Final Project Submission

- Student name: Qilun Chen, Evan Serrano
- Student pace: full time
- Scheduled project review date/time: April/1/2022
- Instructor name: Praveen Gowtham, Joe Comeaux
- Blog post URL:https://github.com/nkbuddy/dsc-phase-2-project-NYC

WHAT FACTORS ARE DRIVING PRICE?

WHAT TOOLS CAN WE USE TO EVALUATE?

WHAT FEATURES ARE RELATED TO EACH OTHER?

WHAT FEATURES CAN PREDICT PRICE?

In [464…

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from matplotlib import style
from matplotlib.ticker import StrMethodFormatter
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error
from sklearn.metrics import mean_squared_error
import statsmodels.api as sm
from statsmodels.formula.api import ols
from scipy import stats
from sklearn.preprocessing import StandardScaler

%matplotlib inline
```

Data cleaning

In [465…

```
data = pd.read_csv('data/kc_house_data.csv')
data.head()
```

Out[465…

	id	date	price	bedrooms	bathrooms	sqft_living	sqft_lot	floors	wate
0	7129300520	10/13/2014	221900.0	3	1.00	1180	5650	1.0	
1	6414100192	12/9/2014	538000.0	3	2.25	2570	7242	2.0	
2	5631500400	2/25/2015	180000.0	2	1.00	770	10000	1.0	
3	2487200875	12/9/2014	604000.0	4	3.00	1960	5000	1.0	
4	1954400510	2/18/2015	510000.0	3	2.00	1680	8080	1.0	

5 rows × 21 columns

In [466…
```
data['grade'].unique()
```

Out[466…
```
array(['7 Average', '6 Low Average', '8 Good', '11 Excellent', '9 Better',
       '5 Fair', '10 Very Good', '12 Luxury', '4 Low', '3 Poor',
       '13 Mansion'], dtype=object)
```

In [467…
```
data.shape
```

Out[467…
```
(21597, 21)
```

In [468…
```
data.isna().sum()
```

Out[468…
```
id                0
date              0
price             0
bedrooms          0
bathrooms         0
sqft_living       0
sqft_lot          0
floors            0
waterfront     2376
view             63
condition         0
grade             0
sqft_above        0
sqft_basement     0
yr_built          0
yr_renovated   3842
zipcode           0
lat               0
long              0
sqft_living15     0
sqft_lot15        0
dtype: int64
```

In [469…
```
data.dtypes
```

Out[469…
```
id                int64
date             object
price           float64
bedrooms          int64
bathrooms       float64
sqft_living       int64
sqft_lot          int64
floors          float64
waterfront       object
view             object
condition        object
grade            object
sqft_above        int64
sqft_basement    object
yr_built          int64
yr_renovated    float64
zipcode           int64
lat             float64
long            float64
sqft_living15     int64
sqft_lot15        int64
dtype: object
```

change sqft_basement from object to float

In [470…
```
data.loc[:, 'sqft_basement'] = data['sqft_basement'].str.replace("?","0.0")
data.loc[:, 'sqft_basement'] = data['sqft_basement'].astype('float64')
```

```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/327206397.py:
1: FutureWarning: The default value of regex will change from True to False in
a future version. In addition, single character regular expressions will *not*
be treated as literal strings when regex=True.
  data.loc[:, 'sqft_basement'] = data['sqft_basement'].str.replace("?","0.0")
```

replace NaN in view to NONE

In [471…
```
data['view'] = data['view'].fillna('NONE')
```

replace NaN in waterfront to NO

In [472…
```
data['waterfront'] = data['waterfront'].fillna('NO')
```

replace NaN in yr_renovated to 0

In [473…
```
data['yr_renovated'] = data['yr_renovated'].fillna(0)
```

check how many NaN in data

In [474…
```
data.isna().sum().sum()
```

Out[474… 0

drop lat column and long column in data

In [475…
```
data.drop(columns = 'lat', inplace = True)
```

In [476…
```
data.drop(columns = 'long', inplace = True)
```

chreate new columns livingAreaRatio, year_sold, houseAge, pricePerSqft

In [477…
```
data['livingAreaRatio'] = data['sqft_living'] / data['sqft_lot']
```

In [478…
```
data['date'] = pd.to_datetime(data['date'])
data['year_sold'] = data['date'].dt.year
```

In [479…
```
data['houseAge'] = data['year_sold'] - data['yr_built']
```

In [480…
```
data['pricePerSqft'] = data['price'] / data['sqft_lot']
```

change columns waterfront, view, condition, grade to Ordinal encoding

In [481…
```
data['waterfront'] = pd.get_dummies(data['waterfront'], drop_first = True)
```

In [482…
```
data['view'] = data['view'].astype('category')
```

In [483…
```
data['view'] = data['view'].cat.reorder_categories(['NONE', 'FAIR', 'AVERAGE'
```

In [484…
```
data['view'] = data['view'].cat.codes
```

In [485…
```
data['condition'] = data['condition'].astype('category')
```

In [486…
```
data['condition'] = data['condition'].cat.codes
```

In [487…
```
data['grade'] = data.apply(lambda x:int(x['grade'][0:2].replace(' ','')),axis
```

Drop the unnecessary columns, "ID" and "Date"

In [488…
```
data.drop(['id','date'],axis=1,inplace=True)
```

To remove outliner

In [489…
```
def find_outliers(col):
    z = np.abs(stats.zscore(col))
    idx_outliers = np.where(z>3.49,True,False)
    return pd.Series(idx_outliers,index=col.index)
```

In [490…
```
df_test = pd.DataFrame()
for col in data.drop(['zipcode'], axis=1).columns:
    idx = find_outliers(data[col])
    df_test[col] = idx
```

In [491…
```
idx_all_outliers = df_test.any(axis=1)
df_clean = data[idx_all_outliers==False]
df_clean
```

Out[491…

	price	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	conditi
0	221900.0	3	1.00	1180	5650	1.0	0	0	
2	180000.0	2	1.00	770	10000	1.0	0	0	
3	604000.0	4	3.00	1960	5000	1.0	0	0	
4	510000.0	3	2.00	1680	8080	1.0	0	0	
6	257500.0	3	2.25	1715	6819	2.0	0	0	
…	…	…	…	…	…	…	…	…	…
21591	475000.0	3	2.50	1310	1294	2.0	0	0	
21593	400000.0	4	2.50	2310	5813	2.0	0	0	
21594	402101.0	2	0.75	1020	1350	2.0	0	0	
21595	400000.0	3	2.50	1600	2388	2.0	0	0	
21596	325000.0	2	0.75	1020	1076	2.0	0	0	

18951 rows × 21 columns

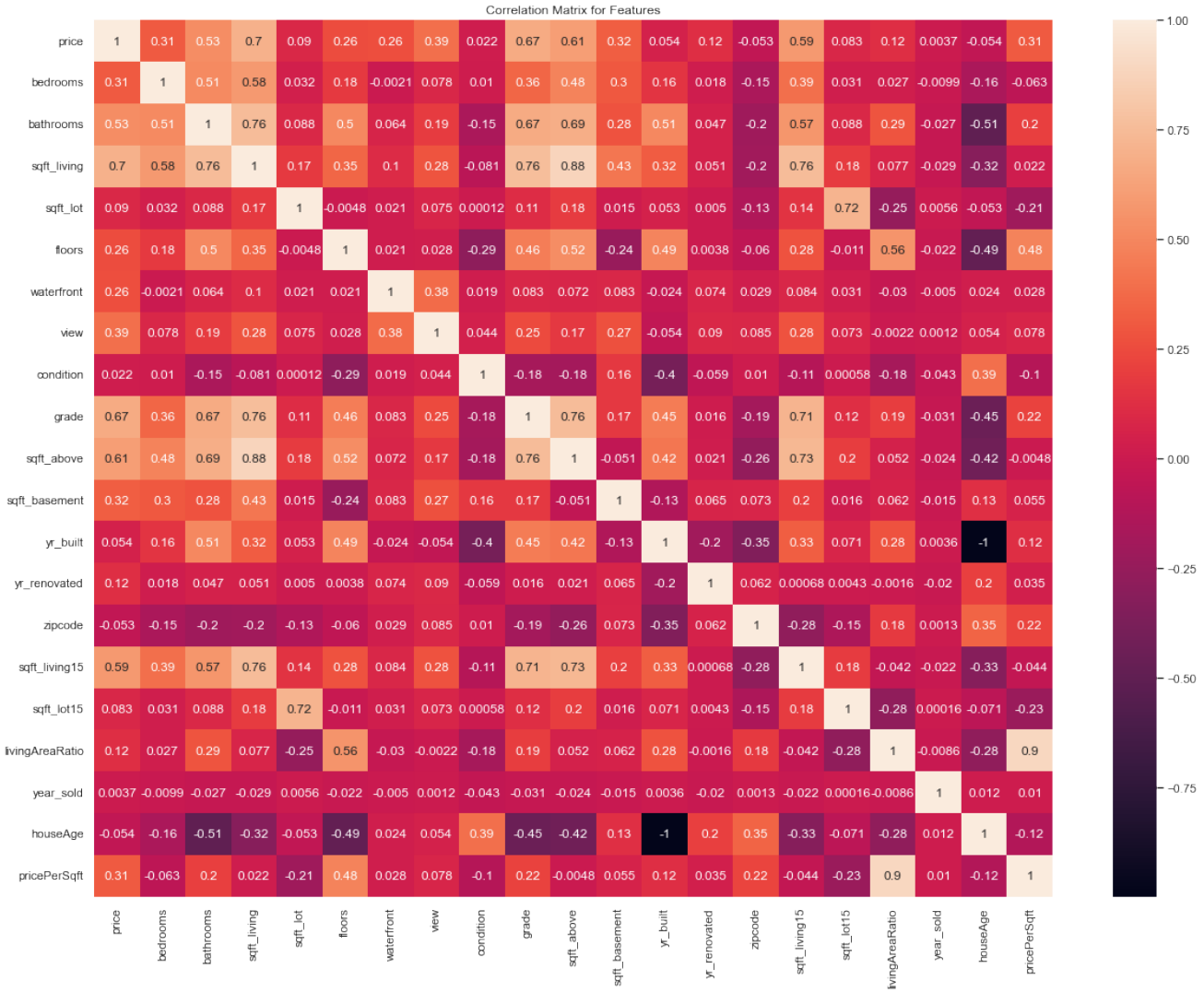
In [492…
```
df_clean.shape
```

Out[492… `(18951, 21)`

Exploring the Data

Create heatmap

In [493…
```
plt.figure(figsize = (20, 15))
sns.set(style="white")
sns.heatmap(data.corr(), annot = True)


plt.title('Correlation Matrix for Features')
plt.savefig("corrmat.jpg" , dpi=300)
plt.show()
```



Highly correlated variables: Sqft_Above vs sqft_living Drop: Sqft_Above

In [494…

```
df_clean.drop(['sqft_above'],axis=1,inplace=True)
```

```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/3810893269.py
:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean.drop(['sqft_above'],axis=1,inplace=True)
```

Focus on Grade, Sqft_Living, Sqft_Living15

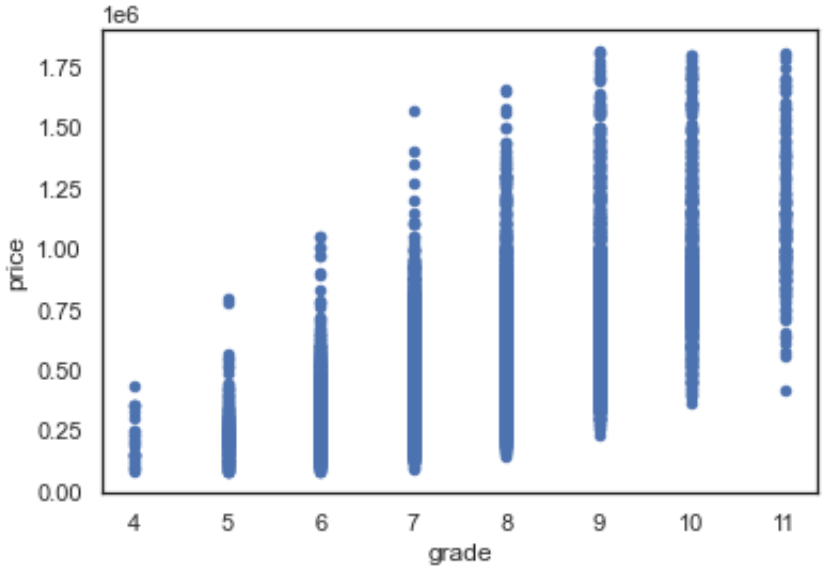
Create scatter plot

In [495…

```
df_clean.plot("grade","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

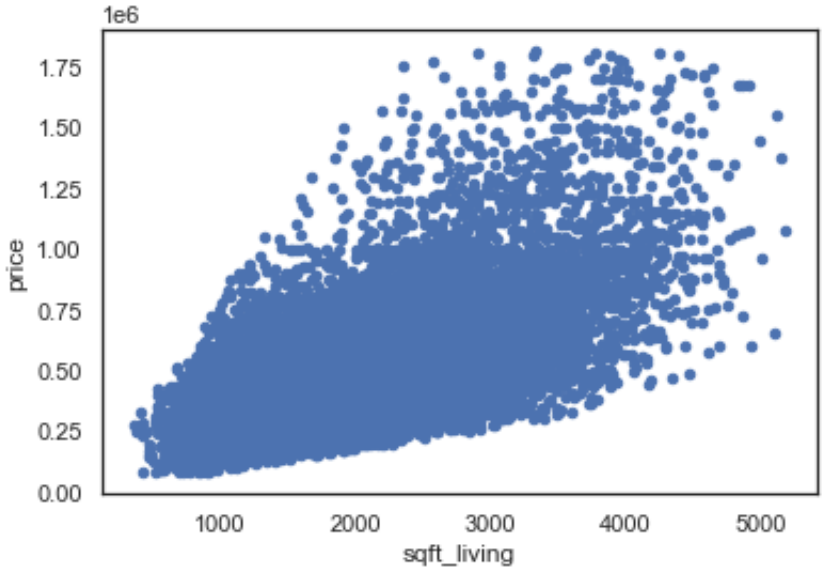
Out[495… `<AxesSubplot:xlabel='grade', ylabel='price'>`



In [496…
```
df_clean.plot("sqft_living","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

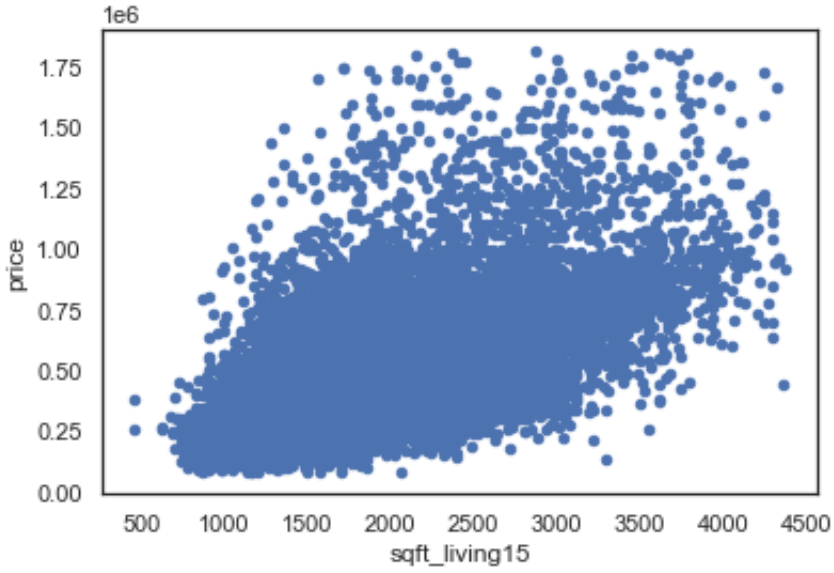
Out[496… `<AxesSubplot:xlabel='sqft_living', ylabel='price'>`



In [497…
```
df_clean.plot("sqft_living15","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

Out[497…
```
<AxesSubplot:xlabel='sqft_living15', ylabel='price'>
```

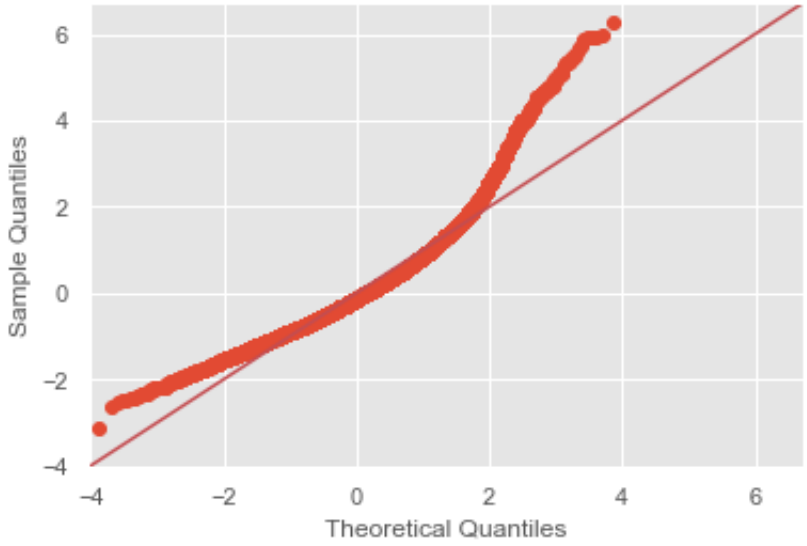


Create qq plots

In [498…

```
plt.style.use('ggplot')

f = 'price~grade'
f2 = 'price~sqft_living'
f3 = 'price~sqft_living15'

model = ols(formula=f, data=df_clean).fit()
model2 = ols(formula=f2, data=df_clean).fit()
model3 = ols(formula=f3, data=df_clean).fit()

resid1 = model.resid
resid2 = model2.resid
resid3 = model3.resid

print(model.summary())

fig = sm.graphics.qqplot(resid1, dist=stats.norm, line='45', fit=True)
plt.show()
print(model2.summary())
fig2 = sm.graphics.qqplot(resid2, dist=stats.norm, line='45', fit=True)
plt.show()
fig3 = sm.graphics.qqplot(resid3, dist=stats.norm, line='45', fit=True)
print(model3.summary())
plt.show()
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  price   R-squared:                       0.422
Model:                            OLS   Adj. R-squared:                  0.422
Method:                 Least Squares   F-statistic:                 1.383e+04
Date:                Fri, 01 Apr 2022   Prob (F-statistic):               0.00
Time:                        14:23:42   Log-Likelihood:            -2.5684e+05
No. Observations:               18951   AIC:                         5.137e+05
Df Residuals:                   18949   BIC:                         5.137e+05
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept  -6.424e+05   9692.046    -66.286      0.000   -6.61e+05   -6.23e+05
grade       1.497e+05   1273.115    117.614      0.000    1.47e+05    1.52e+05
==============================================================================
Omnibus:                     4509.525   Durbin-Watson:                   1.954
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            13173.094
Skew:                           1.242   Prob(JB):                         0.00
Kurtosis:                       6.242   Cond. No.                         55.5
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correct
ly specified.
```



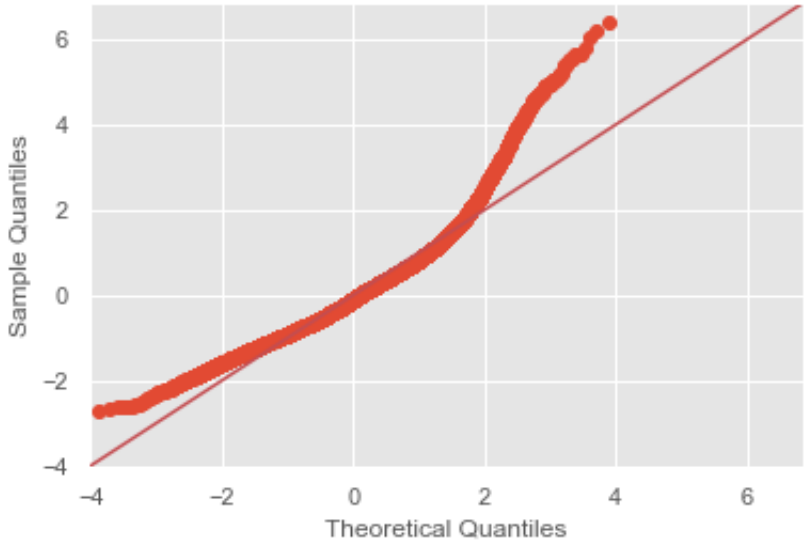
OLS Regression Results

Dep. Variable:	price	R-squared:	0.417
Model:	OLS	Adj. R-squared:	0.417
Method:	Least Squares	F-statistic:	1.358e+04
Date:	Fri, 01 Apr 2022	Prob (F-statistic):	0.00
Time:	14:23:42	Log-Likelihood:	-2.5691e+05
No. Observations:	18951	AIC:	5.138e+05
Df Residuals:	18949	BIC:	5.138e+05
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	8.06e+04	3736.678	21.570	0.000	7.33e+04	8.79e+04
sqft_living	204.9409	1.759	116.535	0.000	201.494	208.388

Omnibus:	4128.934	Durbin-Watson:	1.968
Prob(Omnibus):	0.000	Jarque-Bera (JB):	11750.037
Skew:	1.148	Prob(JB):	0.00
Kurtosis:	6.099	Cond. No.	5.85e+03

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 5.85e+03. This might indicate that there are
strong multicollinearity or other numerical problems.



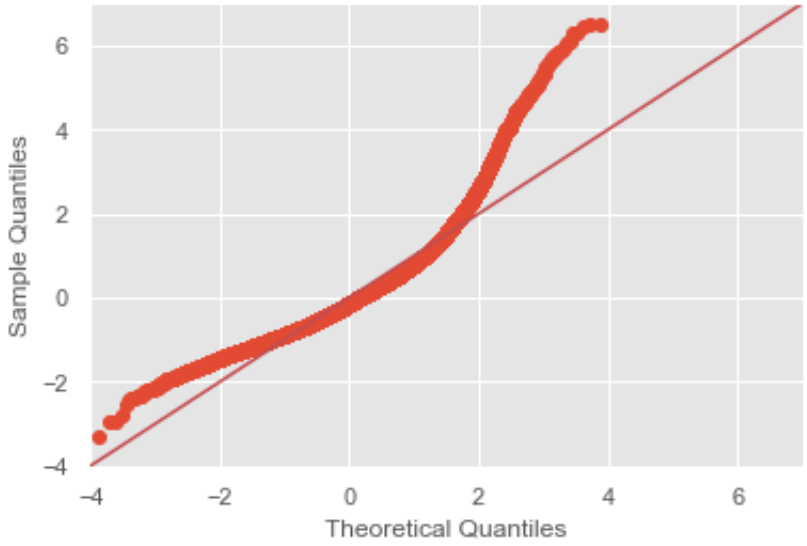
OLS Regression Results

Dep. Variable:	price	R-squared:	0.325
Model:	OLS	Adj. R-squared:	0.324
Method:	Least Squares	F-statistic:	9103.
Date:	Fri, 01 Apr 2022	Prob (F-statistic):	0.00
Time:	14:23:42	Log-Likelihood:	-2.5831e+05
No. Observations:	18951	AIC:	5.166e+05
Df Residuals:	18949	BIC:	5.166e+05
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	5.175e+04	4783.491	10.819	0.000	4.24e+04	6.11e+04
sqft_living15	224.9701	2.358	95.410	0.000	220.348	229.592

Omnibus:	5810.468	Durbin-Watson:	1.968
Prob(Omnibus):	0.000	Jarque-Bera (JB):	22234.938
Skew:	1.497	Prob(JB):	0.00
Kurtosis:	7.381	Cond. No.	6.64e+03

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 6.64e+03. This might indicate that there are
strong multicollinearity or other numerical problems.



Create Initial Model

In [499…

```
f = 'price~grade+sqft_living+sqft_living15'
model = ols(formula=f, data=df_clean).fit()
model.summary()
```

Out[499...

OLS Regression Results

Dep. Variable:	price	**R-squared:**	0.485
Model:	OLS	**Adj. R-squared:**	0.485
Method:	Least Squares	**F-statistic:**	5949.
Date:	Fri, 01 Apr 2022	**Prob (F-statistic):**	0.00
Time:	14:23:42	**Log-Likelihood:**	-2.5574e+05
No. Observations:	18951	**AIC:**	5.115e+05
Df Residuals:	18947	**BIC:**	5.115e+05
Df Model:	3		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-3.939e+05	1.05e+04	-37.500	0.000	-4.14e+05	-3.73e+05
grade	8.185e+04	1884.157	43.439	0.000	7.82e+04	8.55e+04
sqft_living	103.5105	2.811	36.820	0.000	98.000	109.021
sqft_living15	30.1792	3.296	9.156	0.000	23.719	36.640

Omnibus:	4293.239	**Durbin-Watson:**	1.958
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	12545.476
Skew:	1.183	**Prob(JB):**	0.00
Kurtosis:	6.208	**Cond. No.**	2.43e+04

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 2.43e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

Results

Based on the r2 score, .48, this is very low.

Re-explore

Create histograms

In [500…

```
scaler = StandardScaler()
for i in df_clean.columns:
    col_data = df_clean[i].values.reshape(-1,1)
    scale_data = scaler.fit_transform(col_data)
    new_name = i + '_sca'
    df_clean[new_name] = scale_data.flatten()
```

```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
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able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
```

```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
```

```
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/2691878802.py
:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean[new_name] = scale_data.flatten()
```

Create new heatmap

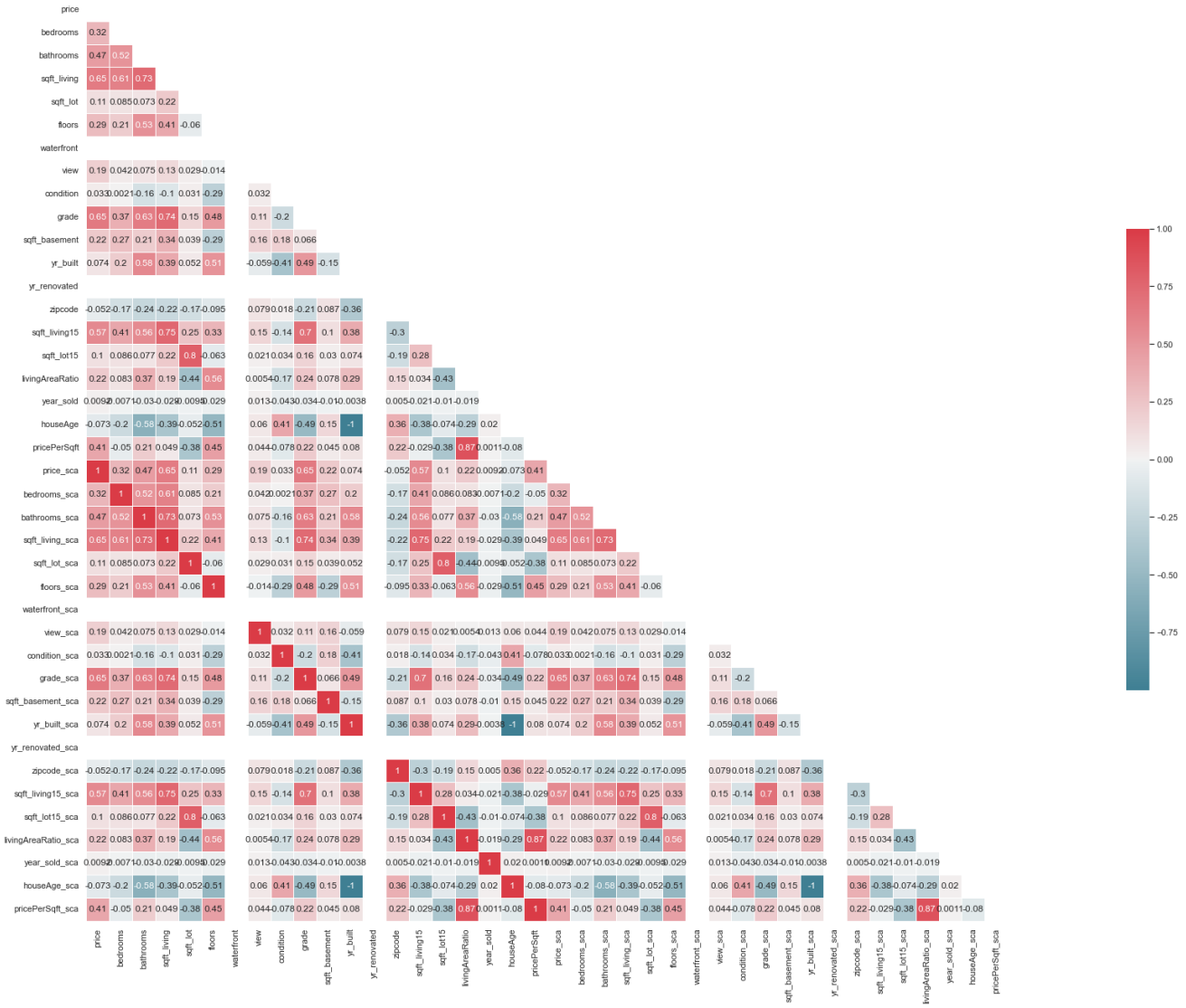
In [501…

```
sns.set(style="white")
#Correlations are low - good thing?


# Compute the correlation matrix
corr = df_clean.corr()

# Generate a mask for the upper triangle
mask = np.zeros_like(corr, dtype=np.bool)
mask[np.triu_indices_from(mask)] = True

# Set up the matplotlib figure
f, ax = plt.subplots(figsize=(55, 22))

# Generate a custom diverging colormap
cmap = sns.diverging_palette(220, 10, as_cmap=True)

# Draw the heatmap with the mask and correct aspect ratio
sns.heatmap(corr, mask=mask, cmap=cmap, center=0,
            square=True, linewidths=.5, cbar_kws={"shrink": .5}, annot=True)
```

```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/179094617.py:
9: DeprecationWarning: `np.bool` is a deprecated alias for the builtin `bool`.
To silence this warning, use `bool` by itself. Doing this will not modify any
behavior and is safe. If you specifically wanted the numpy scalar type, use `n
p.bool_` here.
Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/dev
docs/release/1.20.0-notes.html#deprecations
  mask = np.zeros_like(corr, dtype=np.bool)
```

Out[501…

```
<AxesSubplot:>
```



In [502…
```
df_clean.columns
```

Out[502…
```
Index(['price', 'bedrooms', 'bathrooms', 'sqft_living', 'sqft_lot', 'floors',
       'waterfront', 'view', 'condition', 'grade', 'sqft_basement', 'yr_built'
,
       'yr_renovated', 'zipcode', 'sqft_living15', 'sqft_lot15',
       'livingAreaRatio', 'year_sold', 'houseAge', 'pricePerSqft', 'price_sca'
,
       'bedrooms_sca', 'bathrooms_sca', 'sqft_living_sca', 'sqft_lot_sca',
       'floors_sca', 'waterfront_sca', 'view_sca', 'condition_sca',
       'grade_sca', 'sqft_basement_sca', 'yr_built_sca', 'yr_renovated_sca',
       'zipcode_sca', 'sqft_living15_sca', 'sqft_lot15_sca',
       'livingAreaRatio_sca', 'year_sold_sca', 'houseAge_sca',
       'pricePerSqft_sca'],
      dtype='object')
```

In [503…
```
df_clean.drop(columns = ['bedrooms', 'bathrooms','sqft_living', 'sqft_lot', '
```

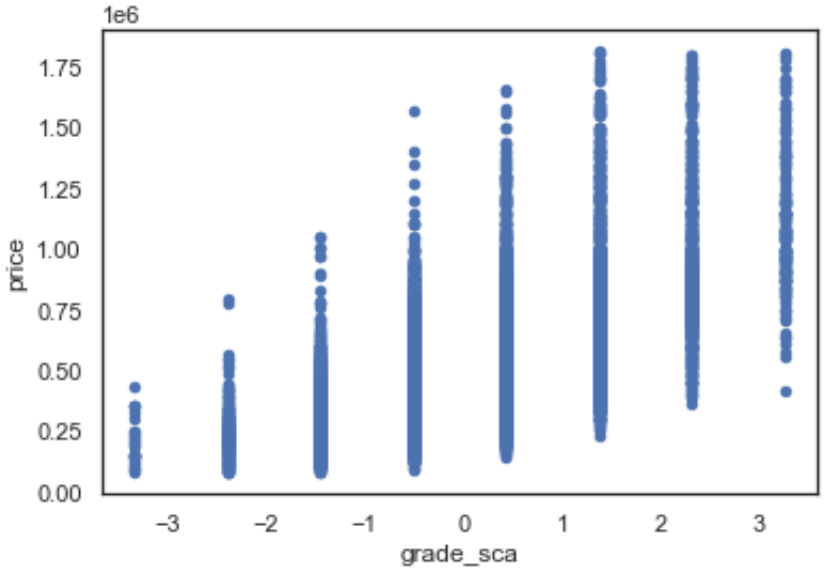
```
/var/folders/8y/cslj48jd39z6f0kr2m9qqjy00000gn/T/ipykernel_76621/4247632582.py
:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/st
able/user_guide/indexing.html#returning-a-view-versus-a-copy
  df_clean.drop(columns = ['bedrooms', 'bathrooms','sqft_living', 'sqft_lot',
'floors', 'waterfront', 'view', 'condition', 'grade', 'sqft_basement', 'yr_bui
lt', 'yr_renovated', 'sqft_living15', 'sqft_lot15', 'livingAreaRatio', 'year_s
old', 'houseAge', 'pricePerSqft', 'price_sca','yr_renovated_sca', 'waterfront_
sca','zipcode_sca','pricePerSqft_sca'],inplace=True)
```

Recreate scatter plots

In [504…
```
df_clean.plot("grade_sca","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

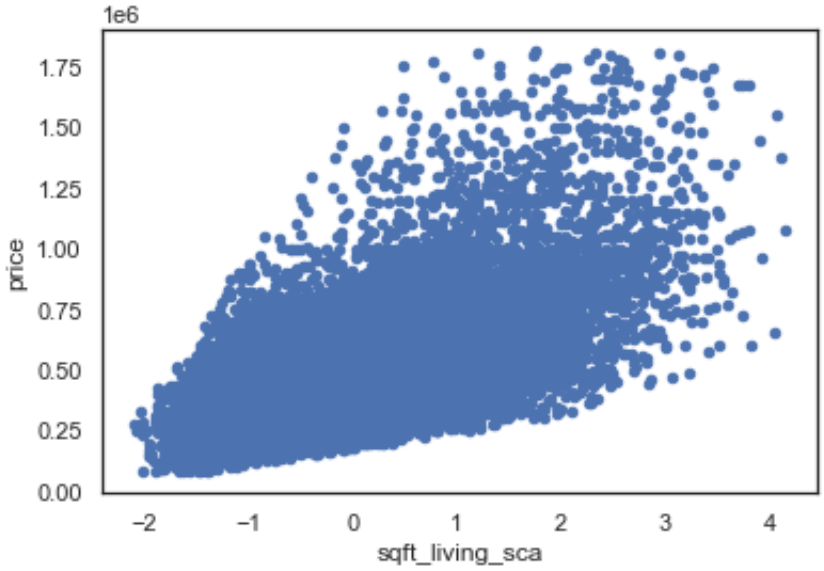
Out[504…
```
<AxesSubplot:xlabel='grade_sca', ylabel='price'>
```



In [505…
```
df_clean.plot("sqft_living_sca","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

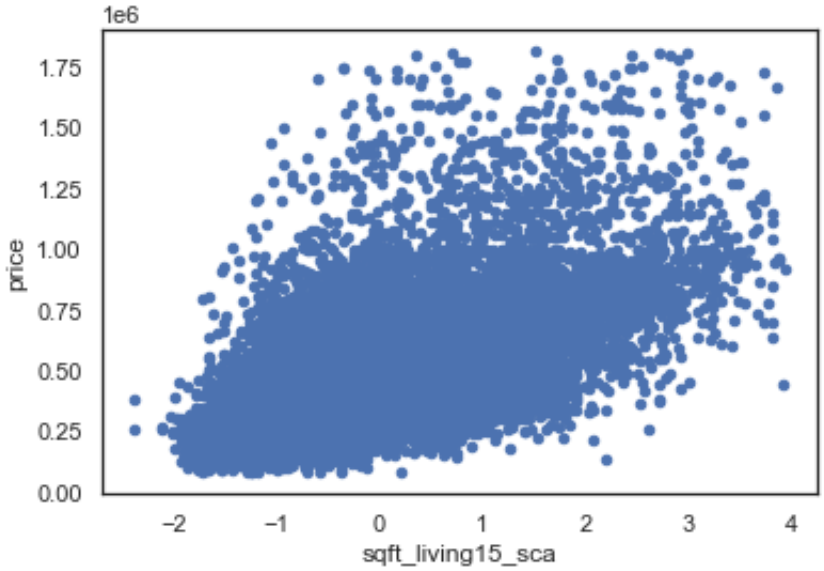
Out[505… <AxesSubplot:xlabel='sqft_living_sca', ylabel='price'>



In [506…
```
df_clean.plot("sqft_living15_sca","price", kind='scatter')
```

```
*c* argument looks like a single numeric RGB or RGBA sequence, which should be
avoided as value-mapping will have precedence in case its length matches with
*x* & *y*.  Please use the *color* keyword-argument or provide a 2D array with
a single row if you intend to specify the same RGB or RGBA value for all point
s.
```

Out[506… <AxesSubplot:xlabel='sqft_living15_sca', ylabel='price'>

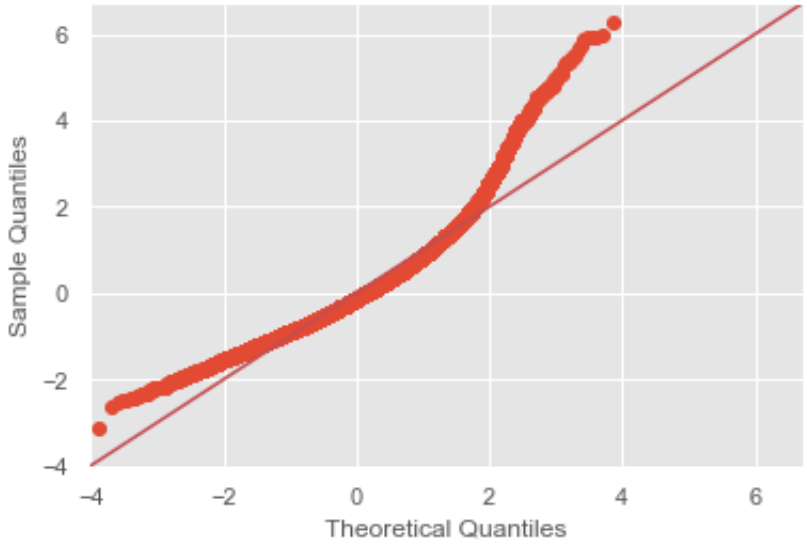


Create updated qq plots

In [507…

```
plt.style.use('ggplot')

f = 'price~grade_sca'
f2 = 'price~sqft_living_sca'
f3 = 'price~sqft_living15_sca'

model = ols(formula=f, data=df_clean).fit()
model2 = ols(formula=f2, data=df_clean).fit()
model3 = ols(formula=f3, data=df_clean).fit()

resid1 = model.resid
resid2 = model2.resid
resid3 = model3.resid

print(model.summary())

fig = sm.graphics.qqplot(resid1, dist=stats.norm, line='45', fit=True)
plt.show()
print(model2.summary())
fig2 = sm.graphics.qqplot(resid2, dist=stats.norm, line='45', fit=True)
plt.show()
fig3 = sm.graphics.qqplot(resid3, dist=stats.norm, line='45', fit=True)
print(model3.summary())
plt.show()
```

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  price   R-squared:                       0.422
Model:                            OLS   Adj. R-squared:                  0.422
Method:                 Least Squares   F-statistic:                 1.383e+04
Date:                Fri, 01 Apr 2022   Prob (F-statistic):               0.00
Time:                        14:23:46   Log-Likelihood:            -2.5684e+05
No. Observations:               18951   AIC:                         5.137e+05
Df Residuals:                   18949   BIC:                         5.137e+05
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept   4.863e+05   1351.412    359.875      0.000    4.84e+05    4.89e+05
grade_sca   1.589e+05   1351.412    117.614      0.000    1.56e+05    1.62e+05
==============================================================================
Omnibus:                     4509.525   Durbin-Watson:                   1.954
Prob(Omnibus):                  0.000   Jarque-Bera (JB):            13173.094
Skew:                           1.242   Prob(JB):                         0.00
Kurtosis:                       6.242   Cond. No.                         1.00
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correct
ly specified.
```



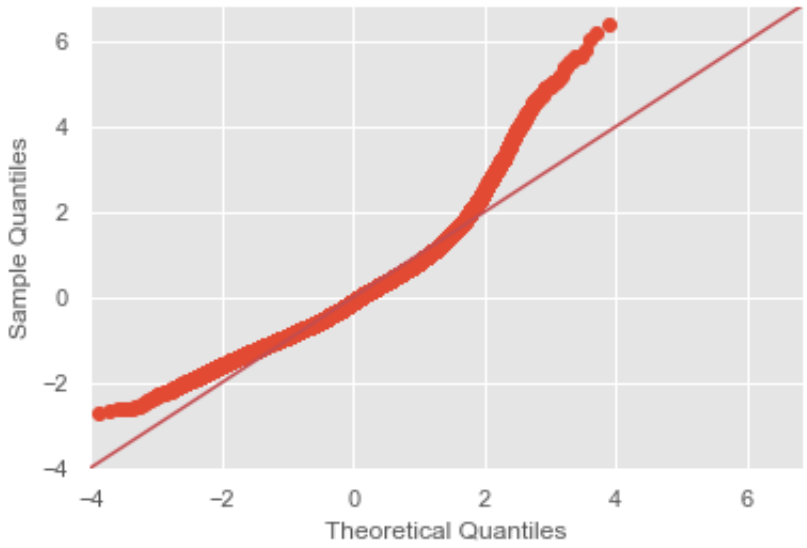
OLS Regression Results

Dep. Variable:	price	R-squared:	0.417
Model:	OLS	Adj. R-squared:	0.417
Method:	Least Squares	F-statistic:	1.358e+04
Date:	Fri, 01 Apr 2022	Prob (F-statistic):	0.00
Time:	14:23:46	Log-Likelihood:	-2.5691e+05
No. Observations:	18951	AIC:	5.138e+05
Df Residuals:	18949	BIC:	5.138e+05
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	4.863e+05	1356.650	358.486	0.000	4.84e+05	4.89e+05
sqft_living_sca	1.581e+05	1356.650	116.535	0.000	1.55e+05	1.61e+05

Omnibus:	4128.934	Durbin-Watson:	1.968
Prob(Omnibus):	0.000	Jarque-Bera (JB):	11750.037
Skew:	1.148	Prob(JB):	0.00
Kurtosis:	6.099	Cond. No.	1.00

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.



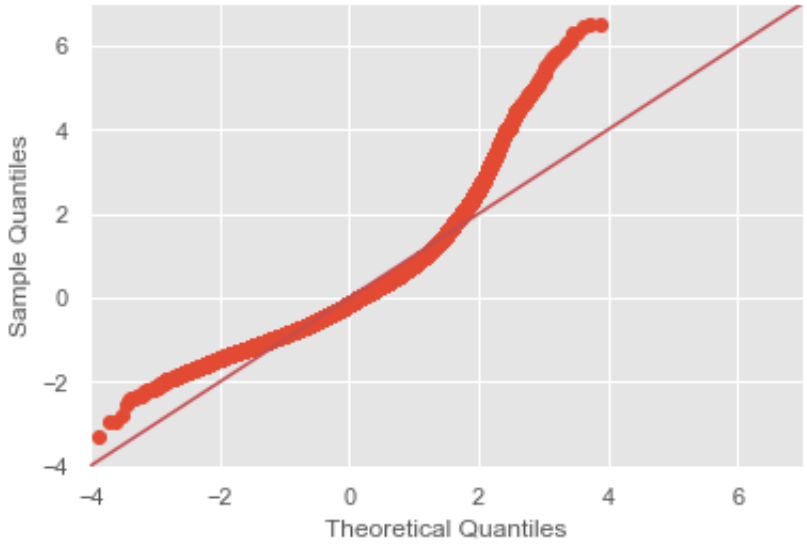
OLS Regression Results

Dep. Variable:	price	R-squared:	0.325
Model:	OLS	Adj. R-squared:	0.324
Method:	Least Squares	F-statistic:	9103.
Date:	Fri, 01 Apr 2022	Prob (F-statistic):	0.00
Time:	14:23:46	Log-Likelihood:	-2.5831e+05
No. Observations:	18951	AIC:	5.166e+05
Df Residuals:	18949	BIC:	5.166e+05
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	4.863e+05	1460.911	332.901	0.000	4.83e+05	4.89e+05
sqft_living15_sca	1.394e+05	1460.911	95.410	0.000	1.37e+05	1.42e+05

Omnibus:	5810.468	Durbin-Watson:	1.968
Prob(Omnibus):	0.000	Jarque-Bera (JB):	22234.938
Skew:	1.497	Prob(JB):	0.00
Kurtosis:	7.381	Cond. No.	1.00

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.



Create Updated Model - Including Zipcodes

In [508…

```
f = 'price~grade_sca+sqft_living_sca+sqft_living15_sca+C(zipcode)'
model = ols(formula=f, data=df_clean).fit()
model.summary()
```

Out[508…

OLS Regression Results

Dep. Variable:	price	**R-squared:**	0.818
Model:	OLS	**Adj. R-squared:**	0.817
Method:	Least Squares	**F-statistic:**	1176.
Date:	Fri, 01 Apr 2022	**Prob (F-statistic):**	0.00
Time:	14:23:47	**Log-Likelihood:**	-2.4590e+05
No. Observations:	18951	**AIC:**	4.919e+05
Df Residuals:	18878	**BIC:**	4.925e+05
Df Model:	72		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	3.049e+05	5607.223	54.368	0.000	2.94e+05	3.16e+05
C(zipcode)[T.98002]	2.883e+04	9424.381	3.059	0.002	1.04e+04	4.73e+04
C(zipcode)[T.98003]	394.3997	8496.292	0.046	0.963	-1.63e+04	1.7e+04
C(zipcode)[T.98004]	6.608e+05	9036.678	73.124	0.000	6.43e+05	6.79e+05
C(zipcode)[T.98005]	3.328e+05	1.03e+04	32.250	0.000	3.13e+05	3.53e+05
C(zipcode)[T.98006]	2.731e+05	7807.400	34.974	0.000	2.58e+05	2.88e+05

C(zipcode)[T.98007]	2.602e+05	1.06e+04	24.558	0.000	2.39e+05	2.81e+05
C(zipcode)[T.98008]	2.485e+05	8625.175	28.816	0.000	2.32e+05	2.65e+05
C(zipcode)[T.98010]	9.508e+04	1.36e+04	7.017	0.000	6.85e+04	1.22e+05
C(zipcode)[T.98011]	1.319e+05	9536.782	13.826	0.000	1.13e+05	1.51e+05
C(zipcode)[T.98014]	1.244e+05	1.24e+04	10.006	0.000	1e+05	1.49e+05
C(zipcode)[T.98019]	8.146e+04	9961.255	8.178	0.000	6.19e+04	1.01e+05
C(zipcode)[T.98022]	3.012e+04	9953.033	3.027	0.002	1.06e+04	4.96e+04
C(zipcode)[T.98023]	-2.526e+04	7354.789	-3.435	0.001	-3.97e+04	-1.08e+04
C(zipcode)[T.98024]	1.643e+05	1.63e+04	10.099	0.000	1.32e+05	1.96e+05
C(zipcode)[T.98027]	1.888e+05	8042.042	23.478	0.000	1.73e+05	2.05e+05
C(zipcode)[T.98028]	1.268e+05	8491.214	14.938	0.000	1.1e+05	1.43e+05
C(zipcode)[T.98029]	2.138e+05	8233.980	25.965	0.000	1.98e+05	2.3e+05
C(zipcode)[T.98030]	-1101.5236	8663.569	-0.127	0.899	-1.81e+04	1.59e+04
C(zipcode)[T.98031]	1.055e+04	8484.414	1.243	0.214	-6079.941	2.72e+04
C(zipcode)[T.98032]	6541.6725	1.1e+04	0.592	0.554	-1.51e+04	2.82e+04
C(zipcode)[T.98033]	3.645e+05	7753.948	47.008	0.000	3.49e+05	3.8e+05
C(zipcode)[T.98034]	1.887e+05	7246.780	26.043	0.000	1.75e+05	2.03e+05
C(zipcode)[T.98038]	2.257e+04	7205.831	3.132	0.002	8443.952	3.67e+04
C(zipcode)[T.98039]	8.558e+05	2.61e+04	32.851	0.000	8.05e+05	9.07e+05
C(zipcode)[T.98040]	5.052e+05	9308.280	54.278	0.000	4.87e+05	5.23e+05
C(zipcode)[T.98042]	6440.0869	7239.896	0.890	0.374	-7750.758	2.06e+04
C(zipcode)[T.98045]	1.111e+05	9503.510	11.691	0.000	9.25e+04	1.3e+05
C(zipcode)[T.98052]	2.44e+05	7199.056	33.887	0.000	2.3e+05	2.58e+05
C(zipcode)[T.98053]	2.273e+05	7934.007	28.649	0.000	2.12e+05	2.43e+05
C(zipcode)[T.98055]	4.627e+04	8605.028	5.377	0.000	2.94e+04	6.31e+04
C(zipcode)[T.98056]	1.094e+05	7695.100	14.214	0.000	9.43e+04	1.24e+05
C(zipcode)[T.98058]	3.331e+04	7548.758	4.412	0.000	1.85e+04	4.81e+04
C(zipcode)[T.98059]	9.713e+04	7567.366	12.835	0.000	8.23e+04	1.12e+05
C(zipcode)[T.98065]	1.129e+05	8457.326	13.353	0.000	9.63e+04	1.3e+05
C(zipcode)[T.98070]	1.633e+05	1.58e+04	10.319	0.000	1.32e+05	1.94e+05
C(zipcode)[T.98072]	1.713e+05	8646.228	19.813	0.000	1.54e+05	1.88e+05
C(zipcode)[T.98074]	1.983e+05	7727.237	25.661	0.000	1.83e+05	2.13e+05

C(zipcode)[T.98075]	2.149e+05	8328.732	25.807	0.000	1.99e+05	2.31e+05
C(zipcode)[T.98077]	1.688e+05	9915.548	17.020	0.000	1.49e+05	1.88e+05
C(zipcode)[T.98092]	-2.698e+04	8240.058	-3.275	0.001	-4.31e+04	-1.08e+04
C(zipcode)[T.98102]	4.703e+05	1.41e+04	33.437	0.000	4.43e+05	4.98e+05
C(zipcode)[T.98103]	3.458e+05	7326.435	47.203	0.000	3.31e+05	3.6e+05
C(zipcode)[T.98105]	4.511e+05	9558.607	47.194	0.000	4.32e+05	4.7e+05
C(zipcode)[T.98106]	1.286e+05	8242.122	15.606	0.000	1.12e+05	1.45e+05
C(zipcode)[T.98107]	3.276e+05	9124.768	35.904	0.000	3.1e+05	3.45e+05
C(zipcode)[T.98108]	1.22e+05	9596.179	12.712	0.000	1.03e+05	1.41e+05
C(zipcode)[T.98109]	4.92e+05	1.31e+04	37.698	0.000	4.66e+05	5.18e+05
C(zipcode)[T.98112]	5.64e+05	9500.561	59.370	0.000	5.45e+05	5.83e+05
C(zipcode)[T.98115]	3.404e+05	7251.748	46.947	0.000	3.26e+05	3.55e+05
C(zipcode)[T.98116]	3.078e+05	8696.180	35.390	0.000	2.91e+05	3.25e+05
C(zipcode)[T.98117]	3.256e+05	7305.183	44.570	0.000	3.11e+05	3.4e+05
C(zipcode)[T.98118]	1.734e+05	7469.944	23.207	0.000	1.59e+05	1.88e+05
C(zipcode)[T.98119]	4.512e+05	1.09e+04	41.301	0.000	4.3e+05	4.73e+05
C(zipcode)[T.98122]	3.4e+05	9018.121	37.702	0.000	3.22e+05	3.58e+05
C(zipcode)[T.98125]	2.029e+05	7827.838	25.923	0.000	1.88e+05	2.18e+05
C(zipcode)[T.98126]	2.103e+05	8151.949	25.803	0.000	1.94e+05	2.26e+05
C(zipcode)[T.98133]	1.615e+05	7439.720	21.701	0.000	1.47e+05	1.76e+05
C(zipcode)[T.98136]	2.675e+05	9111.294	29.356	0.000	2.5e+05	2.85e+05
C(zipcode)[T.98144]	2.476e+05	8453.450	29.295	0.000	2.31e+05	2.64e+05
C(zipcode)[T.98146]	1.171e+05	8733.228	13.406	0.000	1e+05	1.34e+05
C(zipcode)[T.98148]	6.48e+04	1.51e+04	4.300	0.000	3.53e+04	9.43e+04
C(zipcode)[T.98155]	1.487e+05	7601.665	19.565	0.000	1.34e+05	1.64e+05
C(zipcode)[T.98166]	1.148e+05	9197.848	12.486	0.000	9.68e+04	1.33e+05
C(zipcode)[T.98168]	6.059e+04	8572.508	7.068	0.000	4.38e+04	7.74e+04
C(zipcode)[T.98177]	2.235e+05	9231.404	24.209	0.000	2.05e+05	2.42e+05
C(zipcode)[T.98178]	6.288e+04	8889.371	7.074	0.000	4.55e+04	8.03e+04
C(zipcode)[T.98188]	4.062e+04	1.08e+04	3.764	0.000	1.95e+04	6.18e+04
C(zipcode)[T.98198]	3.695e+04	8750.248	4.223	0.000	1.98e+04	5.41e+04

C(zipcode)[T.98199]	3.923e+05	8683.452	45.178	0.000	3.75e+05	4.09e+05
grade_sca	4.934e+04	1245.425	39.614	0.000	4.69e+04	5.18e+04
sqft_living_sca	9.303e+04	1304.757	71.299	0.000	9.05e+04	9.56e+04
sqft_living15_sca	2.264e+04	1322.741	17.116	0.000	2e+04	2.52e+04

Omnibus:	5250.473	**Durbin-Watson:**	2.004
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	34707.185
Skew:	1.166	**Prob(JB):**	0.00
Kurtosis:	9.206	**Cond. No.**	98.4

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

show model.params

In [509…
```
model.params
```

Out[509…
```
Intercept              304851.242019
C(zipcode)[T.98002]     28829.261418
C(zipcode)[T.98003]       394.399672
C(zipcode)[T.98004]    660795.869460
C(zipcode)[T.98005]    332766.589775
                              ...
C(zipcode)[T.98198]     36954.161375
C(zipcode)[T.98199]    392301.318493
grade_sca               49336.707066
sqft_living_sca         93027.739133
sqft_living15_sca       22640.108108
Length: 73, dtype: float64
```

In [510…
```
from sklearn.model_selection import train_test_split
X = df_clean.drop('price', axis=1)
y = df_clean['price']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.20, ran
```

In [511…
```
df_train = pd.DataFrame(X_train, columns = X.columns)
df_train['price'] = y_train
df_test = pd.DataFrame(X_test, columns = X.columns)
df_test['price'] = y_test
```

In [512…
```
from sklearn.metrics import r2_score
y_hat_test = model.predict(df_test)
r2_score(y_test, y_hat_test)
```

Out[512… 0.8309738301524886

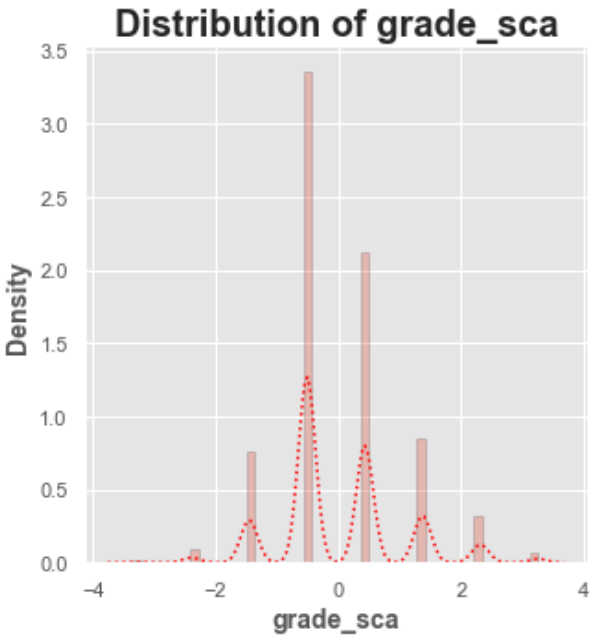
Conclusions & Recommendations

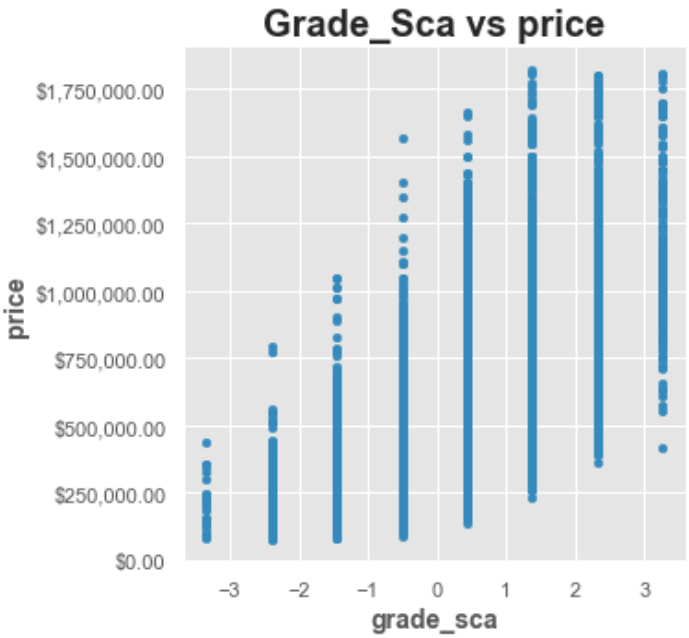
Zipcode Living square footage High quality construction and materials

In [513…
```
def eda_plot(df_clean, col = 'grade_sca', target='price',
             figsize=(10,5),hist_kws = None, kde_kws = None):
    # Lets write our plot together

    fig, axes = plt.subplots(ncols=2,figsize=figsize)

    ax = axes[0]


    if hist_kws is None:
        hist_kws = {'edgecolor':'black',
                    'alpha':0.3}

    if kde_kws is None:
        kde_kws = {'color':'black'}

    sns.distplot(df_clean[col],ax=ax,kde_kws=kde_kws, hist_kws=hist_kws)

    label_fonts = {'weight':'bold',
                   'size':14}
    title_fonts = {'weight':'bold',
                   'size':20}

    ax.set_title(f'Distribution of {col}',fontdict=title_fonts)


    ax.set_ylabel('Density',fontdict=label_fonts)
    ax.set_xlabel(ax.get_xlabel(),fontdict=label_fonts)

    ax = axes[1]
    x_samp = df_clean[col]
    y_samp = df_clean[target]

    beta_1 = np.cov(x_samp, y_samp)[0][1]/x_samp.var()
    beta_0 = y_samp.mean() - beta_1*x_samp.mean()

    df_clean.plot(kind='scatter',x=col,y=target,ax=ax)
    ax.set_title(f"{col.title()} vs {target}",fontdict=title_fonts)
    ax.set_ylabel(ax.get_ylabel(),fontdict=label_fonts)
    ax.set_xlabel(ax.get_xlabel(),fontdict=label_fonts)


#     fmtPrice = '${x:,.0f}'

    tick_format = StrMethodFormatter('${x:,.2f}')
    ax.yaxis.set_major_formatter(tick_format)
        # Formatting dollar sign labels
```

```
#     tickPrice = mtick.StrMethodFormatter(fmtPrice)


    plt.tight_layout()
    plt.show()

    return fig, axes

f,a = eda_plot(df_clean,col='grade_sca',kde_kws={'color':'red','ls':':'})
```

```
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-packages/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

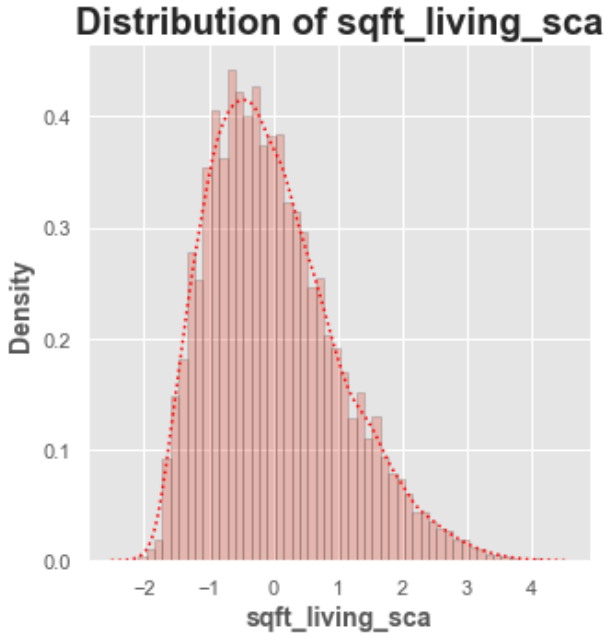


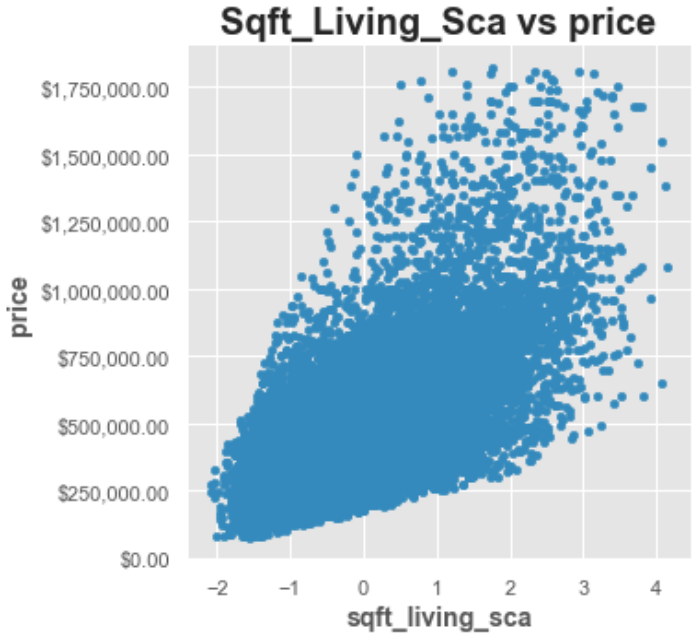


In [514…

```
f,a = eda_plot(df_clean,col='sqft_living_sca',kde_kws={'color':'red','ls':':'
```

```
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-package
s/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated fun
ction and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplo
t` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

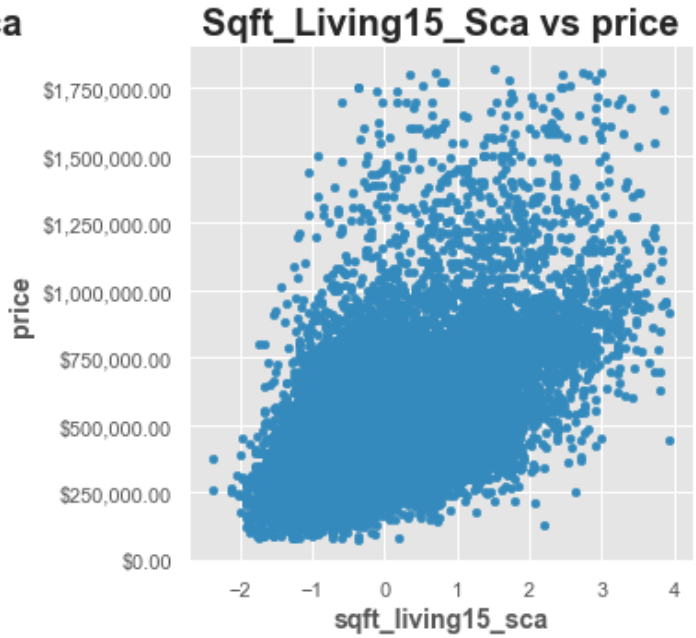




In [515…

```
f,a = eda_plot(df_clean,col='sqft_living15_sca',kde_kws={'color':'red','ls':'
```

```
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-package
s/seaborn/distributions.py:2619: FutureWarning: `distplot` is a deprecated fun
ction and will be removed in a future version. Please adapt your code to use e
ither `displot` (a figure-level function with similar flexibility) or `histplo
t` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



Price Predict base on this three feature

In [516…
```
lr = LinearRegression()
lr
```

Out[516… `LinearRegression()`

In [517…
```
data.head()
```

Out[517…

	price	bedrooms	bathrooms	sqft_living	sqft_lot	floors	waterfront	view	condition
0	221900.0	3	1.00	1180	5650	1.0	0	0	0
1	538000.0	3	2.25	2570	7242	2.0	0	0	0
2	180000.0	2	1.00	770	10000	1.0	0	0	0
3	604000.0	4	3.00	1960	5000	1.0	0	0	4
4	510000.0	3	2.00	1680	8080	1.0	0	0	0

5 rows × 21 columns

In [518…
```
X = data[['sqft_living', 'zipcode', 'sqft_living15','grade']]
Y = data['price']
X.head()
```

Out[518…

	sqft_living	zipcode	sqft_living15	grade
0	1180	98178	1340	7
1	2570	98125	1690	7
2	770	98028	2720	6
3	1960	98136	1360	7
4	1680	98074	1800	8

In [519…
```
X_train, X_test, Y_train, Y_test = train_test_split(X,Y,test_size=0.3)
print(len(X_train), len(Y_train))
```

```
15117 15117
```

Creating our prediction machine

In [520…
```
lr.fit(X_train,Y_train)
```

Out[520… `LinearRegression()`

Get the "learned" weights:

In [521…
```
print(lr.coef_, lr.intercept_)
```

```
[1.76960776e+02 7.49322529e+02 3.47640250e+01 9.37646439e+04] -74107603.743406
6
```

In [522…
```
X.columns
```

Out[522… `Index(['sqft_living', 'zipcode', 'sqft_living15', 'grade'], dtype='object')`

In [523…
```
lr.score(X_train,Y_train)
```

Out[523… `0.5441732588482897`

Evaluating our model on the test data

In [524…
```
Y_pred = lr.predict(X_test)
Y_pred[0:10]
```

Out[524…
```
array([ 318631.62937117,  369752.29185642, 1219843.45898037,
        694643.10421248, 1046167.66647515,  340566.28055669,
        657095.69579394,  525856.3801572 ,  543086.38295621,
        293709.92644045])
```

Evaluate model prediction on test set:

In [525…
```
MAE = mean_absolute_error(Y_pred, Y_test)
MAE
```

Out[525… `157951.74044584285`

In [526…
```
RMSE = np.sqrt(mean_squared_error(Y_pred,Y_test))
RMSE
```

Out[526… `248366.88985569525`

In [527…
```
%%capture price_test
fig, ax = plt.subplots()
Y_test.hist(bins='auto', ax=ax)
ax.set_xlabel("price")
ax.set_ylabel("Counts")
ax.set_title('price expectancy: test distribution')
plt.show()
```

In [528…
```
price_test()
```

In [529…
```
examp_idx = 10
single_examp = X_test.iloc[examp_idx].values
X_test.iloc[examp_idx]
```

Out[529…
```
sqft_living       3030
zipcode          98059
sqft_living15     3030
grade                8
Name: 20977, dtype: int64
```

In [530…
```
lr.predict(single_examp.reshape(1,-1))
```

```
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-package
s/sklearn/base.py:450: UserWarning: X does not have valid feature names, but L
inearRegression was fitted with feature names
  warnings.warn(
```

Out[530…
```
array([761857.456176])
```

In [531…
```
Y_test.iloc[examp_idx]
```

Out[531…
```
525000.0
```

try it to a house over 110 year and pricePerSqft more than 300

In [532…
```
data[['price', 'sqft_living', 'zipcode', 'sqft_living15', 'grade']].head()
```

Out[532…

	price	sqft_living	zipcode	sqft_living15	grade
0	221900.0	1180	98178	1340	7
1	538000.0	2570	98125	1690	7
2	180000.0	770	98028	2720	6
3	604000.0	1960	98136	1360	7
4	510000.0	1680	98074	1800	8

In [533…
```
target_house_dict = {'sqft_living':1180, 'zipcode':98178, 'sqft_living15':134
X_target_house = pd.Series(target_house_dict)
```

In [534…
```
X_target_house_np = X_target_house.values
X_target_house_np
```

Out[534… `array([ 1180, 98178,  1340,     7])`

In [535…
```
X_target_house_input = X_target_house_np.reshape(1,-1)
X_target_house_input
```

Out[535… `array([[ 1180, 98178,  1340,     7]])`

In [536…
```
lr.predict(X_target_house_input)
```

```
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-package
s/sklearn/base.py:450: UserWarning: X does not have valid feature names, but L
inearRegression was fitted with feature names
  warnings.warn(
```

Out[536… `array([371133.55499807])`

In [537…
```
percent_change = (lr.predict(X_target_house_input)[0] - 221900.0 ) / 221900.0
print(percent_change)
```

```
67.25261604239296
/Library/Frameworks/Python.framework/Versions/3.10/lib/python3.10/site-package
s/sklearn/base.py:450: UserWarning: X does not have valid feature names, but L
inearRegression was fitted with feature names
  warnings.warn(
```

In [ ]: