

In [1]:

```
#importing necessary library
import pandas as pd
```

In [2]:

```
#reading the file in
weather = pd.read_csv("merged_dataframe.csv")
```

In [3]:

```
#printing the dataframe
weather.head()
```

Out[3]:

| | state | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp | year |
|---|--------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|
| 0 | Alaska | 2005 | 6.230833 | 73.5 | -22.7 | 35.053333 | 3.210000 | 1.59 | |
| 1 | Alaska | 2006 | 7.095000 | 70.1 | -29.7 | 32.066667 | 2.837500 | 0.99 | |
| 2 | Alaska | 2007 | 6.613333 | 75.1 | -25.8 | 33.525833 | 2.635000 | 0.76 | |
| 3 | Alaska | 2008 | 8.601667 | 70.2 | -23.0 | 31.105833 | 2.935833 | 2.04 | |
| 4 | Alaska | 2009 | 8.861667 | 78.6 | -24.4 | 32.727500 | 2.755833 | 1.28 | |

5 rows x 24 columns



In [4]:

```
#dropping data before 2010
weather = weather[~weather['year'].isin([2005, 2006, 2007, 2008, 2009])]
```

In [5]:

```
weather.head()
```

Out[5]:

| | state | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp | year |
|---|--------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|
| 5 | Alaska | 2010 | 5.407500 | 72.0 | -29.1 | 33.590833 | 2.602500 | 1.19 | |
| 6 | Alaska | 2011 | 7.995000 | 71.1 | -22.3 | 32.845833 | 3.048333 | 0.77 | |
| 7 | Alaska | 2012 | 7.418333 | 72.2 | -45.1 | 30.401667 | 2.878333 | 1.09 | |
| 8 | Alaska | 2013 | 6.785833 | 78.3 | -22.5 | 34.404167 | 3.345833 | 1.54 | |
| 9 | Alaska | 2014 | 3.747500 | 69.5 | -19.7 | 36.409167 | 3.018333 | 1.10 | |

5 rows x 24 columns



In [6]:

```
#resetting the index
weather.reset_index(drop=True, inplace=True)
```

In [7]:

```
states = weather['state'].unique()
```

In [8]:

```
#checking the stats for variables
weather.describe()
```

Out[8]:

| | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp |
|-------|-------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| count | 588.000000 | 572.000000 | 588.000000 | 588.000000 | 588.000000 | 588.000000 | 588.000000 |
| mean | 2015.666667 | 2.717869 | 91.684694 | 14.915986 | 54.972795 | 2.997231 | 0.964252 |
| std | 3.707506 | 2.311846 | 6.994659 | 14.276359 | 8.610831 | 1.314866 | 0.744705 |
| min | 2010.000000 | 0.000000 | 69.500000 | -45.100000 | 30.401667 | 0.397500 | 0.000000 |
| 25% | 2012.750000 | 0.600208 | 86.800000 | 6.575000 | 49.360417 | 1.998333 | 0.250000 |
| 50% | 2015.500000 | 2.438333 | 91.300000 | 15.400000 | 53.507917 | 3.168750 | 0.900000 |
| 75% | 2018.250000 | 3.993750 | 95.800000 | 22.625000 | 61.316042 | 3.865417 | 1.502500 |
| max | 2022.000000 | 10.060833 | 112.500000 | 63.900000 | 77.690000 | 5.833333 | 2.990000 |

8 rows x 22 columns

In [9]:

```
#printing the column names for those to drop
weather.columns
```

Out[9]:

```
Index(['state', 'year', 'yearly_avg_snow', 'yearly_max_temp',
       'yearly_min_temp', 'yearly_avg_temp', 'yearly_avg_prcp',
       'yearly_min_prcp', 'yearly_max_prcp', 'avg_snow_summer',
       'avg_snow_winter', 'max_temp_summer', 'max_temp_winter',
       'min_temp_summer', 'min_temp_winter', 'avg_temp_summer',
       'avg_temp_winter', 'avg_prcp_summer', 'avg_prcp_winter', 'total pop',
       'in-state pop', 'percentage', 'top1', 'top1 state'],
      dtype='object')
```

In [10]:

```
#dropping insignificant variables
droppingcols = ["top1", "top1 state", "avg_snow_summer", "avg_snow_winter", "max_temp_summer", "max_temp_winter", "min_temp_summer", "min_temp_winter", "avg_temp_summer", "avg_temp_winter", "avg_prcp_summer", "avg_prcp_winter"]
weather= weather.drop(columns=droppingcols) #had to drop top columns they were not significant, the other columns had to be dropped because of multicollinearity (NAs in the summary of regression)
```

In [11]:

```
weather.head()
```

Out[11]:

| | state | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp | year |
|---|--------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|
| 0 | Alaska | 2010 | 5.407500 | 72.0 | -29.1 | 33.590833 | 2.602500 | 1.19 | |
| 1 | Alaska | 2011 | 7.995000 | 71.1 | -22.3 | 32.845833 | 3.048333 | 0.77 | |
| 2 | Alaska | 2012 | 7.418333 | 72.2 | -45.1 | 30.401667 | 2.878333 | 1.09 | |
| 3 | Alaska | 2013 | 6.785833 | 78.3 | -22.5 | 34.404167 | 3.345833 | 1.54 | |
| 4 | Alaska | 2014 | 3.747500 | 69.5 | -19.7 | 36.409167 | 3.018333 | 1.10 | |

In [12]:

```
#checking for nas in data
weather.isna().sum()
```

Out[12]:

```
state          0
year           0
yearly_avg_snow 16
yearly_max_temp 0
yearly_min_temp 0
yearly_avg_temp 0
yearly_avg_prcp 0
yearly_min_prcp 0
yearly_max_prcp 0
total pop      0
in-state pop   0
percentage     0
dtype: int64
```

In [13]:

```
#replacing nas with 0s
weather['yearly_avg_snow'] = weather['yearly_avg_snow'].fillna(0)
```

Linear regression

In [14]:

```
#importing library for models
from sklearn.preprocessing import LabelEncoder

#creating a new numerical based on state
label_encoder = LabelEncoder()
weather['state_encoded'] = label_encoder.fit_transform(weather['state'])
```

In [15]:

```
weather.head()
```

Out[15]:

| | state | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp | year |
|---|--------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------|
| 0 | Alaska | 2010 | 5.407500 | 72.0 | -29.1 | 33.590833 | 2.602500 | 1.19 | |
| 1 | Alaska | 2011 | 7.995000 | 71.1 | -22.3 | 32.845833 | 3.048333 | 0.77 | |
| 2 | Alaska | 2012 | 7.418333 | 72.2 | -45.1 | 30.401667 | 2.878333 | 1.09 | |
| 3 | Alaska | 2013 | 6.785833 | 78.3 | -22.5 | 34.404167 | 3.345833 | 1.54 | |
| 4 | Alaska | 2014 | 3.747500 | 69.5 | -19.7 | 36.409167 | 3.018333 | 1.10 | |

In [16]:

```
#printing the final dataset datatypes
final = weather.drop(['state'],axis=1)
final.dtypes
```

Out[16]:

```
year          int64
yearly_avg_snow float64
yearly_max_temp float64
yearly_min_temp float64
yearly_avg_temp float64
yearly_min_prcp float64
yearly_max_prcp float64
dtype: object
```

```
yearly_avg_prcp      float64
yearly_min_prcp      float64
yearly_max_prcp      float64
total pop            int64
in-state pop         int64
percentage            float64
state_encoded         int64
dtype: object
```

In [17]:

```
#X, features for the models
X = weather.drop(["percentage", 'state'], axis = 1)
X.dtypes
```

Out[17]:

```
year            int64
yearly_avg_snow float64
yearly_max_temp float64
yearly_min_temp float64
yearly_avg_temp float64
yearly_avg_prcp float64
yearly_min_prcp float64
yearly_max_prcp float64
total pop       int64
in-state pop    int64
state_encoded    int64
dtype: object
```

In [18]:

```
#y, response variable for the models
y = weather['percentage']
y.dtypes
```

Out[18]:

```
dtype('float64')
```

In [19]:

```
from sklearn.model_selection import train_test_split
```

In [20]:

```
#splitting the data using random split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1234)
```

In [21]:

```
#split by years used to do trial and error
# train_data = weather[(weather['year'] > 2009) & (weather['year'] <= 2019)]
# test_data = weather[weather['year'] > 2019]
#didn't split the data this way as the mse is higher this way
```

In [22]:

```
# X_train = train_data.drop(['percentage', 'state'], axis=1)
# y_train = train_data['percentage']
```

In [23]:

```
# X_test = test_data.drop(['percentage', 'state'], axis=1)
# y_test = test_data['percentage']
```

In [24]:

```
X_test.head()
```

Out[24]:

| | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prctp | yearly_min_prctp | yearly_max |
|-----|------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------|
| 585 | 2019 | 7.970000 | 90.2 | 0.9 | 42.965833 | 1.085000 | 0.31 | |
| 29 | 2015 | 0.708333 | 94.4 | 21.5 | 62.676667 | 5.410000 | 1.26 | |
| 270 | 2016 | 0.614167 | 91.1 | 17.3 | 58.365000 | 3.440833 | 0.63 | |
| 100 | 2014 | 0.216667 | 93.3 | 25.7 | 64.366667 | 3.849167 | 2.46 | |
| 278 | 2012 | 0.000000 | 94.1 | 35.5 | 66.460000 | 4.881667 | 1.48 | |

In [25]:

```
#importing library for LR model
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
```

In [26]:

```
#creating LR instance
linearreg = LinearRegression()
```

In [27]:

```
#fitting the model on train data
#test-train-random split is better
linearreg.fit(X_train, y_train)
```

Out[27]:

```
▼ LinearRegression
LinearRegression()
```

In [28]:

```
#predicting y for test data
y_predreg = linearreg.predict(X_test)
```

In [29]:

```
#printing the predicted ys
y_predreg
```

Out[29]:

```
array([ 3.8207643 ,  2.13530454,  2.92199246,  2.79005287,  2.13871738,
        1.77023111, -0.2325194 ,  3.76954466,  2.08670121,  2.20868854,
        2.35235746,  3.55985747,  1.74065098,  3.95497029,  4.42839977,
        1.24376673,  3.54222457,  4.36979039,  2.99663595,  3.07091355,
        3.2517475 ,  4.07525789,  2.33214208,  2.83361782,  3.13192803,
        1.82889931,  4.11192456,  3.43883626,  1.57374596,  1.06190255,
        2.7098696 ,  3.05458168,  3.16838415,  3.39580774,  3.11152809,
        4.22946757,  3.42657614,  2.27779479,  3.4343234 ,  2.30337981,
        3.77250934,  2.50933627,  2.81583114,  2.86224439,  2.90683374,
        2.99444248,  3.73661428,  3.30271954,  1.74688473,  2.40911194,
        2.63868462,  2.86329993,  3.04663412,  2.93052334,  2.93755879,
        4.00548158,  2.70680566,  3.2669251 ,  2.52224708,  3.33310578,
        2.43506721,  3.41092626,  3.119174 ,  3.48810428,  2.89149661,
        3.40799453,  3.22940365,  2.5677237 ,  2.29182777,  2.76402828,
        1.4781854 ,  3.80756781,  3.71073252,  2.95722954,  2.78053079,
        2.08841321,  2.79054328,  2.88843792,  3.63232827,  2.96401589,
        2.67544546,  1.92442846,  3.86571831,  3.98095085,  2.11227651,
        3.66691951,  3.01813571,  0.29823317,  2.84633269,  3.99282854,
        3.86369732,  2.89111874,  2.98611663,  3.63283255,  3.07399246,
       -0.30576867,  2.70945698,  2.93711248,  3.01116177,  2.50509658,
        3.67752199,  2.61371954,  2.62186385,  3.001959 ,  2.79123667,
        2.97296247,  3.83583455,  2.79673584,  3.164021 ,  3.72272515,
        3.14471646,  2.70323776,  2.57217622,  3.30064518,  2.71046473])
```

```
3.14471040, 2.70523770, 2.37217022, 3.30004310, 2.71040473,
2.84058864, 2.99291211, 1.79923794])
```

In [30]:

```
#printing the test ys
y_test
```

Out[30]:

```
585    5.292545
29     2.785439
270    2.713362
100    2.763425
278    2.497720
...
168    3.384544
575    2.477143
563    2.072432
167    2.219519
285    2.100309
Name: percentage, Length: 118, dtype: float64
```

In [31]:

```
#calculating the mean squared error for linear regression
mse1 = mean_squared_error(y_test, y_predreg)
```

In [32]:

```
#MSE for Linear Regression model
mse1
```

Out[32]:

```
0.3755572893890833
```

ARIMA

In [35]:

```
#installing arima package
!pip install pmdarima
```

```
Collecting pmdarima
  Downloading pmdarima-2.0.4-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.manylinux_2_28_x86_64.whl (2.1 MB)
    2.1/2.1 MB 7.1 MB/s eta 0:00:00
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (1.4.0)
Requirement already satisfied: Cython!=0.29.18,!=0.29.31,>=0.29 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (3.0.10)
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (1.25.2)
Requirement already satisfied: pandas>=0.19 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (2.0.3)
Requirement already satisfied: scikit-learn>=0.22 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (1.2.2)
Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (1.11.4)
Requirement already satisfied: statsmodels>=0.13.2 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (0.14.2)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (2.0.7)
Requirement already satisfied: setuptools!=50.0.0,>=38.6.0 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (67.7.2)
Requirement already satisfied: packaging>=17.1 in /usr/local/lib/python3.10/dist-packages (from pmdarima) (24.0)
Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.19->pmdarima) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.19->pmdarima) (2022.4)
```

```

from pandas>=0.19->pmdarima) (2023.4)
Requirement already satisfied: tzdata>=2022.1 in /usr/local/lib/python3.10/dist-packages
(from pandas>=0.19->pmdarima) (2024.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-pac
kages (from scikit-learn>=0.22->pmdarima) (3.4.0)
Requirement already satisfied: patsy>=0.5.6 in /usr/local/lib/python3.10/dist-packages (f
rom statsmodels>=0.13.2->pmdarima) (0.5.6)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from patsy
>=0.5.6->statsmodels>=0.13.2->pmdarima) (1.16.0)
Installing collected packages: pmdarima
Successfully installed pmdarima-2.0.4

```

In [36]:

```

#installing libraries for arima
from statsmodels.tsa.arima.model import ARIMA
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import ColumnTransformer
from pmdarima import auto_arima

```

In [37]:

```
states
```

Out[37]:

```

array(['Alaska', 'Alabama', 'Arkansas', 'Arizona', 'California',
      'Colorado', 'Connecticut', 'Florida', 'Georgia', 'Hawaii', 'Iowa',
      'Idaho', 'Illinois', 'Indiana', 'Kansas', 'Kentucky', 'Louisiana',
      'Massachusetts', 'Maryland', 'Maine', 'Michigan', 'Minnesota',
      'Missouri', 'Mississippi', 'Montana', 'North Carolina',
      'North Dakota', 'Nebraska', 'New Hampshire', 'New Jersey',
      'New Mexico', 'Nevada', 'New York', 'Ohio', 'Oklahoma', 'Oregon',
      'Pennsylvania', 'Rhode Island', 'South Carolina', 'South Dakota',
      'Tennessee', 'Texas', 'Utah', 'Virginia', 'Vermont', 'Washington',
      'Wisconsin', 'West Virginia', 'Wyoming'], dtype=object)

```

In [38]:

```

#ARIMA models for each state
mse_values = [] #to store mse for each state

# Splitting the data into train and test sets for each state
for state_label, state_name in zip(label_encoder.transform(states), states):
    state_data = weather[weather['state_encoded'] == state_label]
    X_train, X_test, y_train, y_test = train_test_split(state_data.drop(columns=['state'
, 'state_encoded']), state_data['percentage'], test_size=0.2, shuffle=False)

    # Checking if there's sufficient data for training
    if len(X_train) == 0 or len(X_test) == 0:
        print(f"Not enough data for state {state_name}. Skipping...")
        continue

    # Fitting ARIMA model on train data
    arima_model = auto_arima(y_train, seasonal=False, trace=True, error_action='ignore',
suppress_warnings=True)

    # predicting for test data
    y_pred = arima_model.predict(n_periods=len(y_test))

    y_test_aligned = y_test.reset_index(drop=True)

    # Calculating Mean Squared Error
    mse = mean_squared_error(y_test_aligned, y_pred)
    mse_values.append((state_name, mse)) #appending to the index
# print("\nypred are", y_pred, "yactual are", y_test_aligned, "\n")
# print(f"\nState {state_name} - Mean Squared Error: {mse}\n")

```

Performing stepwise search to minimize aic

```

ARIMA(1,0,1)(0,0,0)[0]      : AIC=16.383, Time=0.11 sec
ARIMA(0,0,0)(0,0,0)[0]      : AIC=55.572, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0]      : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0]      : AIC=inf, Time=0.07 sec

```

```

ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=18.663, Time=0.09 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=17.299, Time=0.21 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.17 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.17 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.41 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=9.857, Time=0.08 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=8.316, Time=0.05 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=10.859, Time=0.03 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=8.599, Time=0.30 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=10.182, Time=0.11 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=inf, Time=1.05 sec

```

Best model: ARIMA(0,0,1)(0,0,0)[0] intercept

Total fit time: 2.932 seconds

Performing stepwise search to minimize aic

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=2.161, Time=0.56 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=42.800, Time=0.04 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.26 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.89 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=7.981, Time=0.58 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.25 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.12 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.48 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.36 sec

```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 3.727 seconds

Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
    return get_prediction_index(

```

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
    return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=5.202, Time=0.30 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=44.567, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=2.723, Time=0.48 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.19 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=inf, Time=0.44 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=8.050, Time=0.62 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.45 sec
ARIMA(3,0,0)(0,0,0)[0] : AIC=inf, Time=0.26 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=4.705, Time=0.88 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-6.594, Time=0.35 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.96 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-8.597, Time=0.45 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-9.997, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-5.749, Time=0.03 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.38 sec

```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept

Total fit time: 6.273 seconds

Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
    return get_prediction_index(

```

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
    return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=1.227, Time=0.41 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=51.245, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec

```



```

ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.29 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=0.769, Time=0.69 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.47 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=2.179, Time=0.76 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=2.583, Time=1.07 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=1.05 sec
ARIMA(3,0,0)(0,0,0)[0] : AIC=inf, Time=1.05 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=4.510, Time=1.05 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-4.157, Time=0.83 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-3.861, Time=0.84 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-4.523, Time=0.59 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-5.507, Time=0.23 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-3.599, Time=0.03 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-3.432, Time=0.15 sec

```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept
Total fit time: 9.705 seconds

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarni
ng: No supported index is available. Prediction results will be given with an integer ind
ex beginning at `start`.

```

```

return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarn
ing: No supported index is available. In the next version, calling this method in a model
without a supported index will result in an exception.
return get_prediction_index(

```

Performing stepwise search to minimize aic

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=inf, Time=0.32 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=32.378, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.17 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-26.867, Time=0.04 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-26.820, Time=0.10 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-26.905, Time=0.45 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.59 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.67 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.77 sec

```

Best model: ARIMA(0,0,1)(0,0,0)[0] intercept
Total fit time: 3.304 seconds
Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarni
ng: No supported index is available. Prediction results will be given with an integer ind
ex beginning at `start`.

```

```

return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarn
ing: No supported index is available. In the next version, calling this method in a model
without a supported index will result in an exception.
return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=1.005, Time=0.26 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=52.859, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.20 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.62 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=3.335, Time=0.65 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.31 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.25 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=4.856, Time=1.17 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.85 sec

```

Best model: ARIMA(1,0,1)(0,0,0)[0]
Total fit time: 4.458 seconds
Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarni
ng: No supported index is available. Prediction results will be given with an integer ind
ex beginning at `start`.

```

```

return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarn

```

ing: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=4.002, Time=0.62 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=42.344, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.12 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.49 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.32 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=2.928, Time=0.51 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.25 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.76 sec
ARIMA(1,0,3)(0,0,0)[0] : AIC=inf, Time=0.64 sec
ARIMA(0,0,3)(0,0,0)[0] : AIC=inf, Time=0.39 sec
ARIMA(2,0,3)(0,0,0)[0] : AIC=inf, Time=1.02 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=-6.228, Time=0.80 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.50 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.71 sec
ARIMA(2,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.89 sec
ARIMA(1,0,3)(0,0,0)[0] intercept : AIC=inf, Time=0.95 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.34 sec
ARIMA(0,0,3)(0,0,0)[0] intercept : AIC=inf, Time=0.20 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-9.020, Time=0.20 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-18.435, Time=0.17 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-4.648, Time=0.07 sec
ARIMA(3,0,0)(0,0,0)[0] intercept : AIC=-12.749, Time=0.21 sec
ARIMA(3,0,1)(0,0,0)[0] intercept : AIC=-11.569, Time=0.29 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.08 sec
```

Best model: ARIMA(2,0,0)(0,0,0)[0] intercept

Total fit time: 10.601 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=-0.287, Time=0.20 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=46.088, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=1.909, Time=0.21 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=6.267, Time=0.37 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.27 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.21 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=4.437, Time=0.44 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-7.365, Time=0.35 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-9.365, Time=0.11 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-9.378, Time=0.07 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-8.817, Time=0.11 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 2.503 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=1.880, Time=0.33 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=46.007, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.40 sec
```

```
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.42 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=2.982, Time=0.44 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.22 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.21 sec
```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 1.958 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=15.679, Time=0.08 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=52.535, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.03 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(2,0,1)(0,0,0)[0] : AIC=15.029, Time=0.14 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=inf, Time=0.19 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=12.822, Time=0.20 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=14.397, Time=0.16 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=15.108, Time=0.27 sec
ARIMA(2,0,3)(0,0,0)[0] : AIC=inf, Time=0.16 sec
ARIMA(1,0,3)(0,0,0)[0] : AIC=inf, Time=0.13 sec
ARIMA(3,0,3)(0,0,0)[0] : AIC=15.727, Time=0.25 sec
ARIMA(2,0,2)(0,0,0)[0] intercept : AIC=9.133, Time=0.24 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.22 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=12.075, Time=0.22 sec
ARIMA(3,0,2)(0,0,0)[0] intercept : AIC=10.888, Time=0.31 sec
ARIMA(2,0,3)(0,0,0)[0] intercept : AIC=10.865, Time=0.24 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=10.042, Time=0.21 sec
ARIMA(1,0,3)(0,0,0)[0] intercept : AIC=inf, Time=0.24 sec
ARIMA(3,0,1)(0,0,0)[0] intercept : AIC=13.439, Time=0.28 sec
ARIMA(3,0,3)(0,0,0)[0] intercept : AIC=12.895, Time=0.29 sec
```

Best model: ARIMA(2,0,2)(0,0,0)[0] intercept

Total fit time: 4.037 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=2.177, Time=0.06 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=44.099, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=4.170, Time=0.08 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=4.179, Time=0.19 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.13 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.23 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-4.878, Time=0.12 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-6.839, Time=0.05 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-7.562, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-6.781, Time=0.05 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.188 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1) (0,0,0) [0] : AIC=12.900, Time=0.06 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=53.005, Time=0.01 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```
ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.06 sec
ARIMA(0,0,1) (0,0,0) [0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=inf, Time=0.19 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=14.879, Time=0.16 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,0) (0,0,0) [0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,2) (0,0,0) [0] : AIC=inf, Time=0.20 sec
ARIMA(1,0,1) (0,0,0) [0] intercept : AIC=9.593, Time=0.14 sec
ARIMA(0,0,1) (0,0,0) [0] intercept : AIC=9.145, Time=0.04 sec
ARIMA(0,0,0) (0,0,0) [0] intercept : AIC=9.578, Time=0.04 sec
ARIMA(0,0,2) (0,0,0) [0] intercept : AIC=10.597, Time=0.14 sec
ARIMA(1,0,0) (0,0,0) [0] intercept : AIC=7.676, Time=0.07 sec
ARIMA(2,0,0) (0,0,0) [0] intercept : AIC=9.596, Time=0.08 sec
ARIMA(2,0,1) (0,0,0) [0] intercept : AIC=11.600, Time=0.19 sec
```

```
Best model: ARIMA(1,0,0) (0,0,0) [0] intercept
```

```
Total fit time: 1.651 seconds
```

```
Performing stepwise search to minimize aic
```

```
ARIMA(1,0,1) (0,0,0) [0] : AIC=-10.467, Time=0.09 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=36.591, Time=0.01 sec
ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.06 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```
ARIMA(0,0,1) (0,0,0) [0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=-9.696, Time=0.17 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=inf, Time=0.19 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0) (0,0,0) [0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,2) (0,0,0) [0] : AIC=-9.305, Time=0.21 sec
ARIMA(1,0,1) (0,0,0) [0] intercept : AIC=-18.135, Time=0.16 sec
ARIMA(0,0,1) (0,0,0) [0] intercept : AIC=-20.133, Time=0.05 sec
ARIMA(0,0,0) (0,0,0) [0] intercept : AIC=-22.121, Time=0.03 sec
ARIMA(1,0,0) (0,0,0) [0] intercept : AIC=-20.138, Time=0.05 sec
```

```
Best model: ARIMA(0,0,0) (0,0,0) [0] intercept
```

```
Total fit time: 1.306 seconds
```

```
Performing stepwise search to minimize aic
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```
ARIMA(1,0,1) (0,0,0) [0] : AIC=-10.226, Time=0.17 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=41.159, Time=0.01 sec
ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.06 sec
ARIMA(0,0,1) (0,0,0) [0] : AIC=inf, Time=0.04 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=inf, Time=0.14 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=-8.597, Time=0.17 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.09 sec
```

```

ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.13 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=-6.234, Time=0.21 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-15.832, Time=0.25 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-16.756, Time=0.42 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-12.928, Time=0.08 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=-15.686, Time=0.28 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-17.190, Time=0.19 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-15.514, Time=0.29 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-13.929, Time=0.49 sec

```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept
Total fit time: 3.052 seconds
Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```

return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=6.353, Time=0.35 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=48.420, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.19 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.45 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.17 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.19 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-2.751, Time=0.16 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.11 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-3.701, Time=0.04 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-4.937, Time=0.03 sec

```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept
Total fit time: 2.030 seconds
Performing stepwise search to minimize aic
ARIMA(1,0,1)(0,0,0)[0] : AIC=1.902, Time=0.09 sec

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```

return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
return get_prediction_index(

```

```

ARIMA(0,0,0)(0,0,0)[0] : AIC=44.192, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=0.987, Time=0.16 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=2.982, Time=0.17 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=3.140, Time=0.20 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=5.355, Time=0.16 sec
ARIMA(3,0,0)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=4.924, Time=0.27 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-4.763, Time=0.17 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-5.367, Time=0.16 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-6.308, Time=0.04 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-8.287, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-6.319, Time=0.05 sec

```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept
Total fit time: 1.825 seconds
Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

ng: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

| | |
|------------------------------------|-----------------------------|
| ARIMA(1,0,1) (0,0,0) [0] | : AIC=3.631, Time=0.07 sec |
| ARIMA(0,0,0) (0,0,0) [0] | : AIC=39.895, Time=0.02 sec |
| ARIMA(1,0,0) (0,0,0) [0] | : AIC=inf, Time=0.04 sec |
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=inf, Time=0.15 sec |
| ARIMA(1,0,2) (0,0,0) [0] | : AIC=7.277, Time=0.17 sec |
| ARIMA(0,0,2) (0,0,0) [0] | : AIC=inf, Time=0.08 sec |
| ARIMA(2,0,0) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,2) (0,0,0) [0] | : AIC=7.674, Time=0.19 sec |
| ARIMA(1,0,1) (0,0,0) [0] intercept | : AIC=-1.566, Time=0.08 sec |
| ARIMA(0,0,1) (0,0,0) [0] intercept | : AIC=-3.204, Time=0.05 sec |
| ARIMA(0,0,0) (0,0,0) [0] intercept | : AIC=0.141, Time=0.03 sec |
| ARIMA(0,0,2) (0,0,0) [0] intercept | : AIC=inf, Time=0.18 sec |
| ARIMA(1,0,0) (0,0,0) [0] intercept | : AIC=-2.369, Time=0.04 sec |
| ARIMA(1,0,2) (0,0,0) [0] intercept | : AIC=-0.382, Time=0.24 sec |

Best model: ARIMA(0,0,1) (0,0,0) [0] intercept

Total fit time: 1.498 seconds

Performing stepwise search to minimize aic

| | |
|--------------------------|-----------------------------|
| ARIMA(1,0,1) (0,0,0) [0] | : AIC=-5.337, Time=0.12 sec |
| ARIMA(0,0,0) (0,0,0) [0] | : AIC=41.331, Time=0.01 sec |
| ARIMA(1,0,0) (0,0,0) [0] | : AIC=inf, Time=0.03 sec |

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

| | |
|------------------------------------|------------------------------|
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=-6.203, Time=0.16 sec |
| ARIMA(2,0,0) (0,0,0) [0] | : AIC=inf, Time=0.08 sec |
| ARIMA(3,0,1) (0,0,0) [0] | : AIC=-4.154, Time=0.18 sec |
| ARIMA(2,0,2) (0,0,0) [0] | : AIC=-2.553, Time=0.21 sec |
| ARIMA(1,0,2) (0,0,0) [0] | : AIC=inf, Time=0.20 sec |
| ARIMA(3,0,0) (0,0,0) [0] | : AIC=inf, Time=0.10 sec |
| ARIMA(3,0,2) (0,0,0) [0] | : AIC=-1.199, Time=0.23 sec |
| ARIMA(2,0,1) (0,0,0) [0] intercept | : AIC=-15.695, Time=0.15 sec |
| ARIMA(1,0,1) (0,0,0) [0] intercept | : AIC=-19.521, Time=0.27 sec |
| ARIMA(0,0,1) (0,0,0) [0] intercept | : AIC=inf, Time=0.09 sec |
| ARIMA(1,0,0) (0,0,0) [0] intercept | : AIC=-19.566, Time=0.10 sec |
| ARIMA(0,0,0) (0,0,0) [0] intercept | : AIC=-17.203, Time=0.04 sec |
| ARIMA(2,0,0) (0,0,0) [0] intercept | : AIC=-17.756, Time=0.12 sec |

Best model: ARIMA(1,0,0) (0,0,0) [0] intercept

Total fit time: 2.192 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

| | |
|--------------------------|-----------------------------|
| ARIMA(1,0,1) (0,0,0) [0] | : AIC=-3.912, Time=0.13 sec |
| ARIMA(0,0,0) (0,0,0) [0] | : AIC=45.815, Time=0.01 sec |
| ARIMA(1,0,0) (0,0,0) [0] | : AIC=inf, Time=0.04 sec |
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.05 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=-4.334, Time=0.17 sec |


```
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=-3.993, Time=0.24 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.22 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.13 sec
ARIMA(3,0,0)(0,0,0)[0] : AIC=inf, Time=0.15 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=-2.516, Time=0.25 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-16.318, Time=0.17 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.15 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-17.135, Time=0.13 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-17.976, Time=0.07 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-16.162, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.10 sec
```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept

Total fit time: 2.134 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=17.683, Time=0.08 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=44.584, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=19.990, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=18.750, Time=0.13 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.13 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.20 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=11.679, Time=0.12 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=9.838, Time=0.04 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=8.425, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=9.694, Time=0.05 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.036 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=-2.535, Time=0.11 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=34.227, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.38 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=-3.087, Time=0.46 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.24 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.44 sec
ARIMA(1,0,3)(0,0,0)[0] : AIC=inf, Time=0.36 sec
ARIMA(0,0,3)(0,0,0)[0] : AIC=inf, Time=0.54 sec
ARIMA(2,0,3)(0,0,0)[0] : AIC=inf, Time=0.61 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=-7.156, Time=0.65 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.21 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-7.075, Time=0.18 sec
ARIMA(2,0,2)(0,0,0)[0] intercept : AIC=-4.501, Time=0.26 sec
ARIMA(1,0,3)(0,0,0)[0] intercept : AIC=-5.428, Time=0.26 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-8.675, Time=0.11 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-10.353, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-8.930, Time=0.10 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 5.080 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=-0.315, Time=0.07 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=39.547, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=1.227, Time=0.16 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=0.938, Time=0.17 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=3.190, Time=0.18 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-6.171, Time=0.24 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-8.101, Time=0.06 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-9.873, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-8.166, Time=0.07 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.265 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=-0.134, Time=0.12 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=44.925, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.12 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.18 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.11 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.12 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=3.779, Time=0.20 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-9.156, Time=0.22 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-10.908, Time=0.06 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-11.784, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-9.881, Time=0.07 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.368 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=inf, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=43.223, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-11.070, Time=0.03 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-12.380, Time=0.18 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-10.540, Time=0.10 sec
```



```
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-10.540, Time=0.10 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-10.570, Time=0.21 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.09 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-8.518, Time=0.17 sec
```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept

Total fit time: 1.043 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=16.396, Time=0.11 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=51.526, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.03 sec
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=18.323, Time=0.17 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=18.332, Time=0.18 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.22 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.14 sec
```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 1.077 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=0.516, Time=0.09 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=47.284, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.15 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=2.192, Time=0.22 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=4.483, Time=0.20 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-4.910, Time=0.12 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-5.201, Time=0.05 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-1.826, Time=0.02 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=-4.555, Time=0.17 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-6.262, Time=0.06 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-4.964, Time=0.11 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-2.673, Time=0.23 sec
```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept

Total fit time: 1.761 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=28.287, Time=0.12 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=56.662, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=29.100, Time=0.03 sec
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=30.245, Time=0.06 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=30.096, Time=0.17 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=32.188, Time=0.19 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=22.543, Time=0.15 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=20.701, Time=0.03 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=18.721, Time=0.04 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=20.696, Time=0.05 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.085 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=8.447, Time=0.12 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```
ARIMA(0,0,0)(0,0,0)[0] : AIC=45.745, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=11.011, Time=0.08 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=inf, Time=0.17 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.12 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.20 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.16 sec
```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 1.044 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=22.323, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=50.522, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=22.120, Time=0.05 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.15 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=24.323, Time=0.23 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=16.060, Time=0.09 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=14.578, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=15.781, Time=0.09 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.32 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.251 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(
```

```

ARIMA(1,0,1) (0,0,0) [0] : AIC=-3.681, Time=0.21 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=36.109, Time=0.04 sec
ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.10 sec
ARIMA(0,0,1) (0,0,0) [0] : AIC=inf, Time=0.14 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=-3.688, Time=0.39 sec
ARIMA(2,0,0) (0,0,0) [0] : AIC=inf, Time=0.28 sec
ARIMA(3,0,1) (0,0,0) [0] : AIC=-2.963, Time=0.60 sec
ARIMA(2,0,2) (0,0,0) [0] : AIC=-2.711, Time=0.31 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=-4.076, Time=0.15 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.16 sec
ARIMA(1,0,3) (0,0,0) [0] : AIC=inf, Time=0.14 sec
ARIMA(0,0,3) (0,0,0) [0] : AIC=inf, Time=0.16 sec
ARIMA(2,0,3) (0,0,0) [0] : AIC=-0.447, Time=0.23 sec
ARIMA(1,0,2) (0,0,0) [0] intercept : AIC=-8.705, Time=0.20 sec
ARIMA(0,0,2) (0,0,0) [0] intercept : AIC=-8.730, Time=0.22 sec
ARIMA(0,0,1) (0,0,0) [0] intercept : AIC=inf, Time=0.10 sec
ARIMA(0,0,3) (0,0,0) [0] intercept : AIC=inf, Time=0.21 sec
ARIMA(1,0,1) (0,0,0) [0] intercept : AIC=-7.607, Time=0.13 sec
ARIMA(1,0,3) (0,0,0) [0] intercept : AIC=-6.761, Time=0.25 sec

```

Best model: ARIMA(0,0,2) (0,0,0) [0] intercept

Total fit time: 4.066 seconds

Performing stepwise search to minimize aic

```

ARIMA(1,0,1) (0,0,0) [0] : AIC=17.919, Time=0.12 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=47.445, Time=0.01 sec
ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.03 sec

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```

ARIMA(0,0,1) (0,0,0) [0] : AIC=41.730, Time=0.06 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=21.441, Time=0.18 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=18.700, Time=0.17 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0) (0,0,0) [0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,2) (0,0,0) [0] : AIC=21.460, Time=0.19 sec
ARIMA(1,0,1) (0,0,0) [0] intercept : AIC=11.582, Time=0.14 sec
ARIMA(0,0,1) (0,0,0) [0] intercept : AIC=inf, Time=0.10 sec
ARIMA(1,0,0) (0,0,0) [0] intercept : AIC=9.679, Time=0.05 sec
ARIMA(0,0,0) (0,0,0) [0] intercept : AIC=8.207, Time=0.03 sec

```

Best model: ARIMA(0,0,0) (0,0,0) [0] intercept

Total fit time: 1.238 seconds

Performing stepwise search to minimize aic

```

ARIMA(1,0,1) (0,0,0) [0] : AIC=17.355, Time=0.05 sec
ARIMA(0,0,0) (0,0,0) [0] : AIC=54.210, Time=0.01 sec

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.

```
return get_prediction_index(
```

```

ARIMA(1,0,0) (0,0,0) [0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1) (0,0,0) [0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,1) (0,0,0) [0] : AIC=19.065, Time=0.08 sec
ARIMA(1,0,2) (0,0,0) [0] : AIC=inf, Time=0.15 sec
ARIMA(0,0,2) (0,0,0) [0] : AIC=inf, Time=0.08 sec
ARIMA(2,0,0) (0,0,0) [0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,2) (0,0,0) [0] : AIC=21.304, Time=0.20 sec
ARIMA(1,0,1) (0,0,0) [0] intercept : AIC=11.360, Time=0.16 sec
ARIMA(0,0,1) (0,0,0) [0] intercept : AIC=9.392, Time=0.05 sec
ARIMA(0,0,0) (0,0,0) [0] intercept : AIC=7.677, Time=0.03 sec
ARIMA(1,0,0) (0,0,0) [0] intercept : AIC=9.360, Time=0.05 sec

```

```
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-9.500, Time=0.03 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.080 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=-11.252, Time=0.08 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] : AIC=33.481, Time=0.02 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
```

```
ARIMA(2,0,1)(0,0,0)[0] : AIC=-9.301, Time=0.14 sec
```

```
ARIMA(1,0,2)(0,0,0)[0] : AIC=-9.265, Time=0.15 sec
```

```
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.10 sec
```

```
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.08 sec
```

```
ARIMA(2,0,2)(0,0,0)[0] : AIC=-5.695, Time=0.21 sec
```

```
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-18.544, Time=0.07 sec
```

```
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-20.564, Time=0.04 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-22.543, Time=0.03 sec
```

```
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-20.565, Time=0.09 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.172 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=inf, Time=0.10 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] : AIC=37.019, Time=0.01 sec
```

```
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.08 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-17.812, Time=0.03 sec
```

```
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-15.906, Time=0.08 sec
```

```
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.16 sec
```

```
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.15 sec
```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 0.669 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=inf, Time=0.09 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] : AIC=46.256, Time=0.01 sec
```

```
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
```

```
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-10.333, Time=0.03 sec
```

```
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-12.477, Time=0.09 sec
```

```
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-12.746, Time=0.14 sec
```

```
ARIMA(3,0,0)(0,0,0)[0] intercept : AIC=-8.490, Time=0.27 sec
```

```
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-10.951, Time=0.23 sec
```

```
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-13.034, Time=0.10 sec
```

```

ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.12 sec
ARIMA(1,0,2)(0,0,0)[0] intercept : AIC=-11.162, Time=0.23 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=-13.131, Time=0.12 sec
ARIMA(0,0,3)(0,0,0)[0] intercept : AIC=-11.162, Time=0.17 sec
ARIMA(1,0,3)(0,0,0)[0] intercept : AIC=-9.808, Time=0.33 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.09 sec

```

Best model: ARIMA(0,0,2)(0,0,0)[0] intercept
Total fit time: 2.151 seconds
Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
    return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
    return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=11.176, Time=0.12 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=49.761, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=10.407, Time=0.13 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(3,0,1)(0,0,0)[0] : AIC=11.854, Time=0.19 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=11.844, Time=0.21 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=11.528, Time=0.15 sec
ARIMA(3,0,0)(0,0,0)[0] : AIC=inf, Time=0.10 sec
ARIMA(3,0,2)(0,0,0)[0] : AIC=13.830, Time=0.27 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=4.005, Time=0.64 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=3.608, Time=0.46 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=3.346, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=1.351, Time=0.07 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=3.342, Time=0.07 sec

```

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept
Total fit time: 2.810 seconds
Performing stepwise search to minimize aic

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
    return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
    return get_prediction_index(

```

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=-6.569, Time=0.31 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=38.946, Time=0.02 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.14 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.38 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=-5.562, Time=0.43 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.24 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.25 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=-2.710, Time=0.25 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=-12.420, Time=0.16 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=-13.470, Time=0.05 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=-12.740, Time=0.03 sec
ARIMA(0,0,2)(0,0,0)[0] intercept : AIC=inf, Time=0.14 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-14.410, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=-12.428, Time=0.12 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=-10.410, Time=0.16 sec

```

Best model: ARIMA(1,0,0)(0,0,0)[0] intercept
Total fit time: 2.896 seconds
Performing stepwise search to minimize aic

```

ARIMA(1,0,1)(0,0,0)[0] : AIC=16.771, Time=0.10 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=48.629, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=18.818, Time=0.03 sec

```

ARIMA(1,0,0)(0,0,0)[0] : AIC=10.010, Time=0.05 sec

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index()
```

| | |
|----------------------------------|-----------------------------|
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.06 sec |
| ARIMA(2,0,1)(0,0,0)[0] | : AIC=17.072, Time=0.13 sec |
| ARIMA(1,0,2)(0,0,0)[0] | : AIC=inf, Time=0.16 sec |
| ARIMA(0,0,2)(0,0,0)[0] | : AIC=inf, Time=0.10 sec |
| ARIMA(2,0,0)(0,0,0)[0] | : AIC=inf, Time=0.06 sec |
| ARIMA(2,0,2)(0,0,0)[0] | : AIC=inf, Time=0.21 sec |
| ARIMA(1,0,1)(0,0,0)[0] intercept | : AIC=11.100, Time=0.15 sec |
| ARIMA(0,0,1)(0,0,0)[0] intercept | : AIC=9.169, Time=0.05 sec |
| ARIMA(0,0,0)(0,0,0)[0] intercept | : AIC=7.193, Time=0.04 sec |
| ARIMA(1,0,0)(0,0,0)[0] intercept | : AIC=9.161, Time=0.04 sec |

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 1.161 seconds

Performing stepwise search to minimize aic

| | |
|------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=inf, Time=0.12 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=49.981, Time=0.01 sec |

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index()
```

| | |
|----------------------------------|-----------------------------|
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=inf, Time=0.06 sec |
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.08 sec |
| ARIMA(0,0,0)(0,0,0)[0] intercept | : AIC=-7.969, Time=0.03 sec |
| ARIMA(1,0,0)(0,0,0)[0] intercept | : AIC=-5.969, Time=0.06 sec |
| ARIMA(0,0,1)(0,0,0)[0] intercept | : AIC=inf, Time=0.11 sec |
| ARIMA(1,0,1)(0,0,0)[0] intercept | : AIC=inf, Time=0.21 sec |

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 0.696 seconds

Performing stepwise search to minimize aic

| | |
|------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=inf, Time=0.11 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=49.164, Time=0.01 sec |
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=inf, Time=0.03 sec |

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index()
```

| | |
|----------------------------------|----------------------------|
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.07 sec |
| ARIMA(0,0,0)(0,0,0)[0] intercept | : AIC=2.310, Time=0.03 sec |
| ARIMA(1,0,0)(0,0,0)[0] intercept | : AIC=3.055, Time=0.04 sec |
| ARIMA(0,0,1)(0,0,0)[0] intercept | : AIC=inf, Time=0.08 sec |
| ARIMA(1,0,1)(0,0,0)[0] intercept | : AIC=2.379, Time=0.16 sec |

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept

Total fit time: 0.553 seconds

Performing stepwise search to minimize aic

| | |
|------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=8.317, Time=0.10 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=46.290, Time=0.01 sec |
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=inf, Time=0.06 sec |

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```


ng: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
return get_prediction_index(
```

| | |
|------------------------------------|-----------------------------|
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=10.314, Time=0.10 sec |
| ARIMA(1,0,2) (0,0,0) [0] | : AIC=10.312, Time=0.20 sec |
| ARIMA(0,0,2) (0,0,0) [0] | : AIC=inf, Time=0.10 sec |
| ARIMA(2,0,0) (0,0,0) [0] | : AIC=inf, Time=0.08 sec |
| ARIMA(2,0,2) (0,0,0) [0] | : AIC=12.316, Time=0.20 sec |
| ARIMA(1,0,1) (0,0,0) [0] intercept | : AIC=2.516, Time=0.06 sec |
| ARIMA(0,0,1) (0,0,0) [0] intercept | : AIC=0.552, Time=0.04 sec |
| ARIMA(0,0,0) (0,0,0) [0] intercept | : AIC=-1.447, Time=0.03 sec |
| ARIMA(1,0,0) (0,0,0) [0] intercept | : AIC=0.553, Time=0.07 sec |

Best model: ARIMA(0,0,0) (0,0,0) [0] intercept
Total fit time: 1.128 seconds

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
return get_prediction_index(
```

Performing stepwise search to minimize aic

| | |
|------------------------------------|-----------------------------|
| ARIMA(1,0,1) (0,0,0) [0] | : AIC=-8.445, Time=0.08 sec |
| ARIMA(0,0,0) (0,0,0) [0] | : AIC=40.098, Time=0.01 sec |
| ARIMA(1,0,0) (0,0,0) [0] | : AIC=inf, Time=0.06 sec |
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=-6.525, Time=0.15 sec |
| ARIMA(1,0,2) (0,0,0) [0] | : AIC=inf, Time=0.16 sec |
| ARIMA(0,0,2) (0,0,0) [0] | : AIC=inf, Time=0.10 sec |
| ARIMA(2,0,0) (0,0,0) [0] | : AIC=inf, Time=0.07 sec |
| ARIMA(2,0,2) (0,0,0) [0] | : AIC=-4.453, Time=0.20 sec |
| ARIMA(1,0,1) (0,0,0) [0] intercept | : AIC=inf, Time=0.17 sec |

Best model: ARIMA(1,0,1) (0,0,0) [0]
Total fit time: 1.074 seconds

Performing stepwise search to minimize aic

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.

```
return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
return get_prediction_index(
```

| | |
|------------------------------------|-----------------------------|
| ARIMA(1,0,1) (0,0,0) [0] | : AIC=9.375, Time=0.09 sec |
| ARIMA(0,0,0) (0,0,0) [0] | : AIC=48.750, Time=0.01 sec |
| ARIMA(1,0,0) (0,0,0) [0] | : AIC=inf, Time=0.04 sec |
| ARIMA(0,0,1) (0,0,0) [0] | : AIC=inf, Time=0.06 sec |
| ARIMA(2,0,1) (0,0,0) [0] | : AIC=inf, Time=0.17 sec |
| ARIMA(1,0,2) (0,0,0) [0] | : AIC=11.358, Time=0.17 sec |
| ARIMA(0,0,2) (0,0,0) [0] | : AIC=inf, Time=0.12 sec |
| ARIMA(2,0,0) (0,0,0) [0] | : AIC=inf, Time=0.09 sec |
| ARIMA(2,0,2) (0,0,0) [0] | : AIC=13.108, Time=0.21 sec |
| ARIMA(1,0,1) (0,0,0) [0] intercept | : AIC=3.964, Time=0.18 sec |
| ARIMA(0,0,1) (0,0,0) [0] intercept | : AIC=1.989, Time=0.04 sec |
| ARIMA(0,0,0) (0,0,0) [0] intercept | : AIC=0.443, Time=0.03 sec |
| ARIMA(1,0,0) (0,0,0) [0] intercept | : AIC=1.964, Time=0.08 sec |

Best model: ARIMA(0,0,0) (0,0,0) [0] intercept
Total fit time: 1.317 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=0.061, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=48.640, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.14 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=3.303, Time=0.17 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.21 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.22 sec
```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 1.172 seconds

Performing stepwise search to minimize aic

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=16.439, Time=0.12 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=50.982, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.04 sec
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.14 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=19.941, Time=0.28 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.07 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.06 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=inf, Time=0.23 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=inf, Time=0.14 sec
```

Best model: ARIMA(1,0,1)(0,0,0)[0]

Total fit time: 1.185 seconds

Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
    return get_prediction_index()
```

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
    return get_prediction_index()
```

```
ARIMA(1,0,1)(0,0,0)[0] : AIC=4.450, Time=0.12 sec
ARIMA(0,0,0)(0,0,0)[0] : AIC=48.930, Time=0.01 sec
ARIMA(1,0,0)(0,0,0)[0] : AIC=inf, Time=0.08 sec
ARIMA(0,0,1)(0,0,0)[0] : AIC=inf, Time=0.05 sec
ARIMA(2,0,1)(0,0,0)[0] : AIC=inf, Time=0.15 sec
ARIMA(1,0,2)(0,0,0)[0] : AIC=5.419, Time=0.15 sec
ARIMA(0,0,2)(0,0,0)[0] : AIC=inf, Time=0.14 sec
ARIMA(2,0,0)(0,0,0)[0] : AIC=inf, Time=0.21 sec
ARIMA(2,0,2)(0,0,0)[0] : AIC=8.531, Time=0.61 sec
ARIMA(1,0,1)(0,0,0)[0] intercept : AIC=0.662, Time=0.23 sec
ARIMA(0,0,1)(0,0,0)[0] intercept : AIC=1.214, Time=0.09 sec
ARIMA(1,0,0)(0,0,0)[0] intercept : AIC=-0.935, Time=0.15 sec
ARIMA(0,0,0)(0,0,0)[0] intercept : AIC=3.717, Time=0.03 sec
ARIMA(2,0,0)(0,0,0)[0] intercept : AIC=0.498, Time=0.26 sec
ARIMA(2,0,1)(0,0,0)[0] intercept : AIC=1.765, Time=0.55 sec
```


Best model: ARIMA(1,0,0)(0,0,0)[0] intercept
Total fit time: 2.881 seconds
Performing stepwise search to minimize aic

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(  
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(  
ARIMA(1,0,1)(0,0,0)[0]
```

| | |
|----------------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=3.159, Time=0.21 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=39.193, Time=0.01 sec |
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=inf, Time=0.05 sec |
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.16 sec |
| ARIMA(2,0,1)(0,0,0)[0] | : AIC=3.448, Time=0.50 sec |
| ARIMA(1,0,2)(0,0,0)[0] | : AIC=2.166, Time=0.23 sec |
| ARIMA(0,0,2)(0,0,0)[0] | : AIC=inf, Time=0.10 sec |
| ARIMA(2,0,2)(0,0,0)[0] | : AIC=inf, Time=0.20 sec |
| ARIMA(1,0,3)(0,0,0)[0] | : AIC=inf, Time=0.17 sec |
| ARIMA(0,0,3)(0,0,0)[0] | : AIC=inf, Time=0.14 sec |
| ARIMA(2,0,3)(0,0,0)[0] | : AIC=inf, Time=0.23 sec |
| ARIMA(1,0,2)(0,0,0)[0] intercept | : AIC=-4.385, Time=0.19 sec |
| ARIMA(0,0,2)(0,0,0)[0] intercept | : AIC=inf, Time=0.52 sec |
| ARIMA(1,0,1)(0,0,0)[0] intercept | : AIC=-2.034, Time=0.41 sec |
| ARIMA(2,0,2)(0,0,0)[0] intercept | : AIC=-2.331, Time=0.22 sec |
| ARIMA(1,0,3)(0,0,0)[0] intercept | : AIC=inf, Time=0.22 sec |
| ARIMA(0,0,1)(0,0,0)[0] intercept | : AIC=-3.910, Time=0.11 sec |
| ARIMA(0,0,3)(0,0,0)[0] intercept | : AIC=inf, Time=0.20 sec |
| ARIMA(2,0,1)(0,0,0)[0] intercept | : AIC=-0.124, Time=0.20 sec |
| ARIMA(2,0,3)(0,0,0)[0] intercept | : AIC=inf, Time=0.26 sec |

Best model: ARIMA(1,0,2)(0,0,0)[0] intercept
Total fit time: 4.385 seconds
Performing stepwise search to minimize aic

| | |
|------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=12.028, Time=0.12 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=44.124, Time=0.01 sec |
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=inf, Time=0.03 sec |

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```
return get_prediction_index(  
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarning: No supported index is available. In the next version, calling this method in a model without a supported index will result in an exception.
```

```
return get_prediction_index(  
ARIMA(0,0,1)(0,0,0)[0]
```

| | |
|----------------------------------|-----------------------------|
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.08 sec |
| ARIMA(2,0,1)(0,0,0)[0] | : AIC=13.613, Time=0.08 sec |
| ARIMA(1,0,2)(0,0,0)[0] | : AIC=13.659, Time=0.17 sec |
| ARIMA(0,0,2)(0,0,0)[0] | : AIC=inf, Time=0.09 sec |
| ARIMA(2,0,0)(0,0,0)[0] | : AIC=inf, Time=0.06 sec |
| ARIMA(2,0,2)(0,0,0)[0] | : AIC=14.968, Time=0.22 sec |
| ARIMA(1,0,1)(0,0,0)[0] intercept | : AIC=5.605, Time=0.11 sec |
| ARIMA(0,0,1)(0,0,0)[0] intercept | : AIC=3.791, Time=0.04 sec |
| ARIMA(0,0,0)(0,0,0)[0] intercept | : AIC=1.992, Time=0.03 sec |
| ARIMA(1,0,0)(0,0,0)[0] intercept | : AIC=3.738, Time=0.11 sec |

Best model: ARIMA(0,0,0)(0,0,0)[0] intercept
Total fit time: 1.154 seconds
Performing stepwise search to minimize aic

| | |
|------------------------|-----------------------------|
| ARIMA(1,0,1)(0,0,0)[0] | : AIC=33.799, Time=0.05 sec |
| ARIMA(0,0,0)(0,0,0)[0] | : AIC=56.313, Time=0.01 sec |
| ARIMA(1,0,0)(0,0,0)[0] | : AIC=34.281, Time=0.03 sec |
| ARIMA(0,0,1)(0,0,0)[0] | : AIC=inf, Time=0.05 sec |

```
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarning: No supported index is available. Prediction results will be given with an integer index beginning at `start`.
```

```

    return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarn
ing: No supported index is available. In the next version, calling this method in a model
without a supported index will result in an exception.
    return get_prediction_index(

ARIMA(2,0,1)(0,0,0)[0]                : AIC=inf, Time=0.12 sec
ARIMA(1,0,2)(0,0,0)[0]                : AIC=inf, Time=0.15 sec
ARIMA(0,0,2)(0,0,0)[0]                : AIC=inf, Time=0.09 sec
ARIMA(2,0,0)(0,0,0)[0]                : AIC=35.648, Time=0.06 sec
ARIMA(2,0,2)(0,0,0)[0]                : AIC=inf, Time=0.18 sec
ARIMA(1,0,1)(0,0,0)[0] intercept    : AIC=inf, Time=0.15 sec

```

Best model: ARIMA(1,0,1)(0,0,0)[0]
Total fit time: 0.905 seconds

```

/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: ValueWarni
ng: No supported index is available. Prediction results will be given with an integer ind
ex beginning at `start`.
    return get_prediction_index(
/usr/local/lib/python3.10/dist-packages/statsmodels/tsa/base/tsa_model.py:836: FutureWarn
ing: No supported index is available. In the next version, calling this method in a model
without a supported index will result in an exception.
    return get_prediction_index(

```

In [39]:

```

#creating a dataframe of the mse array
MSEstate = pd.DataFrame(mse_values, columns=['State', 'MSE'])

```

In [40]:

```

#statistics of mse for all states
MSEstate.describe()

```

Out[40]:

| | MSE |
|-------|-----------|
| count | 49.000000 |
| mean | 0.131770 |
| std | 0.229311 |
| min | 0.004619 |
| 25% | 0.024314 |
| 50% | 0.049143 |
| 75% | 0.131105 |
| max | 1.381454 |

In [41]:

```

MSEstate['MSE'].median()

```

Out[41]:

0.04914265101050422

Least Squares Dummy Variable Regression (LSDV)

In [42]:

```

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=123
4)

```

In [43]:

```

#test-train-random split is better

```

```
import statsmodels.api as sm

# Adding a constant term to the features matrix (required for the intercept term)
X_olsdv = sm.add_constant(X_train)

# Fitting model
model_olsdv = sm.OLS(y_train, X_olsdv)
result_olsdv = model_olsdv.fit()

# Predicting on test set
X_test_olsdv = sm.add_constant(X_test)
y_pred_olsdv = result_olsdv.predict(X_test_olsdv)

# Calculating MSE
mse_olsdv = mean_squared_error(y_test, y_pred_olsdv)
```

In [44]:

```
#MSE for LSDV model
mse_olsdv
```

Out[44]:

0.3755572893787338

In [45]:

```
pip install tensorflow
```

```
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.15.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (24.3.25)
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.5.4)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (18.1.1)
Requirement already satisfied: ml-dtypes~=0.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.25.2)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow) (24.0)
Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.20.3)
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.4.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.11.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.36.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.62.2)
Requirement already satisfied: tensorboard<2.16,>=2.15 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.2)
```

Requirement already satisfied: tensorflow-estimator<2.16,>=2.15.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.0)
Requirement already satisfied: keras<2.16,>=2.15.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.15.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.10/dist-packages (from astunparse>=1.6.0->tensorflow) (0.43.0)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (2.27.0)
Requirement already satisfied: google-auth-oauthlib<2,>=0.5 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (1.2.0)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (3.6)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.16,>=2.15->tensorflow) (3.0.2)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->tensorflow) (5.3.3)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->tensorflow) (0.4.0)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->tensorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<2,>=0.5->tensorboard<2.16,>=2.15->tensorflow) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensorflow) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensorflow) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensorflow) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensorflow) (2024.2.2)
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorboard<2.16,>=2.15->tensorflow) (2.1.5)
Requirement already satisfied: pyasn1<0.7.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->tensorflow) (0.6.0)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth-oauthlib<2,>=0.5->tensorboard<2.16,>=2.15->tensorflow) (3.2.2)

Neural Network

In [46]:

```
#random splitting test and train data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1234)
```

In [47]:

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

# Defining the neural network model
model_nn = Sequential([
    Dense(64, activation='relu', input_shape=(X_train.shape[1],)),
    Dense(32, activation='relu'),
    Dense(1) # Output layer with 1 neuron for regression
])

# Compiling the model
model_nn.compile(optimizer='adam', loss='mean_squared_error')

# Training model
model_nn.fit(X_train, y_train, epochs=50, batch_size=32, verbose=0)
```

```
# Predicting on test set
y_pred_nn = model_nn.predict(X_test).flatten() # Flatten to convert to 1D array
```

```
# Calculating MSE
mse_nn = mean_squared_error(y_test, y_pred_nn)
```

```
4/4 [=====] - 0s 4ms/step
```

```
In [48]:
```

```
#Data loss
mse_nn
```

```
Out[48]:
```

```
86502.34578228462
```

```
In [49]:
```

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import EarlyStopping
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import StandardScaler

# Feature scaling
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Defining the neural network mode
model_nn = Sequential([
    Dense(64, activation='relu', input_shape=(X_train_scaled.shape[1],)),
    Dropout(0.2), # Dropout layer to prevent overfitting
    Dense(32, activation='relu'),
    Dropout(0.2),
    Dense(1) # Output layer with 1 neuron for regression
])

# Compiling the model
model_nn.compile(optimizer=Adam(learning_rate=0.001), loss='mean_squared_error')

# Defining early stopping criteria
early_stopping = EarlyStopping(monitor='val_loss', patience=5, restore_best_weights=True)

# Training the model with early stopping
history = model_nn.fit(X_train_scaled, y_train,
                       validation_split=0.2, # Use a portion of training data for validation
                       epochs=100,
                       batch_size=32,
                       callbacks=[early_stopping],
                       verbose=1)

# Predicting on the test set
y_pred_nn = model_nn.predict(X_test_scaled).flatten()

# Calculating MSE
mse_nn = mean_squared_error(y_test, y_pred_nn)
mse_nn
```

```
Epoch 1/100
12/12 [=====] - 2s 42ms/step - loss: 9.9764 - val_loss: 7.9305
Epoch 2/100
12/12 [=====] - 0s 9ms/step - loss: 5.9631 - val_loss: 4.2959
Epoch 3/100
12/12 [=====] - 0s 14ms/step - loss: 3.2923 - val_loss: 1.9696
Epoch 4/100
12/12 [=====] - 0s 13ms/step - loss: 1.7903 - val_loss: 0.8889
Epoch 5/100
12/12 [=====] - 0s 13ms/step - loss: 1.3447 - val_loss: 0.6801
Epoch 6/100
```

```
Epoch 6/100  
12/12 [=====] - 0s 10ms/step - loss: 0.9852 - val_loss: 0.5825  
Epoch 7/100  
12/12 [=====] - 0s 10ms/step - loss: 0.9432 - val_loss: 0.5157  
Epoch 8/100  
12/12 [=====] - 0s 14ms/step - loss: 0.9540 - val_loss: 0.4948  
Epoch 9/100  
12/12 [=====] - 0s 11ms/step - loss: 0.8354 - val_loss: 0.4816  
Epoch 10/100  
12/12 [=====] - 0s 10ms/step - loss: 0.8383 - val_loss: 0.4614  
Epoch 11/100  
12/12 [=====] - 0s 10ms/step - loss: 0.8076 - val_loss: 0.4427  
Epoch 12/100  
12/12 [=====] - 0s 15ms/step - loss: 0.8086 - val_loss: 0.4319  
Epoch 13/100  
12/12 [=====] - 0s 10ms/step - loss: 0.8004 - val_loss: 0.4125  
Epoch 14/100  
12/12 [=====] - 0s 9ms/step - loss: 0.7372 - val_loss: 0.4051  
Epoch 15/100  
12/12 [=====] - 0s 9ms/step - loss: 0.7271 - val_loss: 0.3979  
Epoch 16/100  
12/12 [=====] - 0s 8ms/step - loss: 0.6814 - val_loss: 0.3901  
Epoch 17/100  
12/12 [=====] - 0s 9ms/step - loss: 0.7469 - val_loss: 0.3806  
Epoch 18/100  
12/12 [=====] - 0s 13ms/step - loss: 0.7401 - val_loss: 0.3654  
Epoch 19/100  
12/12 [=====] - 0s 15ms/step - loss: 0.7062 - val_loss: 0.3624  
Epoch 20/100  
12/12 [=====] - 0s 9ms/step - loss: 0.6804 - val_loss: 0.3579  
Epoch 21/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6320 - val_loss: 0.3500  
Epoch 22/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6539 - val_loss: 0.3471  
Epoch 23/100  
12/12 [=====] - 0s 15ms/step - loss: 0.6271 - val_loss: 0.3368  
Epoch 24/100  
12/12 [=====] - 0s 9ms/step - loss: 0.6562 - val_loss: 0.3324  
Epoch 25/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6594 - val_loss: 0.3329  
Epoch 26/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6356 - val_loss: 0.3464  
Epoch 27/100  
12/12 [=====] - 0s 21ms/step - loss: 0.6314 - val_loss: 0.3165  
Epoch 28/100  
12/12 [=====] - 0s 8ms/step - loss: 0.6457 - val_loss: 0.3097  
Epoch 29/100  
12/12 [=====] - 0s 14ms/step - loss: 0.5495 - val_loss: 0.3085  
Epoch 30/100  
12/12 [=====] - 0s 8ms/step - loss: 0.5695 - val_loss: 0.3082  
Epoch 31/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6107 - val_loss: 0.2994  
Epoch 32/100  
12/12 [=====] - 0s 9ms/step - loss: 0.5241 - val_loss: 0.2963  
Epoch 33/100  
12/12 [=====] - 0s 11ms/step - loss: 0.6109 - val_loss: 0.2930  
Epoch 34/100  
12/12 [=====] - 0s 9ms/step - loss: 0.5578 - val_loss: 0.2896  
Epoch 35/100  
12/12 [=====] - 0s 10ms/step - loss: 0.6161 - val_loss: 0.2842  
Epoch 36/100  
12/12 [=====] - 0s 11ms/step - loss: 0.5517 - val_loss: 0.3058  
Epoch 37/100  
12/12 [=====] - 0s 11ms/step - loss: 0.5585 - val_loss: 0.3016  
Epoch 38/100  
12/12 [=====] - 0s 10ms/step - loss: 0.5418 - val_loss: 0.2835  
Epoch 39/100  
12/12 [=====] - 0s 14ms/step - loss: 0.5021 - val_loss: 0.2781  
Epoch 40/100  
12/12 [=====] - 0s 12ms/step - loss: 0.5558 - val_loss: 0.2929  
Epoch 41/100  
12/12 [=====] - 0s 13ms/step - loss: 0.5209 - val_loss: 0.2817  
Epoch 42/100
```

```
Epoch 42/100
12/12 [=====] - 0s 10ms/step - loss: 0.5356 - val_loss: 0.2754
Epoch 43/100
12/12 [=====] - 0s 12ms/step - loss: 0.4715 - val_loss: 0.2806
Epoch 44/100
12/12 [=====] - 0s 25ms/step - loss: 0.5075 - val_loss: 0.2860
Epoch 45/100
12/12 [=====] - 0s 22ms/step - loss: 0.5379 - val_loss: 0.2834
Epoch 46/100
12/12 [=====] - 0s 10ms/step - loss: 0.5083 - val_loss: 0.2831
Epoch 47/100
12/12 [=====] - 0s 16ms/step - loss: 0.5306 - val_loss: 0.2731
Epoch 48/100
12/12 [=====] - 0s 12ms/step - loss: 0.4956 - val_loss: 0.2690
Epoch 49/100
12/12 [=====] - 0s 13ms/step - loss: 0.5005 - val_loss: 0.2696
Epoch 50/100
12/12 [=====] - 0s 15ms/step - loss: 0.5127 - val_loss: 0.2693
Epoch 51/100
12/12 [=====] - 0s 24ms/step - loss: 0.4982 - val_loss: 0.2753
Epoch 52/100
12/12 [=====] - 0s 19ms/step - loss: 0.5271 - val_loss: 0.2738
Epoch 53/100
12/12 [=====] - 0s 22ms/step - loss: 0.5490 - val_loss: 0.2765
4/4 [=====] - 0s 6ms/step
```

Out[49]:

0.30846181316333937

In [49]:

CNN

In [50]:

```
train_data = weather[(weather['year'] > 2009) & (weather['year'] <= 2019)]
test_data = weather[weather['year'] > 2019]
#didn't split the data this way for others as the mse was higher
```

In [51]:

```
X_train = train_data.drop(['percentage', 'state'], axis=1)
y_train = train_data['percentage']
```

In [52]:

```
X_test = test_data.drop(['percentage', 'state'], axis=1)
y_test = test_data['percentage']
```

In [53]:

```
import numpy as np
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv1D, MaxPooling1D, Flatten, Dense

# Reshaping data for CNN input (assuming 1D time series)
X_train_resaped = X_train.values.reshape(X_train.shape[0], X_train.shape[1], 1)
X_test_resaped = X_test.values.reshape(X_test.shape[0], X_test.shape[1], 1)

# Defining the CNN model
model = Sequential([
    Conv1D(filters=64, kernel_size=3, activation='relu', input_shape=(X_train.shape[1],
1)),
    MaxPooling1D(pool_size=2),
    Conv1D(filters=32, kernel_size=3, activation='relu'),
    MaxPooling1D(pool_size=2),
    Flatten(),
```

```
Dense(50, activation='relu'),
Dense(1) # Output layer (1 neuron for regression)
])

# Compiling the model
model.compile(optimizer='adam', loss='mse')

# Training the model
model.fit(X_train_reshaped, y_train, epochs=10, batch_size=32, validation_split=0.1)
```

Epoch 1/10
14/14 [=====] - 3s 33ms/step - loss: 38222757888.0000 - val_loss : 1494652672.0000
Epoch 2/10
14/14 [=====] - 0s 18ms/step - loss: 3474200576.0000 - val_loss: 3250160.7500
Epoch 3/10
14/14 [=====] - 0s 13ms/step - loss: 724311360.0000 - val_loss: 53229368.0000
Epoch 4/10
14/14 [=====] - 0s 14ms/step - loss: 93558664.0000 - val_loss: 9196822.0000
Epoch 5/10
14/14 [=====] - 0s 12ms/step - loss: 11458955.0000 - val_loss: 708069.0625
Epoch 6/10
14/14 [=====] - 0s 20ms/step - loss: 4453759.5000 - val_loss: 983876.8750
Epoch 7/10
14/14 [=====] - 0s 9ms/step - loss: 1939142.3750 - val_loss: 110881.7891
Epoch 8/10
14/14 [=====] - 0s 13ms/step - loss: 280994.6250 - val_loss: 3944.2549
Epoch 9/10
14/14 [=====] - 0s 10ms/step - loss: 83481.7578 - val_loss: 11828.2451
Epoch 10/10
14/14 [=====] - 0s 18ms/step - loss: 51571.5742 - val_loss: 23511.5254

Out[53]:

<keras.src.callbacks.History at 0x7f94e2f84a30>

In [54]:

```
X_test.head()
```

Out[54]:

| | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prcp | yearly_min_prcp | yearly_max |
|----|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|
| 10 | 2021 | 9.310833 | 75.4 | -30.4 | 32.662500 | 3.027500 | 2.00 | |
| 11 | 2022 | 6.554167 | 74.3 | -23.1 | 35.154167 | 3.630000 | 0.89 | |
| 22 | 2021 | 0.100000 | 91.3 | 31.9 | 65.120000 | 5.516667 | 1.57 | |
| 23 | 2022 | 0.094167 | 95.3 | 28.4 | 65.145000 | 4.730833 | 2.36 | |
| 34 | 2021 | 0.952500 | 93.7 | 20.9 | 62.807500 | 3.911667 | 1.77 | |

In [55]:

```
#Predicting on test data
y_predcnn = model.predict(X_test_reshaped)
mse_cnn = mean_squared_error(y_test, y_predcnn)
mse_cnn # MSE for CNNmodel
```

4/4 [=====] - 0s 6ms/step

Out[55]:

62773.63033925313

In [55]:

SVM

In [56]:

```
#random splitting the data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1234)
```

In [57]:

```
#test-train-random split is better
from sklearn.svm import SVR
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import make_pipeline

# Defining the SVR model with a radial basis function (RBF) kernel
svm_model = make_pipeline(StandardScaler(), SVR(kernel='rbf', C=5, gamma=0.1, epsilon=0.02))

# Training SVR model
svm_model.fit(X_train, y_train)

# Predicting on test set
y_pred_svm = svm_model.predict(X_test)

# Calculating MSE
mse_svm = mean_squared_error(y_test, y_pred_svm)
mse_svm #MSE for SVM model
```

Out[57]:

0.1597960748805673

In [58]:

```
#MAE
from sklearn.metrics import mean_absolute_error
mae = mean_absolute_error(y_test, y_pred_svm)
print(mae)
```

0.31048027718968196

Desicion Tree

In [59]:

```
#random split for train-test data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=1234)
```

In [60]:

```
#creating instance of Decision tree
from sklearn import tree
myTree = tree.DecisionTreeRegressor(max_depth=2)
```

In [61]:

```
#fitting the desicion tree
```

```
#test-train-random split is better
myTree.fit(X_train,y_train)
```

Out[61]:

```
▼ DecisionTreeRegressor
DecisionTreeRegressor(max_depth=2)
```

In [62]:

```
#predicting for test data
y_preddt = myTree.predict(X_test)
```

In [63]:

```
#MSE for Desicion tree model
mse_dt = mean_squared_error(y_test, y_preddt)
mse_dt
```

Out[63]:

0.5027920725953638

In [63]:

GBM

In [64]:

```
#random split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=123
4)
```

In [65]:

```
from sklearn.ensemble import GradientBoostingRegressor
```

In [66]:

```
#creating instance of GBM
gbm = GradientBoostingRegressor()
```

In [67]:

```
#fitting GBM on train data
gbm.fit(X_train, y_train)
```

Out[67]:

```
▼ GradientBoostingRegressor
GradientBoostingRegressor()
```

In [68]:

```
#predicting on test data
y_predgbm = gbm.predict(X_test)
```

In [69]:

```
#MSE for GBM
mse_gbm = mean_squared_error(y_test, y_predgbm)
mse_gbm
```

Out[69]:

0.14632775162943512

In [69]:

Random Forest

In [70]:

```
#random split for train-test data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,random_state=1234)
```

In [71]:

```
from sklearn.ensemble import RandomForestRegressor

# Creating a Random Forest Regressor instance
rf_regressor = RandomForestRegressor(n_estimators=100, max_depth=20, max_features= "log2", random_state=42)

# Training the model
rf_regressor.fit(X_train, y_train)

# predicting on test
y_predrf = rf_regressor.predict(X_test)

# MSE for Random Forest
msef = mean_squared_error(y_test, y_predrf)
```

In [72]:

```
X_test.head()
```

Out[72]:

| | year | yearly_avg_snow | yearly_max_temp | yearly_min_temp | yearly_avg_temp | yearly_avg_prctp | yearly_min_prctp | yearly_ma |
|-----|------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|-----------|
| 585 | 2019 | 7.970000 | 90.2 | 0.9 | 42.965833 | 1.085000 | 0.31 | |
| 29 | 2015 | 0.708333 | 94.4 | 21.5 | 62.676667 | 5.410000 | 1.26 | |
| 270 | 2016 | 0.614167 | 91.1 | 17.3 | 58.365000 | 3.440833 | 0.63 | |
| 100 | 2014 | 0.216667 | 93.3 | 25.7 | 64.366667 | 3.849167 | 2.46 | |
| 278 | 2012 | 0.000000 | 94.1 | 35.5 | 66.460000 | 4.881667 | 1.48 | |

In [73]:

```
mserf
```

Out[73]:

0.10695543368689359

In [74]:

```
#MAE for random forest
from sklearn.metrics import mean_absolute_error
mae = mean_absolute_error(y_test,y_predrf)
print(mae)
```

0.23247561613192894

Models mse

Random Forest 0.4000 / 0.4000 (0.000000)

Radom Forest: 0.1062 (random split)

ARIMA : 0.1318 (mean of each state)

GBM: 0.1493 (random split)

SVM: 0.1802 (random split)

NN: 0.3109 (random split) Data loss (4541636.17)

CNN: Data loss (10751.13)

Linear reg: 0.3775 (random split)

LSDM : 0.3775 (random split)

Desicion tree: 0.5027 (random split)

In [75]:

```
#END
```

In []: