.DataFrame()
test8['CentralAir'] = test['CentralAir']
test9 = pd.DataFrame()
test9['FullBath'] = test['FullBath']
test10 = pd.DataFrame()
test10['HalfBath'] = test['HalfBath']
```

```
#test5 = pd.get_dummies(test5)


predicted_prices2 = model2.predict(test1)
predicted_prices3 = model3.predict(test2)
predicted_prices4 = model4.predict(test3)
predicted_prices5 = model5.predict(test4)
predicted_prices6 = model6.predict(test5)
predicted_prices7 = model7.predict(test6)
predicted_prices8 = model8.predict(test7)
predicted_prices9 = model9.predict(test8)
predicted_prices10 = model10.predict(test9)
predicted_prices11 = model11.predict(test10)


y_train_com = y_train.sample(100,random_state=1)

predicted_prices2_comp = pd.DataFrame(predicted_prices2).sample(10
predicted_prices3_comp = pd.DataFrame(predicted_prices3).sample(10
predicted_prices4_comp = pd.DataFrame(predicted_prices4).sample(10
predicted_prices5_comp = pd.DataFrame(predicted_prices5).sample(10
predicted_prices6_comp = pd.DataFrame(predicted_prices6).sample(10
predicted_prices7_comp = pd.DataFrame(predicted_prices7).sample(10
predicted_prices8_comp = pd.DataFrame(predicted_prices8).sample(10
predicted_prices9_comp = pd.DataFrame(predicted_prices9).sample(10
predicted_prices10_comp = pd.DataFrame(predicted_prices10).sample(
predicted_prices11_comp = pd.DataFrame(predicted_prices11).sample(

from sklearn.metrics import mean_squared_error
#y_train_com = pd.DataFrame(y_train_com).fillna('0')
predicted_prices2_comp = predicted_prices2_comp.reset_index()
#y_train_com = y_train_com.reset_index()
np.reshape(y_train_com, (100,1))
predicted_prices2_comp.rename(columns={ predicted_prices2_comp.col
predicted_prices21_comp = pd.DataFrame()
predicted_prices21_comp['SalesPrice'] = predicted_prices2_comp['Sa
print("MSE1",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE2",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE3",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE4",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE5",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE6",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE7",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE8",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE9",mean_squared_error(np.log(y_train_com), np.log(predic
print("MSE10",mean_squared_error(np.log(y_train_com), np.log(predi
```

```
# We will look at the predicted prices to ensure we have something
#print(predicted_prices2)
score_dict={}
pvalue_dict={}
pvalue_lst = []
from sklearn.model_selection import permutation_test_score
score1,perm_score, pvalue= permutation_test_score(model2, train4,
print("OverallQual", score1)
t=train4.columns.values
pvalue_dict[str(t)]=pvalue
score2,perm_score, pvalue= permutation_test_score(model3, train5,
print("GrLiveArea", score2)
t=train5.columns.values
pvalue_dict[str(t)]=pvalue
score3,perm_score, pvalue= permutation_test_score(model4, train6,
print("Steet", score3)
t=train6.columns.values
pvalue_dict[str(t)]=pvalue
score4,perm_score, pvalue= permutation_test_score(model5, train7,
print("KitchenAbvGrd", score4)
t=train7.columns.values
pvalue_dict[str(t)]=pvalue
score5,perm_score, pvalue= permutation_test_score(model6, train8,
t=train8.columns.values
print("SaleCondition",score5)
pvalue_dict[str(t)]=pvalue
#pvalue_dict
```

```
MSE1 0.29654644179500783
MSE2 0.2536328196775782
MSE3 0.17759915876877005
MSE4 0.18886329487491202
MSE5 0.19390747652286883
MSE6 0.1752988431039135
MSE7 0.17458088838859515
MSE8 0.1959718844328004
MSE9 0.2147375052725084
MSE10 0.18619685832443314
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
  warnings.warn(CV_WARNING, FutureWarning)
OverallQual 0.6247257478644835
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
  warnings.warn(CV_WARNING, FutureWarning)
GrLiveArea 0.4924726967831159
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
```

```
predicted_prices21_comp
```

	SalesPrice
0	176408.736044
1	221844.538637
2	221844.538637
3	221844.538637
4	312716.143823
...	...
95	130972.933451

```
y_train2 = pd.DataFrame(y_train)
y_train2.isnull().sum()
```

```
Y    0
dtype: int64
```

```
train4.isnull().sum()
```

```
OverallQual    0
dtype: int64
```

```
import random
c1=0
for i in range(100):
#     print(train4.isnull().sum())
#     print(y_train1.isnull().sum())
    train40 = pd.concat([train4, y_train2], axis=1)
#     print(train40.isnull().sum())
    train41 = train40.sample(1000)
    train41.rename(columns={ train41.columns[1]: "SalePrice" }, ir
    y_train1 = train41['SalePrice']
    train41 = train41.drop('OverallQual',axis=1)
    score,perm_score, pvalue= permutation_test_score(model2, trair
```

```
        c1=c1+perm_score
    c1=c1/100
    #c1
    s = sns.distplot(c1)
    plt.xticks(rotation=45)
```

```
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
  warnings.warn(CV_WARNING, FutureWarning)
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
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  warnings.warn(CV_WARNING, FutureWarning)
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/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
```

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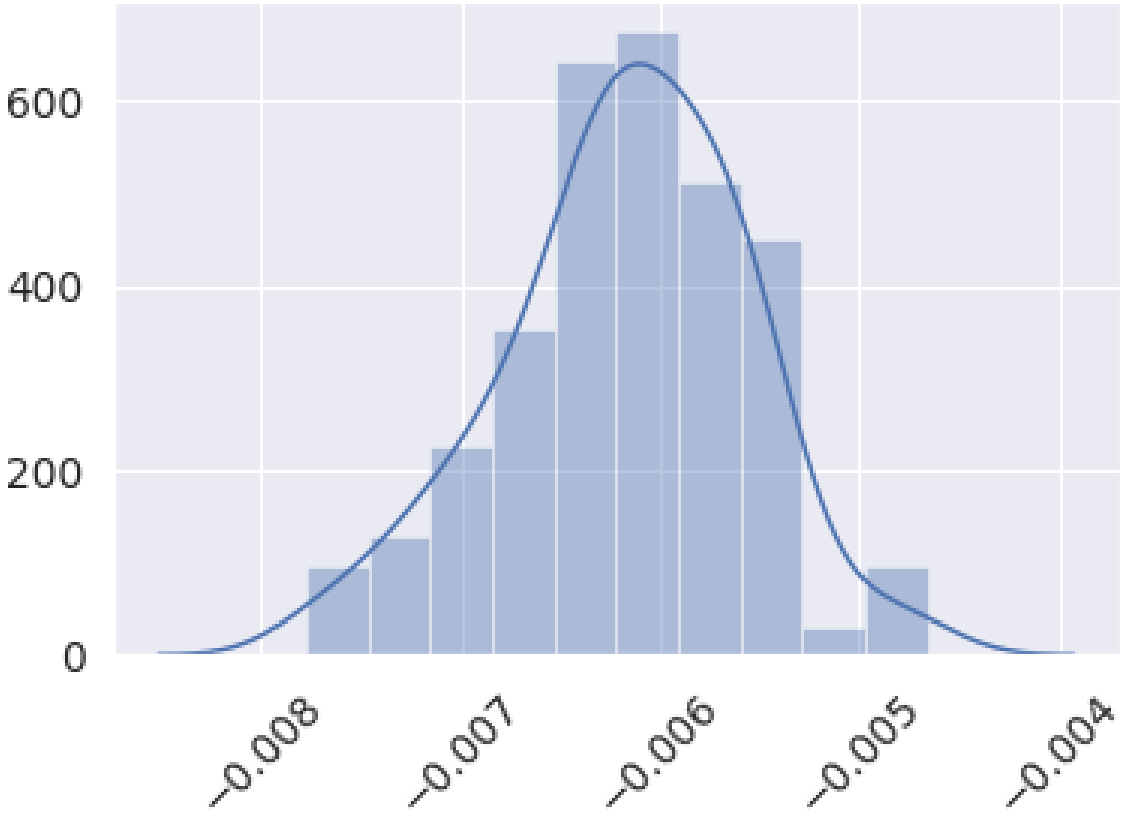
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
  warnings.warn(CV_WARNING, FutureWarning)
(array([-0.009, -0.008, -0.007, -0.006, -0.005, -0.004,
 <a list of 7 Text xticklabel objects>)
```




```
train40.isnull().sum()
```

```
OverallQual    0
Y              0
dtype: int64
```

```
c2=0
for i in range(100):
    train50 = pd.concat([train5, y_train2], axis=1)
    train51 = train50.sample(750)
    train51.rename(columns={ train51.columns[1]: "SalePrice" }, ir
    y_train1 = train51['SalePrice']
    train51 = train51.drop('GrLivArea',axis=1)
    score,perm_score, pvalue= permutation_test_score(model2, trair
    c2=c2+perm_score
c2=c2/100
c2
s = sns.distplot(c2)
plt.xticks(rotation=45)
```

```
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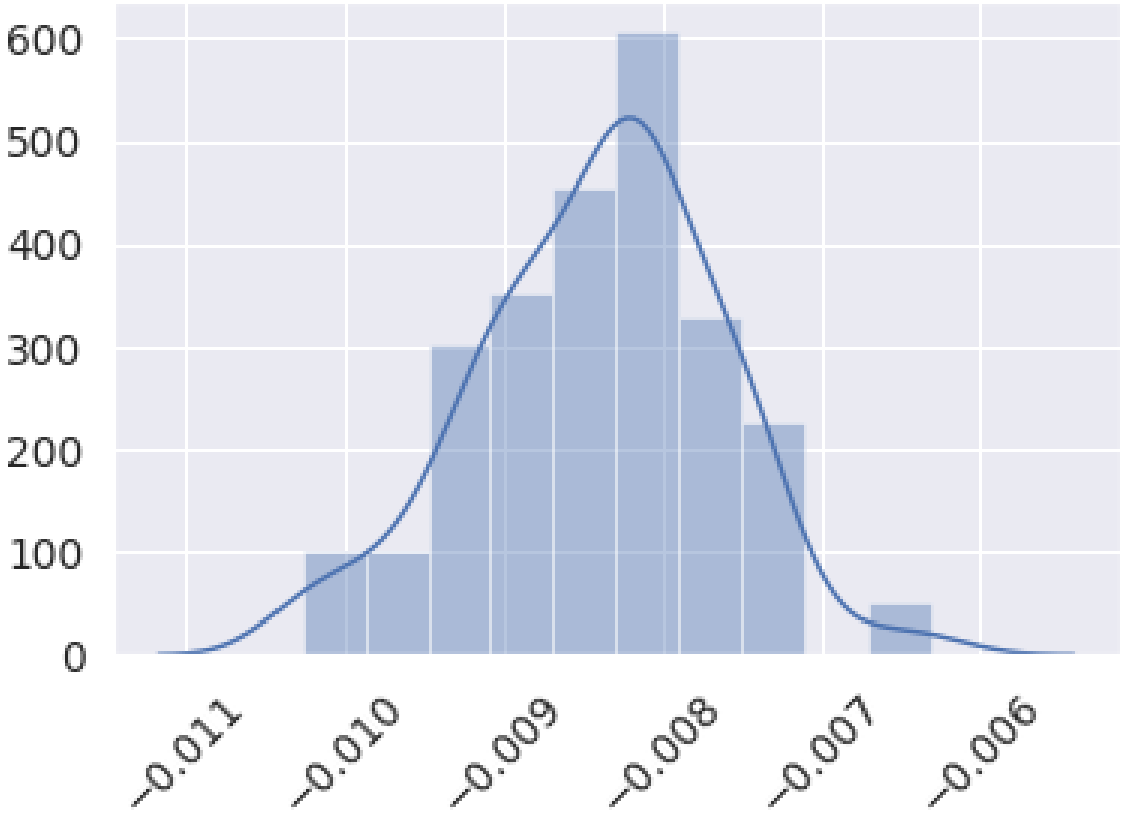
  warnings.warn(CV_WARNING, FutureWarning)
(array([-0.012, -0.011, -0.01 , -0.009, -0.008, -0.007,
 <a list of 8 Text xticklabel objects>)
```




```
c3=0
for i in range(100):
    train60 = pd.concat([train6, y_train2], axis=1)
    train61 = train60.sample(1000)
    train61.rename(columns={ train61.columns[1]: "SalePrice" }, in
    y_train1 = train61['SalePrice']
    train61 = train61.drop('Street',axis=1)
    score,perm_score, pvalue= permutation_test_score(model2, train
    c3=c3+perm_score
```

```
c3=c3/100
c3
s = sns.distplot(c3)
plt.xticks(rotation=45)
```

```
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
  warnings.warn(CV_WARNING, FutureWarning)
/opt/conda/lib/python3.6/site-packages/sklearn/model_sel
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(array([-0.009, -0.008, -0.007, -0.006, -0.005, -0.004])
 <a list of 6 Text xticklabel objects>)
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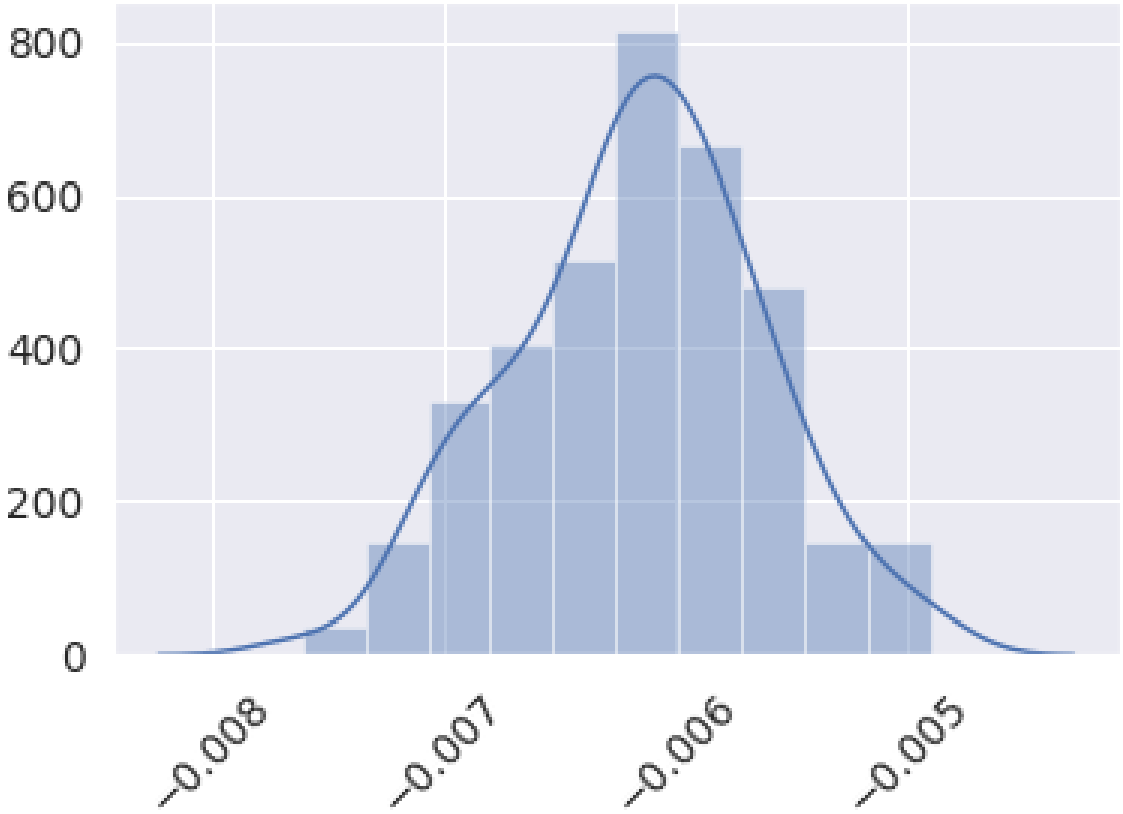


```
c4=0
for i in range(100):
    train70 = pd.concat([train7, y_train2], axis=1)
    train71 = train70.sample(1000)
    train71.rename(columns={ train71.columns[1]: "SalePrice" }, ir
    y_train1 = train71['SalePrice']
    train71 = train71.drop('KitchenAbvGr',axis=1)
    score,perm_score, pvalue= permutation_test_score(model2, trair
    c4=c4+perm_score
```

```
c4=c4/100
c4
s = sns.distplot(c4)
plt.xticks(rotation=45)
```

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