In [215…
```
import numpy as np
import pandas as pd
import itertools
import statsmodels
import matplotlib.pyplot as plt
from sklearn.metrics import mean_absolute_error
import statsmodels.tsa.statespace.sarimax
from sklearn.metrics import accuracy_score
from matplotlib.pyplot import figure
```

Esetablishing Current Rent Prices

In [2]:
```
rent = pd.read_csv('Rentals.csv')
```

In [3]:
```
rent.head()
```

Out[3]:

	RegionID	RegionName	SizeRank	2014-01	2014-02	2014-03	2014-04	2014-05	2014-06	2014-07	...	2(
0	102001	United States	0	1318.0	1323	1328.0	1334	1339	1345	1350	...	1
1	394913	New York, NY	1	2291.0	2301	2311.0	2322	2332	2342	2352	...	2
2	753899	Los Angeles-Long Beach-Anaheim, CA	2	1795.0	1806	1816.0	1827	1838	1849	1860	...	2
3	394463	Chicago, IL	3	1412.0	1416	1419.0	1423	1427	1430	1434	...	1
4	394514	Dallas-Fort Worth, TX	4	1136.0	1140	1143.0	1147	1151	1154	1158	...	1

5 rows × 98 columns

In [4]:
```
rent['State'] = rent['RegionName'].str.slice(-2)
```

In [5]:
```
current_rent_prices = rent[['RegionName', 'State', '2021-10']]
```

Establishing Current Sale Prices

In [6]:
```
#Create Sale DF

sale = pd.read_csv('home_values.csv')

sale.head()
```

Out[6]:

	RegionID	SizeRank	RegionName	RegionType	StateName	2000-01-31	2000-02-29	2000-03-31	2 0
0	102001	0	United States	Country	NaN	127104.0	127448.0	127809.0	128
1	394913	1	New York, NY	Msa	NY	223875.0	225213.0	226416.0	228
2	753899	2	Los Angeles-Long Beach-Anaheim, CA	Msa	CA	231151.0	231956.0	233189.0	235

	RegionID	SizeRank	RegionName	RegionType	StateName	2000-01-31	2000-02-29	2000-03-31	2 0
3	394463	3	Chicago, IL	Msa	IL	169017.0	169416.0	169932.0	170
4	394514	4	Dallas-Fort Worth, TX	Msa	TX	130276.0	130380.0	130466.0	130

5 rows × 268 columns

In [7]:
```
#Create States Column

sale['State'] = sale['RegionName'].str.slice(-2)
```

In [8]:
```
#Create Current Sales Values

current_sales_values = sale[['RegionName', 'State', '2021-10-31']]
```

In [9]:
```
#Check current sales values

current_sales_values.head()
```

Out[9]:

	RegionName	State	2021-10-31
0	United States	es	312486.0
1	New York, NY	NY	568010.0
2	Los Angeles-Long Beach-Anaheim, CA	CA	851153.0
3	Chicago, IL	IL	284452.0
4	Dallas-Fort Worth, TX	TX	332734.0

In [10]:
```
#Import Property Tax Rates

prop_taxes = pd.read_excel('PropertyTax.xlsx', 'Ptax')

#Clean column names

prop_taxes = prop_taxes.rename(columns={'Unnamed: 2': 'StateShort'})

#Check taxes df

prop_taxes.head()
```

Out[10]:

	Rank	State	StateShort	Real Estate Tax Rate	Average Home Price	Annual Property Tax
0	1	Hawaii	HI	0.0028	615300	606
1	2	Alabama	AL	0.0041	142700	895
2	3	Colorado	CO	0.0051	343300	1113
3	4	Louisiana	LA	0.0055	163100	1187
4	5	District of Columbia	DC	0.0056	601500	1221

In [11]:
```
#Merge Sales Table with Property Tax Table

current_sales_values = current_sales_values.merge(prop_taxes[['StateShort', 'Rea
                           how='inner', left_on='State', right_on='StateShort')

#Quick check on Merge Results

current_sales_values[current_sales_values['State'] == 'UT']
```

Out[11]:

	RegionName	State	2021-10-31	StateShort	Real Estate Tax Rate
689	Salt Lake City, UT	UT	539375.0	UT	0.0063
690	Ogden, UT	UT	474251.0	UT	0.0063
691	Provo, UT	UT	524123.0	UT	0.0063
692	St. George, UT	UT	506551.0	UT	0.0063
693	Cedar City, UT	UT	337688.0	UT	0.0063
694	Summit Park, UT	UT	1122965.0	UT	0.0063
695	Vernal, UT	UT	279791.0	UT	0.0063
696	Heber, UT	UT	677724.0	UT	0.0063
697	Price, UT	UT	195269.0	UT	0.0063

In [12]:
```
#Calculate Monthly Mortgage Payments

i = 0.03 / 12
n = 360

current_sales_values['Mortgage Payment'] = round(current_sales_values['2021-10-3


current_sales_values = current_sales_values.dropna()
```

In [13]:
```
#Calculate Property Tax

current_sales_values['MPT'] = round((current_sales_values['2021-10-31'] *
                                     current_sales_values['Real Estate Tax Rate']

current_sales_values['Monthly Payment'] = current_sales_values['Mortgage Payment

current_sales_values.head()
```

Out[13]:

	RegionName	State	2021-10-31	StateShort	Real Estate Tax Rate	Mortgage Payment	MPT	Monthly Payment
0	New York, NY	NY	568010.0	NY	0.0172	2394.75	814.15	3208.90
1	Buffalo, NY	NY	225172.0	NY	0.0172	949.33	322.75	1272.08
2	Rochester, NY	NY	194463.0	NY	0.0172	819.86	278.73	1098.59
3	Albany, NY	NY	249676.0	NY	0.0172	1052.64	357.87	1410.51
4	Syracuse, NY	NY	178093.0	NY	0.0172	750.85	255.27	1006.12

In [14]:
```
#Calculate Property Tax

current_sales_values = current_sales_values.merge(
    current_rent_prices[['RegionName', '2021-10']], how='inner', on='RegionName'

#Label Rent as Rent

current_sales_values = current_sales_values.rename(columns={'2021-10': 'Monthly
```

In [17]:
```
#Find States with Inefficienies

current_sales_values['Diff'] = current_sales_values['Monthly Rent'] - current_sa

current_sales_values.sort_values('Diff', ascending = True).head(20)

current_sales_values['DP'] = current_sales_values['2021-10-31'] * 0.2

current_sales_values['MROI'] = current_sales_values['Diff'] / current_sales_valu

current_sales_values.sort_values(by='MROI', ascending = False).head(20)
```

Out[17]:

	RegionName	State	2021-10-31	StateShort	Real Estate Tax Rate	Mortgage Payment	MPT	Monthly Payment	Monthly Rent	
99	Jackson, MS	MS	171863.0	MS	0.0081	724.58	116.01	840.59	1346.0	50
59	Winston-Salem, NC	NC	204382.0	NC	0.0084	861.68	143.07	1004.75	1575.0	57
72	Memphis, TN	TN	202427.0	TN	0.0071	853.44	119.77	973.21	1459.0	48
93	Columbia, SC	SC	202497.0	SC	0.0057	853.74	96.19	949.93	1357.0	40
58	Greensboro, NC	NC	200833.0	NC	0.0084	846.72	140.58	987.30	1387.0	39
65	Toledo, OH	OH	153719.0	OH	0.0156	648.09	199.83	847.92	1109.0	26
4	Syracuse, NY	NY	178093.0	NY	0.0172	750.85	255.27	1006.12	1306.0	29
26	Scranton, PA	PA	156397.0	PA	0.0158	659.38	205.92	865.30	1122.0	25
35	Lakeland, FL	FL	260283.0	FL	0.0089	1097.36	193.04	1290.40	1715.0	42
39	Augusta, GA	GA	194105.0	GA	0.0092	818.35	148.81	967.16	1282.0	31
85	Birmingham, AL	AL	212611.0	AL	0.0041	896.38	72.64	969.02	1301.0	33
78	Tulsa, OK	OK	184699.0	OK	0.0090	778.70	138.52	917.22	1193.0	27
77	Oklahoma City, OK	OK	192434.0	OK	0.0090	811.31	144.33	955.64	1236.0	28
29	Miami-Fort Lauderdale, FL	FL	381169.0	FL	0.0089	1607.02	282.70	1889.72	2445.0	55
20	El Paso, TX	TX	172417.0	TX	0.0180	726.92	258.63	985.55	1205.0	21
84	Baton Rouge, LA	LA	214389.0	LA	0.0055	903.87	98.26	1002.13	1272.0	26

	RegionName	State	2021-10-31	StateShort	Real Estate Tax Rate	Mortgage Payment	MPT	Monthly Payment	Monthly Rent	
30	Tampa, FL	FL	316271.0	FL	0.0089	1333.41	234.57	1567.98	1932.0	36
63	Dayton, OH	OH	173465.0	OH	0.0156	731.34	225.50	956.84	1148.0	19
68	Indianapolis, IN	IN	235308.0	IN	0.0085	992.07	166.68	1158.75	1399.0	24
21	McAllen, TX	TX	146870.0	TX	0.0180	619.21	220.30	839.51	982.0	14

In [20]:
```
#Screen Top 20 Regions

top_20_regions = current_sales_values.sort_values(by='MROI', ascending = False).

top_20_regions
```

Out[20]:
```
99                  Jackson, MS
59             Winston-Salem, NC
72                   Memphis, TN
93                  Columbia, SC
58                Greensboro, NC
65                    Toledo, OH
4                   Syracuse, NY
26                  Scranton, PA
35                  Lakeland, FL
39                   Augusta, GA
85                Birmingham, AL
78                     Tulsa, OK
77             Oklahoma City, OK
29    Miami-Fort Lauderdale, FL
20                   El Paso, TX
84                Baton Rouge, LA
30                     Tampa, FL
63                    Dayton, OH
68                Indianapolis, IN
21                     McAllen, TX
Name: RegionName, dtype: object
```

ARIMA Forecasting for top 20 States

In [21]:
```
#Identifying columns

sale_cols = ['RegionID', 'SizeRank', 'RegionName', 'RegionType', 'StateName', 'S

rent_cols = ['RegionID', 'RegionName', 'SizeRank', 'State']
```

In [22]:
```
#Melt Data

def melt_data(df, cols):

    melted = pd.melt(df, id_vars=cols, var_name='time')
    melted['time'] = pd.to_datetime(melted['time'], infer_datetime_format=True)
    melted = melted.dropna(subset=['value'])
    return melted
```

In [23]:
```
#Create Sale Time Series
```

```
sale_ts = melt_data(sale, sale_cols)

sale_ts['time'] = pd.to_datetime(sale_ts['time'])

sale_ts.set_index('time', inplace = True)

sale_ts.head()
```

Out[23]:

time	RegionID	SizeRank	RegionName	RegionType	StateName	State	value
2000-01-31	102001	0	United States	Country	NaN	es	127104.0
2000-01-31	394913	1	New York, NY	Msa	NY	NY	223875.0
2000-01-31	753899	2	Los Angeles-Long Beach-Anaheim, CA	Msa	CA	CA	231151.0
2000-01-31	394463	3	Chicago, IL	Msa	IL	IL	169017.0
2000-01-31	394514	4	Dallas-Fort Worth, TX	Msa	TX	TX	130276.0

In [24]:

```
#Create Rental Time Series

rent_ts = melt_data(rent, rent_cols)

rent_ts['time'] = pd.to_datetime(rent_ts['time'])

rent_ts.set_index('time', inplace = True)

rent_ts.head()
```

Out[24]:

time	RegionID	RegionName	SizeRank	State	value
2014-01-01	102001	United States	0	es	1318.0
2014-01-01	394913	New York, NY	1	NY	2291.0
2014-01-01	753899	Los Angeles-Long Beach-Anaheim, CA	2	CA	1795.0
2014-01-01	394463	Chicago, IL	3	IL	1412.0
2014-01-01	394514	Dallas-Fort Worth, TX	4	TX	1136.0

Rent Price Forecasting

In [25]:

```
#Get pdq and PDQS iterations:

# Define the p, d and q parameters to take any value between 0 and 2

p = d = q = range(0,3,1)

# Generate all different combinations of p, q and q triplets
```

```
pdq = list(itertools.product(p, d, q))

# Generate all different combinations of seasonal p, q and q triplets (use 12 fo

pdqs = [(x[0], x[1], x[2], 12) for x in list(itertools.product(p, d, q))]
```

In [26]:
```
#Define best iterations

def get_best_iterations(region):

    #Isolate City

    city_ts = rent_ts[rent_ts['RegionName'] == region]

    #Train test split

    X_train = city_ts['value'][:-12]
    y_train = city_ts['value'][-12:]

    #Find Best combo

    best_iteration = []

    for combo in pdq:
        for seasonal_combo in pdqs:
            final_model = statsmodels.tsa.statespace.sarimax.SARIMAX(X_train,
                                                                     order = com
                                                                     seasonal_or
                                                                     enforce_sta
                                                                     enforce_inv


            final_model_fit = final_model.fit()

            preds = final_model_fit.get_forecast(steps = 12)

            preds = preds.summary_frame()[['mean']]

            mae = mean_absolute_error(preds, y_train)

            best_iteration.append([combo, seasonal_combo, mae])

    #Rank The Best Iterations:

    best_iterations = pd.DataFrame(best_iteration, columns = ['pdq', 'PDQS', 'MA

    top_iteration = best_iterations.sort_values(by='MAE', ascending = True).head

    top_pdq = top_iteration.iloc[0][0]

    top_PDQS = top_iteration.iloc[0][1]

    mae = top_iteration.iloc[0][2]

    #Record top Combos:

    return [region, top_pdq, top_PDQS, mae]
```

In [27]:
```
#Loop through all Regions
```

```
regions = []

for item in range(0,101,1):
    regions.append(rent['RegionName'].iloc[item])
```

In [28]:
```
#No Warnings!

import warnings

def fxn():
    warnings.warn("deprecated", DeprecationWarning)

with warnings.catch_warnings():
    warnings.simplefilter("ignore")
    fxn()
```

In [29]:
```
# #Get Optimal Region Combos

# optimal_region_combos = []

# for region in regions:
#     print(region)
#     optimal_region_combos.append(get_best_iterations(region))
```

In [30]:
```
# save = optimal_region_combos

# save_df = pd.DataFrame(save)

# save_df.columns = ['Region', 'pdq', 'PDQS', 'mae']

# save_df.to_excel('Optimal Combos.xlsx')

save_df = pd.read_excel('Optimal Combos.xlsx')
```

In [31]:
```
#View Optimal Combinations

save_df.head()
```

Out[31]:

	Unnamed: 0	Region	pdq	PDQS	mae	p	d	q	P	D	Q	S
0	0	United States	(2, 0, 1)	(2, 2, 2, 12)	6.995232	2	0	1	2	2	2	12
1	1	New York, NY	(1, 1, 0)	(2, 0, 2, 12)	4.687719	1	1	0	2	0	2	12
2	2	Los Angeles-Long Beach-Anaheim, CA	(1, 2, 2)	(0, 1, 2, 12)	4.662147	1	2	2	0	1	2	12
3	3	Chicago, IL	(2, 1, 2)	(0, 1, 1, 12)	4.400851	2	1	2	0	1	1	12
4	4	Dallas-Fort Worth, TX	(2, 1, 2)	(0, 1, 2, 12)	4.716962	2	1	2	0	1	2	12

In [103…
```
#Get forecasts for November 2022

forecast_preds = []
```

```
for item in range(0,len(save_df)):

    region = save_df['Region'].iloc[item]

    city_ts = rent_ts[rent_ts['RegionName'] == region]

    best_p = save_df.iloc[item]['p']
    best_d = save_df.iloc[item]['d']
    best_q = save_df.iloc[item]['q']

    best_P = save_df.iloc[item]['P']
    best_D = save_df.iloc[item]['D']
    best_Q = save_df.iloc[item]['Q']
    best_S = save_df.iloc[item]['S']


    best_pdq = tuple([best_p, best_d, best_q])
    best_PDQS = tuple([best_P, best_D, best_Q, best_S])

    forecast_model = statsmodels.tsa.statespace.sarimax.SARIMAX(city_ts[['value'
                                    order = best_pdq,
                                    seasonal_order = best_PDQS,
                                    enforce_stationarity = False,
                                    enforce_invertibility = False)

    forecast_model = forecast_model.fit()

    #Create Actual Predictions

    actual_preds = forecast_model.get_forecast(steps=12).summary_frame()['mean']
    forecast = actual_preds[11]
    forecast_preds.append([region, forecast])

    print(region, best_pdq, best_PDQS, forecast)
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
United States (2, 0, 1) (2, 2, 2, 12) 1387.96766338629
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
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  warnings.warn('No frequency information was'
New York, NY (1, 1, 0) (2, 0, 2, 12) 2781.552189007938
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Los Angeles-Long Beach-Anaheim, CA (1, 2, 2) (0, 1, 2, 12) 4501918.536670327
Chicago, IL (2, 1, 2) (0, 1, 1, 12) 1833.8022325712263
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Dallas-Fort Worth, TX (2, 1, 2) (0, 1, 2, 12) 141561585.23581716
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Philadelphia, PA (2, 0, 1) (1, 0, 2, 12) 1950.1226530757522
Houston, TX (2, 2, 2) (2, 2, 0, 12) 1742.670725571414
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Washington, DC (0, 1, 0) (1, 1, 2, 12) 1846.9106870633307
Miami-Fort Lauderdale, FL (1, 2, 2) (0, 0, 1, 12) 3036.836399559199

/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Atlanta, GA (2, 1, 2) (0, 2, 2, 12) 1738.761000144573
Boston, MA (2, 1, 2) (2, 1, 1, 12) 2783.254219577998

/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
San Francisco, CA (1, 0, 1) (2, 1, 1, 12) 3149.3044842172158
Detroit, MI (0, 2, 0) (0, 2, 2, 12) 1549.7487073357856
Riverside, CA (1, 2, 2) (1, 1, 0, 12) 2950.4339619979396

/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Phoenix, AZ (2, 2, 2) (2, 2, 2, 12) 2393.629637994916
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Seattle, WA (0, 2, 2) (2, 2, 0, 12) 2347.7084653325105
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Minneapolis-St Paul, MN (2, 0, 0) (2, 2, 2, 12) 1672.4655094550703
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
San Diego, CA (2, 0, 0) (1, 2, 2, 12) 2850.2256831785626
St. Louis, MO (0, 2, 0) (0, 2, 0, 12) 1367.0000000024306
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Tampa, FL (2, 0, 2) (2, 1, 1, 12) 2524.391340198357
Baltimore, MD (1, 2, 2) (2, 2, 2, 12) 2047.6036160315173
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
Denver, CO (2, 2, 2) (0, 1, 2, 12) 2140.2716806938743
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Pittsburgh, PA (0, 2, 0) (1, 2, 2, 12) 1416.648609708015
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Portland, OR (1, 2, 2) (2, 2, 1, 12) 2125.08974536598
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
Charlotte, NC (2, 1, 2) (1, 2, 2, 12) 2081.0809419304046
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Sacramento, CA (1, 2, 2) (1, 1, 2, 12) -41091013292098.94
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
San Antonio, TX (2, 2, 2) (2, 2, 2, 12) 1542.6437874504616
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Orlando, FL (2, 1, 2) (0, 2, 2, 12) 2233.198352596205
Cincinnati, OH (2, 0, 1) (0, 0, 0, 12) 1508.6106376479008
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Cleveland, OH (0, 2, 0) (2, 2, 1, 12) 1402.3842674219113
Kansas City, MO (0, 2, 0) (0, 2, 0, 12) 1403.9999999977854
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Las Vegas, NV (1, 2, 2) (0, 1, 2, 12) -5.3001790312952356e+45
Columbus, OH (0, 2, 0) (0, 2, 0, 12) 1539.0000000007549
Indianapolis, IN (0, 2, 0) (1, 2, 0, 12) 1643.2671480144368
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
San Jose, CA (2, 1, 2) (2, 0, 0, 12) 3319.0279569598683
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Austin, TX (1, 2, 2) (1, 1, 2, 12) -4659.440868041984
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Virginia Beach, VA (2, 0, 0) (1, 1, 2, 12) -3009.2573909806733
Nashville, TN (2, 2, 2) (2, 2, 0, 12) 2117.981794526341
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
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  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Providence, RI (1, 2, 2) (0, 1, 2, 12) 2015.0732279247463
Milwaukee, WI (1, 2, 2) (2, 2, 2, 12) 1312.8889771669033
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Jacksonville, FL (2, 0, 1) (2, 1, 1, 12) 1401.242463247625
Memphis, TN (0, 2, 0) (0, 2, 2, 12) 1719.278842631873
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Oklahoma City, OK (1, 2, 2) (2, 2, 2, 12) 1418.3849423432782
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Louisville-Jefferson County, KY (0, 2, 0) (0, 2, 2, 12) 1263.0298097925047
Hartford, CT (1, 1, 0) (2, 0, 0, 12) 1795.7211833901747
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
Richmond, VA (2, 2, 2) (2, 2, 2, 12) 1735.204180136886
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
New Orleans, LA (2, 1, 2) (2, 1, 1, 12) 1537.2903352080373
Buffalo, NY (0, 2, 2) (0, 2, 0, 12) 1326.0257379714308
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
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nferred frequency MS will be used.
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Raleigh, NC (1, 2, 2) (0, 1, 2, 12) 3052.4688348248887
Birmingham, AL (0, 2, 0) (1, 2, 0, 12) 1493.6483516479784
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
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  warnings.warn('No frequency information was'
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Salt Lake City, UT (2, 0, 2) (1, 2, 0, 12) 1595.9451151432252
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Rochester, NY (2, 0, 2) (2, 0, 0, 12) 1376.9963325750564
```

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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
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nverge. Check mle_retvals
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nferred frequency MS will be used.
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Grand Rapids, MI (0, 2, 0) (1, 0, 2, 12) 1607.3037755524024
Tucson, AZ (0, 2, 1) (2, 2, 0, 12) 1807.7830350139532
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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nverge. Check mle_retvals
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Urban Honolulu, HI (2, 1, 2) (2, 1, 1, 12) 2769.6800681624372
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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nverge. Check mle_retvals
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Tulsa, OK (1, 2, 2) (2, 1, 2, 12) 1397.5290465275789
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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nverge. Check mle_retvals
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Fresno, CA (1, 2, 2) (1, 1, 2, 12) -238855.59169843484
Worcester, MA (1, 2, 2) (2, 2, 2, 12) 1861.7092471353485
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Stamford, CT (1, 2, 2) (1, 1, 2, 12) 2775.4771942902917
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Albuquerque, NM (1, 2, 2) (2, 1, 0, 12) 1643.1190617674351
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Albany, NY (0, 2, 0) (2, 2, 1, 12) 1552.7715765744886
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Omaha, NE (0, 0, 0) (1, 1, 2, 12) 5207.444181881197
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
New Haven, CT (1, 1, 0) (2, 1, 2, 12) 12244.289428578997
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Bakersfield, CA (1, 1, 2) (2, 2, 0, 12) 1763.385839690723
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Knoxville, TN (2, 2, 2) (2, 2, 2, 12) 1822.8203198271585
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Greenville, SC (2, 1, 2) (0, 1, 2, 12) 1601.5764689400098
Ventura, CA (1, 2, 2) (2, 0, 0, 12) 3236.9018203367727
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Allentown, PA (0, 2, 0) (1, 2, 1, 12) 2023.3944442372479
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
El Paso, TX (0, 2, 2) (2, 2, 2, 12) 1368.1709158482033
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Baton Rouge, LA (0, 2, 2) (2, 2, 2, 12) 1409.0920713947512
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:581: ValueWarning: A date index has been provided, but it has
no associated frequency information and so will be ignored when e.g. forecastin
g.
  warnings.warn('A date index has been provided, but it has no'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:581: ValueWarning: A date index has been provided, but it has
no associated frequency information and so will be ignored when e.g. forecastin
g.
  warnings.warn('A date index has been provided, but it has no'
Dayton, OH (1, 1, 2) (2, 1, 2, 12) 1872.7709353038765
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:376: ValueWarning: No supported index is available. Prediction
results will be given with an integer index beginning at `start`.
  warnings.warn('No supported index is available.'
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexes/range.py in get_
loc(self, key, method, tolerance)
    354                 try:
--> 355                     return self._range.index(new_key)
    356                 except ValueError as err:

ValueError: 11 is not in range

The above exception was the direct cause of the following exception:

KeyError                                  Traceback (most recent call last)
<ipython-input-103-615af494330c> in <module>
     31
     32     actual_preds = forecast_model.get_forecast(steps=12).summary_frame()
['mean']
---> 33     forecast = actual_preds[11]
     34     forecast_preds.append([region, forecast])
     35

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/series.py in __getitem__
(self, key)
    880
    881         elif key_is_scalar:
--> 882             return self._get_value(key)
    883
    884         if is_hashable(key):

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/series.py in _get_value
(self, label, takeable)
    987
    988         # Similar to Index.get_value, but we do not fall back to positio
nal
--> 989         loc = self.index.get_loc(label)
    990         return self.index._get_values_for_loc(self, loc, label)
    991
```

```
~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexes/range.py in get_
loc(self, key, method, tolerance)
    355                     return self._range.index(new_key)
    356                 except ValueError as err:
--> 357                     raise KeyError(key) from err
    358             raise KeyError(key)
    359         return super().get_loc(key, method=method, tolerance=tolerance)

KeyError: 11
```

In [236…

```
def check_forecast(region):

    best_p = save_df[save_df['Region'] == region]['p'].iloc[0]
    best_d = save_df[save_df['Region'] == region]['d'].iloc[0]
    best_q = save_df[save_df['Region'] == region]['q'].iloc[0]

    best_P = save_df[save_df['Region'] == region]['P'].iloc[0]
    best_D = save_df[save_df['Region'] == region]['D'].iloc[0]
    best_Q = save_df[save_df['Region'] == region]['Q'].iloc[0]
    best_S = save_df[save_df['Region'] == region]['S'].iloc[0]


    combo = tuple([best_p, best_d, best_q])
    seasonal_combo = tuple([best_P, best_D, best_Q, best_S])

    #Isolate City

    city_ts = rent_ts[rent_ts['RegionName'] == region]

    #Train test split

    X_train = city_ts['value'][:-12]
    y_train = city_ts['value'][-12:]


    final_model = statsmodels.tsa.statespace.sarimax.SARIMAX(X_train,
                                                             order = combo,
                                                             seasonal_order = se
                                                             enforce_stationarit
                                                             enforce_invertibili


    final_model_fit = final_model.fit()

    preds = final_model_fit.get_forecast(steps = 12)

    preds = preds.summary_frame()[['mean']]

    mae = mean_absolute_error(preds, y_train)

    check_table = pd.merge(y_train, preds, left_index=True, right_index=True)

    check_table['acc'] = round(1 - abs(check_table['mean'] - check_table['value'

    check_table.columns=['Actuals', 'Preds', 'Accuracy']

    check_table['Actuals'] = check_table['Actuals'].apply(lambda x: round(x))
    check_table['Preds'] = check_table['Preds'].apply(lambda x: round(x))

    print('Average Monthly Accuracy:')
    print(round(check_table['Accuracy'].mean(),2))
```

```
    return check_table
```

In [196…

```
def make_forecast(region):

    best_p = save_df[save_df['Region'] == region]['p'].iloc[0]
    best_d = save_df[save_df['Region'] == region]['d'].iloc[0]
    best_q = save_df[save_df['Region'] == region]['q'].iloc[0]

    best_P = save_df[save_df['Region'] == region]['P'].iloc[0]
    best_D = save_df[save_df['Region'] == region]['D'].iloc[0]
    best_Q = save_df[save_df['Region'] == region]['Q'].iloc[0]
    best_S = save_df[save_df['Region'] == region]['S'].iloc[0]


    combo = tuple([best_p, best_d, best_q])
    seasonal_combo = tuple([best_P, best_D, best_Q, best_S])

    #Isolate City

    city_ts = rent_ts[rent_ts['RegionName'] == region]

    #Train test split

    X_train = city_ts['value'][:-12]


    final_model = statsmodels.tsa.statespace.sarimax.SARIMAX(X_train,
                                                             order = combo,
                                                             seasonal_order = se
                                                             enforce_stationarit
                                                             enforce_invertibili


    final_model_fit = final_model.fit()

    preds = final_model_fit.get_forecast(steps = 24)

    preds = preds.summary_frame()[['mean']]

    return preds
```

In [171…

```
forecasted_values = []

for item in save_df['Region']:
    forecasted_values.append([item, make_forecast(item)['2022-11']['mean'][0]])
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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nferred frequency MS will be used.
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
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  warnings.warn("Maximum Likelihood optimization failed to "
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:581: ValueWarning: A date index has been provided, but it has
no associated frequency information and so will be ignored when e.g. forecastin
g.
  warnings.warn('A date index has been provided, but it has no'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
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/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:376: ValueWarning: No supported index is available. Prediction
results will be given with an integer index beginning at `start`.
  warnings.warn('No supported index is available.'
```

```
---------------------------------------------------------------------------
KeyError                                  Traceback (most recent call last)
~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexes/base.py in get_l
oc(self, key, method, tolerance)
   2894             try:
-> 2895                 return self._engine.get_loc(casted_key)
   2896             except KeyError as err:

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/index.pyx in pandas._libs.index.IndexEngine.get_loc()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTa
ble.get_item()

pandas/_libs/hashtable_class_helper.pxi in pandas._libs.hashtable.PyObjectHashTa
ble.get_item()

KeyError: '2022-11'

The above exception was the direct cause of the following exception:
```

```
KeyError                                  Traceback (most recent call last)
<ipython-input-171-58ed8d15a10e> in <module>
      2
      3 for item in save_df['Region']:
----> 4     forecasted_values.append([item, make_forecast(item)['2022-11']['mea
n'][0]])

<ipython-input-165-b4d3382a6705> in make_forecast(region)
     35     preds = preds.summary_frame()[['mean']]
     36
---> 37     return preds['2022-11']

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/frame.py in __getitem__
(self, key)
   2900             if self.columns.nlevels > 1:
   2901                 return self._getitem_multilevel(key)
-> 2902             indexer = self.columns.get_loc(key)
   2903             if is_integer(indexer):
   2904                 indexer = [indexer]

~/opt/anaconda3/lib/python3.8/site-packages/pandas/core/indexes/base.py in get_l
oc(self, key, method, tolerance)
   2895                 return self._engine.get_loc(casted_key)
   2896             except KeyError as err:
-> 2897                 raise KeyError(key) from err
   2898
   2899         if tolerance is not None:

KeyError: '2022-11'
```

In [250…

```
#Load Forecasts into a Table

forecasts = pd.DataFrame(forecasted_values)
forecasts.columns=['Region', 'Nov F22 Preds']
forecasts['Nov F22 Preds'] = round(forecasts['Nov F22 Preds'])
forecast_preds_df = forecasts

#Compare Growth

pred_table = rent_ts[rent_ts.index == '2021-11']
growth_table = pd.merge(pred_table, forecast_preds_df[['Region', 'Nov F22 Preds'
                        how='inner', left_on='RegionName', right_on='Region')

#Retain Nescessary Columns

growth_table.drop(['SizeRank', 'Region'], axis = 1, inplace=True)

growth_table.columns = ['RegionID', 'RegionName', 'State', 'Current Rent', 'Pred

#Round Predicted Rent

growth_table['Predicted Rent'] =  growth_table['Predicted Rent'].apply(lambda x:

#Create Growth Column

growth_table['Growth'] = (growth_table['Predicted Rent'] - growth_table['Current

growth_table['Growth'] = growth_table['Growth'].apply(lambda x: round(x,2))

#Look at top 10

growth_table.sort_values(by='Growth', ascending=False, inplace=True)
```

```
monthly_payment_table = current_sales_values[['RegionName', 'Monthly Payment']]

profits_table = pd.merge(growth_table, monthly_payment_table, how='left', on='Re

profits_table['Income in F22'] = round((profits_table['Predicted Rent']) - profi

profits_table['Predicted Rent'] =  profits_table['Predicted Rent'].apply(lambda

profits_table['Growth'] =  profits_table['Growth'].apply(lambda x: '{:,}'.format

profits_table.sort_values(by='Income in F22', ascending=False).head(5)
```

Out[250…

	RegionID	RegionName	State	Current Rent	Predicted Rent	Growth	Monthly Payment	Income in F22
12	394856	Miami-Fort Lauderdale, FL	FL	2489.0	3,030	0.22	1889.72	1140.0
0	394902	Nashville, TN	TN	1802.0	2,726	0.51	1801.14	925.0
14	394849	Memphis, TN	TN	1476.0	1,782	0.21	973.21	809.0
6	394753	Knoxville, TN	TN	1510.0	1,890	0.25	1270.97	619.0
2	395194	Virginia Beach, VA	VA	1542.0	2,015	0.31	1446.29	569.0

In [255…

```
profits_table
```

Out[255…

	RegionID	RegionName	State	Current Rent	Predicted Rent	Growth	Monthly Payment	Income in F22
0	394902	Nashville, TN	TN	1802.0	2,726	0.51	1801.14	925.0
1	394466	Cincinnati, OH	OH	1362.0	1,838	0.35	1306.61	531.0
2	395194	Virginia Beach, VA	VA	1542.0	2,015	0.31	1446.29	569.0
3	394976	Phoenix, AZ	AZ	1856.0	2,404	0.3	1984.09	420.0
4	395022	Richmond, VA	VA	1502.0	1,909	0.27	1464.57	444.0
…	…	…	…	…	…	…	…	…
66	395053	Salt Lake City, UT	UT	1614.0	1,371	-0.15	2557.20	-1186.0
67	394458	Charlotte, NC	NC	1693.0	1,302	-0.23	1590.12	-288.0
68	102001	United States	es	1879.0	1,301	-0.31	NaN	NaN
69	394347	Atlanta, GA	GA	1875.0	1,248	-0.33	1607.88	-360.0
70	395148	Tampa, FL	FL	1970.0	-1,639	-1.83	1567.98	-3207.0

71 rows × 8 columns

In [229…

```
def graph_results(region):

    #Graph top growers:

    figure(figsize=(8, 6), dpi=80)
```

```
    plt.plot(rent_ts[rent_ts['RegionName'] == region]['2020':]['value'], label =
    plt.plot((make_forecast(region)['2020':]), label='Forecast')
    plt.title(region)
    plt.legend();

    return check_forecast(region)
```

In [251…

```
graph_results('Miami-Fort Lauderdale, FL')
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
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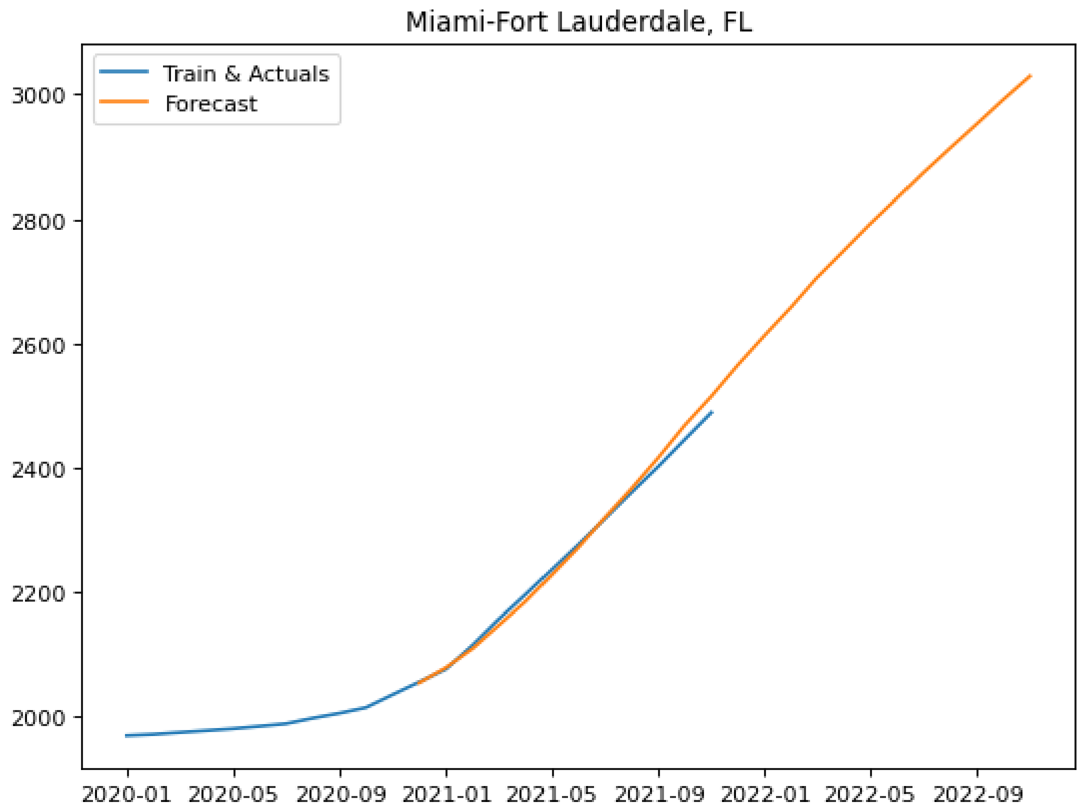
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Average Monthly Accuracy:
1.0
```

Out[251…

time	Actuals	Preds	Accuracy
2020-12-01	2056	2055	1.00
2021-01-01	2077	2079	1.00
2021-02-01	2116	2110	1.00
2021-03-01	2155	2145	1.00
2021-04-01	2195	2184	0.99
2021-05-01	2235	2226	1.00
2021-06-01	2276	2271	1.00
2021-07-01	2317	2319	1.00
2021-08-01	2360	2366	1.00
2021-09-01	2402	2416	0.99
2021-10-01	2445	2468	0.99
2021-11-01	2489	2515	0.99



In [252…

```
graph_results('Nashville, TN')
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
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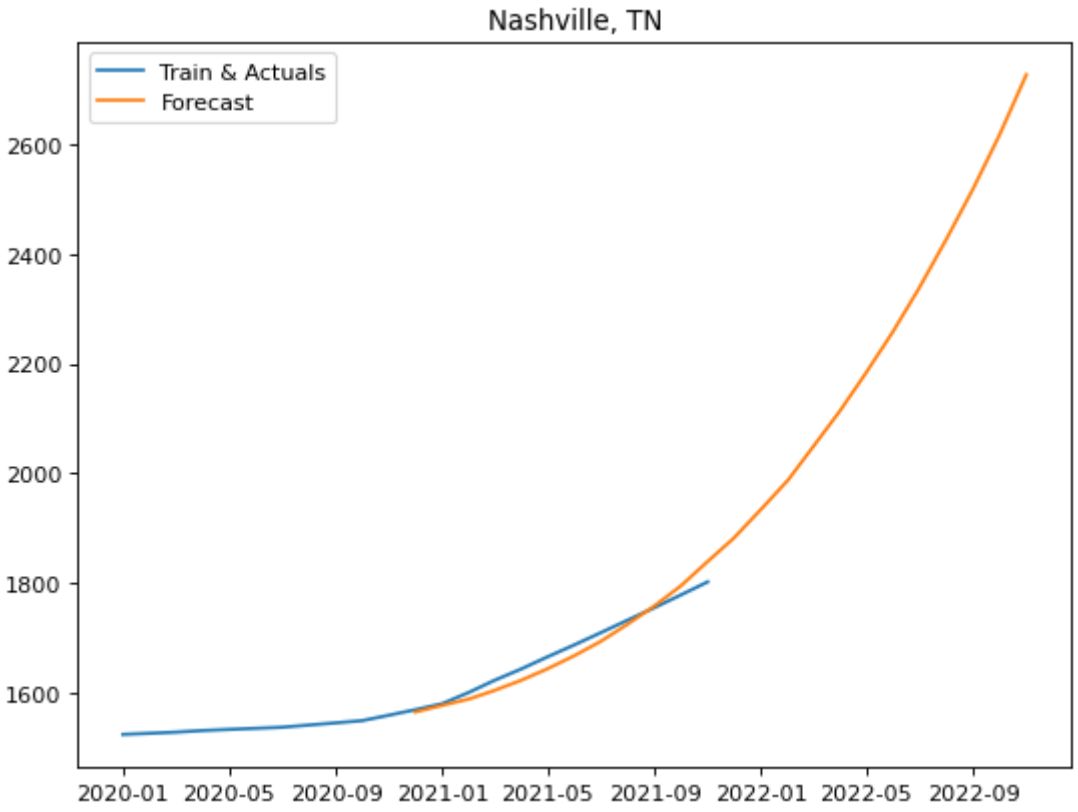
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Average Monthly Accuracy:
0.99
```

Out[252…

time	Actuals	Preds	Accuracy
2020-12-01	1569	1565	1.00
2021-01-01	1580	1577	1.00
2021-02-01	1601	1589	0.99
2021-03-01	1622	1604	0.99
2021-04-01	1643	1622	0.99
2021-05-01	1665	1643	0.99
2021-06-01	1687	1667	0.99

time	Actuals	Preds	Accuracy
2021-07-01	1709	1693	0.99
2021-08-01	1732	1725	1.00
2021-09-01	1755	1758	1.00
2021-10-01	1778	1794	0.99
2021-11-01	1802	1839	0.98



In [239…
```
graph_results('Virginia Beach, VA')
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
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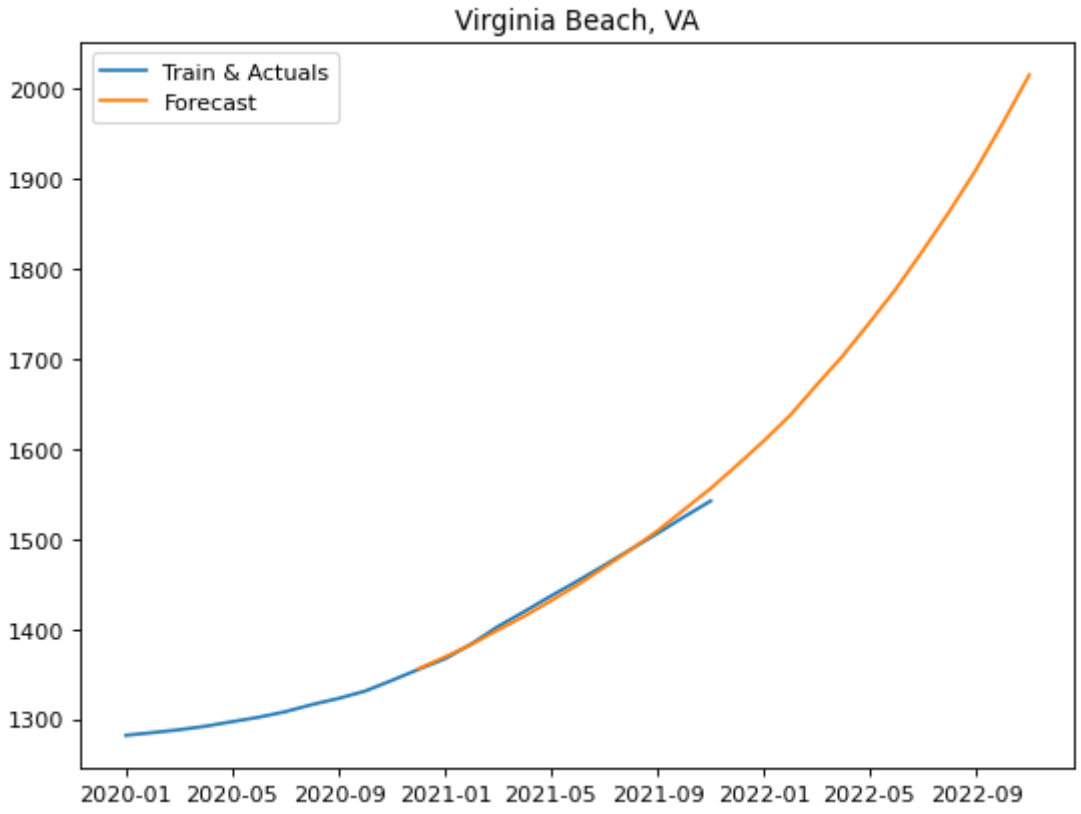
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
statespace/sarimax.py:865: UserWarning: Too few observations to estimate startin
g parameters for seasonal ARMA. All parameters except for variances will be set
to zeros.
  warn('Too few observations to estimate starting parameters%s.'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
```

```
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Average Monthly Accuracy:
1.0
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/bas
e/model.py:566: ConvergenceWarning: Maximum Likelihood optimization failed to co
nverge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
```

Out[239…

time	Actuals	Preds	Accuracy
2020-12-01	1355	1356	1.00
2021-01-01	1367	1369	1.00
2021-02-01	1384	1383	1.00
2021-03-01	1402	1398	1.00
2021-04-01	1419	1414	1.00
2021-05-01	1436	1431	1.00
2021-06-01	1453	1448	1.00
2021-07-01	1470	1468	1.00
2021-08-01	1488	1488	1.00
2021-09-01	1506	1509	1.00
2021-10-01	1524	1532	0.99
2021-11-01	1542	1556	0.99

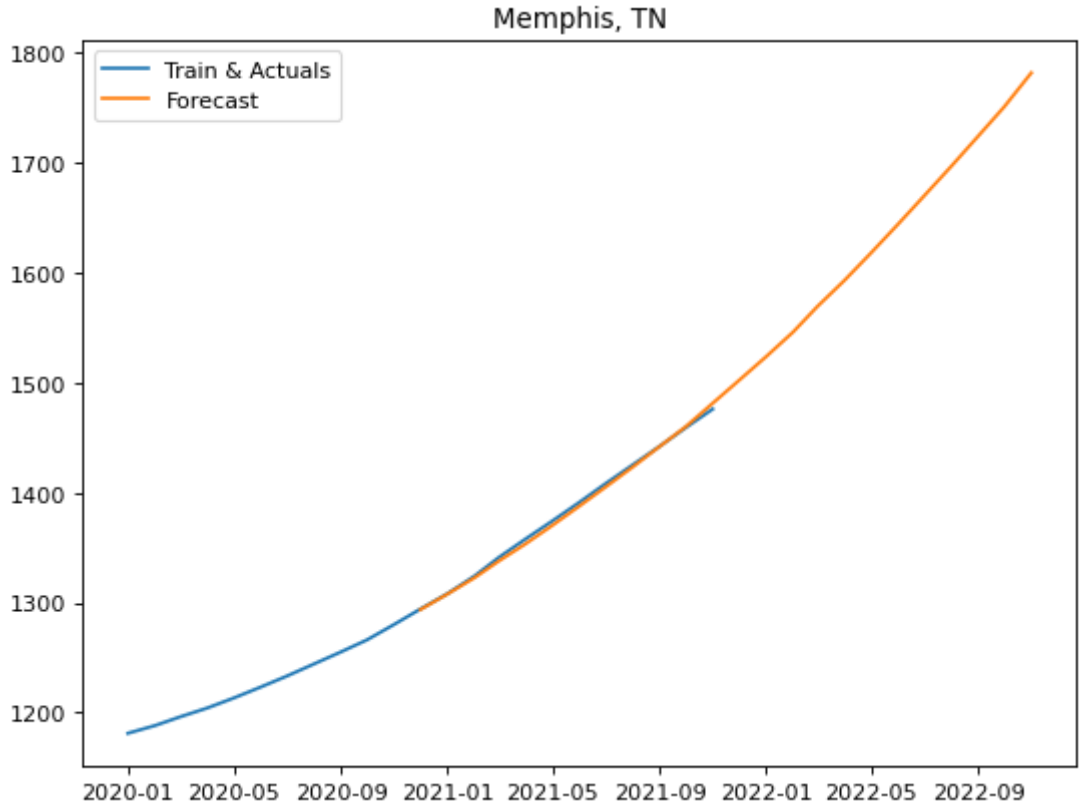


In [253…
```
graph_results('Memphis, TN')
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
statespace/sarimax.py:865: UserWarning: Too few observations to estimate startin
g parameters for seasonal ARMA. All parameters except for variances will be set
to zeros.
  warn('Too few observations to estimate starting parameters%s.'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Average Monthly Accuracy:
1.0
```

Out[253…

time	Actuals	Preds	Accuracy
2020-12-01	1294	1293	1.0
2021-01-01	1308	1308	1.0
2021-02-01	1324	1322	1.0
2021-03-01	1341	1338	1.0
2021-04-01	1358	1354	1.0
2021-05-01	1374	1370	1.0
2021-06-01	1391	1388	1.0
2021-07-01	1408	1405	1.0
2021-08-01	1425	1423	1.0
2021-09-01	1442	1442	1.0
2021-10-01	1459	1460	1.0
2021-11-01	1476	1481	1.0



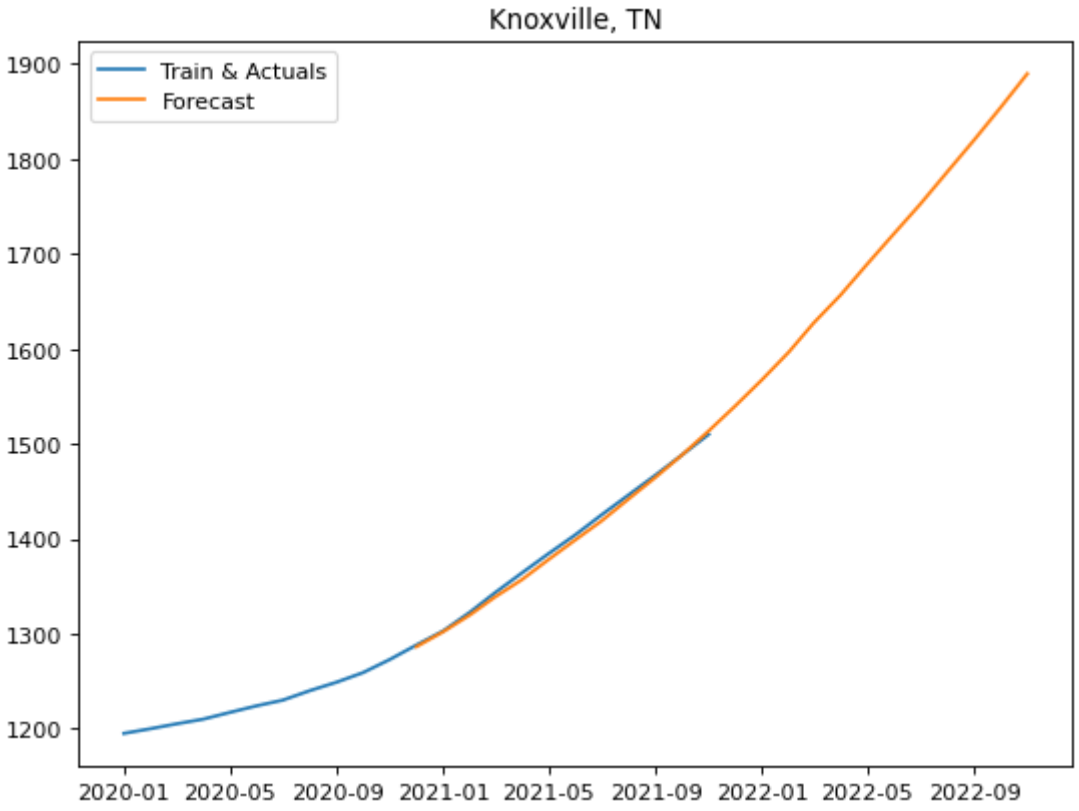
In [254…
```
graph_results('Knoxville, TN')
```

```
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
statespace/sarimax.py:865: UserWarning: Too few observations to estimate startin
g parameters for seasonal ARMA. All parameters except for variances will be set
to zeros.
  warn('Too few observations to estimate starting parameters%s.'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
/Users/angelogayanelo/opt/anaconda3/lib/python3.8/site-packages/statsmodels/tsa/
base/tsa_model.py:524: ValueWarning: No frequency information was provided, so i
nferred frequency MS will be used.
  warnings.warn('No frequency information was'
Average Monthly Accuracy:
1.0
```

Out[254…

time	Actuals	Preds	Accuracy
2020-12-01	1288	1286	1.00
2021-01-01	1303	1302	1.00
2021-02-01	1323	1320	1.00
2021-03-01	1343	1339	1.00

time	Actuals	Preds	Accuracy
2021-04-01	1364	1357	0.99
2021-05-01	1384	1378	1.00
2021-06-01	1404	1399	1.00
2021-07-01	1425	1419	1.00
2021-08-01	1446	1442	1.00
2021-09-01	1467	1465	1.00
2021-10-01	1488	1488	1.00
2021-11-01	1510	1514	1.00



In [ ]: