In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from urllib.request import urlopen
import warnings
warnings.filterwarnings("ignore")
```

In [2]:
```
url='https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv'
data=pd.read_csv(url, dtype={'fips':str})
data['location']=data.county+','+data.state
data['date'] = pd.to_datetime(data['date'])
print('Last timestamp obtained:', data['date'].unique()[-1])
```

```
Last timestamp obtained: 2020-09-08T00:00:00.000000000
```

In [3]:
```
state_codes=pd.read_csv('abbr-name.csv', header=None)
state_codes.columns=['abbr', 'state']
```

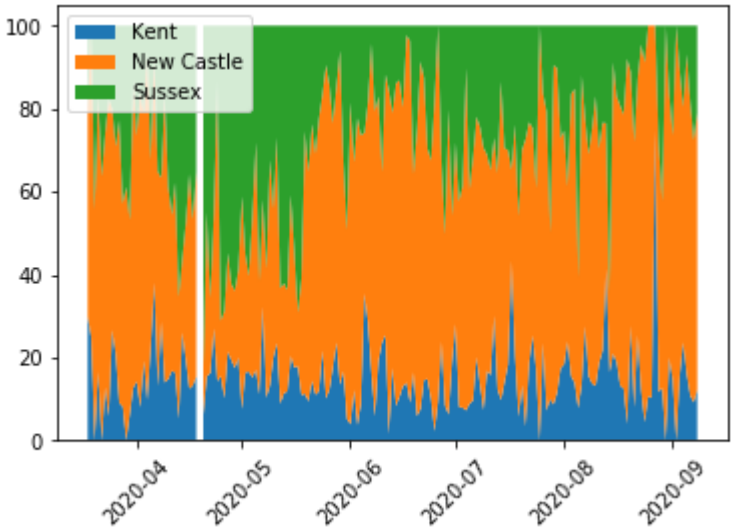
In [4]:
```
def organize_data(df):
    df=df.sort_values(['state', 'county','date'], ascending=[1,1,1])
    return df

def get_state(df,state_name='Maryland'):
    state_df=df[df.state==state_name].reset_index().drop(columns=['index'], ax
is=0)
    return state_df


def get_state_agg(df,state_name):
    agg_df=get_state(df, state_name).groupby(['date']).sum()
    agg_df['state']=state_name
    return agg_df

def get_county(df,county_name='Baltimore city'):
    county_df=df[df.county==county_name].reset_index().drop(columns=['index'],
axis=0)
    return county_df

def get_this(df,state_name='Maryland', county=False, county_name='Baltimore ci
ty'):
    if county==False:
        df_out=get_state_agg(get_state(df,state_name), state_name).reset_index
()
    if county==True:
        df_out=get_county(get_state(df,state_name), county_name)
    return df_out

def get_date(df,start='2020-05-30', end='2020-05-30'):
    mask = (df['date'] >= start) & (df['date'] <= end)
    date_df=df[mask]
    return date_df

def plot_daily(df, county=True):
    #Given a dataframe, plot the daily increase.
    df['SM7']=df.daily.rolling(window=7).mean()
    df['SM14']=df.daily.rolling(window=14).mean()
    a,b=np.polyfit(df.index,df.daily,deg=1)
    plt.figure(figsize=(8,6))
    plt.plot(df.date, df.daily, marker='.', label='daily')
    plt.plot(df.date, np.ones(len(df))*df.daily.mean(), label='total avg')
    plt.plot(df.date, df.index*a+b, label='trend')
    plt.plot(df.date, df.SM14, label='SM14')
    plt.plot(df.date, df.SM7, label='SM7')
    plt.legend(loc='best')
    plt.xticks(rotation=45, fontsize=12)
    plt.ylim([0,max(df.daily)*1.05])
    if county==True:
        plt.title(str(df.county.unique())+', '+str(df.state.unique()))
    else:
        plt.title(str(df.state.unique()))
    plt.show()

def local_cases(data, ff_dct):
    for i in list(ff_dct.keys()):
```

```
        plot_daily(get_this(data,state_name=ff_dct[i],
                            county=True, county_name=i))
        plt.show()

def state_cases(data, state_dct):
    for i in range(len(state_dct)):
        plot_daily(get_this(data,state_name=state_dct[i],
                            county=False), county=False)
        plt.show()
def US_cases(data):
    data['US']=data.sum(axis=1)
    return data

def get_US(df):
    US_df=pd.DataFrame()
    US_df["Washington"]=get_state_agg(df, state_name="Washington").daily
    for i in (df.state.unique()):
        state_i=get_state_agg(df, state_name=i)
        US_df[i]=state_i.daily
    US_df=US_df.fillna(value=0)
    US_df.reindex(sorted(US_df.columns), axis=1)
    return US_df

def stack100(data, list_vals):
    #Convert data to a stacked version, up to 100% for a given day
    data[list_vals]=data[list_vals].divide(data[list_vals].sum(axis=1), axis=0
)*100
    return data
```

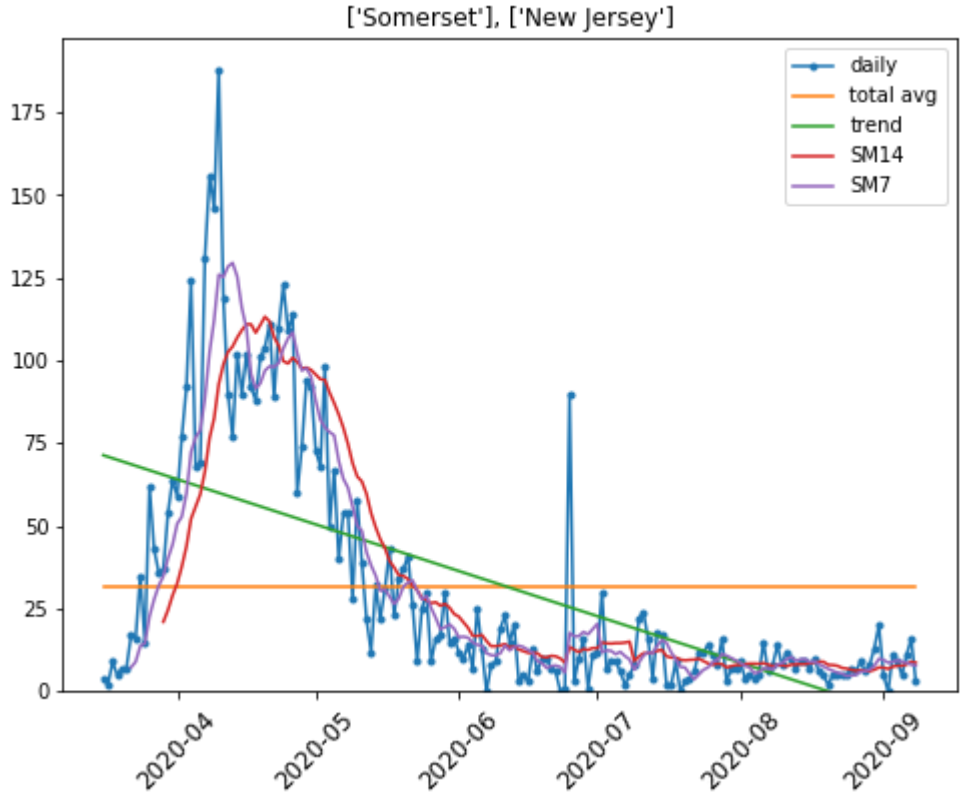
In [5]:

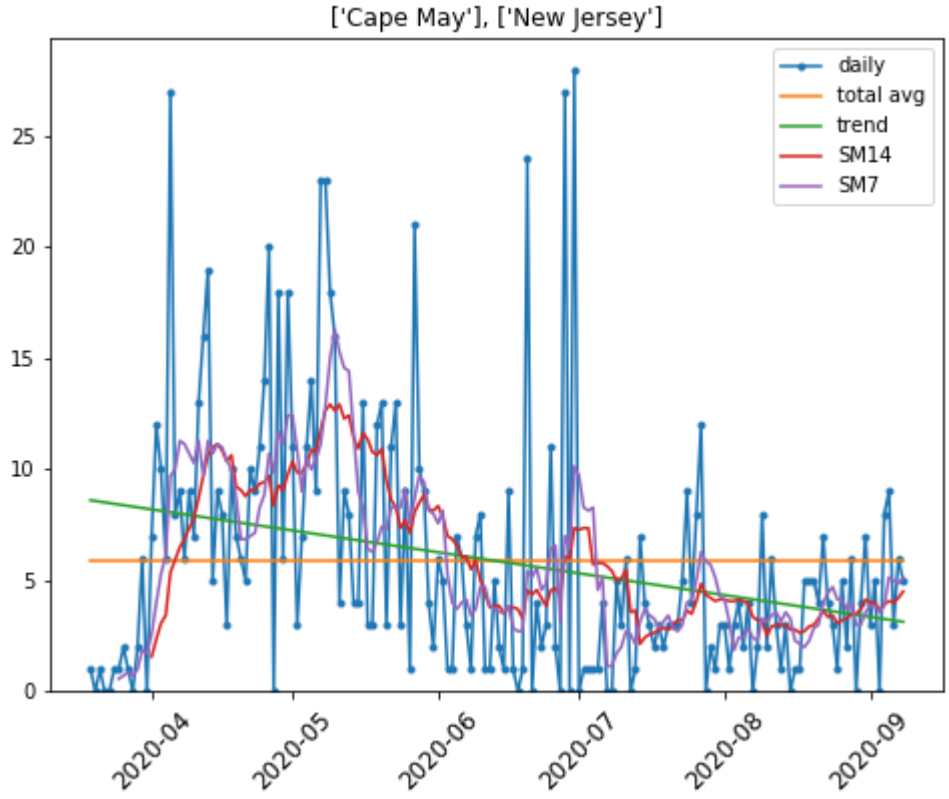
```
states_list=list(state_codes.abbr.unique())
data['abbr']=data['state']
for i in range(len(states_list)):
    data['abbr'].replace(state_codes.loc[i]['state'],
                         state_codes.loc[i]['abbr'], inplace=True)
data['daily']=data['cases']
data=organize_data(data)


for i in range(len(data)-1):
    if i==0:
        data.daily.iloc[i]=data.cases.iloc[i]
    else:
        if data.county.iloc[i]!= data.county.iloc[i-1]:
            data.daily.iloc[i]=data.cases.iloc[i]
        else:
            data.daily.iloc[i] =data.cases.iloc[i]-data.cases.iloc[i-1]
    if  data.daily.iloc[i]<0:
        data.daily.iloc[i]=0
```

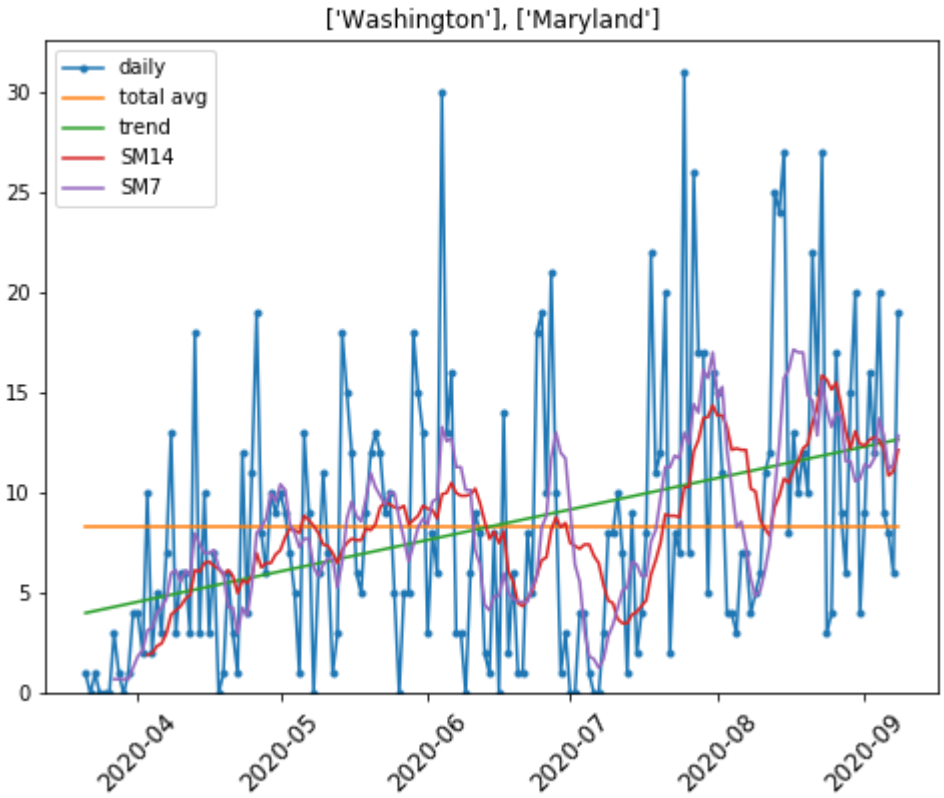
In [6]:
```
Del_data=get_state(data, 'Delaware')
Del_dct={}
for i in Del_data.county.unique():
    Del_dct[i]=get_this(data,state_name='Delaware', county=True, county_name=i
)[['date','daily']]
Del_data_tot=Del_dct['Kent'].merge(right=Del_dct['New Castle'],
                         left_on='date', right_on='date', suffixes=['_Kent','_
New_Castle'])
Del_data_tot=Del_data_tot.merge(right=Del_dct['Sussex'],
                         left_on='date', right_on='date')
Del_data_tot.columns=['date', 'daily_Kent','daily_New_Castle', 'daily_Sussex']
county_list=['daily_Kent','daily_New_Castle', 'daily_Sussex']

Del_data_100=stack100(Del_data_tot,county_list)
plt.stackplot(Del_data_tot.date, np.transpose(Del_data_100[county_list].to_num
py()),
              labels=['Kent', 'New Castle', 'Sussex'])
plt.legend(['Kent', 'New Castle', 'Sussex'], loc='upper left')
plt.xticks(rotation='45')
plt.show()
```

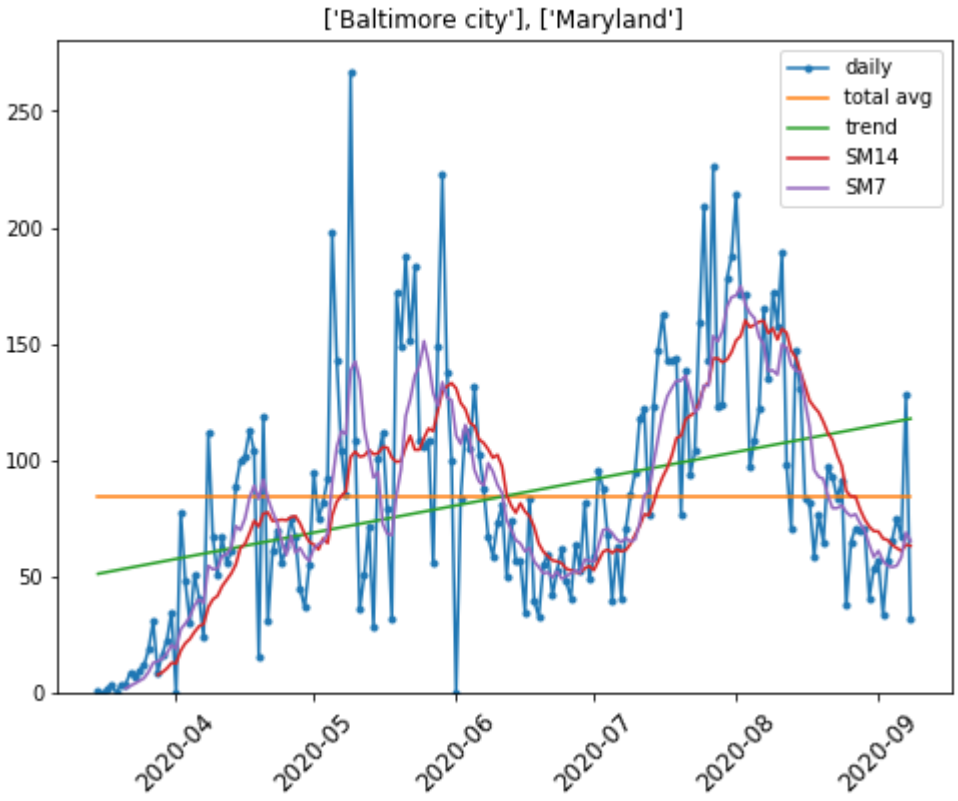


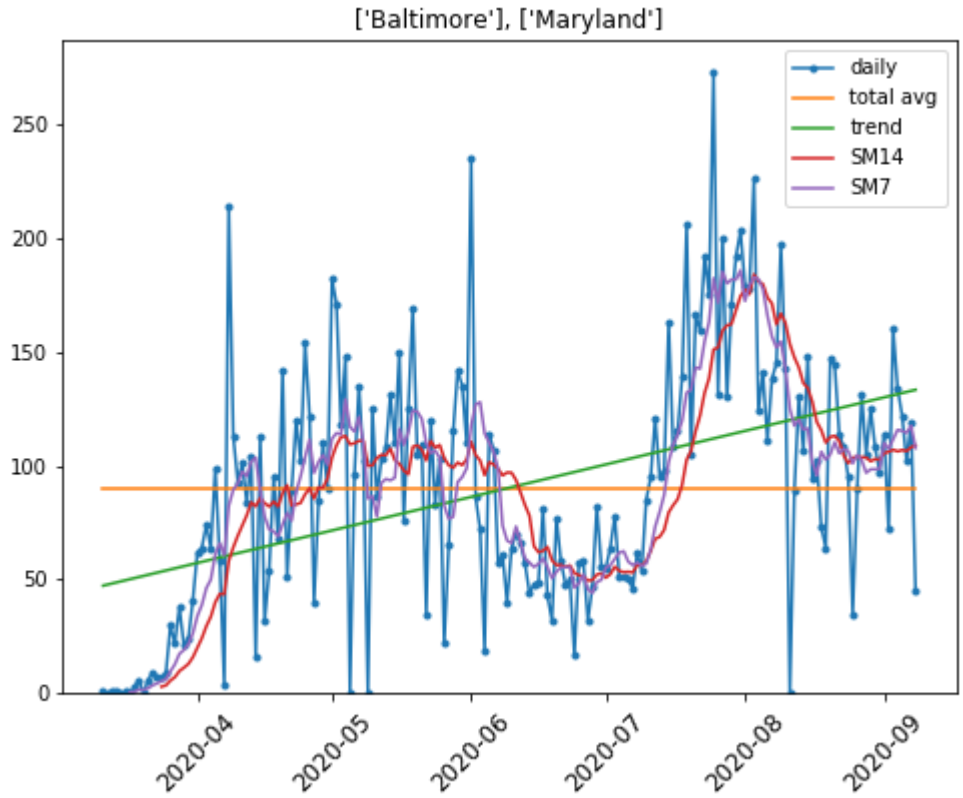
In [7]:
```
ff_dct={'Somerset':'New Jersey',
        'Cape May':'New Jersey',
        'Washington':'Maryland',
        'Baltimore city':'Maryland',
        'Baltimore':'Maryland',
        'Prince George\'s':'Maryland',
        'New Castle':'Delaware',
        'Kent':'Delaware',
        'Sussex':'Delaware',
        'Doña Ana':'New Mexico',
        'James City':'Virginia',
        'Madison':'Alabama',
        'Kanawha': 'West Virginia',
        'Monongalia':'West Virginia',
        'Berkeley':'West Virginia',
       'Greenbrier':'West Virginia',
       'Beaufort':'South Carolina'}
local_cases(data,ff_dct)
```

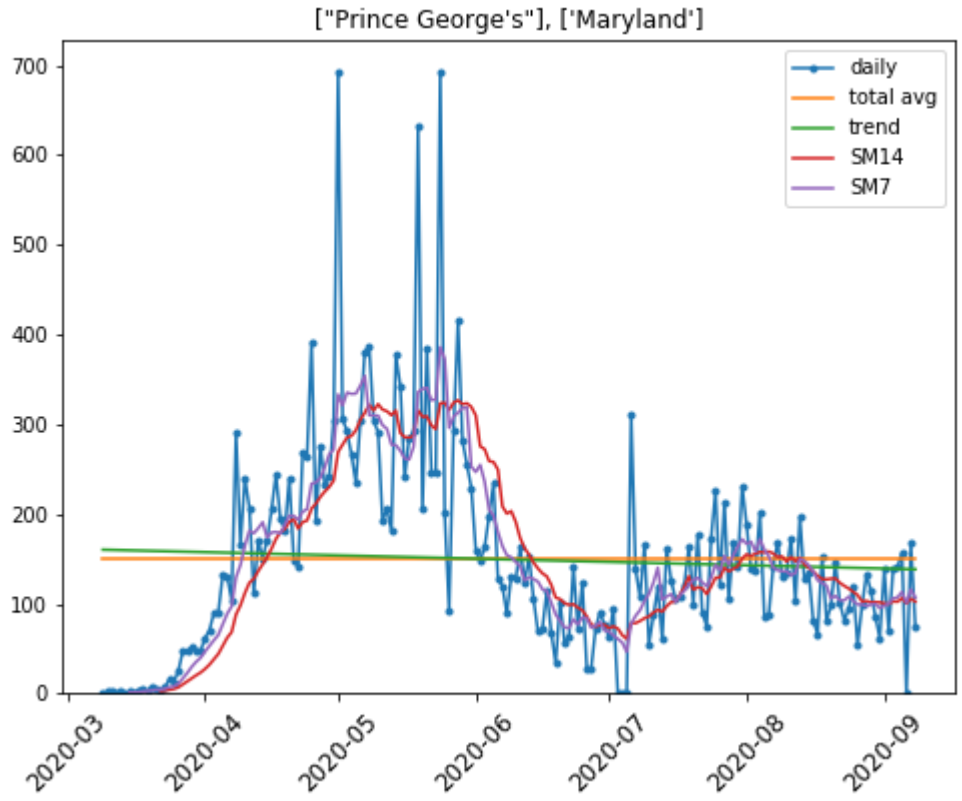

['Somerset'], ['New Jersey']
daily
total avg
trend
SM14
SM7
175
150
125
100
75
50
25
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

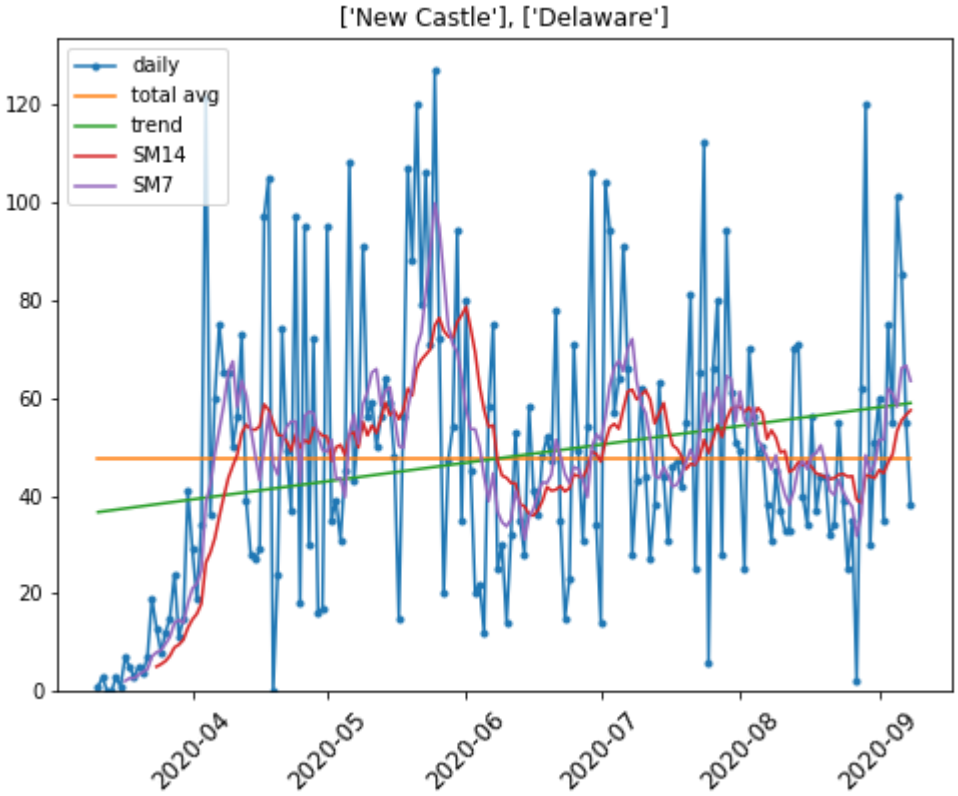

['Cape May'], ['New Jersey']
daily
total avg
trend
SM14
SM7
25
20
15
10
5
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

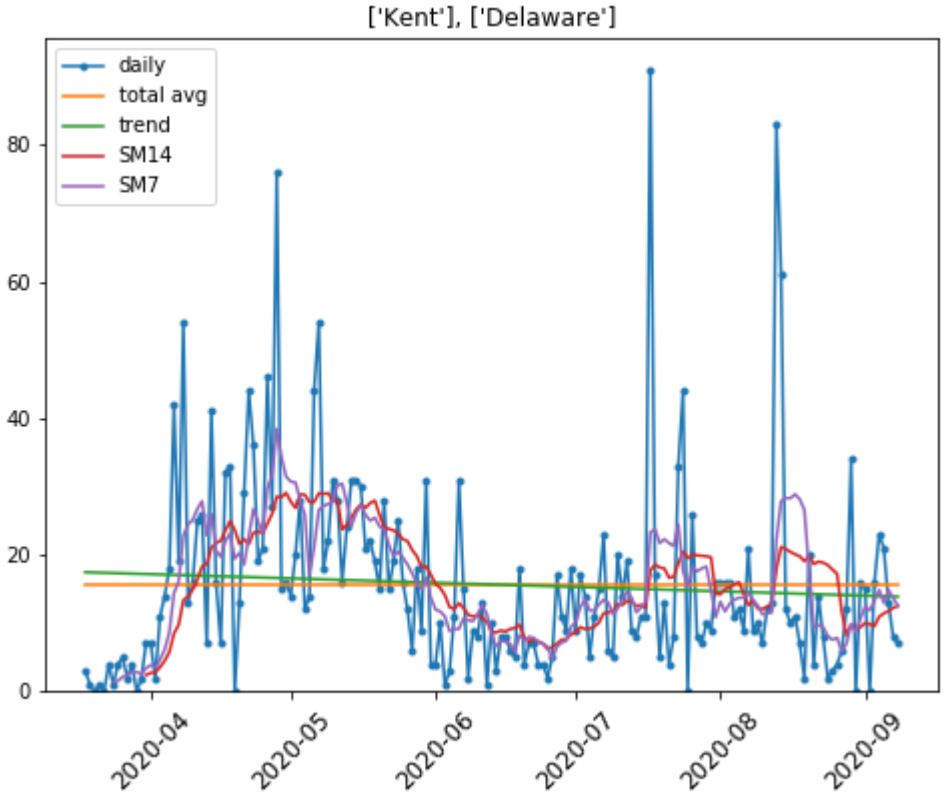

['Washington'], ['Maryland']
daily
total avg
trend
SM14
SM7
30
25
20
15
10
5
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

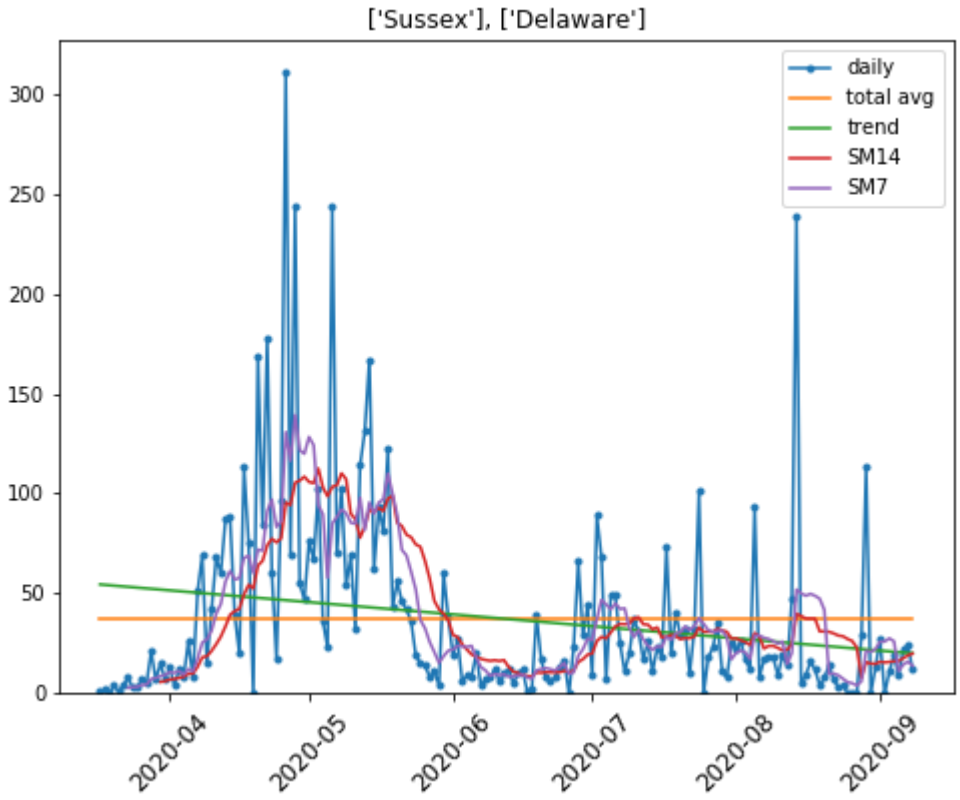

['Baltimore city'], ['Maryland']
daily
total avg
trend
SM14
SM7
250
200
150
100
50
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

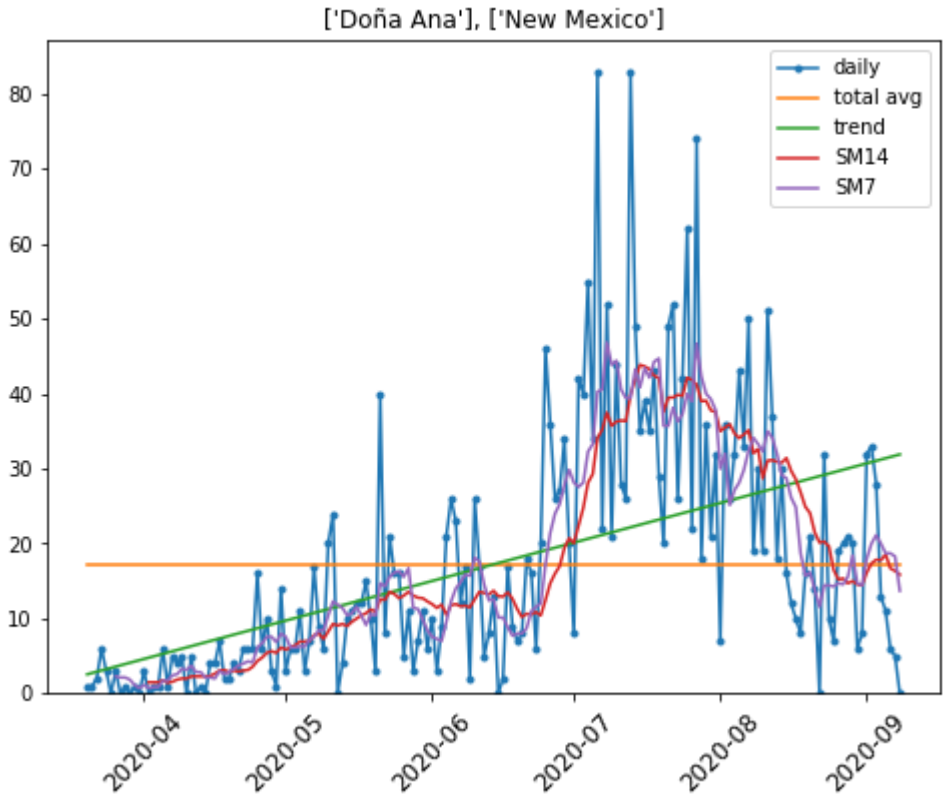

['Baltimore'], ['Maryland']
daily
total avg
trend
SM14
SM7
250
200
150
100
50
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

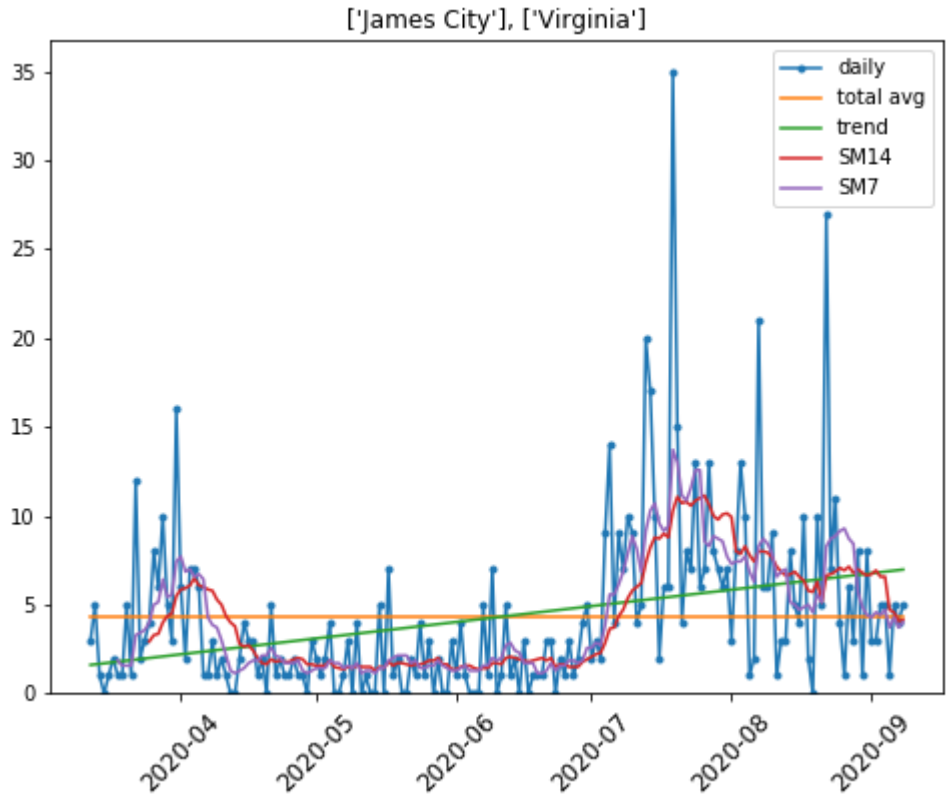

["Prince George's"], ['Maryland']
daily
total avg
trend
SM14
SM7
700
600
500
400
300
200
100
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

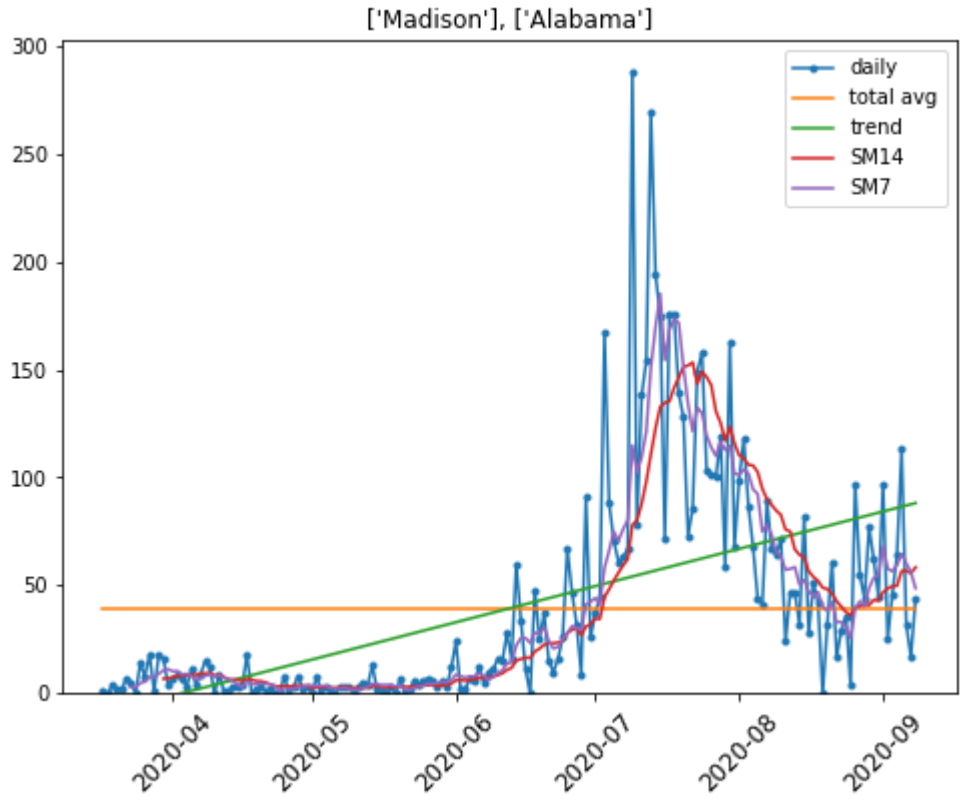

['New Castle'], ['Delaware']
daily
total avg
trend
SM14
SM7
120
100
80
60
40
20
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

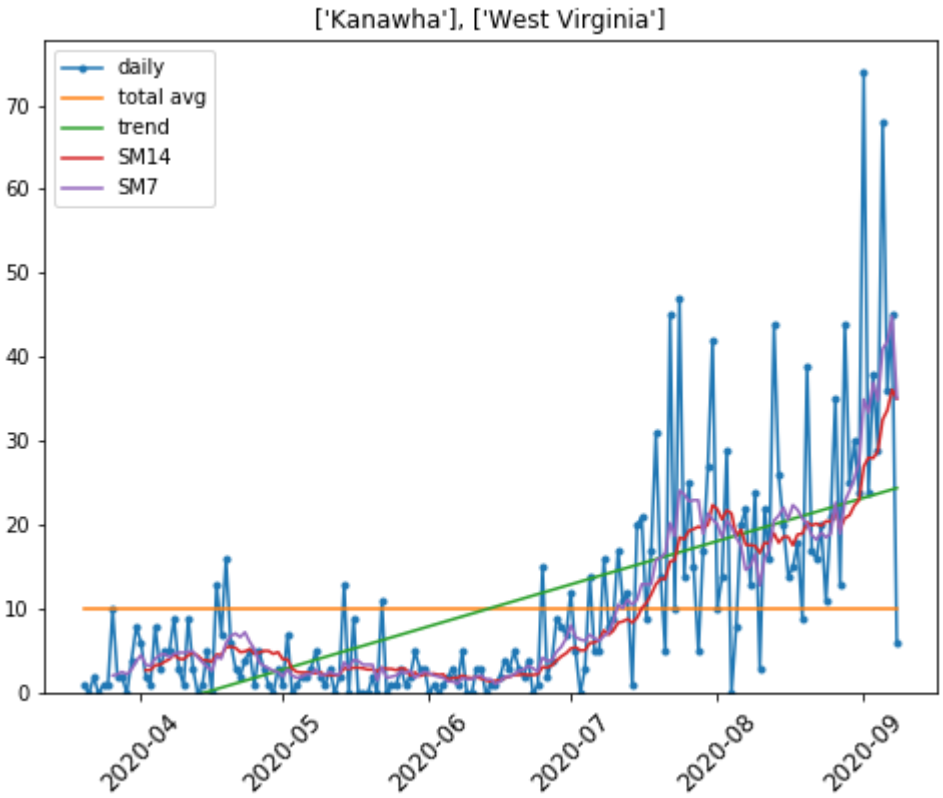

['Kent'], ['Delaware']
daily
total avg
trend
SM14
SM7
80
60
40
20
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

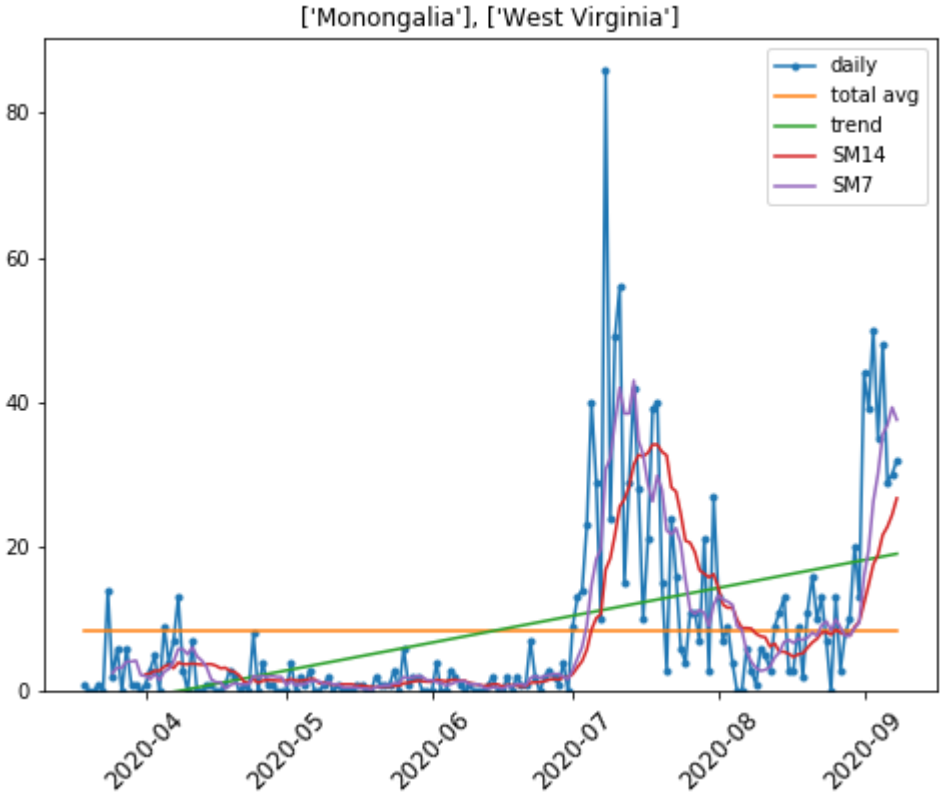

['Sussex'], ['Delaware']
daily
total avg
trend
SM14
SM7
300
250
200
150
100
50
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

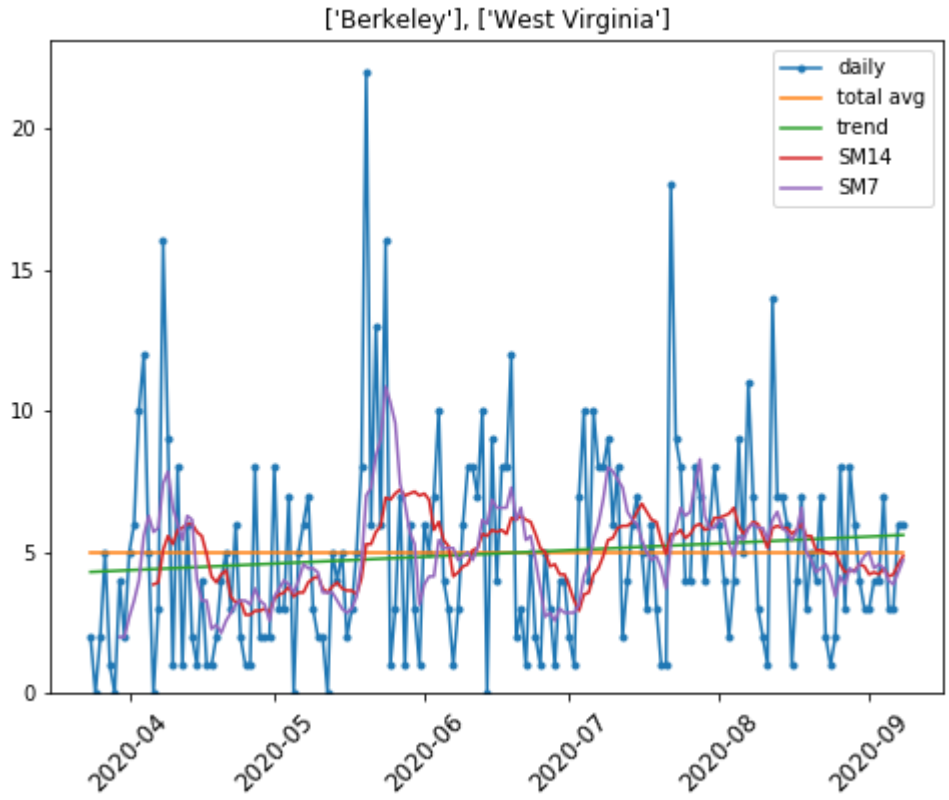

['Doña Ana'], ['New Mexico']
daily
total avg
trend
SM14
SM7
80
70
60
50
40
30
20
10
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

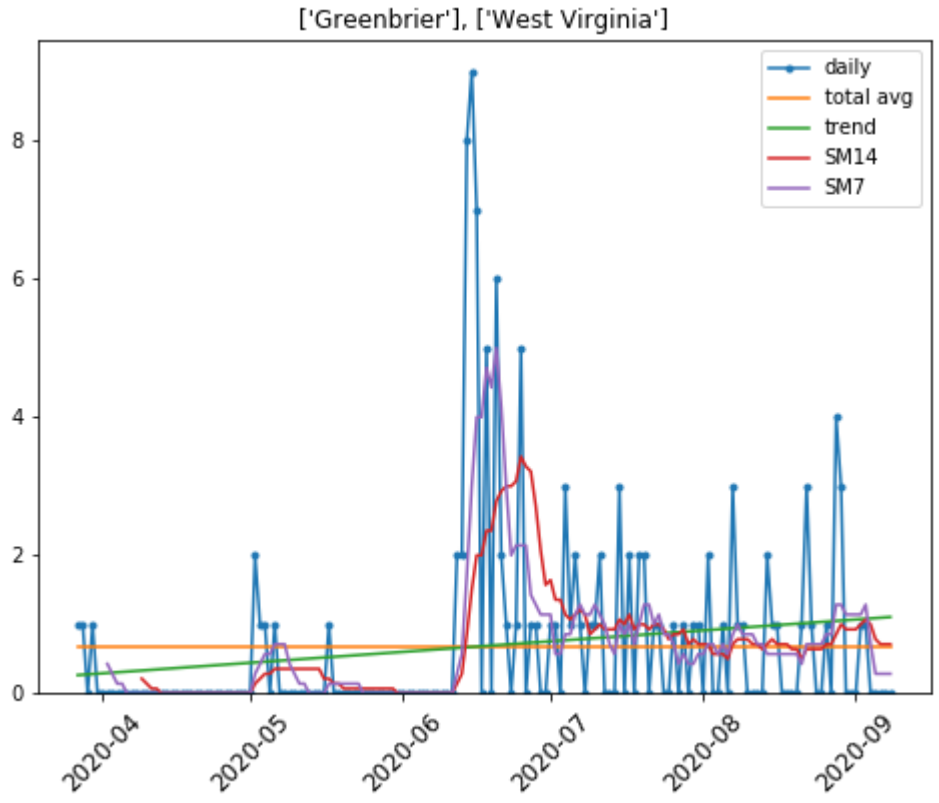

['James City'], ['Virginia']
daily
total avg
trend
SM14
SM7
35
30
25
20
15
10
5
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

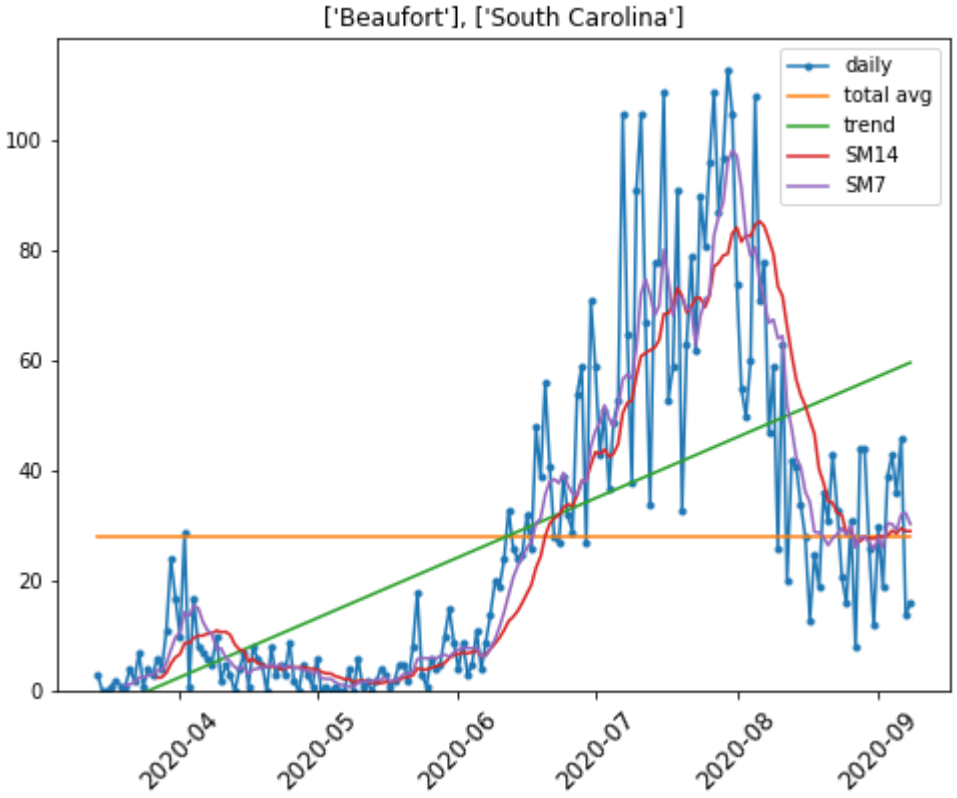

['Madison'], ['Alabama']
daily
total avg
trend
SM14
SM7
300
250
200
150
100
50
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09


['Kanawha'], ['West Virginia']
daily
total avg
trend
SM14
SM7
0
10
20
30
40
50
60
70
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

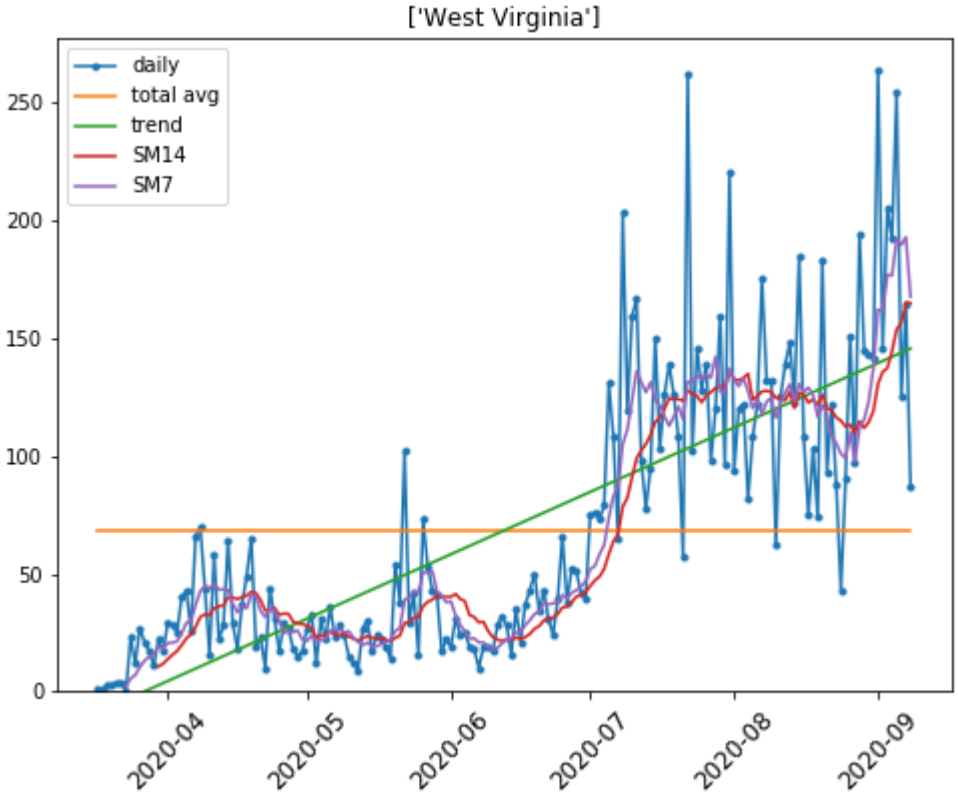

['Monongalia'], ['West Virginia']
daily
total avg
trend
SM14
SM7
0
20
40
60
80
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

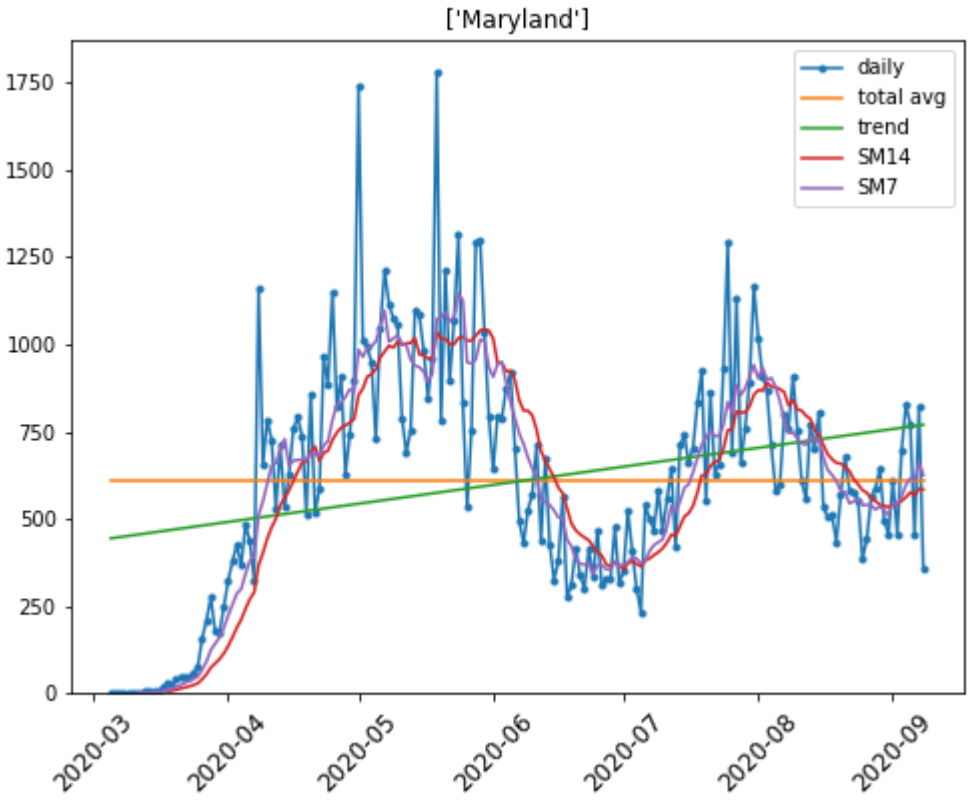

['Berkeley'], ['West Virginia']
daily
total avg
trend
SM14
SM7
0
5
10
15
20
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

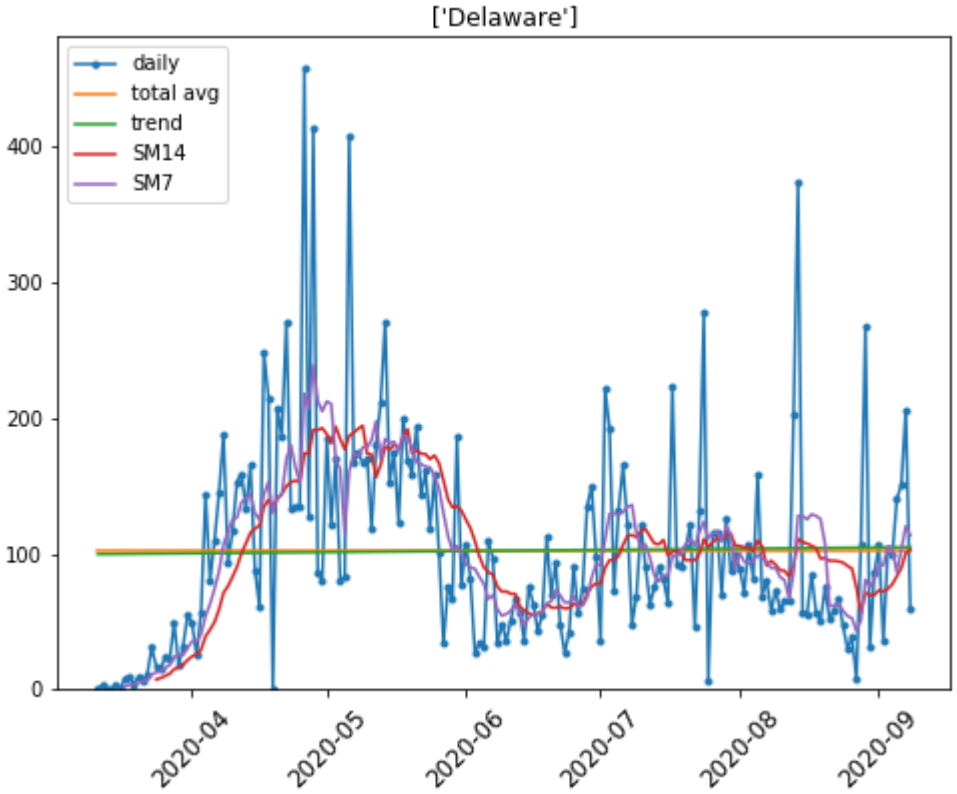

['Greenbrier'], ['West Virginia']
daily
total avg
trend
SM14
SM7
0
2
4
6
8
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

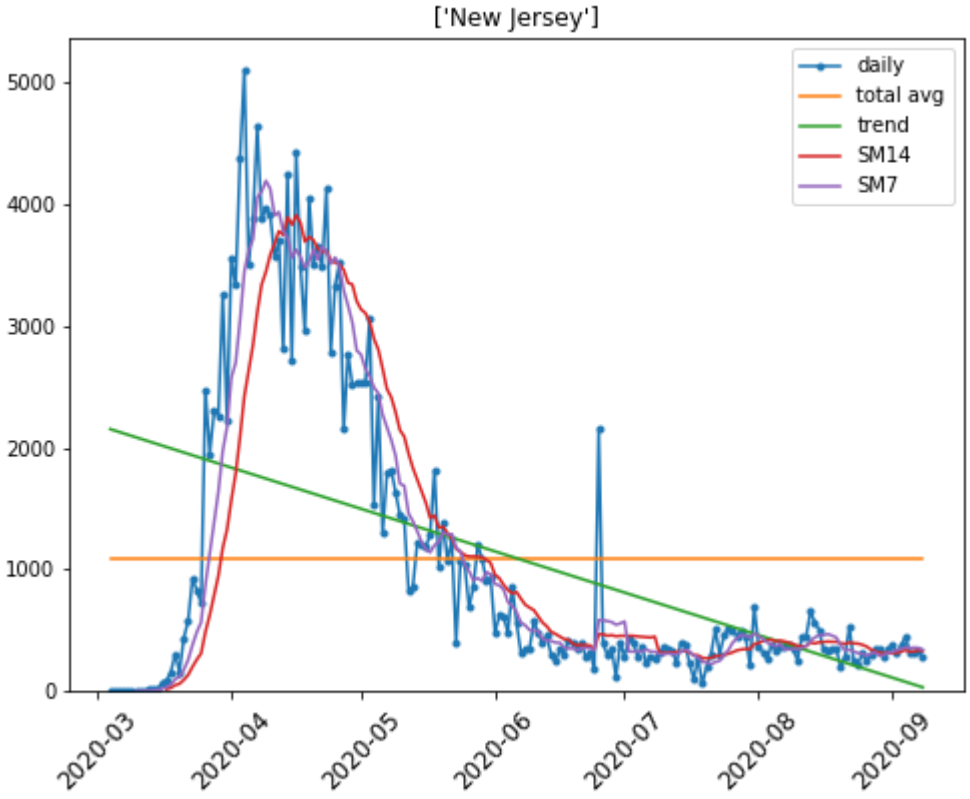

['Beaufort'], ['South Carolina']
daily
total avg
trend
SM14
SM7
100
80
60
40
20
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

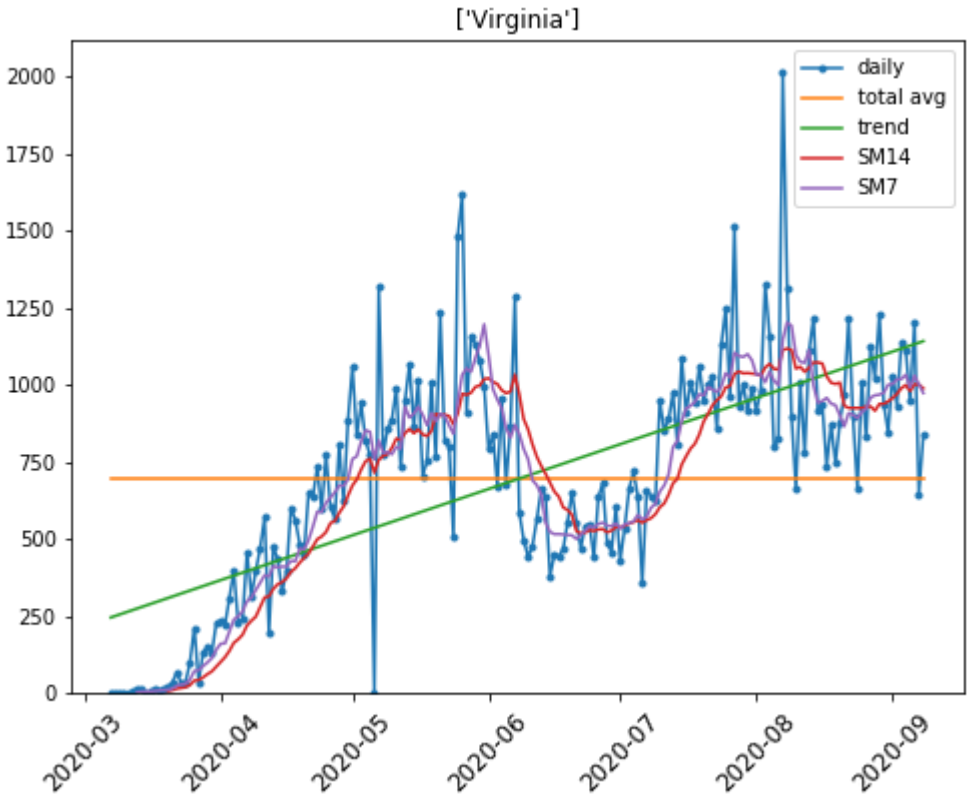
In [8]:
```
state=['West Virginia', 'Maryland', 'Delaware',  'New Jersey','Virginia', 'Pen
nsylvania','South Carolina', 'Florida',  'Alabama', 'Georgia']
state_cases(data,state)
```

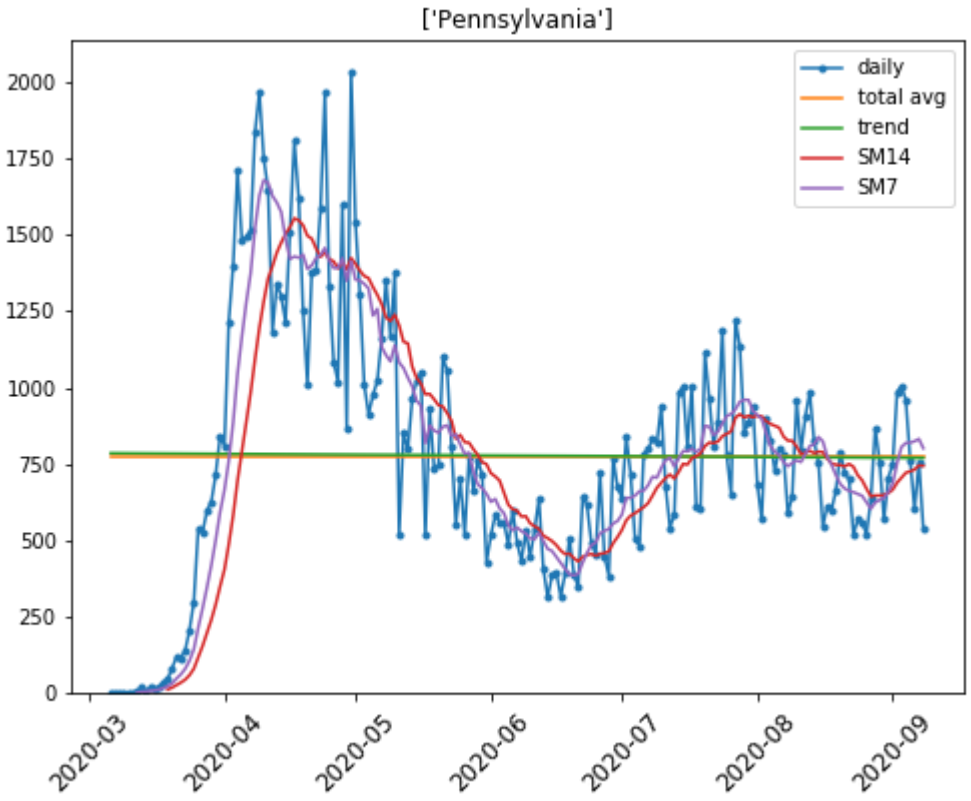

['West Virginia']
daily
total avg
trend
SM14
SM7
250
200
150
100
50
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

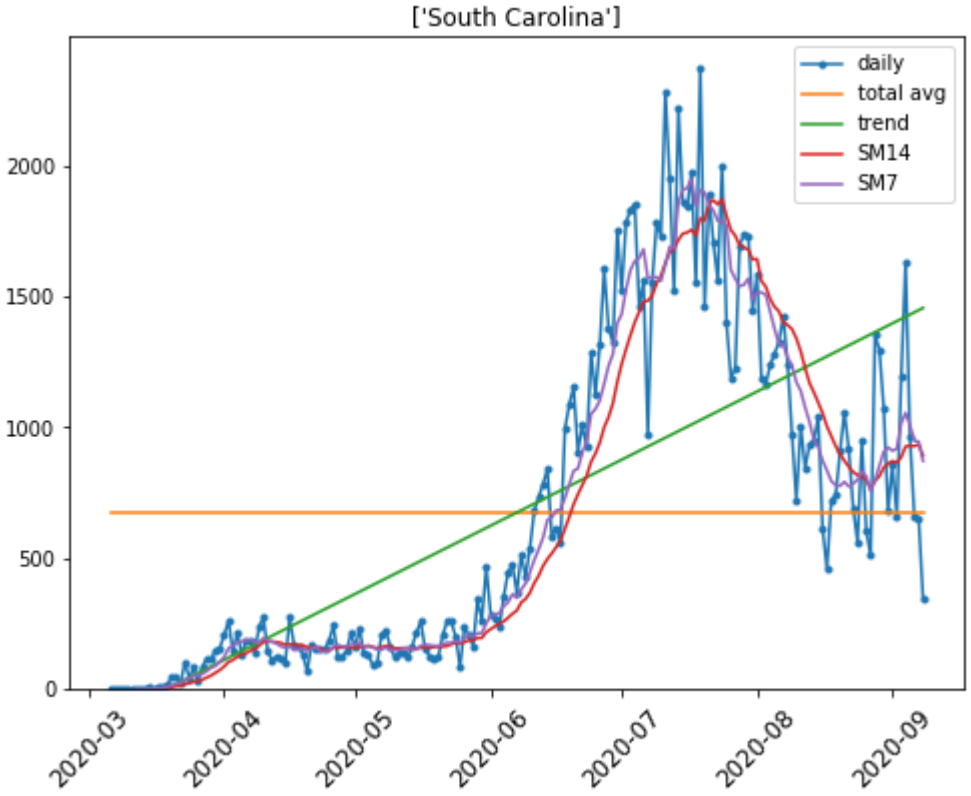

['Maryland']
daily
total avg
trend
SM14
SM7
1750
1500
1250
1000
750
500
250
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

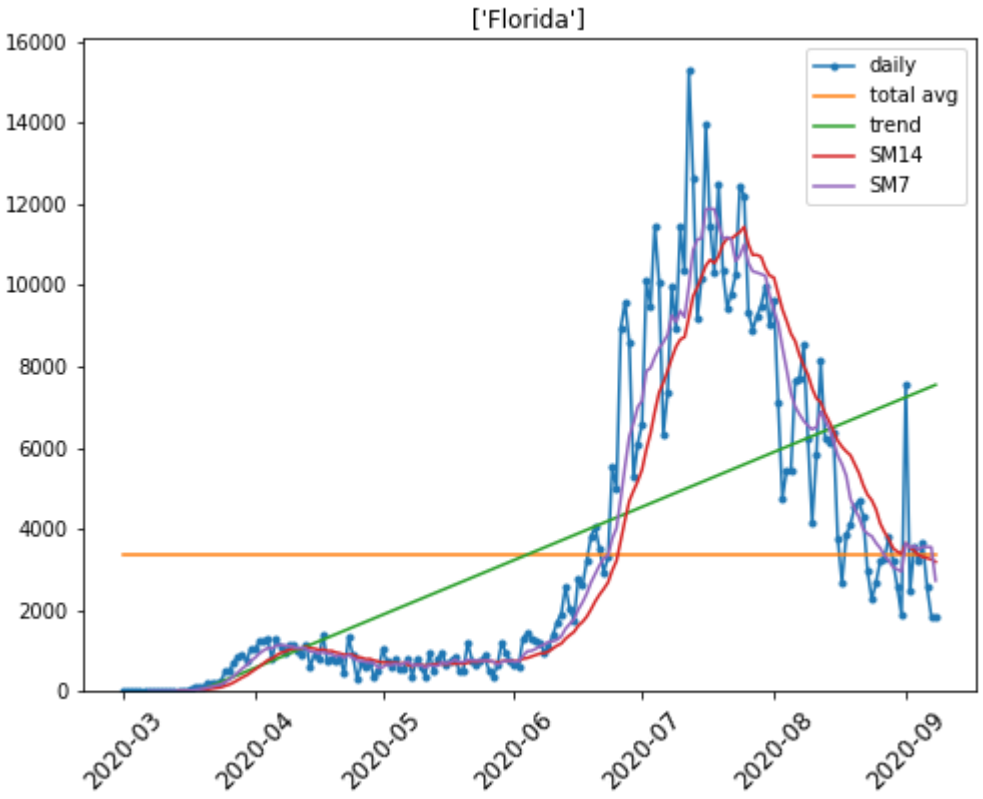

['Delaware']
daily
total avg
trend
SM14
SM7
400
300
200
100
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

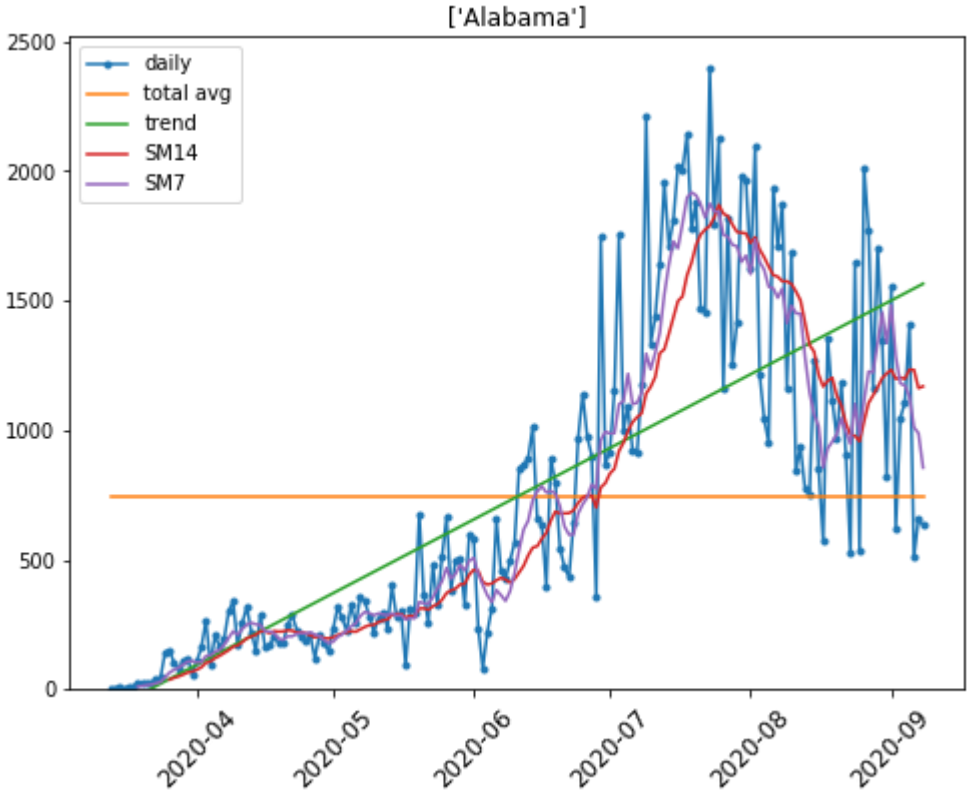

['New Jersey']
daily
total avg
trend
SM14
SM7
5000
4000
3000
2000
1000
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

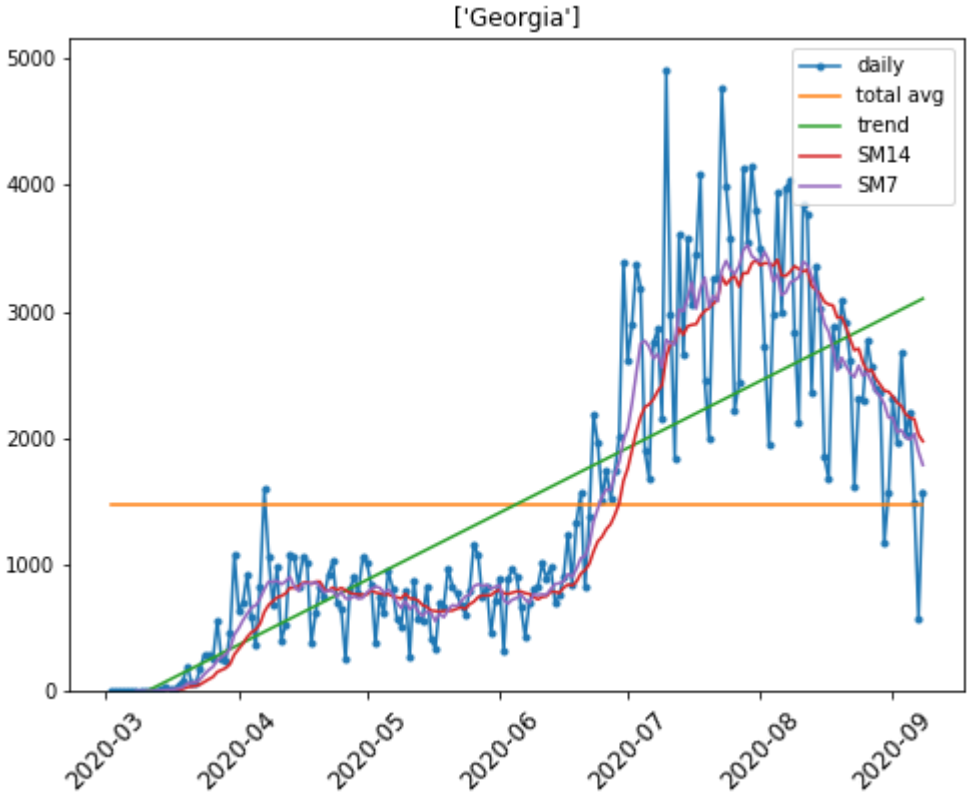

['Virginia']
daily
total avg
trend
SM14
SM7
2000
1750
1500
1250
1000
750
500
250
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09


['Pennsylvania']
daily
total avg
trend
SM14
SM7
2000
1750
1500
1250
1000
750
500
250
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

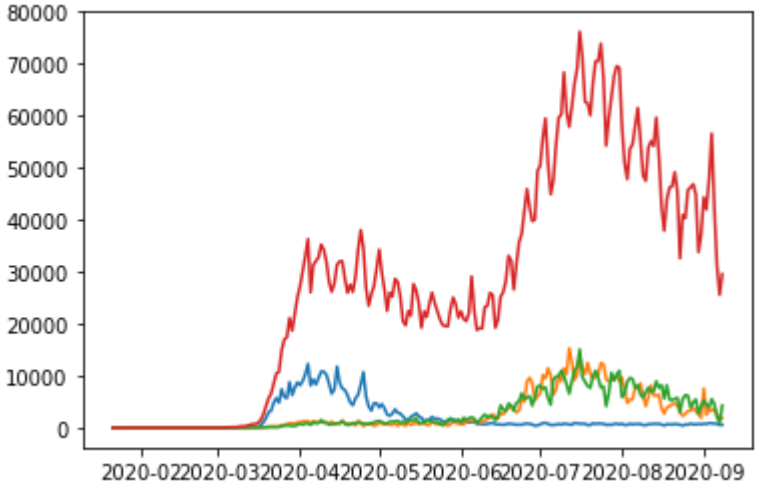

['South Carolina']
daily
total avg
trend
SM14
SM7
2000
1500
1000
500
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09


['Florida']
daily
total avg
trend
SM14
SM7
16000
14000
12000
10000
8000
6000
4000
2000
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09


['Alabama']
daily
total avg
trend
SM14
SM7
2500
2000
1500
1000
500
0
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

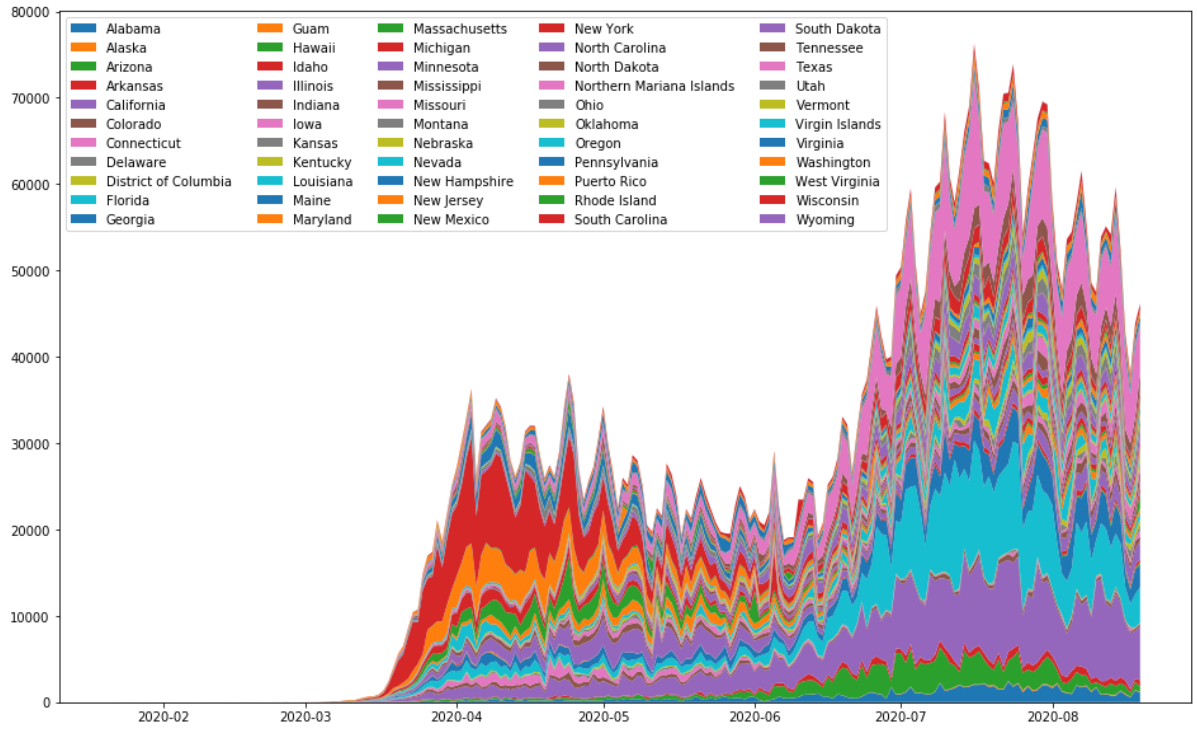

['Georgia']
daily
total avg
trend
SM14
SM7
5000
4000
3000
2000
1000
0
2020-03
2020-04
2020-05
2020-06
2020-07
2020-08
2020-09

In [9]:
```
US_data=US_cases(get_US(data))
plt.plot(US_data["New York"])
plt.plot(US_data["Florida"])
plt.plot(US_data["Texas"])
plt.plot(US_data.US)
plt.show()
```



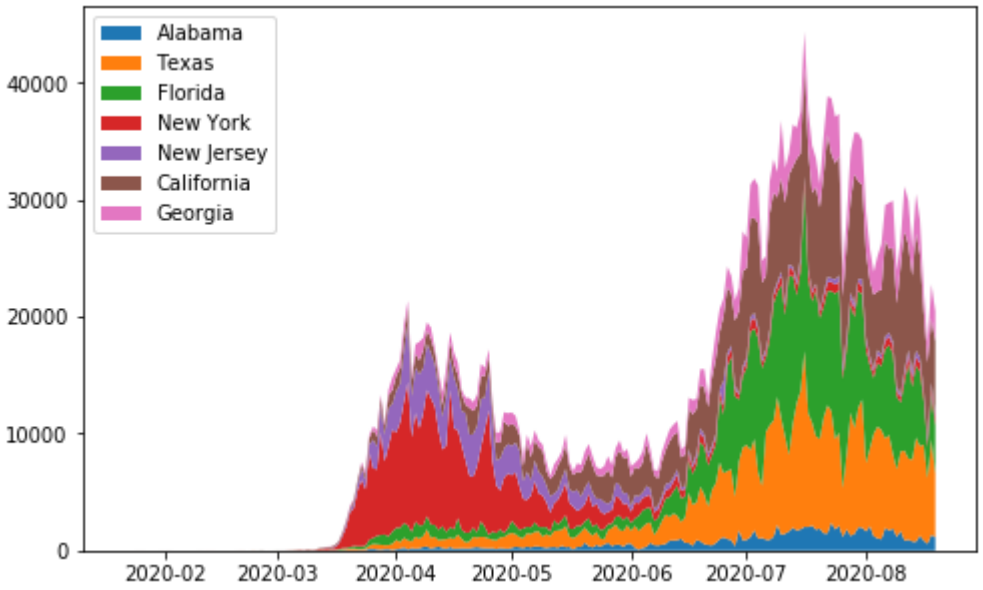
Why are we seeing such a drastic spike in cases? Breaking this down by state may help, though the plot will be messy.

In [10]:
```
plt.figure(figsize=(16,10))
plt.stackplot(US_data.index, np.transpose(US_data[data.state.unique()].to_numpy()),
              labels=data.state.unique())
plt.legend(loc='upper left', fontsize=10, ncol=5)
plt.show()
```



Let's check some of the states we've seen in the news throughout the pandemic. Most notably, NY, NJ, FL, Texas, etc.

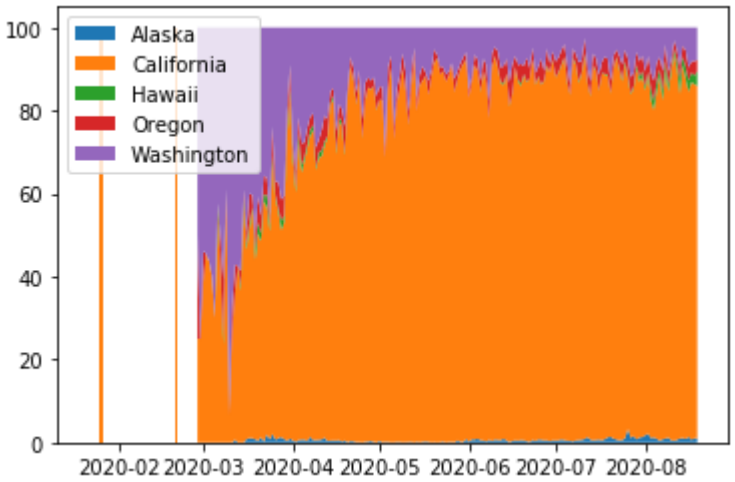
In [11]:
```
plt.figure(figsize=(8,5))
plt.stackplot(US_data.index,
              np.transpose(US_data[['Alabama', 'Texas', 'Florida',
                                    'New York', 'New Jersey', 'California', 'G
eorgia']].to_numpy()),
              labels=['Alabama', 'Texas', 'Florida', 'New York', 'New Jersey',
'California', 'Georgia'])
plt.legend(loc='upper left', fontsize=10)
plt.show()
```



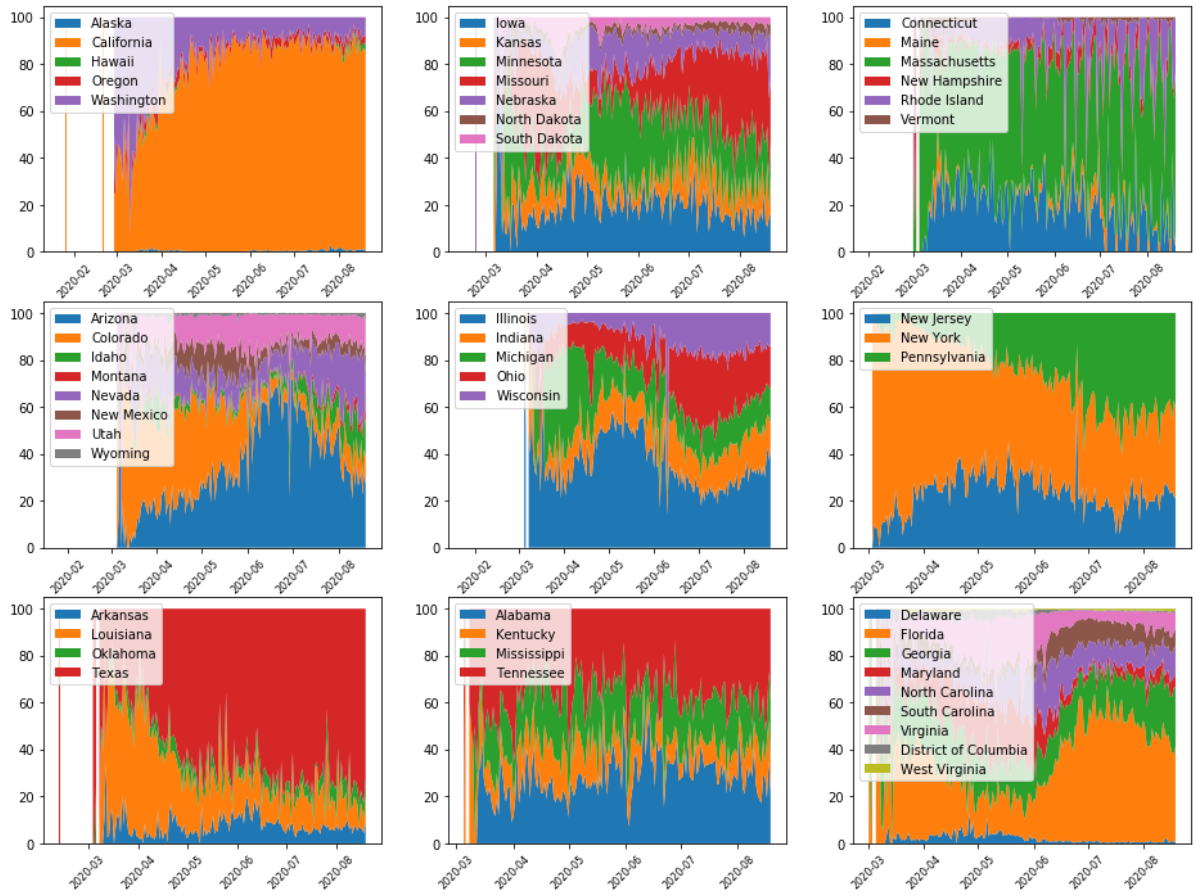
As we can see, it really comes down to where you are during this pandemic. New York has pretty much recovered, whereas Florida is exploding. Let's explore the U.S. Census Bureau designated regions.

In [12]:
```
#US Census Bureau designated regions

#South Atlantic
SA=['Delaware', 'Florida', 'Georgia', 'Maryland',
    'North Carolina', 'South Carolina', 'Virginia',
    'District of Columbia', 'West Virginia']
#East North Central
ENC=['Illinois','Indiana', 'Michigan', 'Ohio', 'Wisconsin']
#West North Central
WNC=['Iowa', 'Kansas', 'Minnesota', 'Missouri',
     'Nebraska', 'North Dakota', 'South Dakota']
#East South Central
ESC=['Alabama', 'Kentucky', 'Mississippi', 'Tennessee']
#West South Central
WSC=['Arkansas', 'Louisiana', 'Oklahoma', 'Texas']
#New England
NE=['Connecticut', 'Maine', 'Massachusetts',
    'New Hampshire', 'Rhode Island', 'Vermont']
#Mid-Atlantic
MA=['New Jersey', 'New York', 'Pennsylvania']
Mountain=['Arizona', 'Colorado', 'Idaho', 'Montana',
          'Nevada', 'New Mexico', 'Utah', 'Wyoming']
Pacific=['Alaska', 'California', 'Hawaii',
         'Oregon','Washington']
Region_list=[Pacific,WNC,NE,Mountain, ENC,MA,WSC,ESC,SA]
```

In [13]:
```
US_data=stack100(US_data,Pacific)
plt.stackplot(US_data.index, np.transpose(US_data[Pacific].to_numpy()), labels
=Pacific)
plt.legend(Pacific, loc='upper left')
plt.show()
```



In [14]:
```
plt.figure(figsize=(16,12))
for i in range(9):
    plt.subplot(3,3,i+1)
    US_data=stack100(US_data,Region_list[i])
    plt.stackplot(US_data.index,
                  np.transpose(US_data[Region_list[i]].to_numpy()),
                  labels=Region_list[i])
    plt.legend(loc='upper left', fontsize=10)
    plt.xticks(rotation=45, fontsize=8)

plt.show()
```



We'll notice that there has been a shift in the najority of cases depending on the region. The Mid-West seems to grow relatively slowly due to the population sparsity. The Northeast had a tougher time back in March, but now the South and Pacific regions seem to be suffering in July.

In [ ]:
```
```