Group Assignment 1, SA1 - Group 13

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0.0 Importing the Library and the Data

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
import glob
import datetime
from dateutil.relativedelta import relativedelta
from statsmodels.tsa.api import SimpleExpSmoothing
from statsmodels.api import add_constant

#Initialize the Variable with starting values
data_list = (glob.glob("C:/Users/tommy/OneDrive/(PYTHON)/5106/Group Assignment 1/5106 Tommy/Condominium
 Notebook/Resale/*.csv"))
df_all = pd.DataFrame()
```

In [2]:
```
#Appending all other datas with additional values
for n in range(55):
    df = pd.read_csv(data_list[n])
    df_all = pd.concat([df_all,df], axis=0, ignore_index = True)
```

In [3]:
```
df_all.head(2)
```

Out[3]:

	Project Name	Address	No. of Units	Area (sqm)	Type of Area	Transacted Price ($)	Nett Price($)	Unit Price ($ psm)	Unit Price ($ psf)	Sale Date	Property Type	Tenure	Completion Date	Type of Sale
0	AZALEA PARK CONDOMINIUM	14 Flora Road #02-02	1	140	Strata	1250000	-	8929	829	11-SEP-2020	Condominium	999 Yrs From 12/10/1885	1996	Resale
1	RIS GRANDEUR	23 Elias Road #04-07	1	143	Strata	1420000	-	9930	923	11-SEP-2020	Condominium	Freehold	2005	Resale

In [4]:
```
df_all.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51530 entries, 0 to 51529
Data columns (total 20 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   Project Name                51530 non-null  object
 1   Address                     51530 non-null  object
 2   No. of Units                51530 non-null  int64
 3   Area (sqm)                  51530 non-null  int64
 4   Type of Area                51530 non-null  object
 5   Transacted Price ($)        51530 non-null  int64
 6   Nett Price($)               51530 non-null  object
 7   Unit Price ($ psm)          51530 non-null  int64
 8   Unit Price ($ psf)          51530 non-null  int64
 9   Sale Date                   51530 non-null  object
 10  Property Type               51530 non-null  object
 11  Tenure                      51530 non-null  object
 12  Completion Date             51530 non-null  object
 13  Type of Sale                51530 non-null  object
 14  Purchaser Address Indicator 51530 non-null  object
 15  Postal District             51530 non-null  int64
 16  Postal Sector               51530 non-null  int64
 17  Postal Code                 51530 non-null  int64
 18  Planning Region             51530 non-null  object
 19  Planning Area               51530 non-null  object
dtypes: int64(8), object(12)
memory usage: 7.9+ MB
```

In [5]:
```
df_all.head(2)
```

Out[5]:

	Project Name	Address	No. of Units	Area (sqm)	Type of Area	Transacted Price ($)	Nett Price($)	Unit Price ($ psm)	Unit Price ($ psf)	Sale Date	Property Type	Tenure	Completion Date	Type of Sale
0	AZALEA PARK CONDOMINIUM	14 Flora Road #02-02	1	140	Strata	1250000	-	8929	829	11-SEP-2020	Condominium	999 Yrs From 12/10/1885	1996	Resale
1	RIS GRANDEUR	23 Elias Road #04-07	1	143	Strata	1420000	-	9930	923	11-SEP-2020	Condominium	Freehold	2005	Resale

1.0 Feature Engineering

In [6]:
```
# Getting the Level
df_all['Level'] = df_all['Address'].str.split('#').str.get(1).str.split('-').str.get(0)
df_all.fillna(0, inplace = True)
```

In [7]:
```
# Removing the B1 data and the 1.6e08 transaction price, for better data understanding
iddrop = df_all[(df_all['Level'] == 'B1') | (df_all['Level'] == 'B2')].index
df_all.drop(index = iddrop, axis = 0, inplace=True)
iddrop2 = df_all[df_all['Transacted Price ($)'] > 150000000].index
df_all.drop(index = iddrop2, axis = 0, inplace=True)
```

In [8]:
```
df_all['Property Type'].value_counts()
```

Out[8]:
```
Condominium               32979
Apartment                 14310
Executive Condominium      3124
Terrace House               803
Semi-Detached House         186
Detached House               73
Name: Property Type, dtype: int64
```

In [9]:
```
# Changin the astype to integer
df_all['Level']=df_all['Level'].astype(int)

# Dropping some unused or redundant columns
# dcol = ['Project Name', 'Address', 'No. of Units', 'Nett Price($)', 'Unit Price ($ psm)',
#         'Unit Price ($ psf)', 'Purchaser Address Indicator',
#         'Postal District', 'Postal Sector']
# df_all.drop(labels = dcol, axis=1, inplace=True)

# Renaming columns into easier
df_all.rename({'Area (sqm)' : 'Area', 'Transacted Price ($)':'Price' }, inplace=True, axis=1)

# Removing unknown Completion Date
iddrop = df_all[df_all['Completion Date'] == 'Unknown'].index
df_all.drop(index= iddrop, axis = 0, inplace=True)
df_all['Completion Date'] = df_all['Completion Date'].astype(int)

# Getting the Year from Sale Date
df_all['Sale Year'] = pd.to_datetime(df_all['Sale Date']).dt.year
df_all['Age'] = df_all['Sale Year'] - df_all['Completion Date']

# Add constant
df_all = add_constant(df_all, has_constant='add')

# Tenure
df_all['Tenure'] = df_all['Tenure'].str.split(' ').str.get(0)
df_all['Tenure'] = df_all['Tenure'].map({'999' : '999', 'Freehold' : 'Freehold',
                     '99' : '99', '946':'999', '103':'99',
                     '956' :'999', '9999' : 'Freehold', '102' : '99',
                     '929' :'999', '947': '999'})

# Covid-19 after March 2020
df_all['Sale Date'] = pd.to_datetime(df_all['Sale Date'])
df_all.loc[df_all['Sale Date'] >= '2020-03-01', 'Covid19'] = 1
df_all.loc[df_all['Sale Date'] < '2020-03-01', 'Covid19'] = 0

# High Price Area
Highpricearea = ['Newton', 'Orchard', 'River Valley', 'Southern Island', 'Tanglin']
ind = []
for x in Highpricearea:
    for i in df_all[df_all['Planning Area'] == x].index:
        ind.append(i)

df_all['High_Price'] = 0
df_all.loc[ind, 'High_Price']  = 1

# Adding Minimum Distance to MRT from Distance Matrix
dist_matrix = pd.read_csv('condo-mrt-distance.csv')
dist_matrix2 = dist_matrix[['Postal Code', 'Minimum']]
df_all= df_all.merge(dist_matrix2, left_on = 'Postal Code', right_on = 'Postal Code', how = 'left')
df_all.dropna(inplace=True)

df_all.head(2)
```

Out[9]:

	const	Project Name	Address	No. of Units	Area	Type of Area	Price	Nett Price($)	Unit Price ($ psm)	Unit Price ($ psf)	...	Postal Sector	Postal Code	Planning Region	Planning Area	Level
0	1.0	AZALEA PARK CONDOMINIUM	14 Flora Road #02-02	1	140	Strata	1250000	-	8929	829	...	50	509731	East Region	Pasir Ris	2
1	1.0	RIS GRANDEUR	23 Elias Road #04-07	1	143	Strata	1420000	-	9930	923	...	51	519930	East Region	Pasir Ris	4

2 rows × 27 columns

In [10]:
```
pd.set_option("display.max_rows", 10, "display.max_columns", 10)
dist_matrix
```

Out[10]:

	Postal Code	Jurong East	Bukit Batok	Bukit Gombak	Choa Chu Kang	...	Samudera	Nibong	Sumang	Soo Teck	Minimum
0	18965	12.60	12.51	12.83	15.21	...	14.23	13.73	13.31	12.94	0.06
1	18985	13.45	13.29	13.55	15.84	...	13.69	13.19	12.77	12.40	0.33
2	78878	12.12	10.60	9.96	10.29	...	7.92	7.56	7.25	7.01	1.11
3	78882	12.31	10.78	10.14	10.43	...	7.74	7.38	7.07	6.83	1.09
4	79903	15.83	14.48	13.95	14.44	...	4.48	4.01	3.62	3.29	0.61
...	...	...	...	...	...	...	...	...	...	...	...
3141	828840	19.67	18.24	17.64	17.81	...	0.98	0.60	0.51	0.67	0.23
3142	828841	19.65	18.22	17.61	17.79	...	1.01	0.62	0.51	0.65	0.20
3143	828842	19.62	18.19	17.59	17.77	...	1.03	0.64	0.51	0.63	0.17
3144	828843	19.57	18.15	17.54	17.73	...	1.04	0.63	0.47	0.58	0.15
3145	829753	20.16	18.67	18.02	18.04	...	0.16	0.59	1.00	1.37	0.16

3146 rows × 159 columns

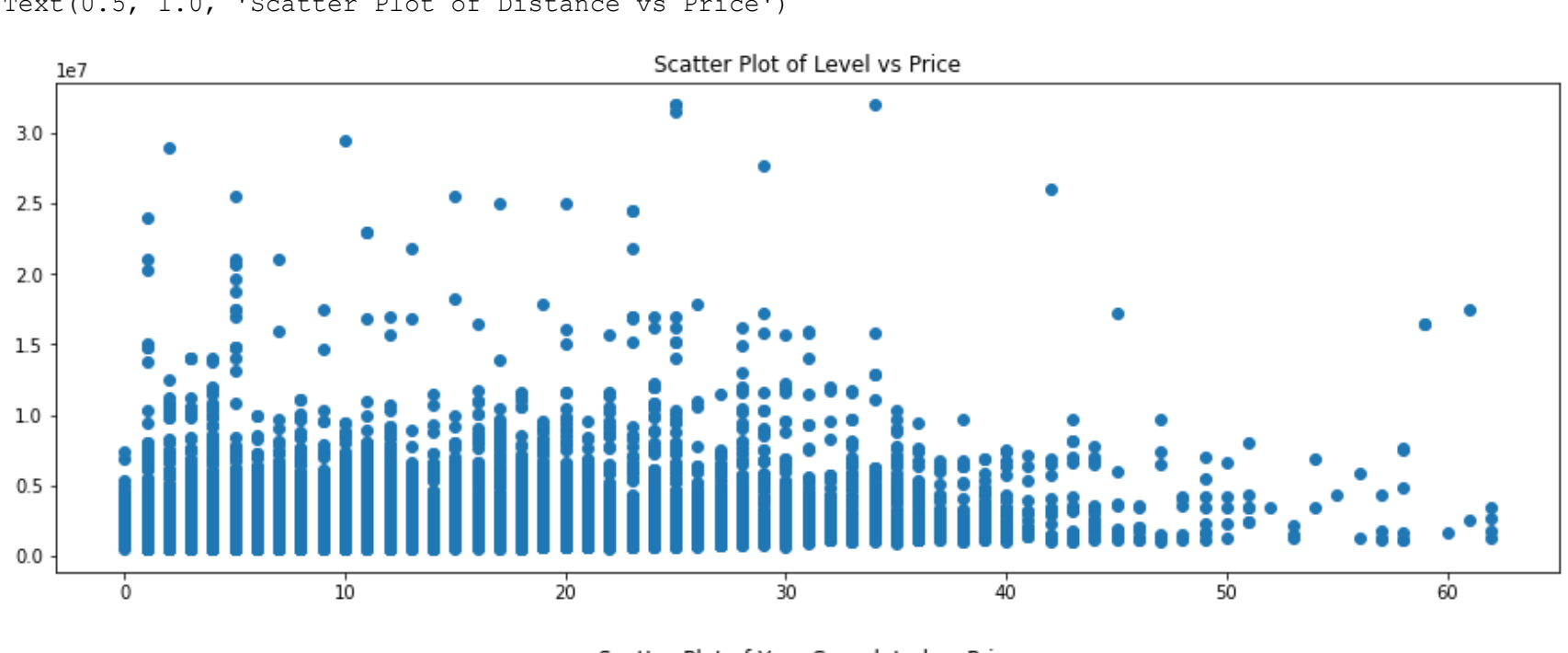
In [11]:
```
df_all['Age_0_5'] = 0
df_all.loc[df_all['Age'].between(0,5), 'Age_0_10'] = 1

df_all['Age_5_10'] = 0
df_all.loc[df_all['Age'].between(5,10), 'Age_5_10'] = 1


df_all['Age_10_20'] = 0
df_all.loc[df_all['Age'].between(10,20), 'Age_10_20'] = 1

df_all['Age_20_40'] = 0
df_all.loc[df_all['Age'].between(20,40), 'Age_20_40'] = 1

df_all['Age_40_above'] = 0
df_all.loc[df_all['Age'] > 40, 'Age_40_above'] = 1

df_all['Property Type'].value_counts()
```

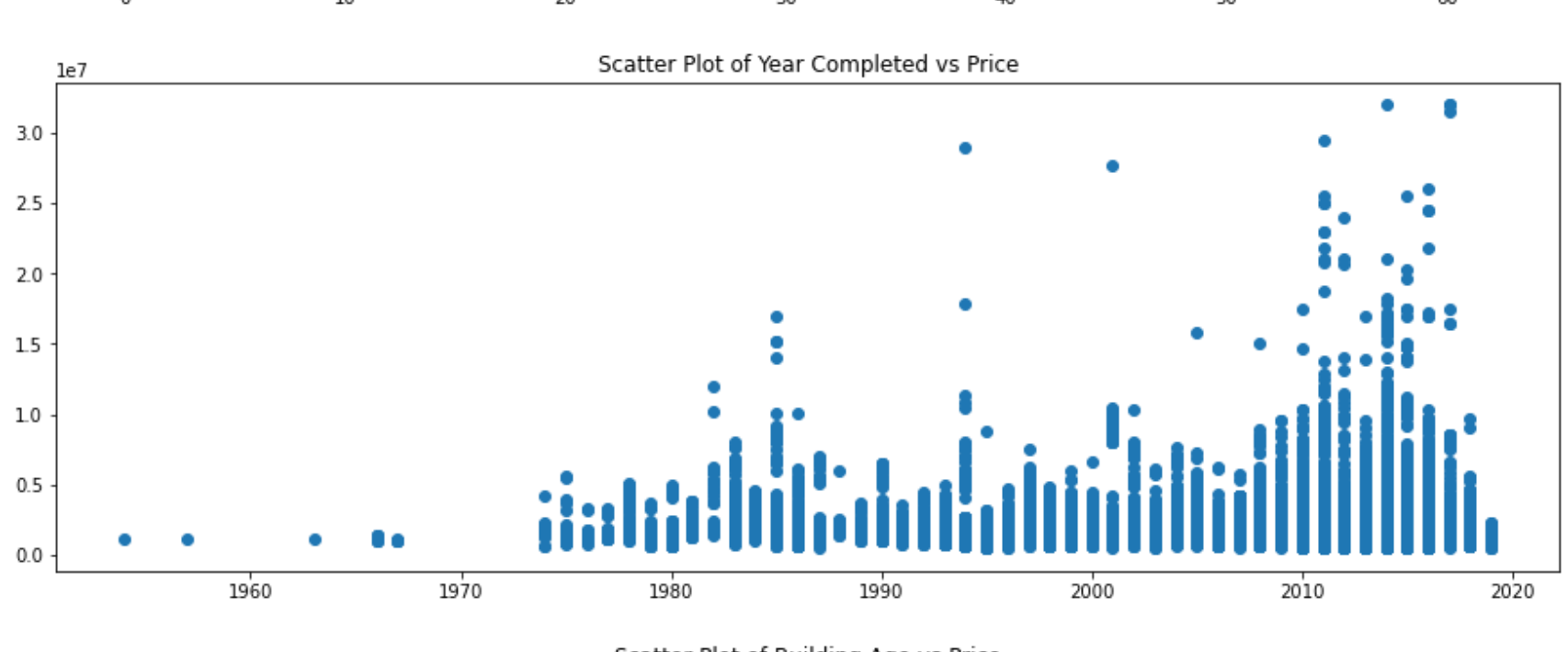
Out[11]:
```
Condominium               26412
Apartment                  9684
Executive Condominium      2862
Terrace House               179
Semi-Detached House          49
Detached House               18
Name: Property Type, dtype: int64
```

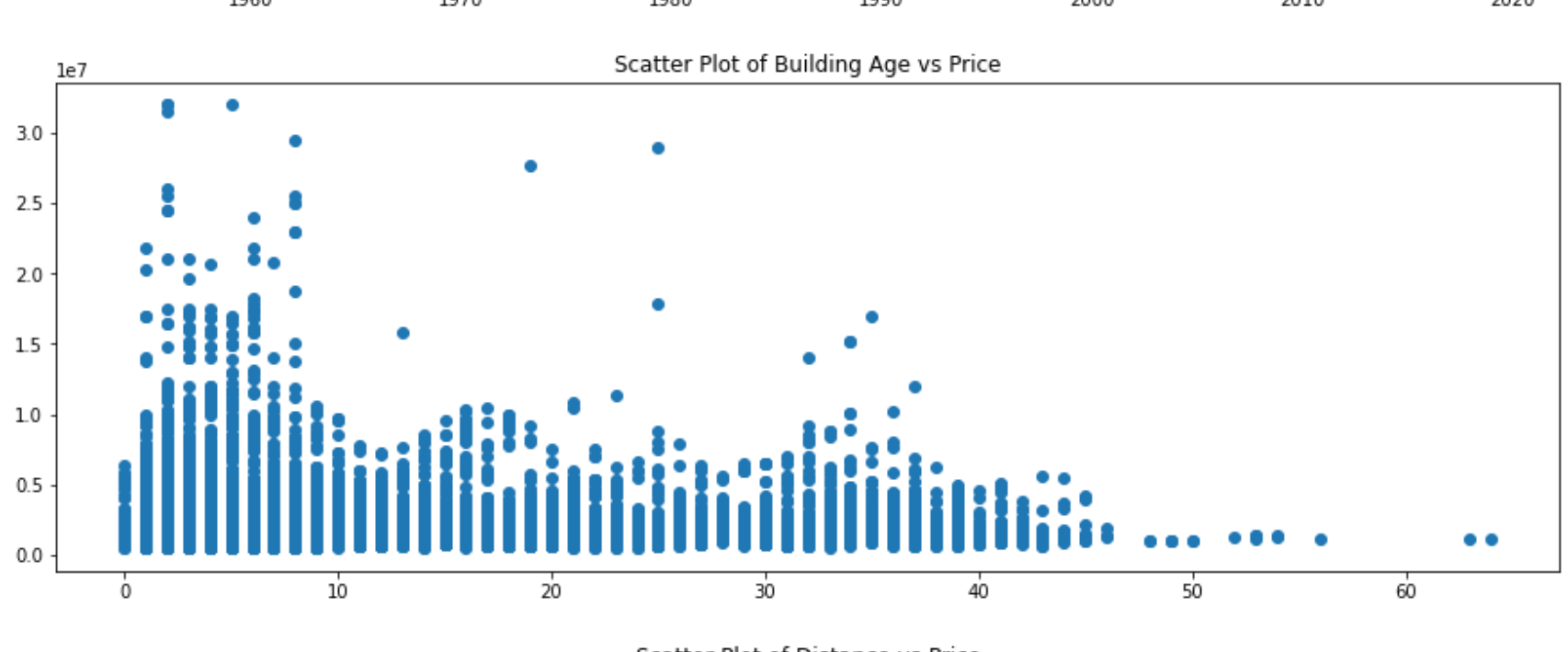
2.0 Data Exploration & Visualization

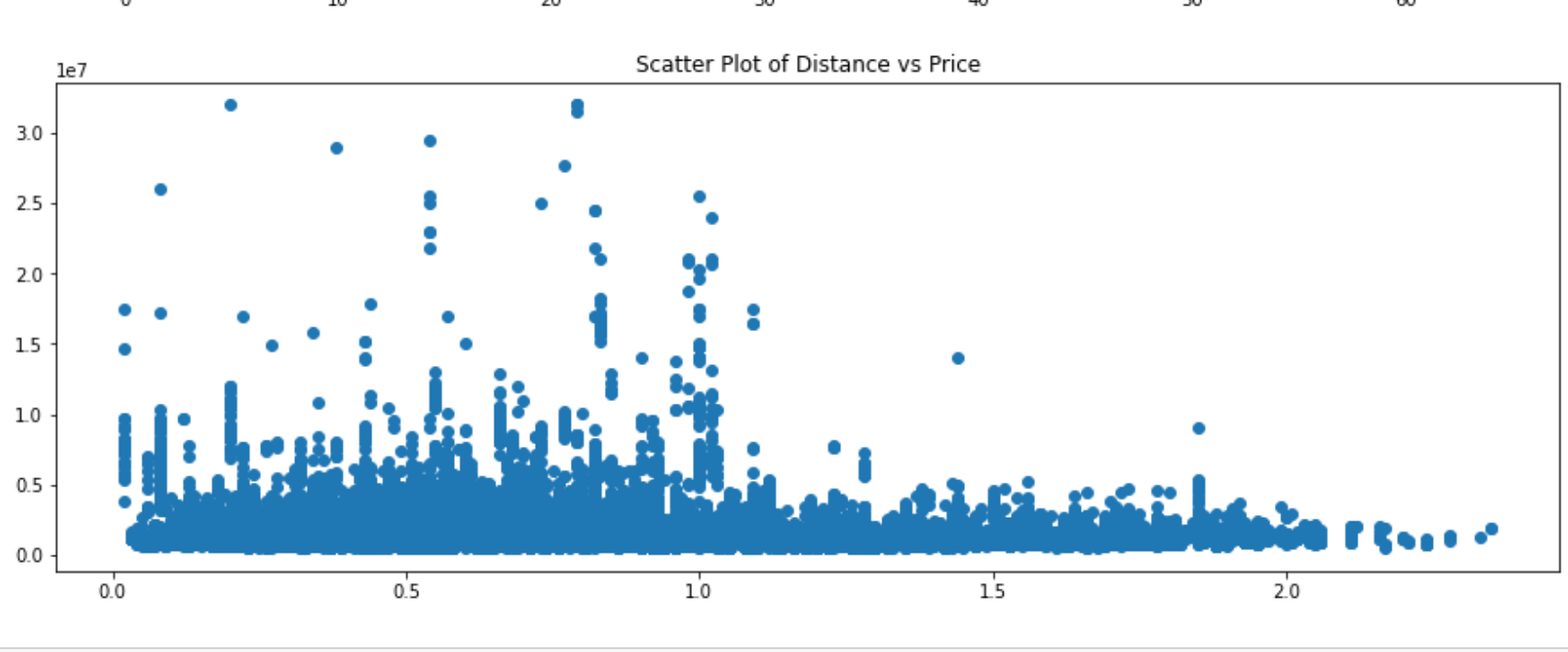
In [12]:
```
# Plotting the data
plt.figure(figsize = (15,5))
plt.scatter(df_all['Level'], df_all['Price'])
plt.title('Scatter Plot of Level vs Price')
plt.figure(figsize = (15,5))
plt.scatter(df_all['Completion Date'], df_all['Price'])
plt.title('Scatter Plot of Year Completed vs Price')
plt.figure(figsize = (15,5))
plt.scatter(df_all['Age'], df_all['Price'])
plt.title('Scatter Plot of Building Age vs Price')
plt.figure(figsize = (15,5))
plt.scatter(df_all['Minimum'], df_all['Price'])
plt.title('Scatter Plot of Distance vs Price')
```

Out[12]: Text(0.5, 1.0, 'Scatter Plot of Distance vs Price')



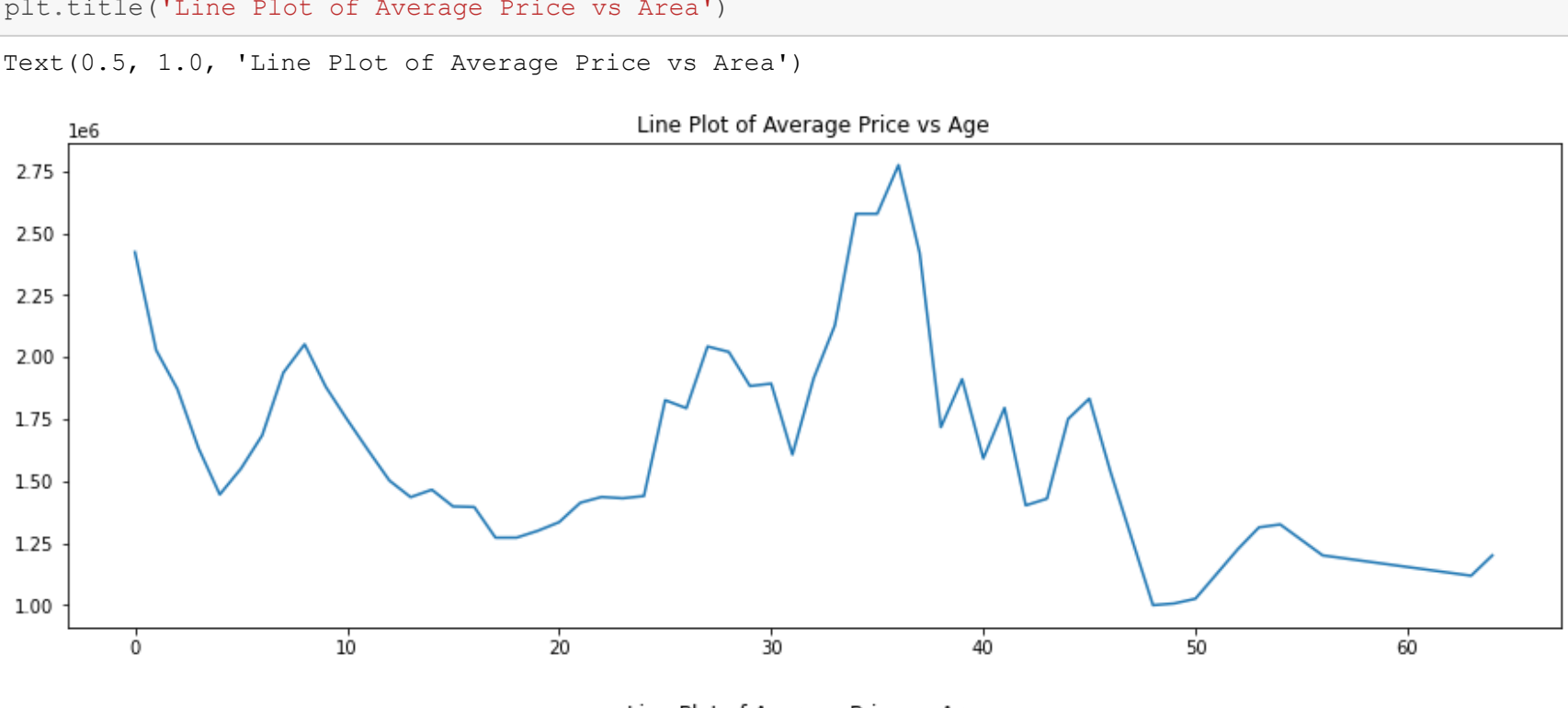


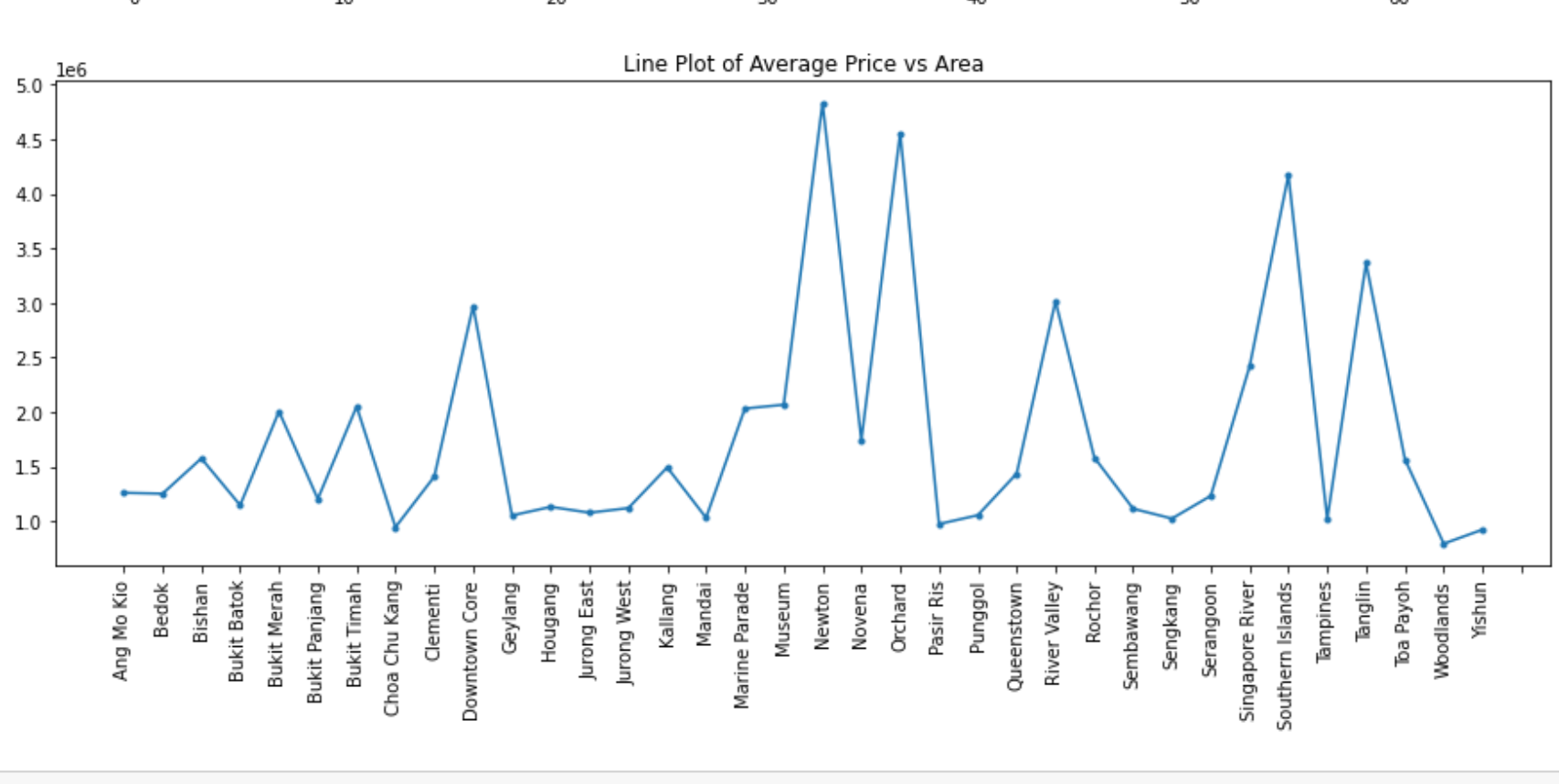




In [13]:
```
# Line plot figure
plt.figure(figsize = (15,5))
plt.plot(df_all[['Age', 'Price']].groupby('Age').mean())
plt.title('Line Plot of Average Price vs Age')

plt.figure(figsize = (15,5))
plt.plot(df_all[['Price', 'Planning Area']].groupby('Planning Area').mean(), marker = '.')
plt.xticks(ticks = range(37), rotation = 90)
plt.title('Line Plot of Average Price vs Area')
```

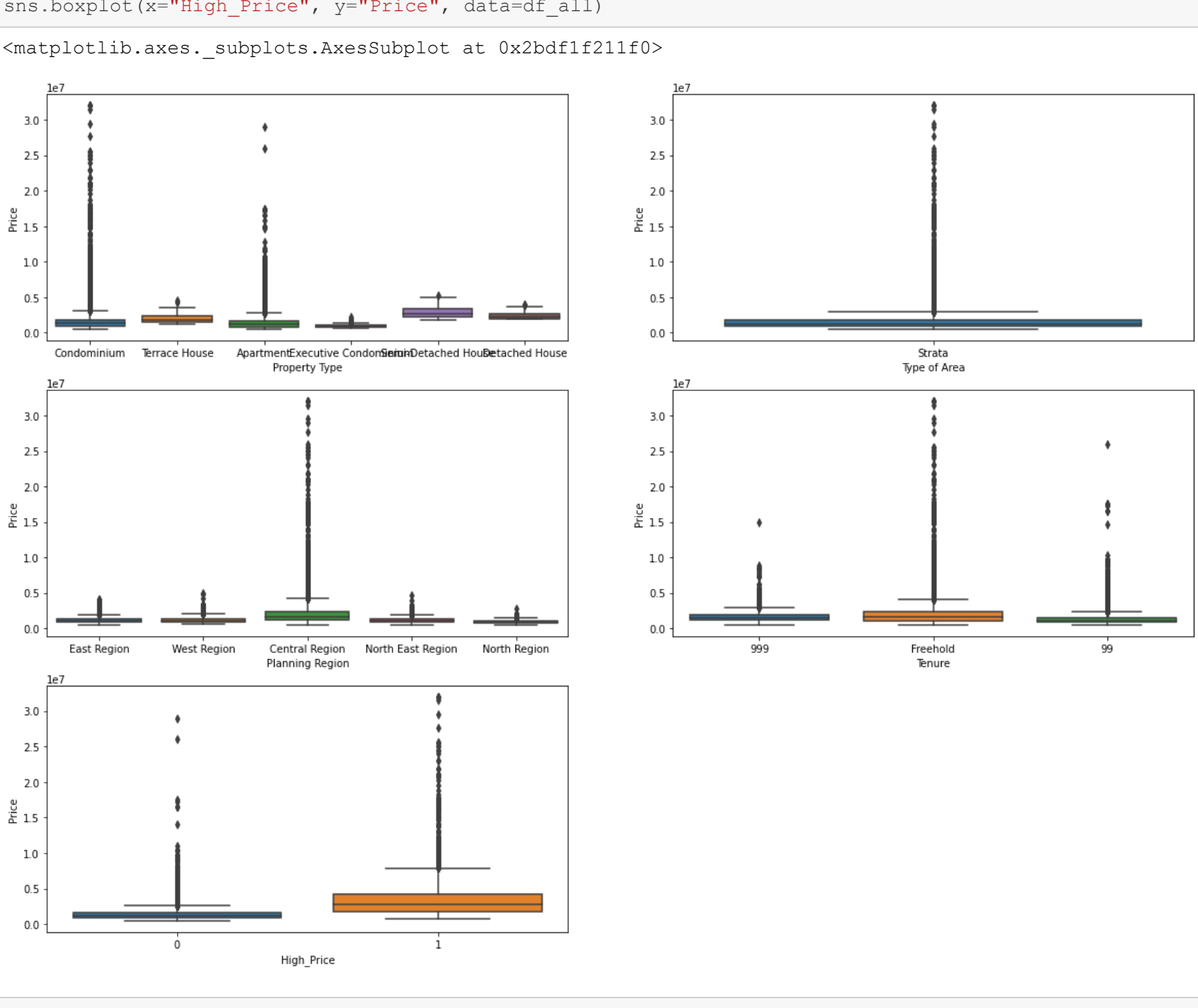
Out[13]: Text(0.5, 1.0, 'Line Plot of Average Price vs Area')





In [14]:
```
# Exploring the dataset
plt.figure(figsize=(20,15))

plt.subplot(321)
sns.boxplot(x="Property Type", y="Price", data=df_all)

plt.subplot(322)
sns.boxplot(x="Type of Area", y="Price", data=df_all)

plt.subplot(323)
sns.boxplot(x="Planning Region", y="Price", data=df_all)

plt.subplot(324)
sns.boxplot(x="Tenure", y="Price", data=df_all)

plt.subplot(325)
sns.boxplot(x="High_Price", y="Price", data=df_all)
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x2bdf1f211f0>



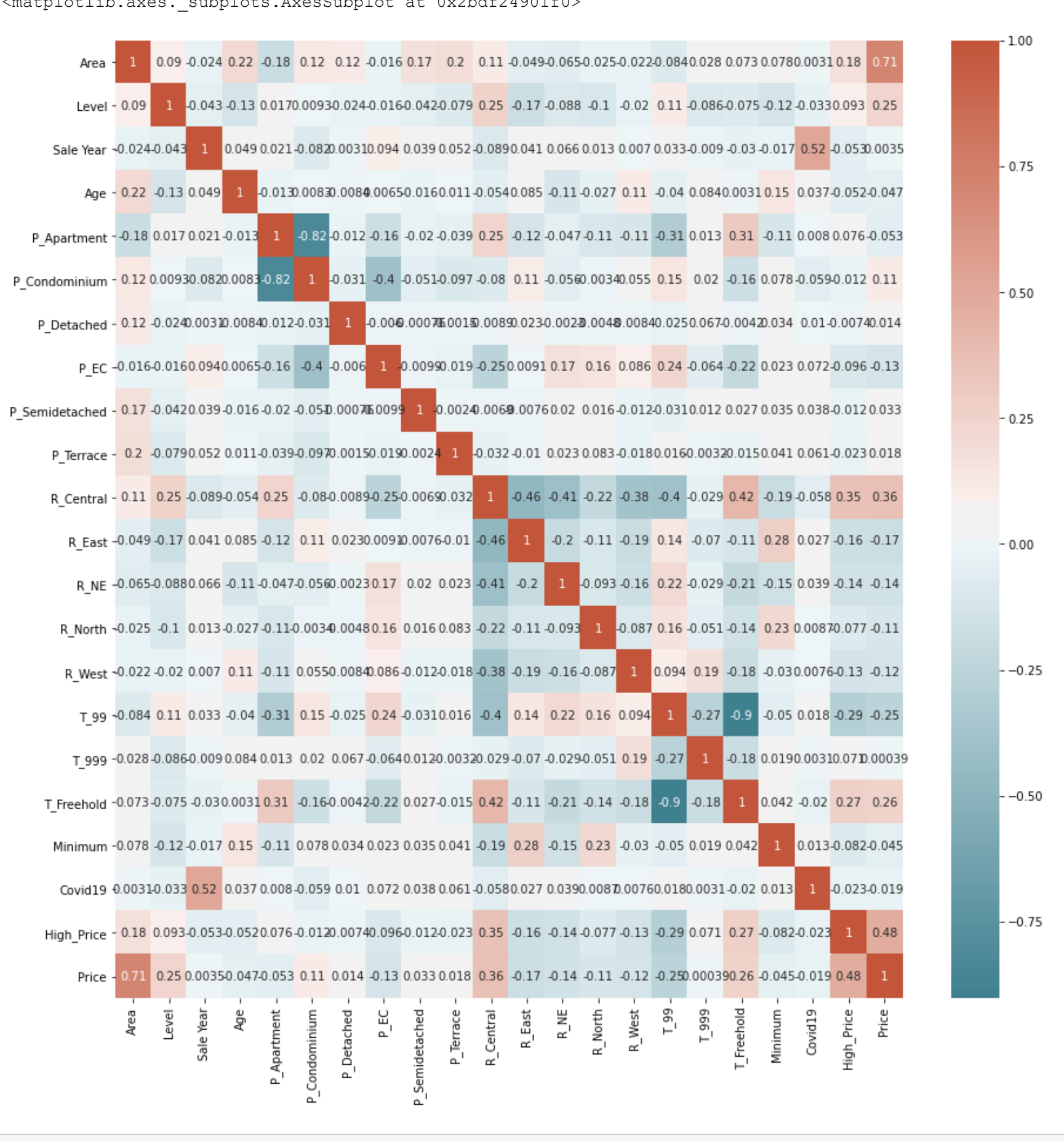
In [15]:
```
print(df_all[["Tenure", "Price"]].groupby("Tenure").mean())
print(df_all[["Covid19", "Price"]].groupby("Covid19").mean())
```

```
                 Price
Tenure
99        1.311842e+06
999       1.619864e+06
Freehold  2.092730e+06
                 Price
Covid19
0.0       1.625813e+06
1.0       1.529790e+06
```

In [16]:
```
# Getting dummies and renaming columns
df_all = pd.get_dummies(df_all, columns=['Property Type', 'Planning Region', 'Tenure'], prefix=['P', 'R', 'T'])

df_all.rename({'R_Central Region' : 'R_Central', 'R_East Region' : 'R_East', 'R_North East Region' : 'R_NE',
    'R_North Region' : 'R_North', 'R_West Region' : 'R_West'}, inplace=True, axis=1)
df_all.rename({'P_Executive Condominium' : 'P_EC', 'P_Detached House' : 'P_Detached',
    'P_Semi-Detached House' : 'P_Semidetached', 'P_Terrace House' : 'P_Terrace'}
    , inplace=True, axis=1)
```

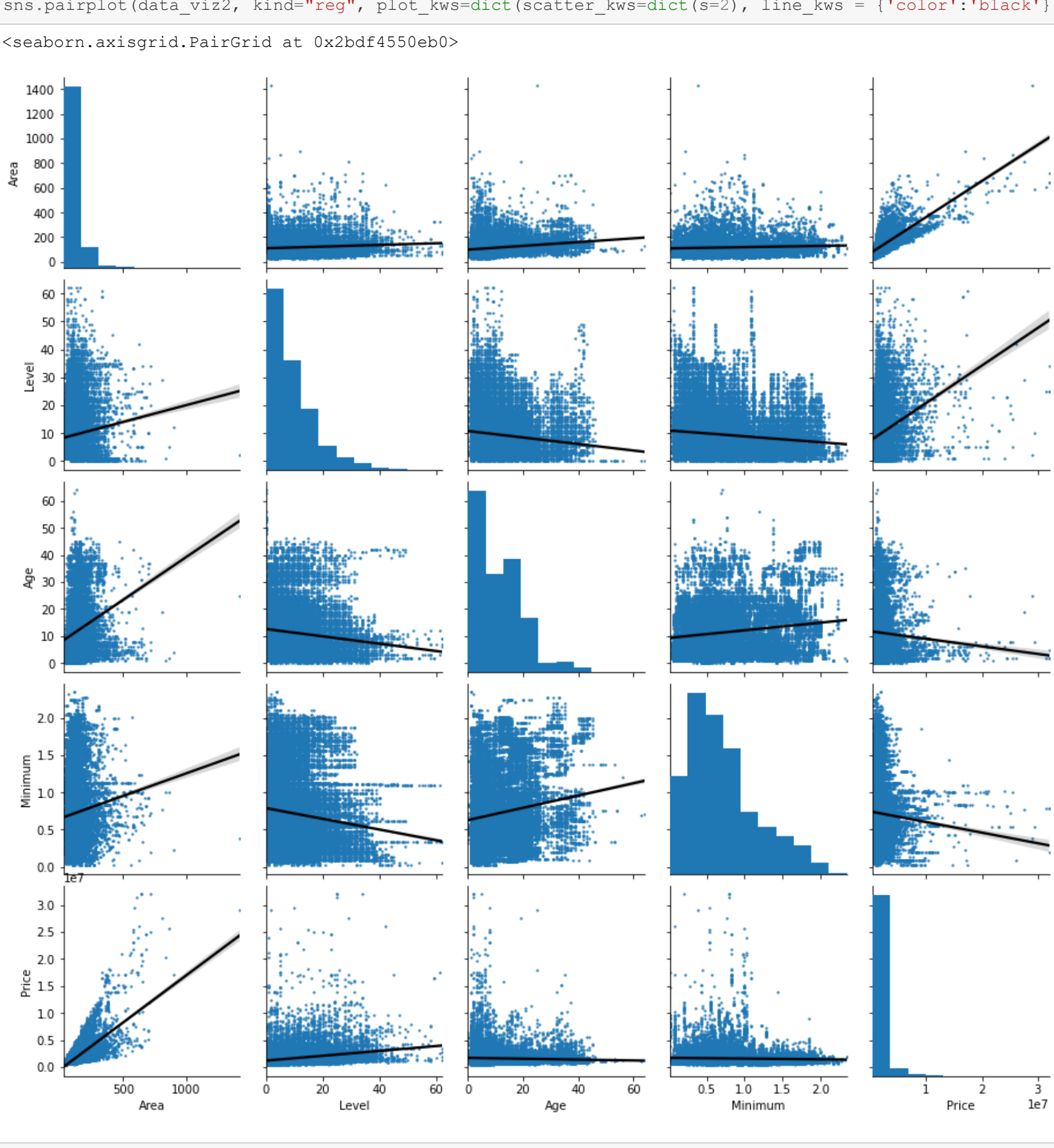
In [17]:
```
data_viz = df_all[['Area', 'Planning Area', 'Level', 'Sale Year', 'Age',
       'P_Apartment', 'P_Condominium', 'P_Detached', 'P_EC', 'P_Semidetached', 'P_Terrace',
       'R_Central', 'R_East', 'R_NE', 'R_North', 'R_West',
       'T_99', 'T_999', 'T_Freehold', 'Minimum', 'Covid19', 'High_Price', 'Price']]
plt.figure(figsize = (20,20))
cmap = sns.diverging_palette(215, 20, as_cmap=True)
sns.heatmap(data_viz.corr(), cmap=cmap, annot = True)
```

Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x2bdf2490f10>



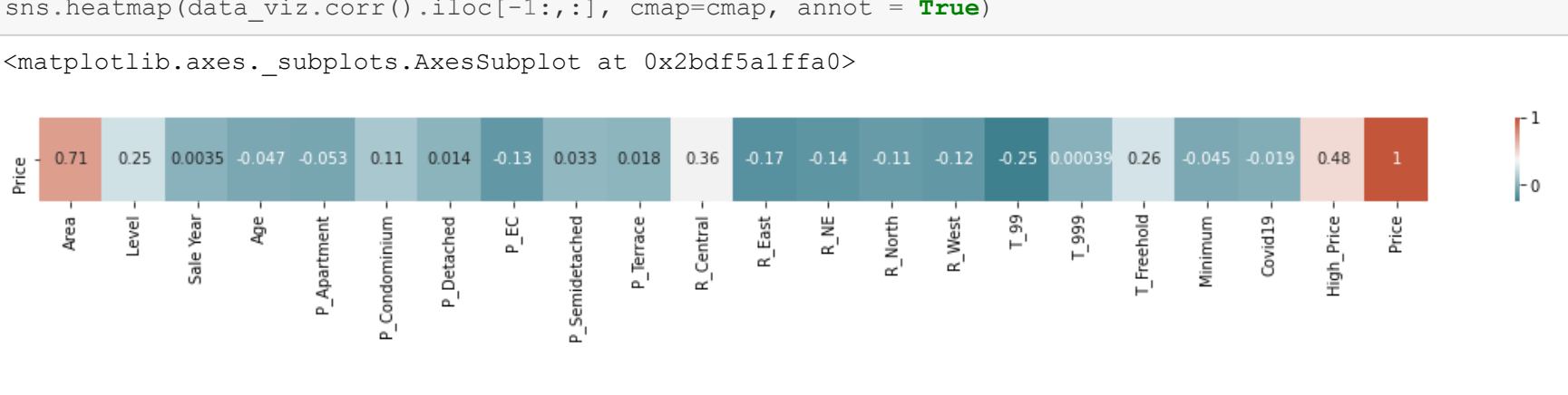
In [18]:
```
data_viz2 = df_all[['Area', 'Level', 'Age', 'Minimum','Price']]
sns.pairplot(data_viz2, kind="reg", plot_kws=dict(scatter_kws=dict(s=2), line_kws = {'color':'black'}))
```

Out[18]: <seaborn.axisgrid.PairGrid at 0x2bdf4550eb0>



In [19]:
```
data_viz = df_all[['Area', 'Type of Sale', 'Planning Area', 'Level', 'Sale Year', 'Age',
       'P_Apartment', 'P_Condominium', 'P_Detached', 'P_EC', 'P_Semidetached', 'P_Terrace',
       'R_Central', 'R_East', 'R_NE', 'R_North', 'R_West',
       'T_99', 'T_999', 'T_Freehold', 'Minimum', 'Covid19', 'High_Price', 'Price']]
plt.figure(figsize = (20,1))
cmap = sns.diverging_palette(215, 20, as_cmap=True)
sns.heatmap(data_viz.corr().iloc[-1:,:], cmap=cmap, annot = True)
```

Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x2bdf5a1ffa0>



3.0 Modeling with OLS

In [20]:
```
mask = df_all['Age_5_10'] == 1
df_some = df_all[mask]
```

In [21]:
```
import statsmodels.formula.api as smf

condominium = smf.ols(formula= 'Price ~ Age*Area + Age*R_West + Age*R_North + Age*R_NE + Age*R_East + A
ge*R_Central + Age*R_NE + Age*Minimum + Age*Level + Age*P_EC+ Age*P_Semidetached + Age*High_Price + Age
*T_Freehold + Age*T_99 + Age*T_999'
                    ,data=df_some).fit()
condominium.summary()
```

Out[21]:

OLS Regression Results

Dep. Variable:	Price	**R-squared:**	0.727
Model:	OLS	**Adj. R-squared:**	0.726
Method:	Least Squares	**F-statistic:**	1168.
Date:	Mon, 28 Sep 2020	**Prob (F-statistic):**	0.00
Time:	22:48:56	**Log-Likelihood:**	-1.6573e+05
No. Observations:	11002	**AIC:**	3.315e+05
Df Residuals:	10976	**BIC:**	3.317e+05
Df Model:	25		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-3.036e+05	8.18e+04	-3.709	0.000	-4.64e+05	-1.43e+05
Age	-2.721e+04	1.16e+04	-2.348	0.019	-4.99e+04	-4497.848
Area	2.222e+04	624.268	35.586	0.000	2.1e+04	2.34e+04
Age:Area	-568.1920	88.286	-6.436	0.000	-741.248	-395.136
R_West	-2.653e+05	1.01e+05	-2.634	0.008	-4.63e+05	-6.79e+04
Age:R_West	1.95e+04	1.37e+04	1.418	0.156	-7452.886	4.64e+04
R_North	5.821e+05	1.62e+05	3.590	0.000	2.64e+05	9e+05
Age:R_North	-1.155e+05	2.52e+04	-4.585	0.000	-1.65e+05	-6.61e+04
R_NE	-1.511e+05	8.88e+04	-1.701	0.089	-3.25e+05	2.3e+04
Age:R_NE	3786.2522	1.36e+04	0.279	0.780	-2.28e+04	3.04e+04
R_East	-6191.0461	8.58e+04	-0.072	0.942	-1.74e+05	1.62e+05
Age:R_East	-2.313e+04	1.25e+04	-1.847	0.065	-4.77e+04	1423.096
R_Central	-4.631e+05	8e+04	-5.793	0.000	-6.2e+05	-3.06e+05
Age:R_Central	8.81e+04	1.11e+04	7.925	0.000	6.63e+04	1.1e+05
Minimum	-5.984e+05	9.39e+04	-6.376	0.000	-7.82e+05	-4.14e+05
Age:Minimum	7.007e+04	1.3e+04	5.390	0.000	4.46e+04	9.56e+04
Level	7279.7809	4748.882	1.533	0.125	-2028.884	1.66e+04
Age:Level	1049.2131	634.227	1.654	0.098	-193.986	2292.412
P_EC	-2.847e+05	1.54e+05	-1.851	0.064	-5.86e+05	1.69e+04
Age:P_EC	3.176e+04	2.6e+04	1.222	0.222	-1.92e+04	8.27e+04
P_Semidetached	-6.693e+06	7.8e+05	-8.576	0.000	-8.22e+06	-5.16e+06
Age:P_Semidetached	3.84e+05	1.01e+05	3.793	0.000	1.86e+05	5.82e+05
High_Price	2.363e+06	1.27e+05	18.669	0.000	2.11e+06	2.61e+06
Age:High_Price	-1.325e+05	1.73e+04	-7.648	0.000	-1.66e+05	-9.85e+04
T_Freehold	4.781e+05	7.08e+04	6.752	0.000	3.39e+05	6.17e+05
Age:T_Freehold	-6.026e+04	9576.779	-6.293	0.000	-7.9e+04	-4.15e+04
T_99	-1.627e+05	6.92e+04	-2.350	0.019	-2.98e+05	-2.7e+04
Age:T_99	-9343.3774	9402.999	-0.994	0.320	-2.78e+04	9088.195
T_999	-6.19e+05	1.26e+05	-4.909	0.000	-8.66e+05	-3.72e+05
Age:T_999	4.239e+04	1.69e+04	2.506	0.012	9229.357	7.56e+04

Omnibus:	11266.929	**Durbin-Watson:**	1.940
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	2775329.512
Skew:	4.563	**Prob(JB):**	0.00
Kurtosis:	80.271	**Cond. No.**	1.17e+16

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 7.49e-23. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.

In [22]:
```
import statsmodels.formula.api as smf

condominium = smf.ols(formula= 'Price ~ Area + Age*R_West + Age*R_NE + Age*R_Central + Age*R_NE + Age*M
inimum + Level+ Age*P_Semidetached + Age*High_Price + Age*T_Freehold'
                    ,data=df_some).fit()
condominium.summary()
```

Out[22]:

OLS Regression Results

Dep. Variable:	Price	**R-squared:**	0.725
Model:	OLS	**Adj. R-squared:**	0.725
Method:	Least Squares	**F-statistic:**	1704.
Date:	Mon, 28 Sep 2020	**Prob (F-statistic):**	0.00
Time:	22:48:56	**Log-Likelihood:**	-1.6577e+05
No. Observations:	11002	**AIC:**	3.316e+05
Df Residuals:	10984	**BIC:**	3.317e+05
Df Model:	17		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-1.761e+05	1.16e+05	-1.521	0.128	-4.03e+05	5.08e+04
Area	1.833e+04	141.731	129.303	0.000	1.8e+04	1.86e+04
Age	-1.084e+05	1.66e+04	-6.529	0.000	-1.41e+05	-7.59e+04
R_West	-4.223e+05	1.38e+05	-3.050	0.002	-6.94e+05	-1.51e+05
Age:R_West	6.488e+04	1.91e+04	3.400	0.001	2.75e+04	1.02e+05
R_NE	-3.179e+05	1.25e+05	-2.543	0.011	-5.63e+05	-7.28e+04
Age:R_NE	5.017e+04	1.9e+04	2.643	0.008	1.3e+04	8.74e+04
R_Central	-5.481e+05	1.06e+05	-5.183	0.000	-7.55e+05	-3.41e+05
Age:R_Central	1.26e+05	1.48e+04	8.537	0.000	9.71e+04	1.55e+05
Minimum	-4.894e+05	9.01e+04	-5.434	0.000	-6.66e+05	-3.13e+05
Age:Minimum	5.461e+04	1.25e+04	4.386	0.000	3.02e+04	7.9e+04
Level	1.528e+04	1052.721	14.515	0.000	1.32e+04	1.73e+04
P_Semidetached	-5.488e+06	7.58e+05	-7.237	0.000	-6.97e+06	-4e+06
Age:P_Semidetached	2.092e+05	9.77e+04	2.142	0.032	1.78e+04	4.01e+05
High_Price	2.471e+06	1.23e+05	20.152	0.000	2.23e+06	2.71e+06
Age:High_Price	-1.501e+05	1.67e+04	-8.962	0.000	-1.83e+05	-1.17e+05
T_Freehold	7.044e+05	8.53e+04	8.253	0.000	5.37e+05	8.72e+05
Age:T_Freehold	-5.786e+04	1.16e+04	-4.994	0.000	-8.06e+04	-3.52e+04

Omnibus:	11246.356	**Durbin-Watson:**	1.943
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	2724826.545
Skew:	4.554	**Prob(JB):**	0.00
Kurtosis:	79.557	**Cond. No.**	1.24e+04

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The condition number is large, 1.24e+04. This might indicate that there are
strong multicollinearity or other numerical problems.

In [23]:
```
pd.set_option("display.max_rows", 10, "display.max_columns", None)
df_some['c_age'] = 2020-df_some['Completion Date']
df_some['c_age_3y'] = 2023 -df_some['Completion Date']
```

```
<ipython-input-23-4044452d6ef0>:2: 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/stable/user_guide/indexin
g.html#returning-a-view-versus-a-copy
  df_some['c_age'] = 2020-df_some['Completion Date']
<ipython-input-23-4044452d6ef0>:3: 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/stable/user_guide/indexin
g.html#returning-a-view-versus-a-copy
  df_some['c_age_3y'] = 2023 -df_some['Completion Date']
```

In [24]:
```
df_some.head(10)
```

Out[24]:

	const	Project Name	Address	No. of Units	Area	Type of Area	Price	Nett Price($)	Unit Price ($ psm)	Unit Price ($ psf)	Sale Date	Completion Date	Type of Sale	Purchaser Address Indicator	Postal District
2	1.0	EUHABITAT	320 Jalan Eunos	1	314	Strata	2200000	-	7006	651	2020-09-11	2015	Resale	Private	14
4	1.0	THE RIVERINE BY THE PARK	398 Kallang Road #19-02	1	165	Strata	2880000	-	17455	1622	2020-09-11	2010	Resale	Private	12
6	1.0	REZI 26	5A Lorong 26 Geylang #08-10	1	60	Strata	818000	-	13633	1267	2020-09-11	2015	Resale	Private	14
7	1.0	RIVERBAY	23 Mar Thoma Road #22-03	1	36	Strata	570000	-	15833	1471	2020-09-11	2014	Resale	HDB	12
11	1.0	LIVIA	73 Pasir Ris Grove #16-28	1	131	Strata	1250000	-	9542	886	2020-09-11	2011	Resale	HDB	18
12	1.0	NV RESIDENCES	83 Pasir Ris Grove #11-01	1	84	Strata	800000	-	9524	885	2020-09-11	2013	Resale	HDB	18
17	1.0	SKY@ELEVEN	5 Thomson Lane #11-02	1	252	Strata	4400000	-	17460	1622	2020-09-11	2010	Resale	Private	11
20	1.0	WATERFRONT ISLE	732 Bedok Reservoir Road #12-15	1	85	Strata	1080000	-	12706	1180	2020-09-11	2015	Resale	HDB	16
31	1.0	TWIN WATERFALLS	112 Punggol Walk #09-22	1	85	Strata	888000	-	10447	971	2020-09-10	2015	Resale	Private	19
34	1.0	SUITES @ PAYA LEBAR	420 Upper Paya Lebar Road #05-17	1	38	Strata	588000	-	15474	1438	2020-09-10	2013	Resale	Private	19

In [25]:
```
# Creating new dataset of X to predict the return 3 years later
new_df_ols = pd.DataFrame()
new_df_ols = df_some[['const', 'Area', 'Age', 'R_West', 'R_NE', 'R_Central',
                      'Minimum', 'Level', 'P_EC', 'P_Semidetached',
                      'T_Freehold', 'High_Price', 'c_age', 'c_age_3y', 'Postal Code']]

age = "c_age"

new_df_ols['Age:R_West'] = new_df_ols[age] * new_df_ols['R_West']
new_df_ols['Age:R_NE'] = new_df_ols[age] * new_df_ols['R_NE']
new_df_ols['Age:R_Central'] = new_df_ols[age] * new_df_ols['R_Central']
new_df_ols['Age:Minimum'] = new_df_ols[age] * new_df_ols['Minimum']
new_df_ols['Age:P_EC'] = new_df_ols[age] * new_df_ols['P_EC']
new_df_ols['Age:P_Semidetached'] = new_df_ols[age] * new_df_ols['P_Semidetached']
new_df_ols['Age:T_Freehold'] = new_df_ols[age] * new_df_ols['T_Freehold']
new_df_ols['Age:High_Price'] = new_df_ols[age] * new_df_ols['High_Price']

new_df_ols1 =new_df_ols[['const', 'Area', 'c_age', 'R_West', 'Age:R_West',
                         'R_NE', 'Age:R_NE', 'R_Central', 'Age:R_Central',
                         'Minimum', 'Age:Minimum',
                         'Level',
                         'P_Semidetached', 'Age:P_Semidetached',
                         'High_Price', 'Age:High_Price',
                         'T_Freehold', 'Age:T_Freehold']]
X = new_df_ols1.values

# getting the coefficient from the models
cpar = condominium.params

print(X.shape)
print(cpar.shape)

# dot product to get the prediction
y_pred = np.dot(X,cpar)
```

```
(11002, 18)
(18,)
```

```
<ipython-input-25-37096ada9739>:9: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_West'] = new_df_ols[age] * new_df_ols['R_West']
<ipython-input-25-37096ada9739>:10: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_NE'] = new_df_ols[age] * new_df_ols['R_NE']
<ipython-input-25-37096ada9739>:11: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_Central'] = new_df_ols[age] * new_df_ols['R_Central']
<ipython-input-25-37096ada9739>:12: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:Minimum'] = new_df_ols[age] * new_df_ols['Minimum']
<ipython-input-25-37096ada9739>:13: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:P_EC'] = new_df_ols[age] * new_df_ols['P_EC']
<ipython-input-25-37096ada9739>:14: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:P_Semidetached'] = new_df_ols[age] * new_df_ols['P_Semidetached']
<ipython-input-25-37096ada9739>:15: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:T_Freehold'] = new_df_ols[age] * new_df_ols['T_Freehold']
<ipython-input-25-37096ada9739>:16: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:High_Price'] = new_df_ols[age] * new_df_ols['High_Price']
```

In [26]:
```
new_df_ols.head()
```

Out[26]:

	const	Area	Age	R_West	R_NE	R_Central	Minimum	Level	P_EC	P_Semidetached	T_Freehold	High_Price	c_age	c_age_3y	P
2	1.0	314	5	0	0	0	0.79	0	0	0	0	0	5	8	4
4	1.0	165	10	0	0	1	0.32	19	0	0	1	0	10	13	3
6	1.0	60	5	0	0	1	0.46	8	0	0	1	0	5	8	3
7	1.0	36	6	0	0	0	0.79	22	0	0	0	0	6	9	3
11	1.0	131	9	0	0	0	0.74	16	0	0	0	0	9	12	5

In [27]:
```
age = "c_age_3y"

new_df_ols['Age:R_West'] = new_df_ols[age] * new_df_ols['R_West']
new_df_ols['Age:R_NE'] = new_df_ols[age] * new_df_ols['R_NE']
new_df_ols['Age:R_Central'] = new_df_ols[age] * new_df_ols['R_Central']
new_df_ols['Age:Minimum'] = new_df_ols[age] * new_df_ols['Minimum']
new_df_ols['Age:P_EC'] = new_df_ols[age] * new_df_ols['P_EC']
new_df_ols['Age:P_Semidetached'] = new_df_ols[age] * new_df_ols['P_Semidetached']
new_df_ols['Age:T_Freehold'] = new_df_ols[age] * new_df_ols['T_Freehold']
new_df_ols['Age:High_Price'] = new_df_ols[age] * new_df_ols['High_Price']

new_df_ols2 =new_df_ols[['const', 'Area', 'c_age_3y', 'R_West', 'Age:R_West',
                         'R_NE', 'Age:R_NE', 'R_Central', 'Age:R_Central',
                         'Minimum', 'Age:Minimum',
                         'Level',
                         'P_Semidetached', 'Age:P_Semidetached',
                         'High_Price', 'Age:High_Price',
                         'T_Freehold', 'Age:T_Freehold']]
X2 = new_df_ols2.values

# getting the coefficient from the models
cpar = condominium.params

print(X2.shape)
print(cpar.shape)

# dot product to get the prediction
y_pred_3y = np.dot(X2,cpar)

# Feature Engineering to get the prediction after 3 years, and comparing with the actual (%)
new_df_ols['price'] = df_all['Price']
new_df_ols['pred'] = condominium.predict()
new_df_ols['price_now'] = y_pred
new_df_ols['price_3y'] = y_pred_3y

new_df_ols['pred%'] = round((new_df_ols['pred'] - new_df_ols['price'])/new_df_ols['price']*100,1)
new_df_ols['profit%'] = round((new_df_ols['price_3y'] - new_df_ols['price_now'])/new_df_ols['price_now']*100,1)
```

```
(11002, 18)
(18,)
```

```
<ipython-input-27-fd10dc952e0b>:3: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_West'] = new_df_ols[age] * new_df_ols['R_West']
<ipython-input-27-fd10dc952e0b>:4: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_NE'] = new_df_ols[age] * new_df_ols['R_NE']
<ipython-input-27-fd10dc952e0b>:5: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:R_Central'] = new_df_ols[age] * new_df_ols['R_Central']
<ipython-input-27-fd10dc952e0b>: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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:Minimum'] = new_df_ols[age] * new_df_ols['Minimum']
<ipython-input-27-fd10dc952e0b>:7: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:P_EC'] = new_df_ols[age] * new_df_ols['P_EC']
<ipython-input-27-fd10dc952e0b>:8: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:P_Semidetached'] = new_df_ols[age] * new_df_ols['P_Semidetached']
<ipython-input-27-fd10dc952e0b>:9: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:T_Freehold'] = new_df_ols[age] * new_df_ols['T_Freehold']
<ipython-input-27-fd10dc952e0b>:10: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['Age:High_Price'] = new_df_ols[age] * new_df_ols['High_Price']
<ipython-input-27-fd10dc952e0b>:31: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['price'] = df_all['Price']
<ipython-input-27-fd10dc952e0b>:32: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['pred'] = condominium.predict()
<ipython-input-27-fd10dc952e0b>:33: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['price_now'] = y_pred
<ipython-input-27-fd10dc952e0b>:34: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['price_3y'] = y_pred_3y
<ipython-input-27-fd10dc952e0b>:36: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['pred%'] = round((new_df_ols['pred'] - new_df_ols['price'])/new_df_ols['price']*100,1)
<ipython-input-27-fd10dc952e0b>:37: 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/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  new_df_ols['profit%'] = round((new_df_ols['price_3y'] - new_df_ols['price_now'])/new_df_ols['price_now']*100,1)
```

In [28]:
```
residual = (new_df_ols['pred'] - new_df_ols['price'])
residual
```

Out[28]:
```
array([2665349.23727201,   29841.47696068,   83146.78518706, ...,
        322010.60550607, -429446.19706476, -147564.5261332 ])
```

In [29]:
```
# filter off the value with off prediction and then check the profit
mask1 = new_df_ols['profit%'] > 0
mask2 = new_df_ols['pred%'].between(-3,3)

new_df_ols['Area'].describe()

profit_df = new_df_ols[mask1 & mask2][['Area', 'c_age_3y', 'Minimum', 'Level', 'High_Price',
       'price', 'pred', 'price_now', 'price_3y', 'pred%', 'profit%', 'Postal Code']]

id = profit_df.index
```

In [30]:
```
pd.set_option("display.max_rows", 10, "display.max_columns", None)
new_df_ols.head(10)
```

Out[30]:

	const	Area	Age	R_West	R_NE	R_Central	Minimum	Level	P_EC	P_Semidetached	T_Freehold	High_Price	c_age	c_age_3y	P
2	1.0	314	5	0	0	0	0.79	0	0	0	0	0	5	8	4
4	1.0	165	10	0	0	1	0.32	19	0	0	1	0	10	13	3
6	1.0	60	5	0	0	1	0.46	8	0	0	1	0	5	8	3
7	1.0	36	6	0	0	0	0.79	22	0	0	0	0	6	9	3
11	1.0	131	9	0	0	0	0.74	16	0	0	0	0	9	12	5
12	1.0	84	7	0	0	0	0.58	11	0	0	0	0	7	10	5
17	1.0	252	10	0	0	1	0.72	11	0	0	1	0	10	13	2
20	1.0	85	5	0	0	0	0.63	12	0	0	0	0	5	8	4
31	1.0	85	5	0	0	0	0.36	2	1	0	0	0	5	8	8
34	1.0	38	7	0	0	1	0.74	5	0	0	1	0	7	10	5

In [31]:
```
profit_df
```

Out[31]:

	Area	c_age_3y	Minimum	Level	High_Price	price	pred	price_now	price_3y	pred%	profit%	Postal Code
335	96	12	0.15	9	0	1358000	1.331326e+06	1.331326e+06	1.408699e+06	-2.0	5.8	357776
471	122	13	0.19	32	0	2160000	2.187305e+06	2.187305e+06	2.271232e+06	1.3	3.8	198784
1150	107	10	0.90	21	0	1300000	1.282237e+06	1.282237e+06	1.299105e+06	-1.4	1.3	679520
1335	154	13	1.35	15	0	2700000	2.705570e+06	2.705570e+06	2.805972e+06	0.2	3.7	439974
1462	86	12	0.35	19	0	1300000	1.301286e+06	1.301286e+06	1.411427e+06	0.1	8.5	319581
...	...	...	...	...	...	...	...	...	...	...	...	...
50165	112	12	0.30	19	0	1628100	1.675713e+06	1.777662e+06	1.879612e+06	2.9	5.7	138638
50175	63	16	0.21	30	0	1060000	1.076631e+06	1.163835e+06	1.251039e+06	1.6	7.5	208745
50399	128	16	1.12	13	0	2190000	2.185479e+06	2.248197e+06	2.310915e+06	-0.2	2.8	437874
50402	86	16	0.61	13	0	1300000	1.261072e+06	1.413812e+06	1.566553e+06	-3.0	10.8	169814
50564	149	13	1.23	17	0	2600000	2.556950e+06	2.637690e+06	2.718431e+06	-1.7	3.1	437880

316 rows × 12 columns

In [32]:
```
info_df = pd.read_csv('info_df.csv')
info_df.set_index('Unnamed: 0', inplace=True)
info_df = info_df.loc[id]
```

In [33]:
```
info_df = pd.read_csv('info_df2.csv')
info_df.head(2)
```

Out[33]:

	Unnamed: 0	Postal Code	Project Name	Property Type	Planning Area	Planning Region
0	0	509731	AZALEA PARK CONDOMINIUM	Condominium	Pasir Ris	East Region
1	1	519930	RIS GRANDEUR	Condominium	Pasir Ris	East Region

In [34]:
```
profit_df = profit_df.merge(info_df, left_on = 'Postal Code', right_on = 'Postal Code', how = 'left')
```

In [35]:
```
pd.set_option("display.max_rows", None, "display.max_columns", None)
profit_df.describe(include= 'all').iloc[:,-4:]
```

Out[35]:

	Project Name	Property Type	Planning Area	Planning Region
count	316	316	316	316
unique	67	3	17	4
top	THE SEA VIEW	Condominium	Marine Parade	Central Region
freq	20	229	80	273
mean	NaN	NaN	NaN	NaN
std	NaN	NaN	NaN	NaN
min	NaN	NaN	NaN	NaN
25%	NaN	NaN	NaN	NaN
50%	NaN	NaN	NaN	NaN
75%	NaN	NaN	NaN	NaN
max	NaN	NaN	NaN	NaN

In [36]:
```
profit_df.drop('Unnamed: 0', axis=1, inplace=True)

profit_df.head(10)
```

Out[36]:

	Area	c_age_3y	Minimum	Level	High_Price	price	pred	price_now	price_3y	pred%	profit%	Postal Code	Project Na
0	86	12	0.15	9	0	1358000	1.331326e+06	1.331326e+06	1.408699e+06	-2.0	5.8	357776	WOODSVI
1	122	13	0.19	32	0	2160000	2.187305e+06	2.187305e+06	2.271232e+06	1.3	3.8	198784	SOUTHBA
2	107	10	0.90	21	0	1300000	1.282237e+06	1.282237e+06	1.299105e+06	-1.4	1.3	679520	TREE HOU
3	154	13	1.35	15	0	2700000	2.705570e+06	2.705570e+06	2.805972e+06	0.2	3.7	439974	ONE AME
4	86	12	0.35	19	0	1300000	1.301286e+06	1.301286e+06	1.411427e+06	0.1	8.5	319581	TREVI
5	106	12	0.31	19	0	1650000	1.667726e+06	1.667726e+06	1.771314e+06	1.1	6.2	319582	TREVI
6	425	8	2.00	0	0	2620000	2.611267e+06	2.611267e+06	3.067742e+06	-0.3	17.5	506842	
7	154	13	1.35	13	0	2750000	2.675011e+06	2.675011e+06	2.775412e+06	-2.7	3.8	439974	ONE AME
8	135	10	1.12	7	0	1915000	1.860013e+06	1.860013e+06	2.098314e+06	-2.9	12.7	109688	INTERL
9	137	10	0.14	5	0	1920000	1.971072e+06	1.971072e+06	2.045806e+06	2.7	3.8	158748	ASCEN

In [37]:
```
pd.set_option("display.max_rows", None, "display.max_columns", None)
profit_df.nlargest(10, columns='profit%')
```

Out[37]:

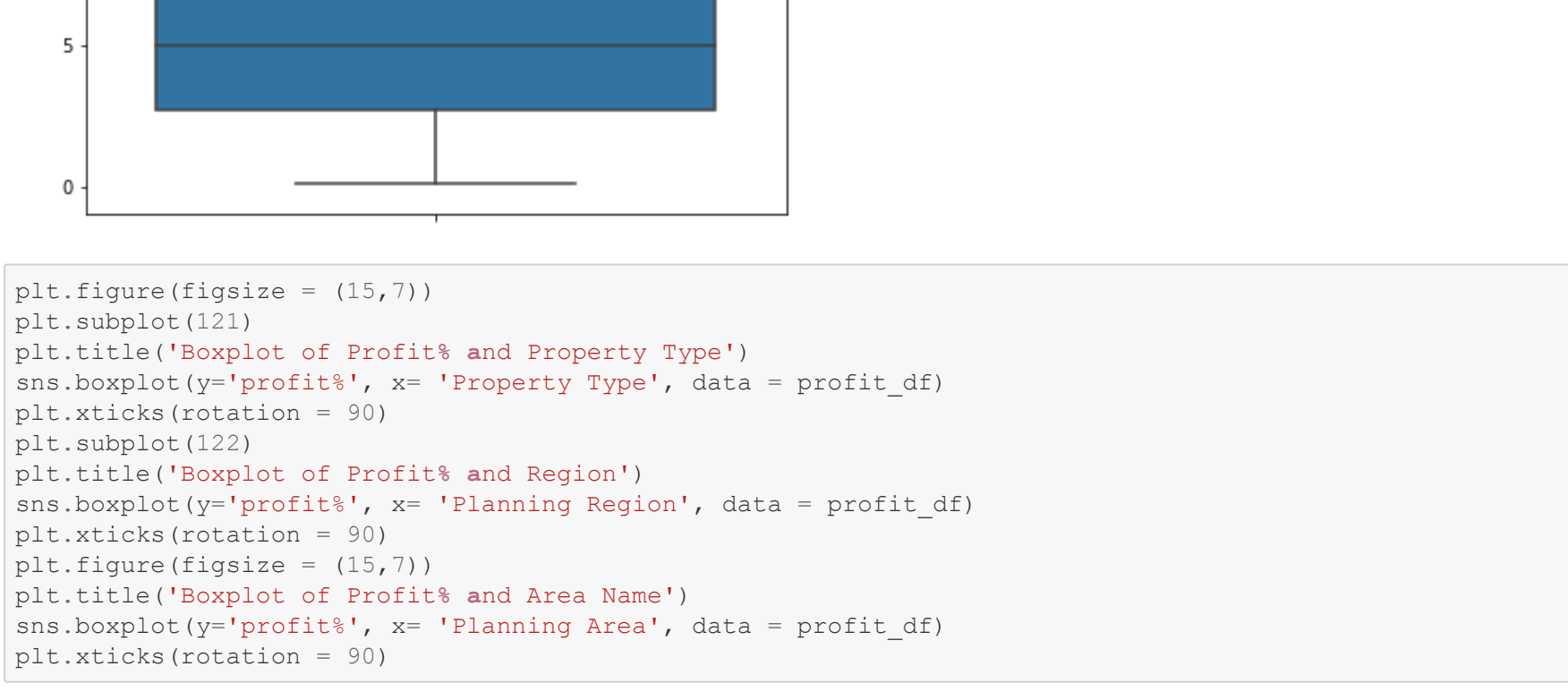
	Area	c_age_3y	Minimum	Level	High_Price	price	pred	price_now	price_3y	pred%	profit%	Postal Code	Project
11	416	10	1.19	0	0	3180000	3.171384e+06	3.171384e+06	3.873173e+06	-0.3	22.1	266241	ESTRIV
6	425	8	2.00	0	0	2620000	2.611267e+06	2.611267e+06	3.067742e+06	-0.3	17.5	506842	
21	110	10	1.12	15	0	1560000	1.524096e+06	1.524096e+06	1.760396e+06	-2.3	15.5	109687	INTER
307	86	11	0.70	9	0	915000	9.259141e+05	1.093401e+06	1.260887e+06	1.2	15.3	328889	BEA HE
169	86	11	0.70	10	0	915000	9.411940e+05	1.108681e+06	1.276167e+06	2.9	15.1	328889	BEA HE
38	414	10	0.92	0	0	2700000	2.719655e+06	2.863002e+06	3.293043e+06	0.7	15.0	554524	VER V
44	414	10	0.92	0	0	2700000	2.719655e+06	2.863002e+06	3.293043e+06	0.7	15.0	554524	VER V
254	89	18	2.01	21	0	1010000	1.032208e+06	1.363431e+06	1.562165e+06	2.2	14.6	128046	HOF
75	125	10	1.12	5	0	1600000	1.567424e+06	1.646191e+06	1.882491e+06	-2.0	14.4	109701	INTER
47	113	12	1.03	3	0	1510000	1.479207e+06	1.553059e+06	1.774614e+06	-2.0	14.3	573975	CLOVE THE

In [38]:
```
from sklearn.metrics import mean_squared_error
print(mean_squared_error(df_some['Price'].values, y_pred))
```

```
717238051580.0867
```

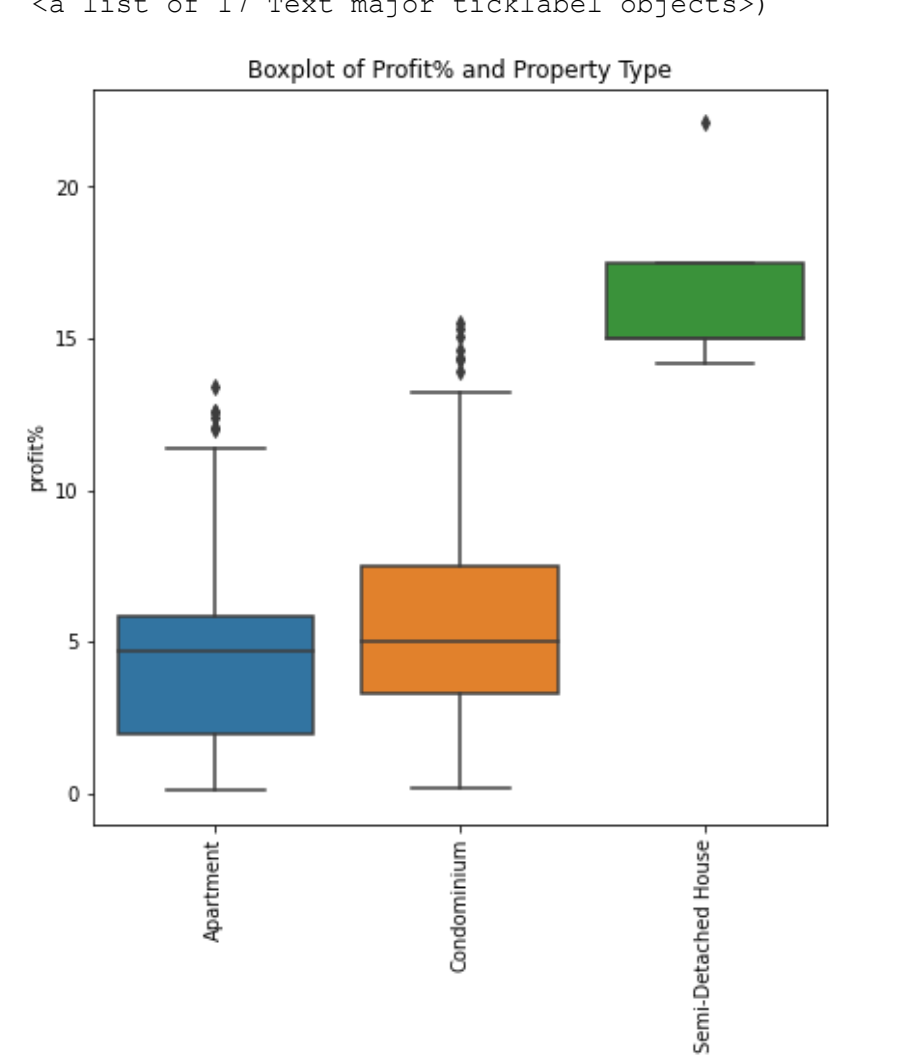
In [39]:
```
plt.figure(figsize = (20,7))
plt.title('Prediction Vs Actual Price')
plt.plot(range(300), df_some['Price'].iloc[0:300], label = 'actual')
plt.plot(range(300), condominium.predict()[0:300], label = 'prediction')
plt.legend()
```

Out[39]: <matplotlib.legend.Legend at 0x2bd8110de20>



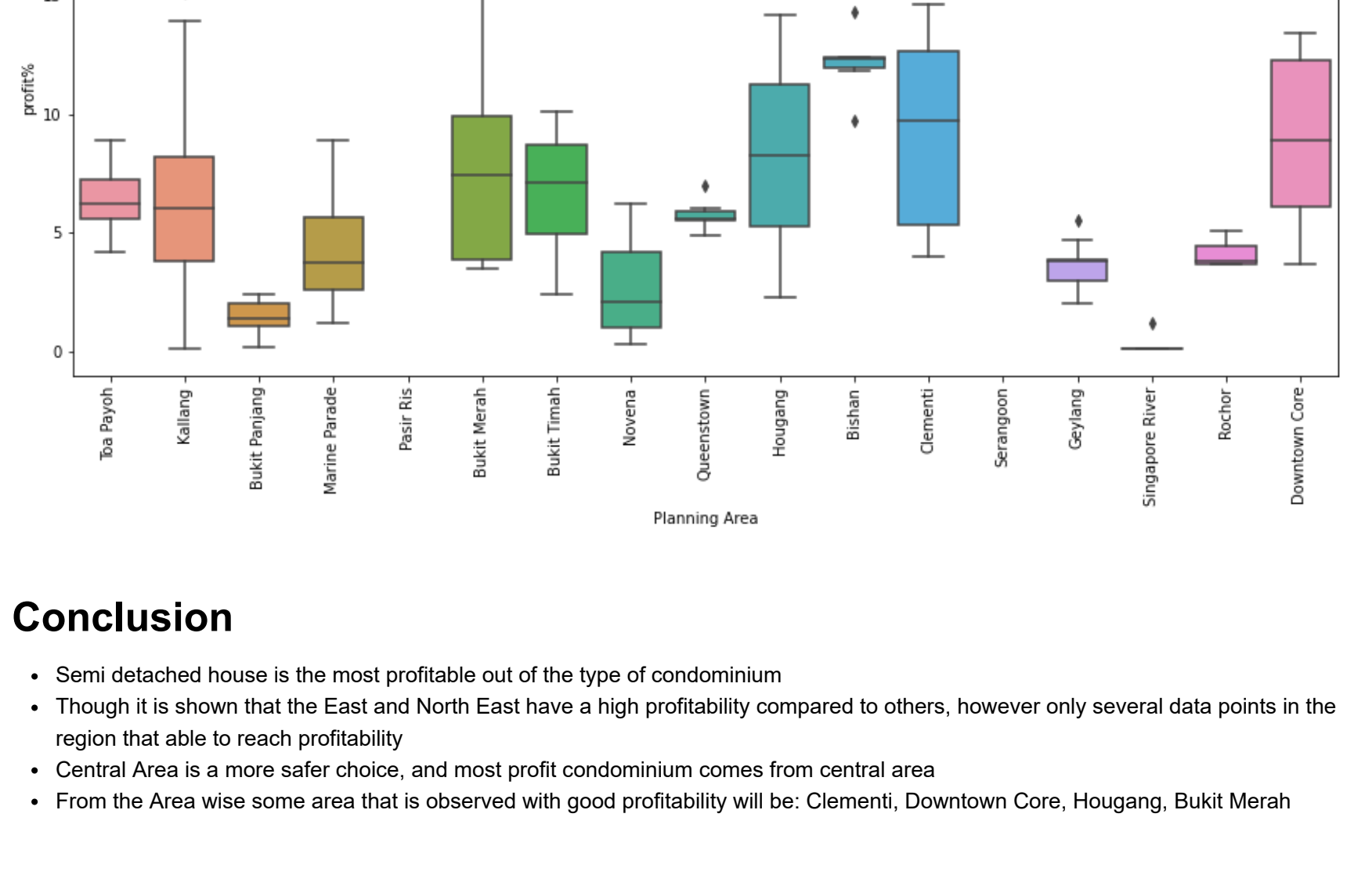
In [40]:
```
plt.figure(figsize = (7,7))
sns.boxplot(y='profit%', data = profit_df)
```

Out[40]: <matplotlib.axes._subplots.AxesSubplot at 0x2bd8116bd60>



In [41]:
```
plt.figure(figsize = (15,7))
plt.subplot(121)
plt.title('Boxplot of Profit% and Property Type')
sns.boxplot(y='profit%', x= 'Property Type', data = profit_df)
plt.xticks(rotation = 90)
plt.subplot(122)
plt.title('Boxplot of Profit% and Region')
sns.boxplot(y='profit%', x= 'Planning Region', data = profit_df)
plt.xticks(rotation = 90)
plt.figure(figsize = (15,7))
plt.title('Boxplot of Profit% and Area Name')
sns.boxplot(y='profit%', x= 'Planning Area', data = profit_df)
plt.xticks(rotation = 90)
```

Out[41]:
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16]),
 <a list of 17 Text major ticklabel objects>)
```



Conclusion

- Semi detached house is the most profitable out of the type of condominium
- Though it is shown that the East and North East have a high profitability compared to others, however only several data points in the region that able to reach profitability
- Central Area is a more safer choice, and most profit condominium comes from central area
- From the Area wise some area that is observed with good profitability will be: Clementi, Downtown Core, Hougang, Bukit Merah