■ 1 COVID-19 Data Analysis and Contents 2 Forecasting

```
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
      1.1.1 Probletther: Joseph Denney
  ▼ 1.2 Table of Conten
      1.2.1 Standard joseph.d.denney@gmail.com (mailto:joseph.d.denney@gmail.com)
      1.2.2 Custom Libi
  ▼ 1.3 Explore Data
github:

1.3.1 Create http://vww.github.com/josephdenney/Covid_Analysis

1.3.1 Create http://vww.github.com/josephdenney/Covid_Analysis
      1.3.3 Plot Alaska
▼ 2 Modeling and Forec 
2.0.1 Alaska SAF Introduction
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
      2.T.2 New 1.1 Problem and Purpose
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California project will use forecasting to model Covid-19 deaths based on current
      2.1.6 Texahospitalization, ventilator, and death data. I will be using API html links to bring in up to
      date data regularly. This project will use supervised learning in the form of SARIMA and 2.1.7 Texas ARIMAX in order to create time series death forecasts.
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 Florifie purpose of this analysis is to provide an accurate forecast of Covid-19 related
      2.1.11 Unite attas as 2021 progresses.
▼ 3 Summary Recomm.
Our challenges are -
  ▼ 3.1 State by State F
      3.1.1 New York
      3.1.2 California Create multiple forecasts by creating forecasts for specific states
      3.1.3 Texas
      3.1.4 Florida. Build a forecast for the United States as a whole
      3.1.5 United State
    3.2 Conclusions. Provide insights as to the urgency of making changes to how we are operating as a
    3.3 Future Weduntry
▼ 4 Appendix and Ancill
    4.1 Using an Exoge
  ▼ 4.2 Univariate 1.2° Table of Contents
      4.2.1 Texas
      4.2.2 Florida
  4.2.3 California

▼ 4.3 Multivariate For
                         Standard Libraries
      4.3.1 Data Import
                           from tensorflow.random import set seed
    In [31]:
                        2
                            import numpy as np
                        3
                           set seed(42)
                           np.random.seed(42)
```

```
In [32]:
                        import pandas as pd
                        import matplotlib.pyplot as plt
                        from matplotlib.lines import Line2D
                        import matplotlib
Contents 2 *
                     5
                        %matplotlib inline
                        import functools
▼ 1 COVID-19 Data Ana<sup>6</sup>
                        from jupyter_plotly_dash import JupyterDash
  ▼ 1.1 Introduction
                        import datetime as dt
      1.1.1 Problem anc<sup>8</sup>
                        from datetime import date
  ▼ 1.2 Table of Conten
                        from datetime import datetime, timedelta
      1.2.1 Standard Li
                        import pandas datareader as pdr
     1.2.2 Custom Libi -
                        import holidays
  ▼ 1.3 Explore Data
      1.3.1 Create New
                        from statsmodels.tsa.statespace.tools import diff
    In 3.33 Plot of Vent 1
                        from statsmodels.tsa.stattools import acovf, acf, pacf_yw, pacf_ol
      1.3.3 Plot Alaska <sup>2</sup>
                        from statsmodels.graphics.tsaplots import plot_acf, plot_pacf

▼ 2 Modeling and Forec<sup>3</sup>

      2.0.1 Alaska SAF_
                        from statsmodels.tsa.stattools import adfuller
                        from statsmodels.tools.eval measures import mse,rmse
  ▼ 2.1 SARIMAX Mode
                        from pmdarima import auto_arima
      2.1.1 New York St
                        from statsmodels.tsa.seasonal import seasonal decompose as sd
      2.1.2 New York S _{8}^{'}
                        from statsmodels.tsa.statespace.varmax import VARMAX, VARMAXResults
      2.1.3 New York A q
                        from statsmodels.tsa.ar model import AR, ARResults
      2.1.4 California Q0
                        from statsmodels.tsa.arima model import ARMA, ARIMA, ARMAResults
      2.1.5 California A 1
                        from statsmodels.tsa.statespace.sarimax import SARIMAX
      2.1.6 Texas Hosp 2
                        from sklearn.preprocessing import MinMaxScaler, StandardScaler
      2.1.7 Texas Deatt 3
                        from keras.preprocessing.sequence import TimeseriesGenerator
      2.1.8 Texas Anal 4
                        from keras.models import Sequential
      2.1.9 Florida Dea5
                        from keras.layers import Dense, LSTM, Dropout
                        from keras.callbacks import EarlyStopping
      2.1.10 Florida Anl 6
                        from keras.callbacks import ModelCheckpoint, TensorBoard
      2.1.11 United Stat7
      2.1.12 United Sta
▼ 3 $µmmaary Recommon
                        import warnings
  ▼ 3.1 State by State F<sub>2</sub>
                        warnings.filterwarnings('ignore')
      3.1.1 New York
      3.1.2 California 4
                       import itertools
                        import statsmodels.api as sm
      3.1.3 Texas
                       from matplotlib.pylab import rcParams
      3.1.4 Florida
                        plt.style.use('ggplot')
      3.1.5 United State 7
    3.2 Conclusions
    3.3 Fyture Work
                     1
                        scaler = MinMaxScaler()

▼ 4 Appendix and Ancill 2

                        standard scaler = StandardScaler()
    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      42.1 Texas 1.2.2 Custom Libraries
      4.2.2 Florida
      4.2.3 California
                       %load_ext autoreload
  ₹14.3[ Martivariate For 1
                        %autoreload 2
      4.3.1 Data Import <sup>2</sup>
                        %reload ext autoreload
                        from Cust_Func import *
                   The autoreload extension is already loaded. To reload it, use:
                     %reload ext autoreload
```

1.3 Explore Data

```
1.3.1 Create New DataFrame
Contents 2 *
▼ 1 COVID-19 Data Ana
                           open links = False

▼ 1.1 Introduction

       1.1.1 Problem and
                           import webbrowser
  ▼ 1.2 Table of Conten 1
       1.2.1 Standard Lil 2
                           if open links == True:
      1.2.2 Custom Libi<sup>3</sup>
                                webbrowser.open("https://covidtracking.com/")
  ▼ 1.3 Explore Data
                                webbrowser.open("https://covidtracking.com/data/api")
       1.3.1 Create New
       1.3.2 Plot of Vent
       1.3.3 Plot Alaska
The Covid Tracking Project was organized by the news agency The Atlantic early in 2020 in an effort to provide as much data on the pandemic as possible. Coordination of 2.0.1 Alas state by state Covid data required building working relationships with state officials to
  ▼ 2.1 SARIMA blatain relevant state information. Above are links to the project that can provide further
       _{2.1.1\  \, \text{New}} information regarding Covid-19. Additionally, it is worth noting that the project is
       2.1.2 New Federal collection of data.
       2.1.3 New York A
       2.1.4 California D
     In [39]:
2.1.5 California A
                           # set to true to fetch new data
                           get_data = True
       2.1.6 Texas Hosp
       2.1.7 Texas Death
    Ing. [.80] exas Manal 1
                           if get data == True:
                                df states = pd.read csv('https://api.covidtracking.com/v1/states/dail
       2.1.9 Florida Dea 2
                                df whole US = pd.read csv('https://api.covidtracking.com/v1/us/daily
       2.1.10 Florida Ana
                                df states.to csv('StateData.csv')
       2.1.11 United Stat 4
                                df whole US.to csv('USA.csv')
       2.1.12 United $ta<sup>5</sup>
                           else:

▼ 3 Summary Recomme

                                df states = pd.read csv('StateData.csv', index col='date', parse date
  df whole US = pd.read csv('USA.csv', index col='date', parse dates=Ti
       3.1.1 New York
       3.1.2 California
    In [41]exas ▶
                           df states.head()
       3.1.4 Florida
       3.1.5 United State
                                                                negative pending totalTestResultsSource totalTestRe
                              state
                                     positive probableCases
    3.2 Conclusions
                       date
    3.3 Future Work

▼ 4 Appendix and Ancill 2021-

                                     54282.0
                               ΑK
                                                         NaN
                                                                    NaN
                                                                              NaN
                                                                                              totalTestsViral
                                                                                                                  1584
    4.1 Using an Exog@2.12
  ▼ 4.2 Univariate Fore 2021-
                                    478667.0
                                                     103040.0
                                                              1842516.0
                                                                                        totalTestsPeopleViral
                                                                                                                  2218
       4.2.1 Texas
                                                                              NaN
                      02-12
       4.2.2 Florida
       4.2.3 California 2021-
                                    311608.0
                                                      64580.0 2322916.0
                                                                              NaN
                                                                                              totalTestsViral
                                                                                                                  25699
  ▼ 4.3 Multivariate For 12
       4.3.1 Data Impor2021-
                               AS
                                          0.0
                                                         NaN
                                                                  2140.0
                                                                              NaN
                                                                                              totalTestsViral
                                                                                                                     2
                      02-12
                      2021-
                                AZ 793532.0
                                                      53218.0 2864855.0
                                                                              NaN
                                                                                              totalTestsViral
                                                                                                                  71409
                      02-12
                     5 rows × 54 columns
```

```
In [42]:
                         df states.info()
                    <class 'pandas.core.frame.DataFrame'>
                    DatetimeIndex: 19485 entries, 2021-02-12 to 2020-01-13
                    Data columns (total 54 columns):
Contents 2 *
                          Column
▼ 1 COVID-19 Data Ana
                                                            Non-Null Count
                                                                               Dtype
  ▼ 1.1 Introduction
                          state
                                                            19485 non-null
                                                                               object
      1.1.1 Problem anq
                                                                               float64
                          positive
                                                            19296 non-null
  ▼ 1.2 Table of Conten,
                          probableCases
                                                            8390 non-null
                                                                               float64
      1.2.1 Standard Lib
                          negative
                                                            15509 non-null
                                                                               float64
      1.2.2 Custom Lib
                          pending
                                                            2024 non-null
                                                                               float64
  ▼ 1.3 Explore Data 5
                                                                               object
                          totalTestResultsSource
                                                            19485 non-null
      1.3.1 Create News
                          totalTestResults
                                                            19383 non-null
                                                                               float64
      1.3.2 Plot of Vent7
                          hospitalizedCurrently
                                                            16119 non-null
                                                                               float64
                          hospitalizedCumulative
                                                            12017 non-null
                                                                               float64
      1.3.3 Plot Alaska8
                          inIcuCurrently
                                                            10568 non-null
                                                                               float64
▼ 2 Modeling and Fore ②
                          inIcuCumulative
                                                            3516 non-null
                                                                               float64
      2.0.1 Alaska SAF10
                          onVentilatorCurrently
                                                            8386 non-null
                                                                               float64
  ▼ 2.1 SARIMAX Model1
                          onVentilatorCumulative
                                                            1201 non-null
                                                                               float64
      2.1.1 New York S<sup>12</sup>
                                                            13992 non-null
                                                                               float64
                          recovered
      2.1.2 New York S^{13}
      2.1.3 New York A
    Ir2.1.43Califoria D1
                         df_whole_US.head()
      2.1.5 California A
      2.1.6 Texas Hosp
                                                  negative pending hospitalizedCurrently hospitalizedCumulative
                            states
                                      positive
      2.1.7 Texas Death
      2.1.8 Texas Analydate
      2.1.9 Florida Dea 2021-
      2.1.10 Florida An 12 12
                                              122400369.0
                                                             9434.0
                                                                                 71504.0
                               56
                                   27266230.0
                                                                                                      839119.0
      2.1.11 United Stat
      2.1.12 United Sta 2021-
                                   27165660.0
                                              121833298.0
                                                            11981.0
                                                                                 74225.0
                                                                                                      836774.0
▼ 3 Summary Recomm
  ▼ 3.1 State by State 2021-
                                                                                 76979.0
                                   27063243.0
                                              121244702.0
                                                            12079.0
                                                                                                      834314.0
      3.1.1 New York 02-10
      3.1.2 California 2021-
                                   26968049.0
                                               120859564.0
                                                            10516.0
                                                                                 79179.0
                                                                                                      831088.0
                     02-09
      3.1.3 Texas
      3.1.4 Florida
                     2021-
                                   26875063.0
                                              120367478.0
                                                            12114.0
                                                                                 80055.0
                                                                                                      827944.0
      3.1.5 United State 2-08
    3.2 Conclusions
    3.3 Future Work 5 rows × 24 columns

▼ 4 Appendix and Ancill

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas 1.3.2 Plot of Ventilators and Deaths for Each State
      4.2.2 Florida
      4.2.3 California
  4.3 Multivariate For
      4.3.1 Data Import
```

```
In [44]:
                      df states.columns.unique
        Out[44]: <bound method Index.unique of Index(['state', 'positive', 'probableCases',
                   'negative', 'pending',
                          'totalTestResultsSource', 'totalTestResults', 'hospitalizedCurrentl
Contents 2 *
▼ 1 COVID-19 Data Ana
                          'hospitalizedCumulative', 'inIcuCurrently', 'inIcuCumulative',
  ▼ 1.1 Introduction
                          'onVentilatorCurrently', 'onVentilatorCumulative', 'recovered',
      1.1.1 Problem and
                          'dataQualityGrade', 'lastUpdateEt', 'dateModified', 'checkTimeEt',
  ▼ 1.2 Table of Conten
                          'death', 'hospitalized', 'dateChecked', 'totalTestsViral',
     1.2.1 Standard Lil
                          'positiveTestsViral', 'negativeTestsViral', 'positiveCasesViral',
      1.2.2 Custom Libi
                          'deathConfirmed', 'deathProbable', 'totalTestEncountersViral',
  ▼ 1.3 Explore Data
                          'totalTestsPeopleViral', 'totalTestsAntibody', 'positiveTestsAntibod
     1.3.1 Create New ,
      1.3.2 Plot of Vent
                          'negativeTestsAntibody', 'totalTestsPeopleAntibody',
                          'positiveTestsPeopleAntibody', 'negativeTestsPeopleAntibody',
     1.3.3 Plot Alaska
                          'totalTestsPeopleAntigen', 'positiveTestsPeopleAntigen',
▼ 2 Modeling and Forec
                          'totalTestsAntigen', 'positiveTestsAntigen', 'fips', 'positiveIncrea
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mo&e',
                          'negativeIncrease', 'total', 'totalTestResultsIncrease', 'posNeg',
      2.1.1 New York St
                          'deathIncrease', 'hospitalizedIncrease', 'hash', 'commercialScore',
      2.1.2 New York S
                          'negativeRegularScore', 'negativeScore', 'positiveScore', 'score',
      2.1.3 New York A
                          'grade'],
      2.1.4 California D
                         dtype='object')>
      2.1.5 California A
      2.1.6 Texas Hosp
      2.1.7 Texas Death
    In_1.1857exas Manaly1 df_states.isnull().sum()
      2.1.9 Florida Dea total Tests People Antigen
                                                    18601
     2.1.10 Florida ApositiveTestsPeopleAntigen
                                                    18921
     2.1.11 United State al Tests Antigen
                                                    16559
     2.1.12 United States itiveTestsAntigen
                                                    17563
▼ 3 Summary Recommins
                                                         0
  ▼ 3.1 State by StatepositiveIncrease
                                                         0
      3.1.1 New York negativeIncrease
                                                         0
      3.1.2 California total
                                                         0
                  totalTestResultsIncrease
                                                         0
      3.1.3 Texas
                  posNeg
                                                         0
      3.1.4 Florida
     3.1.5 United State thIncrease
                                                         0
    3.2 Conclusions hospitalizedIncrease
    3.3 Future Work hash
                                                         0
▼ 4 Appendix and AncilonmercialScore
                                                         0
    4.1 Using an Exoge
                                                         0
  ▼ 4.2 Univariate Fore
                                                         0
                  positiveScore
                                                         0
      4.2.1 Texas
                  score
      4.2.2 Florida
     4.2.3 California
                                                    19485
  ▼ 4.3 Multivariate For
                       # columns to keep in dataframe
    In<sub>4.3.1</sub>6 Data Import 1
                      columns = ['state','death','inIcuCurrently','onVentilatorCurrently','pos
                       for col in columns:
    In [47]:
                    1
                           df_states[col] = df_states[col].fillna(0)
                    2
```

```
In [48]:
                        df states = sort and clean df(dataframe=df states, target columns=column
    In [49]:
                        df_states.info()
Contents 2 *
                    <class 'pandas.core.frame.DataFrame'>
▼ 1 COVID-19 Data ADatetimeIndex: 19485 entries, 2020-01-13 to 2021-02-12
  ▼ 1.1 Introduction Data columns (total 7 columns):
                         Column
                                                    Non-Null Count
                                                                       Dtype
      1.1.1 Problem an#
  ▼ 1.2 Table of Contem
                                                    19485 non-null
                         state
                                                                       object
      1.2.1 Standard Lip
                         death
                                                    19485 non-null
                                                                       float64
      1.2.2 Custom Lib
                                                    19485 non-null
                                                                       float64
                         inIcuCurrently
  ▼ 1.3 Explore Data
                         onVentilatorCurrently
                                                                       float64
      1.3.1 Create New<sup>3</sup>
                                                    19485 non-null
                         positive
                                                    19485 non-null
                                                                       float64
      1.3.2 Plot of Vent
                         hospitalizedCurrently
                                                    19485 non-null
                                                                       float64
      1.3.3 Plot Alaska
                         deathIncrease
                                                    19485 non-null
                                                                       int64
▼ 2 Modeling and Forect atypes: float64(5), int64(1), object(1)
      2.0.1 Alaska SAFE usage: 1.2+ MB
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
                         df_states.iloc[-50:].sort_values(by='death',ascending=False)
    In 150 New York S<sup>1</sup>
      2.1.3 New York A 2
                         # # only graph the top 7
                         # that keep state ventilator data
      2.1.4 California D
      2.15 Catifornia A
      2.1.6 Texas Hosp
                           state
                                   death inlcuCurrently onVentilatorCurrently
                                                                              positive hospitalizedCurrently
      2.1.7 Texas Death date
      2.1.8 Texas Analy
      2.1.9 Florida De 2021-
                                46002.0
                                                 2930.0
                                                                            3381615.0
                                                                                                   10505.0
      2.1.10 Florida Ark -12
      2.1.11 United Stato 21-
                                 40095.0
                                                 2582.0
                                                                            2541845.0
                                                                                                    8607.0
      2.1.12 United Sta02-12
▼ 3 Summary Recomm<sub>1</sub> 2021-
  ▼ 3.1 State by State 52.12
                             NY
                                 36882.0
                                                 1358.0
                                                                      941.0 1512690.0
                                                                                                    7068.0
      3.1.1 New York
                    2021-
      3.1.2 California
                                 29061.0
                                                    0.0
                                                                            1781450.0
                                                                                                    4825.0
                     02-12
      3.1.3 Texas
                     2021-
      3.1.4 Florida
                                 22959.0
                                                  496.0
                                                                      286.0
                                                                              888256.0
                                                                                                    2548.0
      3.1.5 United State -12
    3.2 Conclusions
                    2021-
                             NJ 22393.0
                                                  525.0
                                                                      336.0
                                                                              740062.0
                                                                                                    2565.0
    3.3 Future Work 02-12
 4 Appendix and Ancill ---
    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
                        df_states['state'].unique() # list of states to iterate through
      1 | 514:
4.2.1 Texas
      4.<sup>2</sup> ብርያነው array(['WA', 'MA', 'VA', 'FL', 'NJ', 'NE', 'IN',
                                                                             'MI',
                                                                                    'RI',
      4.2.3 California
                            'PA', 'TX', 'VT', 'WI', 'IL', 'HI', 'NC', 'CO', 'CA',
                            'NH', 'OR', 'SC', 'MD', 'DC', 'NM', 'TN',
  4.3 Multivariate For
                                                                             'OH', 'NV', 'IA', 'KY',
      4.3.1 Data Import
                                  'AR', 'DE', 'AK', 'MN', 'WV', 'ID', 'LA', 'CT',
                            'ME', 'MT', 'MS', 'UT', 'SD', 'ND', 'OK', 'GU', 'AS', 'MP', 'VI'
                            'PR'], dtype=object)
```

```
Covid Notebook - Jupyter Notebook
                        # for loop iterates through shortened list and prints ventilator usage
    In [52]:
                         # for the trailing 180 day period.
                      3
                         state_postal = ['NY', 'PA', 'NJ','IL','MI','MA','OH']
Contents 2 &
                     5
                        fig = plt.figure(figsize=(14,7));
▼ 1 COVID-19 Data Ane<sup>6</sup>
                         for state in state postal:
  ▼ 1.1 Introduction
                             df individual = df states[df states['state']==state]['onVentilatorCul
      1.1.1 Problem and 8
                             df_plot = df_individual.iloc[(df_individual.index.argmax()-180):(df_
  ▼ 1.2 Table of Conten
                             plt.plot(df_plot,label=f'{state}');
      1.2.1 Standard Li
                             plt.title('Number of People on Ventilators')
      1.2.2 Custom Libit
                             plt.xlabel('Date')
  ▼ 1.3 Explore Data
                             plt.ylabel('People')
      1.3.1 Create New 4
                             plt.legend();
      1.3.2 Plot of Vent
                                                      Number of People on Ventilators
      1.3.3 Plot Alaska
▼ 2 Modeling and Forec
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
      2.1.2 New York S
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California A
      2.1.6 Texas Hosp
      2.1.7 Texas Death
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 Florida Ana
      2.1.11 United Stat
```

2020-11

2020-12

2.1.12 United Stat

▼ 3 Summary Recomme ▼ 3.1 State by State F 3.1.1 New York 3.1.2 California 3.1.3 Texas 3.1.4 Florida 3.1.5 United State 3.2 Conclusions 3.3 Future Work ▼ 4 Appendix and Ancill 4.1 Using an Exoge ▼ 4.2 Univariate Fore 4.2.1 Texas 4.2.2 Florida 4.2.3 California ▼ 4.3 Multivariate For 4.3.1 Data Import 2020-09

2020-10

2021-01

2021-02

```
In [53]:
                         # same as above graph - all states have death data, this is a graph of the
                         # states with the highest covid mortality
                      3
                         state_postal = ['CA', 'NY', 'TX', 'FL', 'PA', 'NJ','IL','MI','MA','OH']
                         # some do not have ventilator data reported.
Contents 2 &
                         fig = plt.figure(figsize=(14,7));
▼ 1 COVID-19 Data Ana<sup>6</sup>
  ▼ 1.1 Introduction
                         for state in state postal:
      1.1.1 Problem and 8
                              df_individual = df_states[df_states['state']==state].death.sort_index
  ▼ 1.2 Table of Conten
                              df_plot = df_individual.iloc[(df_individual.index.argmax()-180):(df_:
      1.2.1 Standard Li
                              plt.plot(df plot,label=f'{state}');
      1.2.2 Custom Libī-
                              plt.title('Number of Total Covid Related Deaths')
  ▼ 1.3 Explore Data
                              plt.xlabel('Date')
      1.3.1 Create New A
                              plt.ylabel('Deaths')
      1.3.2 Plot of Vent 5
                              plt.legend();
      1.3.3 Plot Alaska
                                                      Number of Total Covid Related Deaths
▼ 2 Modeling and Forec
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
      2.1.2 New York S
      2.1.3 New York A
      2.1.4 California D 30000
      2.1.5 California A
      2.1.6 Texas Hosp
      2.1.7 Texas Death 20000
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 Florida Ana 10000
      2.1.11 United Stat
      2.1.12 United Stat

▼ 3 Summary Recomme

                                   2020-09
                                                2020-10
                                                             2020-11
                                                                          2020-12
                                                                                       2021-01
                                                                                                    2021-02

▼ 3.1 State by State F

      3.1.1 New York
      3.1.2 California
      3.▼.3 Texa¶.3.3 Plot Alaska Death Count
      3.1.4 Florida
    In 3.1.5 United State
                         df_AK = df_states[df_states['state']=='AK'] # just look at Alaska for now
    3.2 Conclusions
    3.3 Future Work

▼ 4 Appendix and Ancill

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
  ▼ 4.3 Multivariate For
      4.3.1 Data Import
```

```
In [55]:
                                                                fig = plt.figure(figsize=(15,7));
                                                         3
                                                                df AK['death'].plot(legend=True,title='Current Ventilator Usage and Deat|
                                                         4
                                                                df AK['onVentilatorCurrently'].plot(legend=True);
Contents 2 &
                                                                df AK['deathIncrease'].plot(legend=True);
 ▼ 1 COVID-19 Data Ana
                                                                                                                                  Current Ventilator Usage and Death Totals
      ▼ 1.1 Introduction
                1.1.1 Problem and
                                                                      onVentilatorCurrently
                                                                       deathIncrease
      ▼ 1.2 Table of Contenso
                1.2.1 Standard Lil
                1.2.2 Custom Libbo
      ▼ 1.3 Explore Data
                1.3.1 Create New
                1.3.2 Plot of Vent
                1.3.3 Plot Alaska
 ▼ 2 Modeling and Fore to a modeling and F
                2.0.1 Alaska SAF
      ▼ 2.1 SARIMAX Modeo
                2.1.1 New York St
                2.1.2 New York S
                2.1.3 New York A
                                                                                                                                                         Aug
                                                                                                                                                                                                                                                                               Feb
                2.1.4 California D
                                                                                                                                                                       date
                2.1.5 California A
                2.1.6 Texas Hosp
                2.1.7 Texas Death
                2.1.8 Texas Analy
                2.1.9 Florida Dea
                2.1.10 Florida Ana
                2.1.11 United Stat
                2.1.12 United Stat

▼ 3 Summary Recomme

▼ 3.1 State by State F

                3.1.1 New York
                3.1.2 California
                3.1.3 Texas
                3.1.4 Florida
                3.1.5 United State
           3.2 Conclusions
           3.3 Future Work
 ▼ 4 Appendix and Antiflator usage in Alaska peaks right before the end of December. deathIncrease is the rate of
           4.1 Using an Exorge or 'volume' of death. Spikes in that line correspond to a steeper increase in deaths along the
      ▼ 4.2 Univariate Fore red trend.
                4.2.1 Texas
                4.2.2 Florida
                4.2.3 California
      ▼ Multivari P F Modeling and Forecasts
                4.3.1 Data Import
                                        2.0.1 Alaska SARIMA Model - Initial Modeling
                                                               df_AK = df_AK.sort_index()
            In [56]:
```

```
In [57]:
                         df AK = df AK.dropna(subset=['death'])
                         df AK = df AK.dropna(subset=['onVentilatorCurrently'])
                          df alaska = pd.DataFrame(df AK)
Contents 2
▼ 1 COVID-19 Data Ana
                          print(df alaska.index.min())
  ▼ In Infreduction
                          print(df_alaska.index.max())
       1.1.1 Problem anc 2
  ▼ 1.2 Table of Conten <sup>3</sup>
                          print('Length of dataframe: ' , len(df_alaska))
      1.2.1 Standard Lil
      1.2.2 Custom Libia. 2021-02-12 00:00:00
  	ilde{f v} 1.3 Explore Data Length of dataframe:
                                                344
       1.3.1 Create New
       1.3.2 Plot of Vent
                          sd(df_alaska['death'], model='additive').plot(); # alaska = seasonal
     In 1601:
1.3.3 Plot Alaska
▼ 2 Modeling and Forec
                                                       death
       2.0.1 Alaska SAF
                          250
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St
                               2020-024020-025020-026020-025020-025020-025020-125020-125020-125021-02021-02
       2.1.2 New York S
       2.1.3 New York At
                          250
       2.1.5 California A
                               2020-02020-02020-02020-02020-02020-02020-02020-02020-120020-120020-12020-12021-02021-02
       2.1.6 Texas Hosp
       2.1.7 Texas Deatl
       2.1.8 Texas Analy
       2.1.9 Florida Dea
                               2020-024020-025020-026020-027020-028020-029020-127020-127020-127021-02021-02
       2.1.10 Florida Ana
       2.1.11 United Stat
       2.1.12 United Sta
                               2020-02020-02020-02020-02020-02020-02020-120020-120020-120021-02021-02

▼ 3 Summary Recomme

▼ 3.1 State by State F

     Ir8.1.61New York
                          stepwise_fit = auto_arima(df_alaska['death'],start_p=0,start_q=0,max_p=1
      3.1.2 California
                       2
                                                           max q=10, seasonal=True, seasonal test='ocsb',
                       3
                                                           n jobs=-1,stepwise=True)
       3.1.3 Texas
       3.1.4 Florida
       3.1.5 United State
     3.2 Conclusions
     3.3 Future Work

▼ 4 Appendix and Ancill

     4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate For
       4.3.1 Data Import
```

model = SARIMAX(df alaska['death'], order=stepwise fit.order,seasonal order

In [62]:

```
model.summary()
          Out[62]:
                      SARIMAX Results
Contents 2 *
                          Dep. Variable:
                                                     death No. Observations:
                                                                                     344
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
                                 Model:
                                          SARIMAX(0, 2, 1)
                                                               Log Likelihood
                                                                                -771.585
       1.1.1 Problem and
                                          Sat, 13 Feb 2021
                                   Date:
                                                                          AIC
                                                                               1547.170
  ▼ 1.2 Table of Conten
       1.2.1 Standard Lil
                                   Time:
                                                                                1554.840
                                                  10:52:41
                                                                          BIC
       1.2.2 Custom Libi
                                Sample:
                                                03-06-2020
                                                                         HQIC
                                                                               1550.225
  ▼ 1.3 Explore Data
       1.3.1 Create New
                                              - 02-12-2021
       1.3.2 Plot of Vent Covariance Type:
                                                       opg
       1.3.3 Plot Alaska
▼ 2 Modeling and Forec
                                                                  [0.025 0.975]
                                   coef std err
                                                           P>|z|
       2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Modema.L1
                               -0.9661
                                          0.010
                                                 -94.202
                                                          0.000
                                                                  -0.986
                                                                          -0.946
       2.1.1 New York St
       2.1.2 New York S
                                 5.2930
                                                          0.000
                                          0.095
                                                  55.531
                                                                  5.106
                                                                          5.480
       2.1.3 New York A
                           Ljung-Box (L1) (Q):
                                                 0.07 Jarque-Bera (JB): 19731.69
       2.1.4 California D
       2.1.5 California A
                                     Prob(Q):
                                                 0.79
                                                               Prob(JB):
                                                                               0.00
       2.1.6 Texas Hosp Heteroskedasticity (H):
                                                                   Skew:
                                                                               5.22
       2.1.7 Texas Death
       2.1.8 Texas Analy Prob(H) (two-sided):
                                                 0.00
                                                               Kurtosis:
                                                                              38.72
       2.1.9 Florida Dea
       2.1.10 Florida Ana
       2.1.11 United Stat
Warnings:
2.1.12 United Star [1] Covariance matrix calculated using the outer product of gradients (complex-step). 

▼ 3 Summary Recommod
  ▼ 3.1 State by State F
     Ing. 1.63New York
                          # dont forget get_predict
                        1
                           predictions_AK = model.get_forecast(30)
       3.1.2 California
       3.1.3 Texas
       3.1.4 Florida
       3.1.5 United State
     3.2 Conclusions
     3.3 Future Work

▼ 4 Appendix and Ancill

     4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate For
       4.3.1 Data Import
```

```
In [64]:
                         predictions AK.predicted mean
         Out[64]: 2021-02-13
                                     283.716071
                    2021-02-14
                                     285.432141
                    2021-02-15
                                     287.148212
Contents 2 *
                     2021-02-16
                                     288.864283
▼ 1 COVID-19 Data A
                     2021-02-17
                                     290.580353
  ▼ 1.1 Introduction
                     2021-02-18
                                     292.296424
      1.1.1 Problem and 2021-02-19
                                     294.012495
  ▼ 1.2 Table of Content 2021-02-20
                                     295.728565
      1.2.1 Standard Lib21-02-21
                                     297.444636
      1.2.2 Custom Libo21-02-22
                                     299.160706
  ▼ 1.3 Explore Data 2021-02-23
                                     300.876777
      1.3.1 Create Negro 1-02-24
                                     302.592848
      1.3.2 Plot of Ver21021-02-25
                                     304.308918
      1.3.3 Plot Alask2021-02-26
                                     306.024989
▼ 2 Modeling and For 2021-02-27
                                     307.741060
      2.0.1 Alaska SAP021-02-28
                                     309.457130
  ▼ 2.1 SARIMAX Mo2021-03-01
                                     311.173201
      2.1.1 New York 3021-03-02
                                     312.889272
      2.1.2 New York 3021-03-03
                                     314.605342
      2.1.3 New York A
     Ir2.[.45Califor|ia D1 | predictions_AK.predicted_mean
      2.1.5 California A 2 predictions_AK.conf_int(alpha=.05)
      2.1.6 Texas Hosp
      2.1.7 Texas Death
                                 lower death upper death
      2.1.8 Texas Analy
      2.1.9 Florida De2021-02-13
                                 279.206865
                                              288.225277
      2.1.10 Florida An: 2021-02-14
                                  278.946285
                                              291.917998
      2.1.11 United State
      2.1.12 United Sta 2021-02-15
                                 279.070661
                                              295.225763
▼ 3 Summary Recomm. 2021-02-16
                                  279.381611
                                              298.346954
  ▼ 3.1 State by State F
      3.1.1 New York 2021-02-17
                                  279.803728
                                              301.356978
      3.1.2 California 2021-02-18
                                 280.299039
                                              304.293809
      3.1.3 Texas
                     2021-02-19
                                 280.845396
                                              307.179593
      3.1.4 Florida
      3.1.5 United State 021-02-20
                                 281.428635
                                              310.028495
    3.2 Conclusions
                     2021-02-21
                                  282.039103
                                              312.850169
    3.3 Future Work
▼ 4 Appendix and Anci2021-02-22
                                 282.669908
                                              315.651505
    4.1 Using an Exoge 2021-02-23
                                 283.315951
                                              318.437603
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
    In4.2.26 Ftorid ▶
                          stepwise_fit.order
      4.2.3 California
  ▼ 4.3 Multivariate For 2, 1)
      4.3.1 Data Import
```

stepwise_fit.summary()

In [67]:

```
Out[67]:
                      SARIMAX Results
Contents 2 *
                          Dep. Variable:
                                                           No. Observations:
                                                                                     344

▼ 1 COVID-19 Data Ana

                                 Model:
                                         SARIMAX(0, 2, 1)
                                                               Log Likelihood
                                                                                -770.318
  ▼ 1.1 Introduction
                                          Sat, 13 Feb 2021
                                   Date:
                                                                          AIC
                                                                               1546.637
       1.1.1 Problem and
  ▼ 1.2 Table of Conten
                                  Time:
                                                  10:52:43
                                                                          BIC
                                                                               1558.141
       1.2.1 Standard Lil
                                Sample:
                                                                        HQIC
                                                                              1551.220
                                                         0
       1.2.2 Custom Libi
   ▼ 1.3 Explore Data
                                                     - 344
       1.3.1 Create New
       1.3.2 Plot of Vent Covariance Type:
                                                      opg
       1.3.3 Plot Alaska
                                    coef
                                          std err
                                                            P>|z| [0.025 0.975]
▼ 2 Modeling and Forec
       2.0.1 Alaska SAlintercept
                                  0.0067
                                            0.004
                                                     1.851
                                                            0.064
                                                                   -0.000
                                                                           0.014
  ▼ 2.1 SARIMAX Mode
                                 -0.9870
                                                            0.000
                                                                  -1.009
                          ma.L1
                                            0.011
                                                   -88.631
                                                                           -0.965
       2.1.1 New York St
       2.1.2 New York S sigma2
                                  5.2394
                                           0.186
                                                   28.104
                                                           0.000
                                                                   4.874
                                                                           5.605
       2.1.3 New York A
       2.1.4 California D
                          Ljung-Box (L1) (Q):
                                                0.00 Jarque-Bera (JB): 20653.57
       2.1.5 California A
                                     Prob(Q):
                                                1.00
                                                              Prob(JB):
                                                                              0.00
       2.1.6 Texas Hosp
       2.1.7 Texas DeatHeteroskedasticity (H):
                                                                              5.36
                                               76.47
                                                                 Skew:
       2.1.8 Texas Analy
                         Prob(H) (two-sided):
                                                0.00
                                                              Kurtosis:
                                                                             39.53
       2.1.9 Florida Dea
       2.1.10 Florida Ana
       2.1.11 United Stat
       2.1.12 United SMarnings:
▼ 3 Summary Recomm Covariance matrix calculated using the outer product of gradients (complex-step).
  ▼ 3.1 State by State F
       3.1.1 New York
     In3.1.28 Galifornia
                           length = len(df alaska)-45
       3.1.3 Texas
     3.1.4 Florida
In 69 inited State
                           train data = df alaska.iloc[:length]
                           test_data = df_alaska.iloc[length:]
     3.2 Conclusions
     3.3 Future Work

▼ 4 Appendix and Ancill

     4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate For
       4.3.1 Data Import
```

```
SARIMAX Results
Contents 2 *
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
                   Dep. Variable:
                                                                No. Observations:
                                                       death
      1.1.1 Problem and
  ▼ 1.2 Table of Contended:
                                         SARIMAX(0, 2, 1)
                                                                Log Likelihood
                                                                                                  -594.
      1.2.1 Standard Libs
      1.2.2 Custom Libate:
                                          Sat, 13 Feb 2021
                                                                AIC
                                                                                                  1193.
  ▼ 1.3 Explore Data 389
      1.3.1 Create Newime:
                                                    10:52:44
                                                                BIC
                                                                                                  1200.
      1.3.2 Plot of Ven777
      1.3.3 Plot AlaskSample:
                                                 03-06-2020
                                                                HOIC
                                                                                                  1196.

▼ 2 Modeling and Fore47

                                               - 12-29-2020
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mo@ovariance Type:
      2.1.2 New York $
                                                                          P>|z|
                                                                                       [0.025
                                      coef
                                               std err
                                                                                                    0.9
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California A
      2.1.6 Texas Hosp
                                  -0.9494
                                                 0.014
                                                           -66.756
                                                                          0.000
                                                                                       -0.977
                                                                                                    -0.
      2.1.7 Texas Death
      2.1.8 Texas Analy ma2
                                    3.1868
                                                 0.093
                                                             34.116
                                                                          0.000
                                                                                        3.004
                                                                                                     3.
      2.1.9 Florida Dear
      2.1.10 Florida An
      2.1.11 United Stat_____
      2.1.12 United Statiung-Box (L1) (Q):
                                                              0.47
                                                                      Jarque-Bera (JB):

▼ 3 Summary Recommon 3291.62

                                                                      Prob(JB):

▼ 3.1 State by StatePFrob(Q):
                                                              0.49
      3.1.1 New York 0.00
      3.1.2 California Heteroskedasticity (H):
                                                             70.71
                                                                      Skew:
      3.1.3 Texas
                   4.78
                   Prob(H) (two-sided):
                                                              0.00
                                                                      Kurtosis:
      3.1.4 Florida
      3.1.5 United State 34
    3.2 Conclusions
    3.3 Future Work
▼ 4 Appendix and Ancill | Warnings:
    4.1 Using an Exoge 1 Covariance matrix calculated using the outer product of gradients (comp
  ▼ 4.2 Univariate Fore 1.
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
    4.3 Multivariate For
                        start = len(train data)
      1 171 ...
4.3.1 Dåta Import 2
                        end = len(train data) + len(test data) - 1
                        predictions_AK = res.predict(start,end,typ='endogenous').rename('SARIMAX
    In [72]:
```

```
In [73]:
                                         train data.index
               Out[73]: DatetimeIndex(['2020-03-06', '2020-03-07', '2020-03-08', '2020-03-09',
                                                                 '2020-03-10', '2020-03-11', '2020-03-12', '2020-03-13',
                                                                 '2020-03-14', '2020-03-15',
Contents 2 &
 ▼ 1 COVID-19 Data Ana
                                                                 '2020-12-20', '2020-12-21', '2020-12-22', '2020-12-23',
    ▼ 1.1 Introduction
                                                                 '2020-12-24', '2020-12-25', '2020-12-26', '2020-12-27',
          1.1.1 Problem and
                                                                 '2020-12-28', '2020-12-29'],
    ▼ 1.2 Table of Conten
                                                              dtype='datetime64[ns]', name='date', length=299, freq=None)
          1.2.1 Standard Lil
           1.2.2 Custom Libi
                                         test data.index
    ▼ F.3 Explore Data
          1.3duC[eate New DatetimeIndex(['2020-12-30', '2020-12-31', '2021-01-01', '2021-01-02',
           1.3.2 Plot of Vent
                                                                 '2021-01-03', '2021-01-04', '2021-01-05', '2021-01-06',
          1.3.3 Plot Alaska
                                                                 '2021-01-07', '2021-01-08', '2021-01-09', '2021-01-10'
 ▼ 2 Modeling and Forec
                                                                 '2021-01-11', '2021-01-12', '2021-01-13', '2021-01-14',
           2.0.1 Alaska SAF
                                                                 '2021-01-15', '2021-01-16', '2021-01-17', '2021-01-18'
    ▼ 2.1 SARIMAX Mode
                                                                 '2021-01-19', '2021-01-20', '2021-01-21', '2021-01-22',
           2.1.1 New York St
                                                                 '2021-01-23', '2021-01-24', '2021-01-25', '2021-01-26',
                                                                 '2021-01-27', '2021-01-28', '2021-01-29', '2021-01-30'
           2.1.2 New York S
                                                                 '2021-01-31', '2021-02-01', '2021-02-02', '2021-02-03',
           2.1.3 New York A
                                                                 '2021-02-04', '2021-02-05', '2021-02-06', '2021-02-07'
           2.1.4 California D
                                                                 '2021-02-08', '2021-02-09', '2021-02-10', '2021-02-11',
           2.1.5 California A
                                                                 '2021-02-12'],
           2.1.6 Texas Hosp
                                                              dtype='datetime64[ns]', name='date', freq=None)
           2.1.7 Texas Death
          2.1.8 Texas Analy
       Ir2.1.95Florida Dea 1
                                           predictions AK = pd.DataFrame(predictions AK)
           2.1.10 Florida Ana
           2.1.11 United Stat
                                           predictions_AK.index.name = 'date'
           2.1.12 United Star

▼ 3 Summary Recomme

    ▼ 3.1 State by State F
Compare Test Data with Predictions
3.1.1 New York
           3.1.2 California
                                         train data.index.freq = 'D'
       In<sub>3.</sub>[37†exas ▶
                                         test data.index.freq = 'D' # -1D is reverse index, ie most recent date is
           3.1.4 Florida
          3.1.5 United State<sup>3</sup>
                                           # perform sort index on dataframe to correct. set frequencies to match for
                                           # on same visualization
       3.2 Conclusions
       3.3 Future Work
 ▼ 4 ৣAppe্নিজা and Mncill1 | pd.DataFrame(test_data['death']).info()
       4.1 Using an Exoge
    ▼ 4.2 Univariate Fore | value | value
                                  DatetimeIndex: 45 entries, 2020-12-30 to 2021-02-12
           4.2.1 Texas
                                  Freq: D
           4.2.2 Florida
                                  Data columns (total 1 columns):
           4.2.3 California
                                            Column
                                                            Non-Null Count Dtype
    ▼ 4.3 Multivariate For
           4.3.1 Data Import
                                            death
                                                            45 non-null
                                                                                            float64
                                  dtypes: float64(1)
                                  memory usage: 720.0 bytes
```

```
In [79]:
                          predictions AK.info()
                     <class 'pandas.core.frame.DataFrame'>
                     DatetimeIndex: 45 entries, 2020-12-30 to 2021-02-12
                     Freq: D
Contents 2 *
                     Data columns (total 1 columns):
▼ 1 COVID-19 Data Ar
                           Column
                                                              Non-Null Count
                                                                                  Dtype
  ▼ 1.1 Introduction
      1.1.1 Problem and
                           SARIMAX(0,2,1) Predictions
                                                              45 non-null
                                                                                  float64
  ▼ 1.2 Table of Content of Types: float64(1)
      1.2.1 Standard memory usage: 720.0 bytes
      1.2.2 Custom Libi
  ▼ 1.3 Explore Data
    In 1.3.1 Greate New 1
                           pd.DataFrame(test_data['death']).plot(figsize=(16,8),legend=True,title='
      1.3.2 Plot of Vent 2
                           plt.plot(pd.DataFrame(predictions AK))
      1.3.3 Plot Alaska 3
                           plt.show()

▼ 2 Modeling and Forec

                                                              Test Data vs SARIMA
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
      2.1.2 New York S<sub>80</sub>
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California Aso
      2.1.6 Texas Hosp
      2.1.7 Texas Death
      2.1.8 Texas Analyo
      2.1.9 Florida Dea
      2.1.10 Florida Ana
      2.1.11 United State
      2.1.12 United State

▼ 3 Summary Recomme

▼ 3.1 State by State F<sub>10</sub>
      3.1.1 New York
                                                                                            Feb
                           Jan
2021
      3.1.2 California
                                                                     date
      3.1.3 Texas
      3.1.4 Florida
      3.1.5 United State
    3.2 Conclusions
    3.3 Future Work

▼ 4 Appendix and Ancill

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
  ▼ 4.3 Multivariate For
      4.3.1 Data Import
```

ontents & •							
1 COVID-19 Data Ana			======	=====	========		======
▼ 1.1 Introduction	. Variable:		death	No	Observations:		
1.1.1 Problem and	. Vai labie.		ueacii	NO.	observacions.		
▼ 1.2 Table of Content	۰1.	SARIMAX(0	. 2. 1)	lοg	Likelihood		-771.
1.2.1 Standard Libs	-1·	SANTI IAX(O	, 2, 1/	208	LIKCIINOOG		,,
1.2.2 Custom Libat	_ :	Sat, 13 F	eb 2021	AIC			1547.
▼ 1.3 Explore Data 170				/			
1.3.1 Create Newim	e:	1	0:52:48	BIC			1554.
1.3.2 Plot of Ve 840							
1.3.3 Plot Alask §am	ole:	03-	06-2020	HQI	С		1550.
2 Modeling and For 25							
2.0.1 Alaska SAF		- 02-	12-2021				
▼ 2.1 SARIMAX Mo@PV	ariance Type:		opg				
2.1.1 New York St		=======	======	=====	=========	=======	======
2.1.2 New York \$==							
2.1.3 New York A	coe-	f std e	rr	Z	P> z	[0.025	0.9
2.1.4 California 75							
2.1.5 California A							
2.1.6 Texas Hosp	0.066		.10	4 202	0.000	0.006	•
ma. 2.1.7 Texas Death	L1 -0.966	1 0.0	10 -9	4.202	0.000	-0.986	-0.
2.1.8 Texas Analy	na2 5.2930	0.0	OF F	5.531	0 000	F 106	5.
2.1.9 Florida De	lid2 3.2930	0.0	כ כפי	I	0.000	5.106	٥.
100							
2.1.11 United Stat	====						
	ng-Box (L1) (Q):			0.07	Jarque-Bera	(JB):	
3 Summary Recommon 31.69						(,-	
▼ 3.1 State by StateFirob(Q):				0.79	Prob(JB):		
3.1.1 New York 0.00					, ,		
3.1.2 California Heteroskedasticity (H):			10	2.42	Skew:		
3.1.3 Texas 5.2							
3.1.4 Florida Prob(H) (two-sided):				0.00	Kurtosis:		
3.1.5 United State	72						
3.2 Conclusions ===		=======	======	=====	=========	=======	=====
3.3 Future Work	====						
4 Appendix and Ancill							
4.1 Using an Exoge	nings:						,
▼ 4.2 Univariate Fore Tex	Covariance matrix	x calculat	ed using	the o	outer product	ot gradient	s (comp
4.2.1 Texas	-step).						
4.2.2 Florida)
4.2.3 California							
▼ 4.3 Multivariate For 1	fcast = res.pred	ict(start	=len(df_/	AK),en	d=len(df_AK)+4	5, typ='end	logenous
4.3.1 Data Import							
1.0							

```
In [83]:
                          fig, ax = plt.subplots()
                       3
                          train_data['death'].plot(figsize=(16,8),legend=True,ylabel='Deaths',title
                       4
                          test data['death'].plot(grid=True);
Contents 2 &
                          fcast.plot(legend=True, figsize=(18,8));
                          ax.grid();
▼ 1 COVID-19 Data Ana 6
                          plt.show();
  ▼ 1.1 Introduction
      1.1.1 Problem and
                                                              Forecast Deaths, Alaska
  ▼ 1.2 Table of Conten
      1.2.1 Standard Lil
      1.2.2 Custom Libi
  ▼ 1.3 Explore Data
      1.3.1 Create New 250
      1.3.2 Plot of Vent
      1.3.3 Plot Alaska
▼ 2 Modeling and Fore
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode 10)
      2.1.1 New York St
      2.1.2 New York S
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California A
      2.1.6 Texas Hosp
      2.1.7 Texas Death
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 Florida Ana
      2.1.11 United Stat
      2.1.12 United State

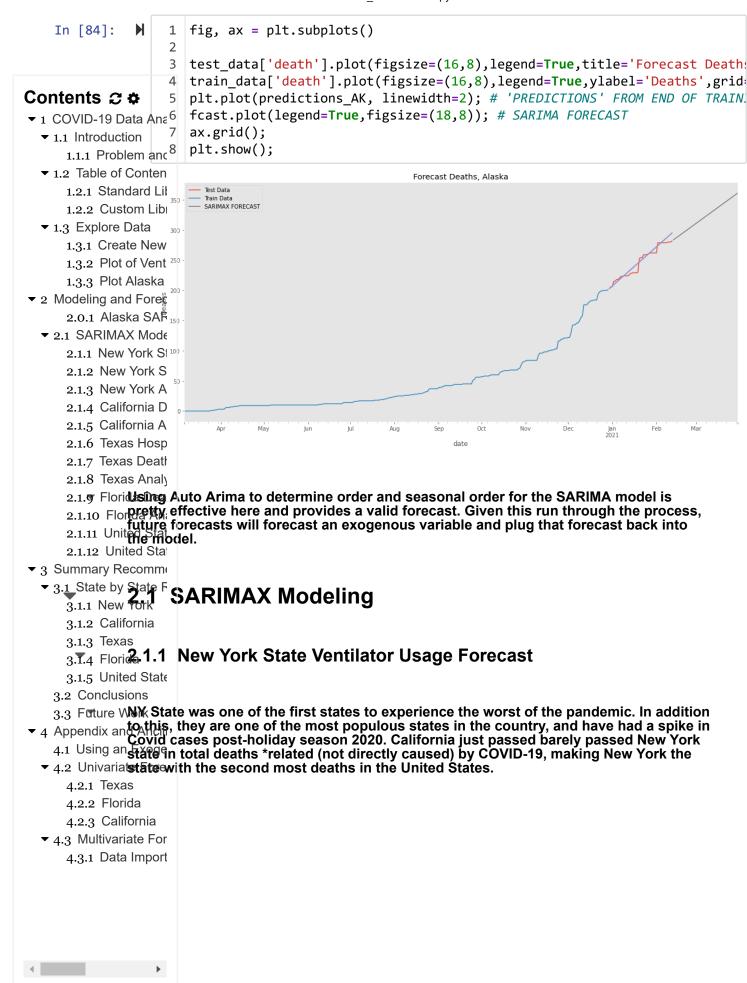
▼ 3 Summary Recomme

▼ 3.1 State by State F

      3.1. New Below graph will show prediction data against test data as well as a separate future
      3.1.2 Californacast.
      3.1.3 Texas
      3.1.4 Florida
      3.1.5 United State
    3.2 Conclusions
    3.3 Future Work

▼ 4 Appendix and Ancill

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
  ▼ 4.3 Multivariate For
      4.3.1 Data Import
```



```
In [85]:
                                                                                # change to True, run cell to follow link
                                                                                open links = False
                                                                      3
                                                                      4
                                                                                import webbrowser
Contents 2 *
                                                                      5
                                                                                if open_links == True:
 ▼ 1 COVID-19 Data Ana<sup>6</sup>
                                                                                               webbrowser.open("https://deadline.com/2021/02/california-south-africality and a second second
        ▼ 1.1 Introduction
                                                                                               webbrowser.open("https://www.cityandstateny.com/articles/politics/new
                    1.1.1 Problem and 8
                                                                                               webbrowser.open("http://www.op.nysed.gov/COVID-19 EO.html#") # new yo
        ▼ 1.2 Table of Conten
                                                                                               # the number of healtchare workers
                    1.2.1 Standard Lit
                    1.2.2 Custom Libi
        ▼ 1.3 Explore Data
                                                                             df = state dataframe(df states, 'NY')
               In 1.460 reate New 1
                    1.3.2 Plot of Vent ____. Successfully returned indexed dataframe for NY
                    1.3.3 Plot Alaska
 ▼ 2 Modeling and Forec
               Inp. 687 A Maska SAF1 | df_ref = state_dataframe(df states, 'NY')
        ▼ 2.1 SARIMAX Mode
                                                                        ccessfully returned indexed dataframe for NY
                    2.1.1 New York S
                    2.1.2 New York S
               In2.[.88] ew York A1 | df.info()
                   2.1.4 California D

2.1.5 California Califor
                    2.1.6 Texas Hosp
Freq: D
                    2.1.7 Texas Death Data columns (total 7 columns):
                    2.1.8 Texas Analy
                                                                                  Column
                                                                                                                                                                                                                                    Dtype
                                                                                                                                                                        Non-Null Count
                    2.1.9 Florida Dea
                    2.1.10 Florida Ana
                                                                                  state
                                                                                                                                                                         348 non-null
                                                                                                                                                                                                                                    object
                    2.1.11 United State
                                                                                  death
                                                                                                                                                                                                                                    float64
                                                                                                                                                                        348 non-null
                    2.1.12 United Stay
                                                                                                                                                                        348 non-null
                                                                                                                                                                                                                                    float64
                                                                                  inIcuCurrently

▼ 3 Summary Recomm®
                                                                                  onVentilatorCurrently
                                                                                                                                                                        348 non-null
                                                                                                                                                                                                                                    float64

▼ 3.1 State by State F4

                                                                                  positive
                                                                                                                                                                        348 non-null
                                                                                                                                                                                                                                    float64
                    3.1.1 New York 5
                                                                                  hospitalizedCurrently
                                                                                                                                                                        348 non-null
                                                                                                                                                                                                                                    float64
                                                                                  deathIncrease
                                                                                                                                                                        348 non-null
                                                                                                                                                                                                                                    int64
                    3.1.2 California 6
                                                                dtypes: float64(5), int64(1), object(1)
                    3.1.3 Texas
                                                                memory usage: 21.8+ KB
                    3.1.4 Florida
                    3.1.5 United State
              3.2 Conclusions
              3.3 Future Work

▼ 4 Appendix and Ancill

              4.1 Using an Exoge
        ▼ 4.2 Univariate Fore
                    4.2.1 Texas
                    4.2.2 Florida
                    4.2.3 California
        ▼ 4.3 Multivariate For
                    4.3.1 Data Import
```

```
In [89]:
                   M
                            plt.rcParams['figure.figsize']=(15,10);
                            sd(df.loc['04-2020':'06-2020']['deathIncrease']).plot();
                                                                     deathIncrease
                         800
Contents 2 *
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
       1.1.1 Problem and 0-
                                                                      2020-05-15
                                       2020-04-15
                                                        2020-05-01
  ▼ 1.2 Table of Conten <sup>800</sup>
       1.2.1 Standard Lil 600
       1.2.2 Custom Libi 400
  ▼ 1.3 Explore Data
       1.3.1 Create New
                                       2020-04-15
                                                        2020-05-01
                                                                      2020-05-15
                                                                                        2020-06-01
                                                                                                       2020-06-15
       1.3.2 Plot of Vent
       1.3.3 Plot Alaska
▼ 2 Modeling and Fore
       2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St 500.04-01
       2.1.2 New York S
       2.1.3 New York A
       2.1.4 California D
     Ir2.[30California A1 # death increase seasonal decomp plot shows that we have near weekly seas
       2.1.6 Texas Hosp
     Tr2.1.71 Texas Peatl
                            plt.rcParams['figure.figsize']=(15,10);
       2.1.8 Texas Analy
                            sd(df.loc['04-2020':'06-2020']['onVentilatorCurrently']).plot();
       2.1.9 Florida Dea
                                                                   onVentilatorCurrently
       2.1.10 Florida Ana 2500
       2.1.11 United Stat 2000
       2.1.12 United Stat 1500

▼ 3 Summary Recomme

▼ 3.1 State by State F

                          2020-04-01
                                        2020-04-15
                                                         2020-05-01
                                                                       2020-05-15
                                                                                        2020-06-01
                                                                                                       2020-06-15
       3.1.1 New York
       3.1.2 California
                          1500
       3.1.3 Texas
       3.1.4 Florida
       3.1.5 United State
                                        2020-04-15
                                                                       2020-05-15
                                                                                        2020-06-01
                                                                                                       2020-06-15
     3.2 Conclusions
     3.3 Future Work
▼ 4 Appendix and Ancill 
     4.1 Using an Exoge®
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
                          1000
       4.2.2 Florida
       4.2.3 California
  4.3 Multivariate For
     Ir4.342 Pata Import
                            # seasonality peaks match the peaks of the deathIncrease seasonal decomp
```

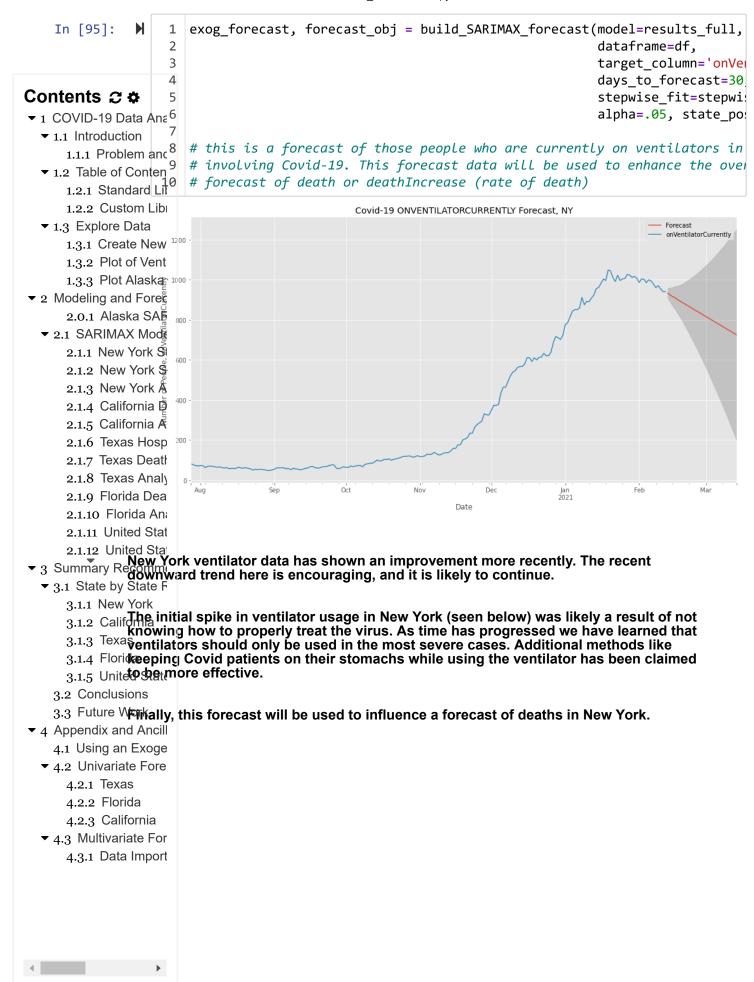
```
In [93]:
                         stepwise fit, stepwise full, results, results full = arima tune(df, 'onVo
                      1
                                                                                                      days to
                      3
                                                                                                      verbose=
                         # train days arg defaults to 270 days, but can be changed. seasonality co
                      4
Contents 2 &
                      5
                         # see docstring for further details
                         # forecasting 30 days out into the future with a seasonality length of 6
▼ 1 COVID-19 Data Ana<sup>6</sup>
  ▼ 1.1 Introduction
      1.1.1 Problem apprima order is:
                                         (0, 2, 2)
  ▼ 1.2 Table of Contegeasonal ARIMA order is: (0, 0, 1, 7)
      1.2.1 Standard Use ARIMA object stepwise fit to store ARIMA and seasonal ARIMA orders in
      1.2.2 Custom Libar iables.
  ▼ 1.3 Explore Data
      1.3.1 Create NewARIMAX Results
      1.3.2 Plot of Vent
                        Dep. Variable:
                                              onVentilatorCurrently
                                                                 No. Observations:
                                                                                         240
      1.3.3 Plot Alaska

▼ 2 Modeling and Forec

                              Model: SARIMAX(0, 2, 2)x(0, 0, [1], 7)
                                                                    Log Likelihood
                                                                                    -881.528
      2.0.1 Alaska SAF
                                                 Sat, 13 Feb 2021
                                Date:
                                                                               AIC
                                                                                    1771.057
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
                                Time:
                                                         10:53:04
                                                                               BIC
                                                                                    1784.774
      2.1.2 New York S
                             Sample:
                                                      05-19-2020
                                                                             HQIC 1776.591
      2.1.3 New York A
      2.1.4 California D
                                                     - 01-13-2021
      2.1.5 California A
      2.1.6 Texas Hosp Covariance Type:
                                                             opg
      2.1.7 Texas Death
                                  coef std err
                                                        P>|z|
                                                                [0.025
                                                                         0.9751
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.40 Floridea Sonable q-q plot. Model summary is good overall.
      2.1.11 United Stat
      2.1.12 United Sta
                         evaluate predictions(results, df, 'onVentilatorCurrently', stepwise fit=
 ▼ 3 Summary Recomm
                                                   alpha=.05, days_to_forecast=30)
  # plot training time and test time
      3.1.1 New York
                         # this evaluates the model using a train test split while also providing
      3.1.2 California
                         # a forecast of confidence intervals with an alpha of .05.
      3.1.3 Texas
                                                         Number of onVentilatorCurrently
      3.1.4 Florida
      3.1.5 United State 18 00
                                                                                                   Model Prediction
                                                                                                    Test Data
    3.2 Conclusions
    3.3 Future Work

▼ 4 Appendix and Ancill 1400

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
                      1000
      4.2.2 Florida
      4.2.3 California
  4.3 Multivariate For
      4.3.1 Data Import
                                                                                                  Feb
                                                                    Jan
2021
                                                                   Date
```



```
In [96]:
                          df['onVentilatorCurrently'].plot(figsize=(12,4)); # see spike here coming
                          # from initial May 2020 reporting.
                      2500
Contents 2 &
                      2000
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
      1.1.1 Problem and
  ▼ 1.2 Table of Contendo
      1.2.1 Standard Lil
      1.2.2 Custom Lib<sub>1500</sub>
  ▼ 1.3 Explore Data
      1.3.1 Create New 0
                                                                              Oct
                                Apr
                                        May
                                                               Aug
                                                                       Sep
                                                                                      Nov
                                                                                             Dec
                                                                                                             Feb
      1.3.2 Plot of Vent
      1.3.3 Plot Alaska
                                                                    date
▼ 2 Modeling and Forec
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
                        New York State Deaths Forecast
      2.1.1 New York St
      2.1.2 New York S
      2.1.3 New Modeled using New York's Ventilator Usage Forecast
      2.1.4 California D
    Ir2.1.37California A1
                          stepwise fit, df forecast = get exogenous forecast dataframe(dataframe=d
      2.1.6 Texas Hosp 2
                                                                                                     original da
      2.1.7 Texas Deatl 3
                                                                                                     exog_forecas
      2.1.8 Texas Analy4
                                                                                                     target colu
      2.1.9 Florida Dea 5
                                                                                                     exogenous co
                                                                                                     days to fore
      2.1.10 Florida Ani 6
                                                                                                     m periods=7
      2.1.11 United Stat /
      2.1.12 United State
▼ 3 $\min@ry:Rec\mm(1 | df forecast.tail(5)
  3.1.9utlewsyork
                                                         onVentilatorCurrently positive hospitalizedCurrently
                                   death
                                          inlcuCurrently
                                                                                                             death
                             state
      3.1.2 California
      3.1.3 Texas
                      2021-
                             NaN
                                    NaN
                                                    NaN
                                                                   752.720906
                                                                                  NaN
                                                                                                        NaN
                      03-10
      3.1.4 Florida
      3.1.5 United State 2021-
                             NaN
                                                    NaN
                                                                   745.607978
                                                                                  NaN
                                                                                                        NaN
                                    NaN
    3.2 Conclusions
    3.3 Future Work
3.3 Future Work 2021-

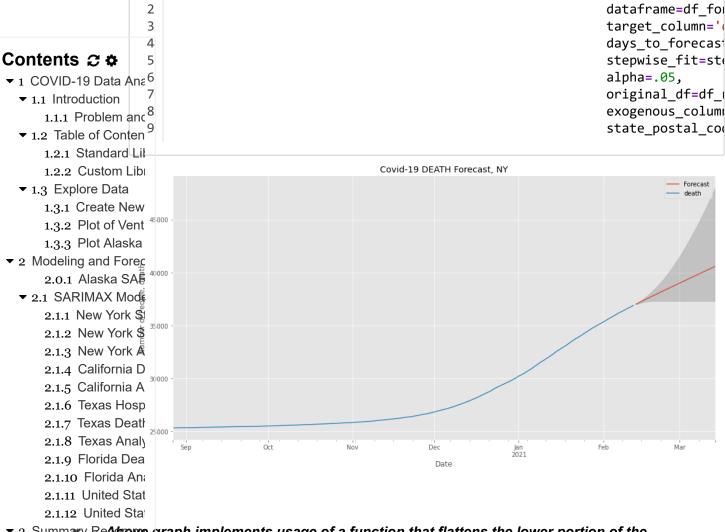
▼ 4 Appendix and Anci 03-12
                             NaN
                                    NaN
                                                    NaN
                                                                   738.495049
                                                                                  NaN
                                                                                                        NaN
    4.1 Using an Exoge

▼ 4.2 Univariate Fore<sup>20</sup>
<sup>21</sup>
-
                                                    NaN
                                                                   731.382121
                             NaN
                                    NaN
                                                                                  NaN
                                                                                                        NaN
                      03-13
      4.2.1 Texas
      4.2.2 Florida
                      2021-
                             NaN
                                                    NaN
                                                                   724.269192
                                                                                  NaN
                                    NaN
                                                                                                        NaN
      4.2.3 California 03-14
  ▼ 4.3 Multivariate For
      4.3.1 Data Import
    In [99]:
                 H
                       1
                          # create model
                          full exog model = SARIMAX(df['death'],df['onVentilatorCurrently'],
                       2
                       3
                                                          order=stepwise fit.order, seasonal order=stepwise
                          # fit model
                          model = full exog model.fit()
```

exog forecast, results forecast = build SARIMAX forecast(model=model,

In [100]:

1

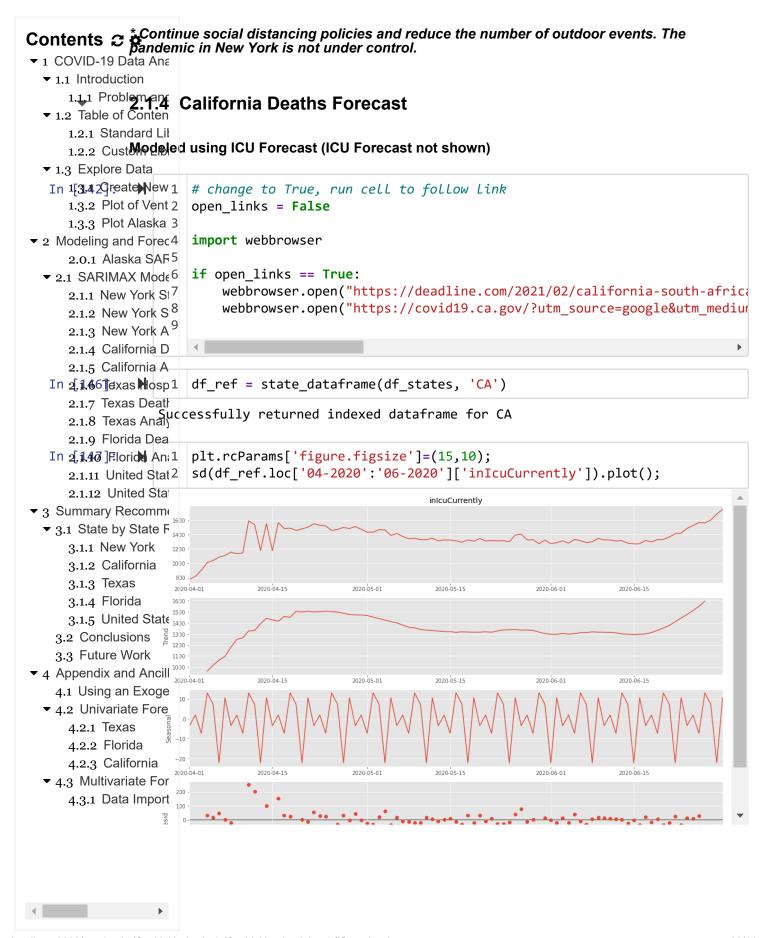


- ▼ 3 Summary ReAlbrowe graph implements usage of a function that flattens the lower portion of the ▼ 3.1 State by sometidence interval instead of allowing it to decrease. Deaths remain flat in a best case 3.1.1 New York

 - 3.1.2 California
 - 3.1.3 Texas
 - 3.T.4 Floria 1.3 New York Analysis and Recommendations
 - 3.1.5 United State
 - 3.2 Conclusions
- $_{3.3}$ Future WNew York flattened its curve from the beginning of the pandemic until the Thanksgiving holidays when everything suddenly became more difficult. There is a clear increase in deaths beginning around mid November and into Christmas and the New Year, likely a
 - 4.1 Using an result of family gatherings, social gatherings, and increased survivability in the
 - ▼ 4.2 Univariateofidre
 - 4.2.1 Texas
 - 4.2.2 Florighere is every possibility that without continuing social distancing and enforcing the 4.2.3 Califwearing of masks that the rate of death will once again increase.
 - 4.3 Multivariate For
 - 4.3.1 Data Import
 - Recommendations for the state include the following:

*Lower the number of people allowed at indoor private gatherings from the current amount of 10. Social gatherings are not economically essential. Certain states have limits of one or two households per private residence which has proven to limit the enroad of the disease.

* Increase effort to improve awareness. Covering the mouth but not the nose does not limit the spread of Covid-19. Mandate signage depicting proper mask usage at public establishments.



```
In [148]:
                       1
                           state dataframe, exog forecast = create exog forecast(df states, 'inIcuCo
                       2
                                                                                              m periods=7, state
                     Warnings:
Contents 2 *
                     [1] Covariance matrix calculated using the outer product of gradients (complex-step).
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
       1.1.1 Problem and
  ▼ 1.2 Table of Conten
      1.2.1 Standard Lil
       1.2.2 Custom Libi
  ▼ 1.3 Explore Data
      1.3.1 Create New
       1.3.2 Plot of Vent
      1.3.3 Plot Alaska
                                    Standardized residual for "i"
                                                                                 Histogram plus estimated density
▼ 2 Modeling and Forec
                                                                       0.4
       2.0.1 Alaska SAF
                                                                       0.3
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St
       2.1.2 New York S
       2.1.3 New York A
       2.1.4 California D
   In 2.1.52Califor ia A 1
                          # normal q-q plot
       2.1.6 Texas Hosp
   In 2.1.79 Texas Peatl 1
                           forecast_object = graph_exog_forecast(dataframe=state_dataframe,
       2.1.8 Texas Analy 2
                                                                          target column='death',
       2.1.9 Florida Dea 3
                                                                          exogenous column='inIcuCurrently',
       2.1.10 Florida Ana
                                                                          exog forecast=exog forecast,
       2.1.11 United Stat 5
                                                                          df ref=df ref,
       2.1.12 United $ta 6
                                                                          alpha=.05, days to forecast=30,

▼ 3 Summary Recomme7

                                                                          train_days=270, m_periods=7,
                                                                          state_postal_code='CA')

▼ 3.1 State by State F8

       3.1.1 New York
                                                             Covid-19 DEATH Forecast, CA
       3.1.2 California
       3.1.3 Texas
                       60000
      3.1.4 Florida
      3.1.5 United State
    3.2 Conclusions
    3.3 Future Work
▼ 4 Appendix and Anci
    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
                        30000
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate For <sup>20000</sup>
       4.3.1 Data Import
```

```
In [150]:
                        forecast object.predicted mean[-5:] # projected mean deaths
                        # by March 14th, 2021 stand at 57,730.
       Out[150]: 2021-03-10
                                    56063.879182
                    2021-03-11
                                    56515.194316
Contents 2 *
                    2021-03-12
                                    56978.468058
▼ 1 COVID-19 Data A
                    2021-03-13
                                    57444.262203
  ▼ 1.1 Introduction
                    2021-03-14
                                    57729.645022
      1.1.1 Problem and D, Name: predicted_mean, dtype: float64
  ▼ 1.2 Table of Conten
      1.2.1 Standard Lil
                        forecast_object.conf_int()[-5:] # upper confidence interval of 95% forec
   In 1[2530 ustor Libi1
                        # deaths of over 61,000 by March 14th, 2021.
  ▼ 1.3 Explore Data
      1.3.1 Create New
      1.3.2 Plot of Vent
                                 lower death
                                               upper death
      1.3.3 Plot Alaska
▼ 2 Modeling and Fore2021-03-10 52931.486803
                                             59196.271562
      2.0.1 Alaska SAF2021-03-11 53183.717245
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York S<sup>20</sup>21-03-12 53443.382517
                                             60513.553599
      2.1.2 New York 2021-03-13 53689.901401
                                             61198.623006
      2.1.3 New York A
                     2021-03-14 53749.443886 61709.846157
      2.1.4 California D
      2.1.5 California A
      2.1.6 Texas Hosp
      2.7.7 Texa2D1a California Analysis and Recommendations
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 FlorCalifornia has experienced an even more drastic increase in deaths since the holidays
      2.1.11 Unitedantany other state. What is happening is an emergency with over 540 Covid deaths on
      2.1.12 United to 11th, 2021 alone. The California state website talks about helping to slow the
                รี่pread of Covid. Given the circumstances, this language is not urgently and clearly
▼ 3 Summary Recentiveying the message that the situation needs immediate attention from each and
  ▼ 3.1 State by @teetryFindividual living in the state.
      3.1.1 New York
      3.1.2 California
      3.1.3 TexaRecommendations for the state include the following:
      3.1.5 United Require wearing a mask if an individual is not in or on their private property. Allow no
    3.2 Conclusiexceptions.
    3.3 Future Work
▼ 4 Appendix and Ancill Prohibit private and public gatherings of 5 or more people unless from the same
    4.1 Using an Fousehold.
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
The spread of this disease in this state will continue to take lives if people are not
      4.2.2 Floridade to understand the consequences of selfish behavior. Introduce visual evidence of
      4.2.3 Califundammifications of the virus with an emphasis on personal stories on public social
  ▼ 4.3 Multivariancepia and television.
      4.3.1 Data Import
               2.1.6 Texas Hospitalized Forecast
```

```
In [154]:
                           # change to True, run cell to follow link(s)
                       2
                           open links = False
                       3
                       4
                           import webbrowser
Contents 2 &
                       5
                           if open_links == True:
▼ 1 COVID-19 Data Ana 6
                                webbrowser.open("https://www.kvue.com/article/news/health/coronavirus
  ▼ 1.1 Introduction
                                webbrowser.open("https://www.khou.com/article/news/local/texas/texas
      1.1.1 Problem anc 8
                                webbrowser.open("https://apps.texastribune.org/features/2020/texas-co
  ▼ 1.2 Table of Conten
       1.2.1 Standard Lil
       1.2.2 Custom Libi
  ▼ 1.3 Explore Data
       1.3.1 Create New
       1.3.2 Plot of Vent | Texas is also a populous state and has been inclined to open back up quickly to keep
1.3.3 Plot the economy going. The state has not reported ICU or Ventilator numbers to the Covid 
▼ 2 Modeling and Facking Project. A KHOU article cites a decrease in hospitalizations while warning
       2.0.1 Alas about the continued threat of breaching hospital capacity.
  ▼ 2.1 SARIMAX Mode
   In 2.1.5 New York Sil | df = state dataframe(df states, 'TX')
       2.1.2 New York S
       2.1.3 New York Successfully returned indexed dataframe for TX
       2.1.4 California D
   In 4.1.58 palifor ia A1 df ref = state_dataframe(df_states, 'TX')
       2.1.6 Texas Hosp
       2.1.7 Texas Dealuccessfully returned indexed dataframe for TX
       2.1.8 Texas Analy
   In 4.1.92 Florid Dea 1 df.tail()
       2.1.10 Florida Ana
       2.94 United Stat
                              state
                                      death inlcuCurrently onVentilatorCurrently
                                                                                     positive hospitalizedCurrently de
       2.1.12 United State

▼ 3 Summary Recommedate

▼ 3.1 State by State F

                                TX 38700.0
                                                    2667.0
                                                                              0.0 2491227.0
                                                                                                            9401.0
       3.1.1 New York
                      02-08
       3.1.2 California
                      2021-
       3.1.3 Texas
                                    39001.0
                                                    2777.0
                                                                                  2504556.0
                                                                                                            9401.0
                      02-09
       3.1.4 Florida
       3.1.5 United Stat2021-
                                    39386.0
                                                    2740.0
                                                                                  2517453.0
                                                                                                            9165.0
                      02-10
    3.2 Conclusions
    3.3 Future Work
                      2021-
                               TX 39771.0
                                                    2703.0
                                                                                  2529343.0
                                                                                                            8933.0

▼ 4 Appendix and Ancilo2-11

    4.1 Using an Exoge 2021-
                               TX 40095.0
                                                    2582.0
                                                                              0.0 2541845.0
                                                                                                            8607.0
  ▼ 4.2 Univariate Fore 1.12
       4.2.1 Texas
       4.2.2 Florida
       4.2.3 California
  4.3 Multivariate For
       4.3.1 Data Import
```

```
In [193]:
                           plt.rcParams['figure.figsize']=(15,10);
                           sd(df.loc['04-2020':'06-2020']['hospitalizedCurrently']).plot();
                                                                hospitalizedCurrently
Contents 2 &
▼ 1 COVID-19 Data Ana 3000
  ▼ 1.1 Introduction
      1.1.1 Problem and 0.
                                      2020-04-15
                                                                                     2020-06-01
                                                                                                  2020-06-15
  ▼ 1.2 Table of Conten 5000
      1.2.1 Standard Lil
       1.2.2 Custom Lib 3000
  ▼ 1.3 Explore Data
      1.3.1 Create New
                                                      2020-05-01
                                                                    2020-05-15
                                                                                     2020-06-01
                                                                                                  2020-06-15
      1.3.2 Plot of Vent
      1.3.3 Plot Alaska
▼ 2 Modeling and Fore §
       2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St
       2.1.2 New York S
       2.1.3 New York A
       2.1.4 California D
   In 2.1.34Califor ia A 1
                           stepwise_fit, stepwise_full, results, results_full = arima_tune(df, 'hos
       2.1.6 Texas Hosp 2
                                                                                                             days to
       2.1.7 Texas Deatl 3
                                                                                                             verbose=
                           # train days arg defaults to 270 days, but can be changed. seasonality co
       2.1.8 Texas Analy 4
                           # see docstring for further details
       2.1.9 Florida Dea 5
       2.1.10 Florida Ana
       2.1.11 United Stat
       2.1.12 United State

▼ 3 Summary Recomme

▼ 3.1 State by State F

      3.1.1 New York SARIMAX Results
       3.1.2 California
      3.1.3 Texas
                          Dep. Variable:
                                         hospitalizedCurrently No. Observations:
                                                                                       240
      3.1.4 Florida
                                 Model:
                                            SARIMAX(0, 2, 1)
                                                                 Log Likelihood
                                                                                 -1560.634
      3.1.5 United State
    3.2 Conclusions
                                  Date:
                                             Sat, 13 Feb 2021
                                                                            AIC
                                                                                  3125.269
    3.3 Future Work
                                  Time:
                                                    12:43:32
                                                                            BIC
                                                                                  3132.197

▼ 4 Appendix and Ancill

                               Sample:
                                                  05-19-2020
                                                                          HQIC
                                                                                  3128.061
    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
                                                - 01-13-2021
       4.2.1 Texas
                       Covariance Type:
                                                        opg
       4.2.2 Florida
       4.2.3 California
                                     coef
                                             std err
                                                               P>|z|
                                                                        [0.025
                                                                                   0.975]
  ▼ 4.3 Multivariate For
       4.3.1 Data Import
                 The ends of the q-q plot are not quite in line.
```

```
In [195]:
                           evaluate predictions(results, df, 'hospitalizedCurrently',
                                                       stepwise_fit=stepwise_fit, alpha=.05, days_to_foreca
                        3
                           # plot training time and test time
                                                              Number of hospitalizedCurrently
Contents ₽ 🌣
▼ 1 COVID-19 Data Ana
                                                                                                            hospitalizedCurrently
                                                                                                             Test Data
  ▼ 1.1 Introduction
       1.1.1 Problem and 22,500
  ▼ 1.2 Table of Conten
       1.2.1 Standard Lil 20000
       1.2.2 Custom Lib
  ▼ 1.3 Explore Data
       1.3.1 Create New
       1.3.2 Plot of Ven₹
       1.3.3 Plot Alaska 12500
▼ 2 Modeling and Forec
       2.0.1 Alaska SAF 10000
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St
       2.1.2 New York S
                                           Dec
                                                                                                           Feb
       2.1.3 New York A
                                                                         Date
       2.1.4 California D
       2.1.5 California A
       2.1.6 Texas Hosp
       2.1.7 Texas Death
       2.1.8 Texas Analy
       2.1.9 Florida Dea
   In 2.1.18 Florida Ana
                            exog forecast, forecast obj = build SARIMAX forecast(model=results full,
       2.1.11 United Stat 2
                                                                                                 dataframe=df,
       2.1.12 United $tata
                                                                                                 target_column='hosp:

▼ 3 Summary Recomm<sub>4</sub>

                                                                                                 days to forecast=30

▼ 3.1 State by State F<sub>5</sub>

                                                                                                 alpha=.05,
       3.1.1 New York
                                                                                                 state postal code=
       3.1.2 California
                                                         Covid-19 HOSPITALIZEDCURRENTLY Forecast, TX
       3.1.3 Texas
       3.1.4 Florida
                                                                                                            hospitalizedCurrently
       3.1.5 United State
     3.2 Conclusions
                         10000
     3.3 Future Work
▼ 4 Appendix and Anci
     4.1 Using an Exog®
  ▼ 4.2 Univariate Fore
       4.2.1 Texas
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate Fof
       4.3.1 Data Import
                         -:10000
                              Aug
                                                                         Date
```

In [197]: •

graph of those currently hospitalized and subsequent forecast above shot# a declining rate of hospitalization with a chance to remain flat.

```
Contents € $.1.7 Texas Deaths Forecast
▼ 1 COVID-19 Data Ana
  ▼ 1.1 Introduction
      Modeled using Texas's Hospitalized Forecast
  ▼ 1.2 Table of Conten-
                          stepwise_fit, df_forecast = get_exogenous_forecast_dataframe(dataframe=d-
   In 1[2.98] tandald Lil1
                                                                                                   original da
      1.2.2 Custom Libi 2
                                                                                                   exog forecas
  ▼ 1.3 Explore Data
                                                                                                   target colu
      1.3.1 Create New 4
                                                                                                   exogenous co
      1.3.2 Plot of Vent <sup>5</sup>
      1.3.3 Plot Alaska 6
                                                                                                   days to fore
                                                                                                   m_periods=7

▼ 2 Modeling and Forec<sup>7</sup>

      2.0.1 Alaska SAF
                          # get exogenous forecast dataframe will return an extended dataframe
  VI2.1[SAR]MAX Mod€1
                          # containing the forecasted exogenous column from build SARIMAX forecast
      2.1.1 New York St2
                          # above after taking in the variable exog forecast
      2.1.2 New York S<sup>3</sup>
      2.1.3 New York A
   In 2.1.40 California D1
                         full exog model = SARIMAX(df['death'],df['hospitalizedCurrently'],
      2.1.5 California A 2
                                                         order=stepwise fit.order, seasonal order=stepwise
      2.1.6 Texas Hosp
   In 2.1.7 Texas Deatl 1
                          # fit model
      2.1.8 Texas Analy
                          model = full exog model.fit()
      2.1.9 Florida Dea
      2.1.10 Florida Ana
      2.1.11 United Stat
      2.1.12 United State

▼ 3 Summary Recomme

▼ 3.1 State by State F

      3.1.1 New York
      3.1.2 California
      3.1.3 Texas
      3.1.4 Florida
      3.1.5 United State
    3.2 Conclusions
    3.3 Future Work

▼ 4 Appendix and Ancill

    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
  ▼ 4.3 Multivariate For
      4.3.1 Data Import
```

```
In [202]:
                           exog forecast, results forecast = build SARIMAX forecast(model=model,
                        1
                        2
                                                                                                    dataframe=df for
                        3
                                                                                                    target column='
                        4
                                                                                                    days to forecast
Contents 2 &
                        5
                                                                                                    stepwise fit=st
                                                                                                    alpha=.05,
▼ 1 COVID-19 Data Ana6
                                                                                                    original df=df i
  ▼ 1.1 Introduction
      1.1.1 Problem anc 8
                                                                                                    exogenous columi
                                                                                                    state postal co
  ▼ 1.2 Table of Conten
       1.2.1 Standard Lik
                                                               Covid-19 DEATH Forecast, TX
       1.2.2 Custom Libi

▼ 1.3 Explore Data

       1.3.1 Create New 45,000
       1.3.2 Plot of Vent
       1.3.3 Plot Alaska 4000
▼ 2 Modeling and Fore
       2.0.1 Alaska SA₽
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York St
       2.1.2 New York $ 25000
       2.1.3 New York A
       2.1.4 California D 20000
       2.1.5 California A
       2.1.6 Texas Hosp
       2.1.7 Texas Death
                                                                                     Jan
2021
       2.1.8 Texas Analy
                                                                       Date
       2.1.9 Florida Dea
       2.1.10 Florida Ana
                           results_forecast.predicted_mean[-5:]
   In 2.2.93 United Stat 1
      2.1.12 United State 2021-03-10
                                       47041.298532
▼ 3 Summary Recomm 2021-03-11
                                       47432.913649
  ▼ 3.1 State by State 7021-03-12
                                       47774.846888
      3.1.1 New York 2021-03-13
                                       48082,671287
       3.1.2 California 2021-03-14
                                       48239.111011
       3.1.3 Texas
                      Freq: D, Name: predicted_mean, dtype: float64
       3.1.4 Florida
       3.1.5 United State
    3.2 Conclusions
                        Texas Analysis and Recommendations
    3.3 Future Work
4 Appendix and Ancill
  4.1 Using an Exoge The number of people currently hospitalized has decreased in recent weeks and I am 4.2 Univariate forecasting that to continue. However, deaths are forecasted to slow only slightly over
       4.2.1 Texathe next 30 days. There is some improvement, but it isn't enough.
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivari Recommendations for the state include the following:
       4.3.1 Data Import
                 * Limit private social gatherings.
                 * There are those in Texas who believe that the virus is a joke, that the rules don't apply
                 to them, and that there are no consequences. Like California, an awareness campaign
```

with personal stories and visual evidence of what Covid does could help contain the

* Make wearing a mask outside of one's private property required.

2.1.9 Florida Deaths Forecast

Contents 2 *

```
▼ 1 COVID-19 Databled using Hospitalized Currently Forecast
  ▼ 1.1 Introduction
  In 1.1 Problem and 1

▼ 1.2 Table of Conten 2
                          # change to True, run cell to follow link
                          open links = False
      1.2.1 Standard Lil 3
      1.2.2 Custom Libi⊿
                          import webbrowser

▼ 1.3 Explore Data

      1.3.1 Create New 6
                          if open links == True:
      1.3.2 Plot of Vent 7
                               webbrowser.open("https://www.newsweek.com/covid-florida-travel-advice
      1.3.3 Plot Alaska
▼ 2 Modeling and Forec
      2.0. ♣ Alas Florada currently has 300 new cases of the UK variant of Covid with 0 travel restrictions
  ▼ 2.1 SARIMAMN dace. The spread of the virus within Florida and throughout the rest of the United
      _{2.1.1} New States as a result of a lack of travel bans and restraint is a serious issue. This section
                will forecast rate of death, total deaths, and will use the number of people currently
      2.1.2 New no spitalized as an exogeous forecast. (data as of 2-10-2021)
      2.1.3 New York A
      2.1.4 California D
125 California A
                          df_ref = state_dataframe(df_states, 'FL')
      2.1.6 Texas Hospuccessfully returned indexed dataframe for FL
      2.1.7 Texas Death
      2.1.8 Texas Analy
1126
2.1.9 Florida Dea
                          df ref.tail()
      2.0.10 Flogida Ana
      2.1.11 United Stat
                             state
                                      death inlcuCurrently onVentilatorCurrently
                                                                                    positive hospitalizedCurrently de
      2.1.12 United Star

▼ 3 Summary Recomme

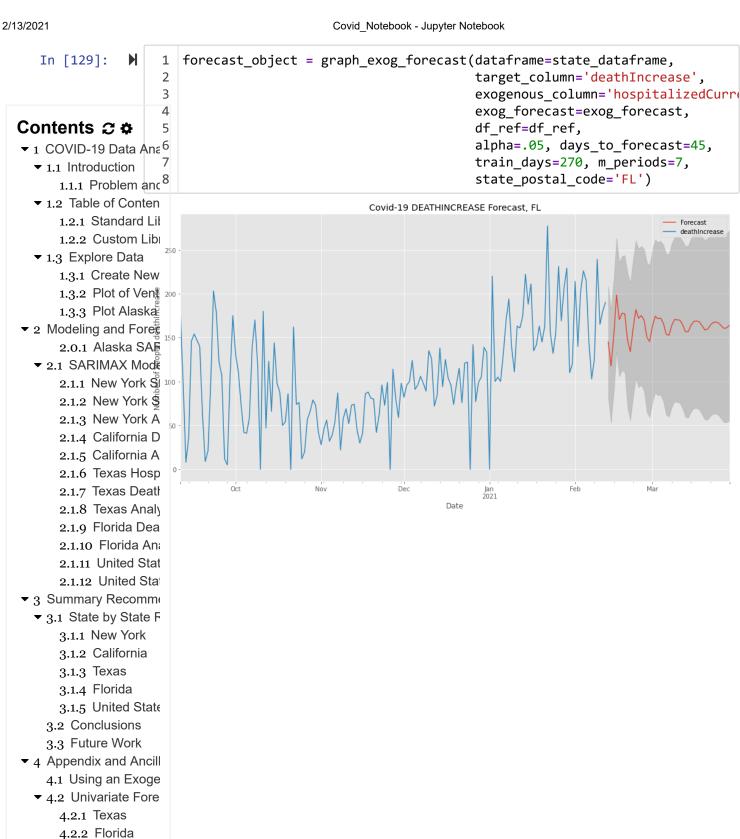
  ▼ 3.1 State by State 2021-
                               FL 28287.0
                                                        0.0
                                                                              0.0 1751343.0
                                                                                                            5381.0
      3.1.1 New York 02-08
      3.1.2 California 2021-
                                    28526.0
                                                        0.0
                                                                                  1758254.0
                                                                                                            5307.0
                      02-09
      3.1.3 Texas
      3.1.4 Florida
                      2021-
      3.1.5 United State -10
                                    28691.0
                                                       0.0
                                                                                  1765659.0
                                                                                                            5129.0
    3.2 Conclusions
                      2021-
    3.3 Future Work
                                   28871.0
                                                       0.0
                                                                                                            4906.0
                                                                                 1774013.0
▼ 4 Appendix and Ancill
    4.1 Using an Exog@021-
                               FL 29061.0
                                                        0.0
                                                                              0.0 1781450.0
                                                                                                            4825.0
  ▼ 4.2 Univariate Fore 12-12
      4.2.1 Texas
      4.2.2 Florida
      4.2.3 California
  4.3 Multivariate For
      4.3.1 Data Import
```

```
In [127]:
                            plt.rcParams['figure.figsize']=(15,10);
                            sd(df ref.loc['10-2020':'12-2020']['hospitalizedCurrently']).plot(); # sd
                                                                   hospitalizedCurrently
                         6000
Contents 2 *
▼ 1 COVID-19 Data Ana 4000
  ▼ 1.1 Introduction
       1.1.1 Problem and 2000
                                        2020-10-15
                                                         2020-11-01
                                                                       2020-11-15
                                                                                       2020-12-01
                                                                                                     2020-12-15
  ▼ 1.2 Table of Conten 6000
       1.2.1 Standard Lil 5000
       1.2.2 Custom Lib 4000
  ▼ 1.3 Explore Data
       1.3.1 Create New 2000
                                       2020-10-15
                                                         2020-11-01
                                                                       2020-11-15
                                                                                                     2020-12-15
       1.3.2 Plot of Vent
       1.3.3 Plot Alaska
▼ 2 Modeling and Fore §
       2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mod€
                                                         2020-11-01
                                                                       2020-11-15
       2.1.1 New York St
       2.1.2 New York S
       2.1.3 New York A
       2.1.4 California D
   In 2.1.38Califor ia A 1
                            state_dataframe, exog_forecast = create_exog_forecast(df_states, 'hospite')
                                                                                                    days to forecast=4!
       2.1.6 Texas Hosp 2
       2.1.7 Texas Deatl 3
                                                                                                    state postal code=
       2.1.8 Texas Analy
                                  Model: SARIMAX(0, 1, 0)x(0, 0, [1], 6)
                                                                            Log Likelihood
                                                                                             -1650.364
       2.1.9 Florida Dea
                                   Date:
                                                       Sat, 13 Feb 2021
                                                                                       AIC
                                                                                              3304.729
       2.1.10 Florida Ana
       2.1.11 United Stat
                                   Time:
                                                               11:08:55
                                                                                       BIC
                                                                                              3311.489
       2.1.12 United Stat
                                 Sample:
                                                            05-19-2020
                                                                                      HQIC
                                                                                              3307.460

▼ 3 Summary Recomme

▼ 3.1 State by State F

                                                           - 12-29-2020
       3.1.1 New York
                        Covariance Type:
                                                                    opg
       3.1.2 California
       3.1.3 Texas
                                                std err
                                                                   P>|z|
                                                                             [0.025
                                                                                       0.975]
                                       coef
       3.1.4 Florida
       3.1.5 United Statma.S.L6
                                     0.1485
                                                 0.234
                                                           0.634
                                                                  0.526
                                                                             -0.311
                                                                                        0.608
     3.2 Conclusions
                        sigma2 2.362e+05 2300.288
                                                        102.690 0.000
                                                                         2.32e+05 2.41e+05
     3.3 Future Work
▼ 4 Appendix and Ancill
                           Ljung-Box (L1) (Q): 0.71 Jarque-Bera (JB):
                                                                          335172.89
     4.1 Using an Exoge
  ▼ 4.2 Univariate Fore
                                      Prob(Q): 0.40
                                                              Prob(JB):
                                                                               0.00
       4.2.1 Texas
                       Heteroskedasticity (H): 0.01
                                                                  Skew:
                                                                              13.52
       4.2.2 Florida
       4.2.3 California
  ▼ 4.3 Multivariate For
       4.3.1 Data Import
```



4.2.3 California ▼ 4.3 Multivariate For 4.3.1 Data Import deathIncrease

```
In [130]:
                          forecast object = graph exog forecast(dataframe=state dataframe,
                      1
                                                                        target column='death',
                       2
                      3
                                                                        exogenous column='hospitalizedCurre
                      4
                                                                        exog forecast=exog forecast,
Contents 2 &
                      5
                                                                        df ref=df ref,
                                                                        alpha=.05, days_to_forecast=45,
▼ 1 COVID-19 Data Ana6
                                                                        train days=270, m periods=7,
  ▼ 1.1 Introduction
      1.1.1 Problem anc<sup>8</sup>
                                                                        state postal code='FL')
  ▼ 1.2 Table of Conten
                                                           Covid-19 DEATH Forecast, FL
      1.2.1 Standard Lil 4000
      1.2.2 Custom Libi
  ▼ 1.3 Explore Data
      1.3.1 Create New
      1.3.2 Plot of Vent
      1.3.3 Plot Alaska 3000

▼ 2 Modeling and Fore
②
      2.0.1 Alaska SAF
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York $
      2.1.2 New York S 20000
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California A
      2.1.6 Texas Hosp
                                                                         Jan
2021
      2.1.7 Texas Death
      2.1.8 Texas Analy
      2.1.9 Florida Dea
                         forecast_object.predicted_mean[-5:] # projected mean deaths for
   In 2[136] Florida An:1
                         # by the end of March
      2.1.11 United Stat 2
      2.1.12 United State 2021-03-25
                                     35837.119536
▼ 3 Summary Recommo 2021-03-26
                                     36003.597226
  ▼ 3.1 State by State 7021-03-27
                                     36168.891724
      3.1.1 New York 2021-03-28
                                     36333.435035
      3.1.2 California 2021-03-29
                                     36498.392480
      3.1.3 Texas
                    Freq: D, Name: predicted_mean, dtype: float64
      3.1.4 Florida
      3.1.5 United State
    3.2 Conclusiana 1.10 Florida Analysis and Recommendations
    3.3 Future Work

▼ 4 Appendix and Ancill

    4.1 Using an Exoge Florida does not have any travel restrictions in place. There have been and will
  ▼ 4.2 Univariate continue to be a steady rate of Covid deaths, likely reaching over 35000 by the end of
      4.2.1 TexaMarch.
      4.2.2 Florida
      4.2.3 California
  ▼ 4.3 Multivari Recommendations for the state include the following:
      4.3.1 Data Import
                * Florida is fully opened - implement travel restrictions and reduce the number of
                people allowed to privately gather.
```

^{*} Pre and post-Super Bowl footage showed business as usual with zero mask usage. Implement and enforce laws requiring masks in public. There are plenty of states that sponsibly open that are mitigating the spread of this virus. Florida seems to be encouraging the spread.

* Common sense is easy. Don't breathe into peoples' faces, wear a mask, and keep your distance.

```
Contents 2 2.1.11 United States Death Forecast
▼ 1 COVID-19 Data Ana
  ▼In1 [latreduction
                           # change to True, run cell to follow link(s)
                           open links = False
       1.1.1 Problem anc 2

▼ 1.2 Table of Conten <sup>3</sup>

                           import webbrowser
       1.2.1 Standard Lil4
       1.2.2 Custom Libi5
                           if open links == True:
  ▼ 1.3 Explore Data
                                webbrowser.open("")
       1.3.1 Create New
       1.3.2 Plot of Vent
   In 1[3.33] lot Alaska 1
                           df whole US.head()
▼ 2 Modeling and Forec
       2.0.1 Alaska SAF
                                                     negative pending hospitalizedCurrently hospitalizedCumulative
                             states
                                        positive
  ▼ 2.1 SARIMAX Mode
       2.1.1 New York Sidate
       2.1.2 New York $2021-
                                     27266230.0 122400369.0
                                                                9434.0
                                                                                     71504.0
                                                                                                            839119.0
       2.1.3 New York A02.12
      2.1.4 California D
2.1.5 California A
02-11
                                     27165660.0
                                                 121833298.0
                                                                11981.0
                                                                                     74225.0
                                                                                                            836774.0
       2.1.6 Texas Hosp
       2.1.7 Texas Deat 2021-
                                     27063243.0
                                                 121244702.0
                                                               12079.0
                                                                                     76979.0
                                                                                                            834314.0
       2.1.8 Texas Analy 02-10
       2.1.9 Florida De 2021-
                                     26968049.0
                                                 120859564.0
                                                               10516.0
                                                                                     79179.0
                                                                                                            831088.0
       2.1.10 Florida Ar (2-09)
       2.1.11 United State 21-
                                     26875063.0 120367478.0
                                                               12114.0
                                                                                     80055.0
                                                                                                            827944.0
       2.1.12 United Sta02-08

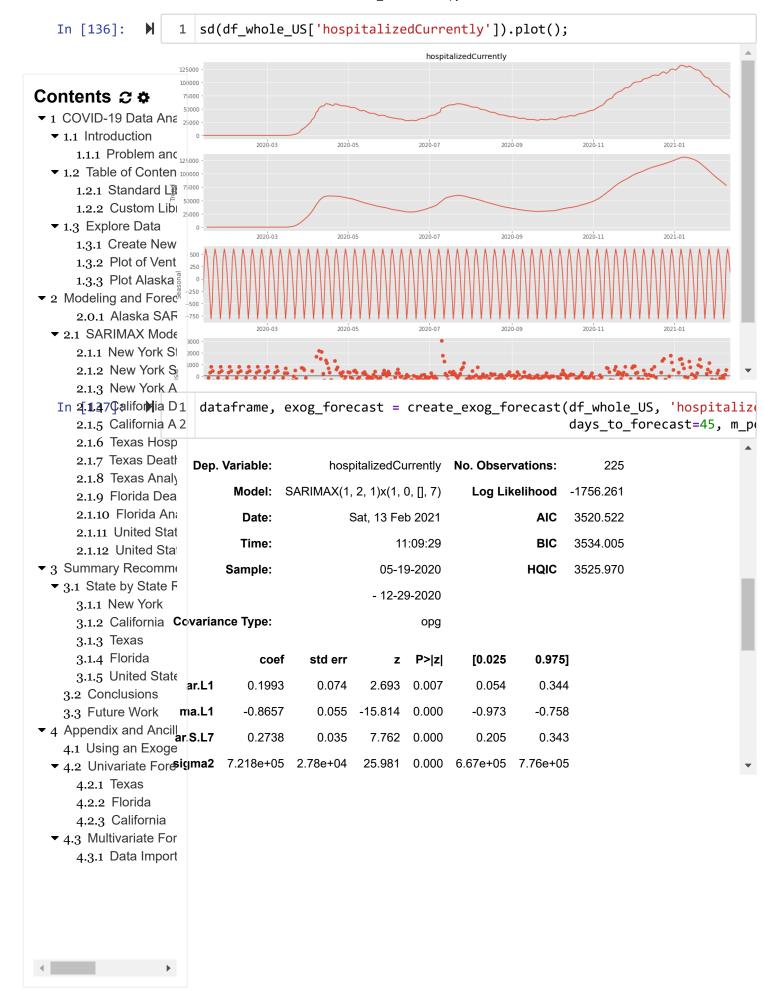
▼ 3 Summary Recomme

▼ 3.1 State by State5 rows × 24 columns

       3.1.1 New York
       3.1.2 California
   In 3.1.34<sup>Texas</sup> ▶
                           columns =
                                         ['death',
       3.1.4 Florida
                                          'inIcuCurrently',
       3.1.5 United State 3
                                          'onVentilatorCurrently',
     3.2 Conclusions
                                          'positive',
     3.3 Future Work
                       5
                                          'hospitalizedCurrently',

▼ 4 Appendix and Ancill 6

                                          'deathIncrease']
    4.1 Using an Exoge 7
                                          # sort and clean df(df whole US, columns)
  ▼ 4.2 Univariate Fore
    In 4.235 Texas
                          df whole US = sort and clean df(df whole US, columns)
       4.2.2 Florida
       4.2.3 California
  4.3 Multivariate For
       4.3.1 Data Import
```



```
In [138]:
                       1
                          forecast object deaths = graph exog forecast(dataframe=dataframe,
                       2
                                                                         target column='death',
                       3
                                                                         exogenous column='hospitalizedCurre
                       4
                                                                         exog forecast=exog forecast,
Contents 2 &
                       5
                                                                         df ref=df ref,
                                                                         alpha=.05, days_to_forecast=45,
▼ 1 COVID-19 Data Ana<sup>6</sup>
                                                                         train days=270, m periods=7)
  ▼ 1.1 Introduction
      1.1.1 Problem and
                                                              Covid-19 DEATH Forecast
  ▼ 1.2 Table of Conten 900000
                                                                                                             Forecast
      1.2.1 Standard Lil
      1.2.2 Custom Libi 80000
  ▼ 1.3 Explore Data
      1.3.1 Create New 7(10000
      1.3.2 Plot of Vent
      1.3.3 Plot Alaska
2.0.1 Alaska SA
  ▼ 2.1 SARIMAX Mode
      2.1.1 New York St
      2.1.2 New York S
      2.1.3 New York A
      2.1.4 California D
      2.1.5 California A
                                   Oct
                                                                           Jan
2021
      2.1.6 Texas Hosp
                                                                     Date
      2.1.7 Texas Death
      2.1.8 Texas Analy
      2.1.9 Florida Dea
      2.1.10 Florida Ana
      2.1.11 United Stat
      2.1.12 United Stat

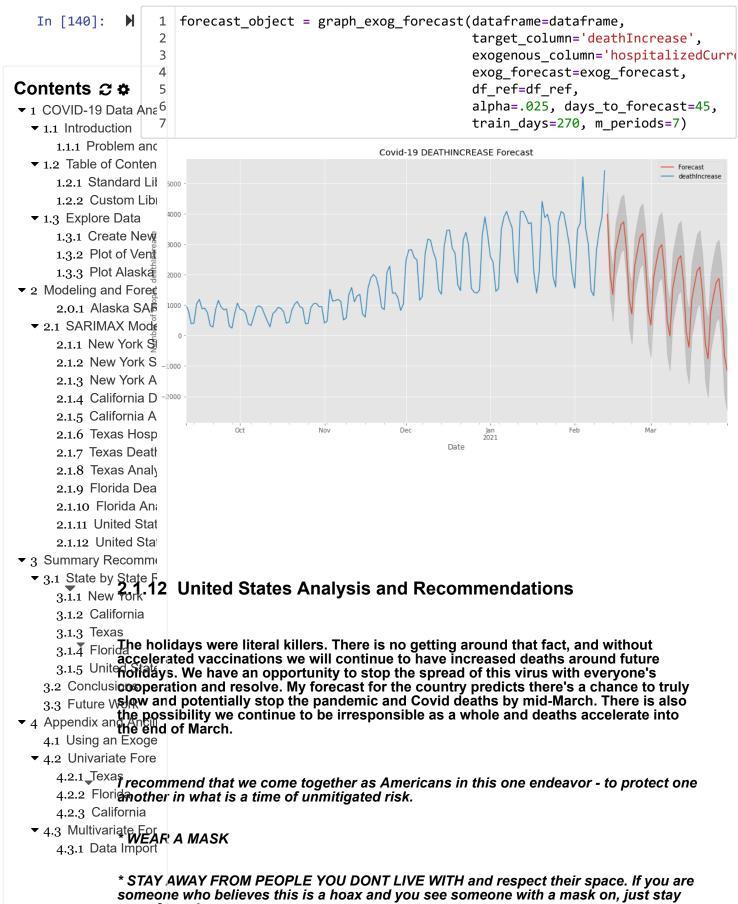
▼ 3 Summary Recomme

▼ 3.1 State by State F

      3.1.1 New York
      3.1.2 California
      3.1.3 Texas
      3.1.4 Florida
      3.1.5 United State
   I3.2 Conclusions
                       1 | forecast_object_deaths.conf_int(alpha=.05)[-5:]
    3.3 Future Work

▼ 4 Appendix and Ancill

                                    lower death
                                                   upper death
    4.1 Using an Exoge
  ▼ 4.2 Univariate Fore2021-03-25 542285.791255
                                                 845053.763793
      4.2.1 Texas
                      2021-03-26 542201.557896
                                                 855979.672209
      4.2.2 Florida
      4.2.3 California 2021-03-27 542053.546031
                                                 866972.095110
  ▼ 4.3 Multivariate For 2021-03-28 541839.945093
                                                 878027.715806
      4.3.1 Data Import
                      2021-03-29 541571.173458
                                                 889155.497596
```



away from them.

* Have your groceries delivered - grocery stores continue to stay extremely busy but there are services that are helping individuals pay their bills that can help limit the spread of this disease.

Contents & Limit your time indoors with friends and family not in your household and wear a mask when taking that time with them.

- ▼ 1 COVID-19 Data Ana
 - ▼ 1.1 Introduction
 - Table of Sintes ummary Recommendations
 - 1.2.1 Standard Lil
 - 1.2.2 Custom Libi
 - ▼ 1.3 Explore 13:4 State by State Recommendations
 - 1.3.1 Create New
 - 1.3.2 Plot of Vent
- 1.3.3 Plot 3aka ▼ 2 Modeling and Forec

 New York
- - 2.0.1 Alaska SAF
 - ▼ 2.1 SARIMAX Mode Recommendations for the state include the following: 2.1.1 New York Si

 - 2.1.2 New York S
 - 2.1.3 New New the number of people allowed at indoor private gatherings from the current
 - 2.1.4 California of 10. Social gatherings are not economically essential. Certain states have limits of one or two households per private residence which has proven to limit the
 - 2.1.5 Californie ad of the disease.
 - 2.1.6 Texas Hosp
 - 2.1.7 Texas Death Increase effort to improve awareness. Covering the mouth but not the nose does not
 - $^{2.1.8}$ Texa in the spread of Covid-19. Mandate signage depicting proper mask usage at public
 - 2.1.9 Flories lablishments.
 - 2.1.10 Florida Ana
 - 2.1.11 United Stationue social distancing policies and reduce the number of outdoor events. The 2.1.12 United Stationue social distancing policies and reduce the number of outdoor events. The
- ▼ 3 Summary Recomme
 - ▼ 3.1 State by State F
 - 3♣1 New 第件.2 California
 - 3.1.2 California
 - 3.1.3 Texas
 - 3.1.4 Floridae commendations for the state include the following:
 - 3.1.5 United State
- 3.3 Future Workequire wearing a mask if an individual is not in or on their private property. Allow no ▼ 4 Appendix and Ancill
- - 4.1 Using an Exoge
 - ▼ 4.2 Univariate Probibit private and public gatherings of 5 or more people unless from the same 4.2.1 Texas household.

 - 4.2.2 Florida
 - 4.2.3 Califor The spread of this disease in this state will continue to take lives if people are not
 - * 4.3 Multivariate to understand the consequences of selfish behavior. Introduce visual evidence of the rammifications of the virus with an emphasis on personal stories on public social 4.3.1 Data media and television.

3.1.3 Texas

nmendations for the state include the following:

- * Limit private social gatherings.
- * There are those in Texas who believe that the virus is a joke, that the rules don't apply Contents & With personal stories and visual evidence of what Covid does could help contain the virus. to them, and that there are no consequences. Like California, an awareness campaign

▼ 1 COVID-19 Data Ana

- - ▼ 1.1 Introduction * Make wearing a mask outside of one's private property required.
 - ▼ 1.2 Table of Conten
 - 1.2.1 Standard Lil
 - 1.7.2 Custon 1.4 Florida
 - ▼ 1.3 Explore Data
 - 1.3.1 Create New
 - 1.3.2 Plot Recommendations for the state include the following:
 - 1.3.3 Plot Alaska
- ▼ 2 Modeling and Fibrida is fully opened implement travel restrictions and reduce the number of 2.0.1 Alas people allowed to privately gather.
 - ▼ 2.1 SARIMAX Mode
 - 2.1.1 New Yorke and post-Super Bowl footage showed business as usual with zero mask usage.

 - 2.1.2 New Implement and enforce laws requiring masks in public. There are plenty of states that $2.1.3~{\rm New}$ are responsibly open that are mitigating the spread of this virus. Florida seems to be
 - 2.1.4 California Uraging the spread.
 - 2.1.5 California A
 - 2.1.6 Texas Gommon sense is easy. Don't breathe into peoples' faces, wear a mask, and keep your
 - 2.1.7 Texas distance.
 - 2.1.8 Texas Analy
 - 2.1.9 Florida Dea

2.T.10 Flora 1A5 United States

- 2.1.11 United Stat
- 2.1.12 United Stat
- ▼ 3 Summary Relocanommend that we come together as Americans in this one endeavor to protect one ▼ 3.1 State by another in what is a time of unmitigated risk.
 - 3.1.1 New York
 - 3.1.2 Califor MEAR A MASK
 - 3.1.3 Texas
 - 3.1.4 Florida STAY AWAY FROM PEOPLE YOU DONT LIVE WITH and respect their space. If you are
 - 3.1.5 Unites of the one who believes this is a hoax and you see someone with a mask on, just stay
 - 3.2 Conclusionay from them.
 - 3.3 Future Work
- ▼ 4 Appendix and Decilitre drive-thru whenever possible, have food delivered. Let's do our best to keep 4.1 Using antheofood service industry going without sacrificing common sense.
 - ▼ 4.2 Univariate Fore
 - 4.2.1 Texas Have your groceries delivered grocery stores continue to stay extremely busy but
 - 4.2.2 Florighere are services that are helping individuals pay their bills that can help limit the
 - 4.2.3 Califspread of this disease.
 - ▼ 4.3 Multivariate For
 - 4.3.1 Data In Data Limit your time indoors with friends and family not in your household and wear a mask when taking that time with them.

3.2 Conclusions



I chose to undertake this project for several reasons. It is relevant to what is happening now, and it has real implications peoples' lives. On a much more personal level, it is frustrating to have three grandparents in their 90's all of whom I am unable to see during this time. Additionally, mother has an auto-immune deficiency, which makes her risk around others who are irresponsible that much more real for me.

Contents 2 &

- ▼ 1 COVID-19 Datiostroeople seem to be respectful enough to wear a mask, but after nearly a year many
 - ▼ 1,1 Introductione growing tired of the simple task. One hopes that respect for others would prevail
 - 1.1.1 Problems is with each other. It's to protect each other, be considerate, and be
 - ▼ 1.2 Table of Canderstanding that one person's wants (the desire to not wear a mask, to party, to have
 - 1.2.1 Standagpood time) do not supercede the responsibility to protect our fellow
 - 1.2.2 Customericans.
 - ▼ 1.3 Explore Data
 - 1.3.1 CrealEulthermore, the argument for personal freedom is in this case ridiculous it's akin to
 - 1.3.2 Plot arguing that one should have the personal freedom to walk around shooting anyone
 - 1.3.3 Plot you please simply because you deserve that 'freedom'. With vaccine distribution occurring, we don't have much longer to endure the difficulties.
- ▼ 2 Modeling and Forect
 - 2.0.1 Alaska SAR

 - SARIMAX Mode Future Work
 - 2.1.2 New York S
 - 2.1.3 New York A
 - 2.1.4 California A California A

 - 2.1.6 Texas Hosp
 - 2.1.7 Texas Find a future source of data to actively pull in and compare future actual data with the
 - 2.1.8 Texas Anal Texas
 - 2.1.9 Florida Dea
 - 2.1.10 Florida Ana

▶ 2.1.11 Unit 4 StAppendix and Ancillary Code 2.1.12 United State

[...]

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- ▼ 3.1 State by State F
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 - 4.2.3 California
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 - 4.3.1 Data Import