In [83]:
```
#Load relevant packages
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import statsmodels.api as sm
import statsmodels.formula.api as smf
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
from pandas import DataFrame
from scipy.stats import uniform
from math import sqrt
from statsmodels.tsa.arima_model import ARIMA
from statsmodels.tsa.api import ARMA as arma
from statsmodels.tsa.arima_model import ARIMAResults as arima_results
from statsmodels.tsa.stattools import acf, pacf
from statsmodels.tsa.stattools import adfuller
from numpy import nan
from statsmodels.graphics.tsaplots import plot_acf, plot_pacf
from matplotlib import pyplot
from datetime import datetime
from math import sqrt
from numpy import round
```

In [84]:
```
#split the files in two because github wouldn't accept such a large file. Load, append
zips_temp = pd.read_csv('https://raw.githubusercontent.com/barrettfranks/ist718/master/
zips_temp2 = pd.read_csv('https://raw.githubusercontent.com/barrettfranks/ist718/master
zips = zips_temp.append(zips_temp2, ignore_index=True)
zips.head(5)
```

Out[84]:

	RegionID	SizeRank	RegionName	State	City	Metro	CountyName	1/31/97	2/28/97	3/3
0	61639	0	10025	NY	New York	New York-Newark-Jersey City	New York County	NaN	NaN	
1	84654	1	60657	IL	Chicago	Chicago-Naperville-Elgin	Cook County	376806.0	380122.0	384
2	61637	2	10023	NY	New York	New York-Newark-Jersey City	New York County	NaN	NaN	
3	91982	3	77494	TX	Katy	Houston-The Woodlands-Sugar Land	Harris County	201687.0	202931.0	204
4	84616	4	60614	IL	Chicago	Chicago-Naperville-Elgin	Cook County	566446.0	569659.0	573

5 rows × 286 columns

In [85]:
```
#note - because of the file size issue with github I manually deleted a few irrelevant
#make sure all zips have 5 digits...solve for leading zeroes
zips['RegionName'] = zips['RegionName'].astype('str').apply(lambda x: x.zfill(5))
#drop na
zips = zips.dropna()
```

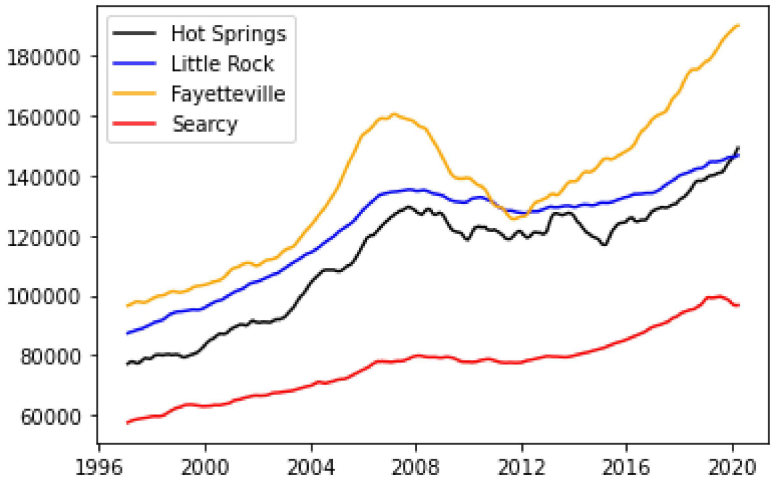
In [86]:
```
zips.describe()
```

Out[86]:

	RegionID	SizeRank	1/31/97	2/28/97	3/31/97	4/30/97	5/3
count	12652.000000	12652.000000	1.265200e+04	1.265200e+04	1.265200e+04	1.265200e+04	1.265200e
mean	79520.249684	10487.963721	1.364534e+05	1.368703e+05	1.373016e+05	1.377571e+05	1.382175e
std	32516.832690	8031.507297	9.390761e+04	9.443318e+04	9.495935e+04	9.531324e+04	9.574706e
min	58059.000000	1.000000	1.003700e+04	1.003600e+04	1.003500e+04	9.994000e+03	9.926000e
25%	65083.250000	3992.500000	7.961700e+04	7.976225e+04	8.004425e+04	8.018800e+04	8.044150e
50%	74566.500000	8595.500000	1.161285e+05	1.165190e+05	1.168435e+05	1.171810e+05	1.175735e
75%	90315.250000	15326.250000	1.674278e+05	1.678210e+05	1.682070e+05	1.689070e+05	1.692795e
max	753844.000000	34430.000000	3.108947e+06	3.138019e+06	3.138945e+06	3.112536e+06	3.095231e

8 rows × 281 columns

In [87]:
```
#define graphical inputs for Hot Springs, Little Rock, Fayetteville & Searcy
hot_springs = zips.loc[(zips['State']=='AR') & (zips['Metro'].str.contains('Hot Springs
hot_springs_mean = hot_springs.iloc[:, 7:].mean(axis=0)
hot_springs_mean.index = pd.to_datetime(hot_springs_mean.index)

little_rock = zips.loc[(zips['State']=='AR') & (zips['Metro'].str.contains('Little Rock
little_rock_mean = little_rock.iloc[:, 7:].mean(axis=0)
little_rock_mean.index = pd.to_datetime(little_rock_mean.index)

fayetteville = zips.loc[(zips['State']=='AR') & (zips['Metro'].str.contains('Fayettevil
fayetteville_mean = fayetteville.iloc[:, 7:].mean(axis=0)
fayetteville_mean.index = pd.to_datetime(fayetteville_mean.index)

searcy = zips.loc[(zips['State']=='AR') & (zips['Metro'].str.contains('Searcy'))]
searcy_mean = searcy.iloc[:, 7:].mean(axis=0)
searcy_mean.index = pd.to_datetime(searcy_mean.index)

#plot above values
plt.plot(hot_springs_mean.index, hot_springs_mean.values, color='black', label='Hot Spr
plt.plot(little_rock_mean.index, little_rock_mean.values, color='blue', label='Little R
plt.plot(fayetteville_mean.index, fayetteville_mean.values, color='orange', label='Faye
plt.plot(searcy_mean.index, searcy_mean.values, color='red', label='Searcy')
plt.legend()
plt.show()
```

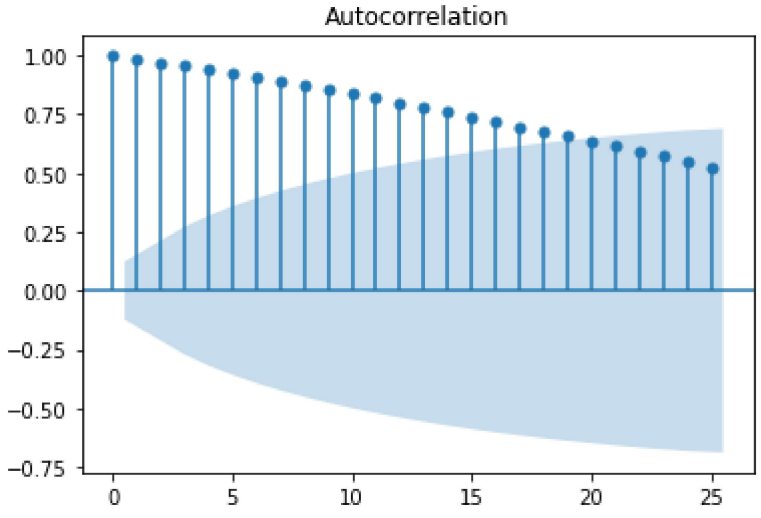


In [88]:
```
#list(zips.columns)
```

In [89]:
```
#set training data 97 through 17
train_zip = zips.loc[:, '1/31/97':'12/31/17']
train_zip.columns = pd.to_datetime(train_zip.columns)

#set test data for 2018
zip_test_2018 = zips.loc[:, '1/31/18':'12/31/18']
zip_test_2018.columns = pd.to_datetime(zip_test_2018.columns)

#create predictions
prediction_2018 = pd.DataFrame(zip_test_2018)
prediction_2018.fillna(nan, inplace=True)
```

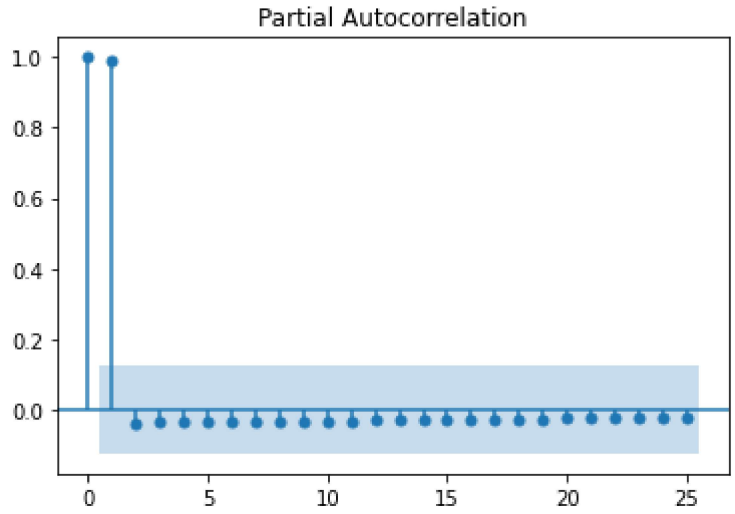
In [90]:
```
zip_mean = train_zip.mean(axis=0)
```

In [102…
```
#visualize auto-correlation function
plot_acf(zip_mean)
pyplot.show()
```



In [92]:
```
#visualize partial auto-correlation function
```

```
plot_pacf(zip_mean)
pyplot.show()
```



In [93]:
```
#trimming the data set to make a more reasonable run time for the model
zips_trim = zips[:5000]
```

In [94]:
```
zips_trim.head(5)
```

Out[94]:

	RegionID	SizeRank	RegionName	State	City	Metro	CountyName	1/31/97	2/28/97	3/
1	84654	1	60657	IL	Chicago	Chicago-Naperville-Elgin	Cook County	376806.0	380122.0	38
3	91982	3	77494	TX	Katy	Houston-The Woodlands-Sugar Land	Harris County	201687.0	202931.0	20
4	84616	4	60614	IL	Chicago	Chicago-Naperville-Elgin	Cook County	566446.0	569659.0	57
5	91940	5	77449	TX	Katy	Houston-The Woodlands-Sugar Land	Harris County	97543.0	97263.0	9
7	91733	7	77084	TX	Houston	Houston-The Woodlands-Sugar Land	Harris County	96895.0	96481.0	9

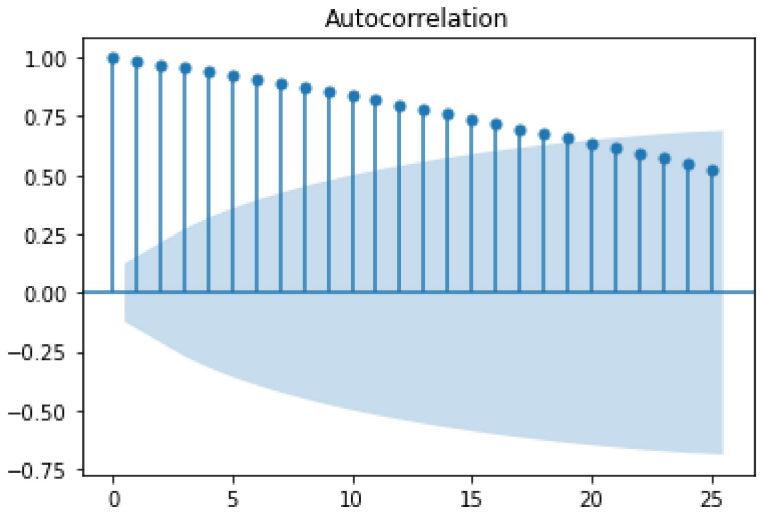
5 rows × 286 columns

In [95]:
```
#re-run test/predictions with trimmed dataset
#set training data 97 through 17
train_zip = zips_trim.loc[:, '1/31/97':'12/31/17']
train_zip.columns = pd.to_datetime(train_zip.columns)
```

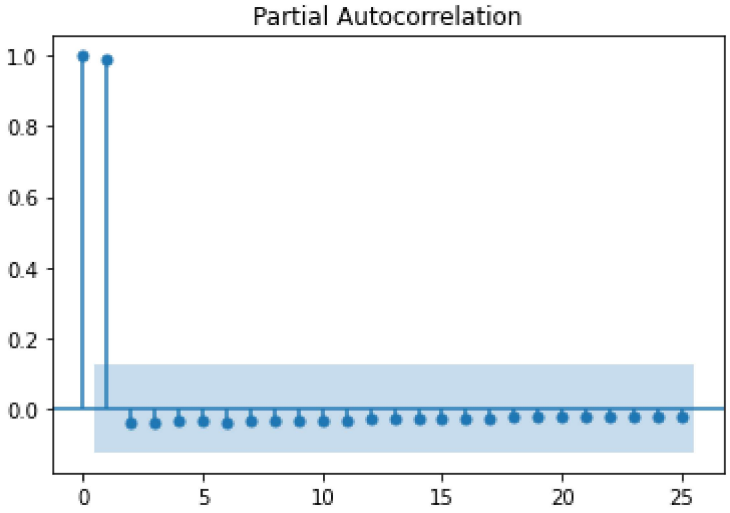
```
#set test data for 2018
zip_test_2018 = zips_trim.loc[:, '1/31/18':'12/31/18']
zip_test_2018.columns = pd.to_datetime(zip_test_2018.columns)

#create predictions
prediction_2018 = pd.DataFrame(zip_test_2018)
prediction_2018.fillna(nan, inplace=True)
```

In [96]:
```
zip_mean = train_zip.mean(axis=0)
```

In [97]:
```
#visualize auto-correlation function
plot_acf(zip_mean)
pyplot.show()
```



In [98]:
```
#visualize partial auto-correlation function
plot_pacf(zip_mean)
pyplot.show()
```



In [99]:
```
#create ARMA model for the trimmed zip file
for i in train_zip.index:
```

```
  zip_train_model = train_zip.loc[i]
  try:
    model = arima(zip_train_model, order=(2, 0, 0))
    model_fit = model.fit()
  except:
    pass
  else:
    prediction_2018.loc[i] = model_fit.predict(start='1/31/18', end='12/31/18').apply(l
  finally:
    prediction_2018.dropna(axis=0, how='any', inplace=True)
```

In [101…

```
#predict the top three zip codes for SREIT
growth_rate = pd.DataFrame(index=prediction_2018.index, columns=['Growth Rate', 'Zip',
for i in prediction_2018.index:
  predict = round(prediction_2018.loc[i].mean(), 1)
  actual = round(zip_test_2018.loc[i].mean(), 1)
  growth_rate.loc[i, 'Growth Rate'] = round(abs(predict - actual) / actual * 100, 1)
  growth_rate.loc[i, 'Zip'] = zips_trim.loc[i, 'RegionName']
  growth_rate.loc[i, 'City'] = zips_trim.loc[i, 'City']

growth_rate.sort_values('Growth Rate', ascending=False).iloc[0:3]
```

Out[101…

	Growth Rate	Zip	City
5453	550.3	94085	Sunnyvale
648	550.0	94086	Sunnyvale
2748	548.1	94043	Mountain View

In [ ]:

```
"""
According to the model's predictions the top three zips using 5000 samples are:
94085 - Sunnyvale
94086 - Sunnyvale
94043 - Mountain View

This is using historical data and strong growth rates to indicate potential for future
"""
```

In [ ]:

```
"""
Sources:
files.zillowstatic.com/research/public/Zip/Zip_Zhvi_SingleFamilyResidence.csv
https://www.machinelearningplus.com/time-series/arima-model-time-series-forecasting-pyt
https://medium.com/@feraguilari/time-series-analysis-modfinalproyect-b9fb23c28309
"""
```