In [1]:

```python
import os
os.chdir('C:\\Users\\LENOVO\\Downloads')
```

In [2]:

```python
import pandas as pd
#Load the data
file_path = 'null.csv'
data = pd.read_csv(file_path)
#Display the first few rows of the dataframe
data.head()
```

Out[2]:

	Month_Year	Area Type	Borough_SNT	Area name	Area code	Offence Group	Offence Subgroup	Measure	Financial Year	FY_FYIndex	Count
0	2023-04-01	Borough	Aviation Security(SO18)	Aviation Security(SO18)	SO18	Arson and Criminal Damage	Criminal Damage	Offences	fy23-24	fy23-24_07	3
1	2023-04-01	Borough	Aviation Security(SO18)	Aviation Security(SO18)	SO18	Drug Offences	Drug Trafficking	Offences	fy23-24	fy23-24_07	1
2	2023-04-01	Borough	Aviation Security(SO18)	Aviation Security(SO18)	SO18	Drug Offences	Possession of Drugs	Offences	fy23-24	fy23-24_07	4
3	2023-04-01	Borough	Aviation Security(SO18)	Aviation Security(SO18)	SO18	Drug Offences	Possession of Drugs	Outcomes	fy23-24	fy23-24_07	3
4	2023-04-01	Borough	Aviation Security(SO18)	Aviation Security(SO18)	SO18	Miscellaneous Crimes Against Society	Making, Supplying or Possessing Articles for u...	Offences	fy23-24	fy23-24_07	2

In [3]:

```python
#Convert 'Month_Year' to datetime format
data['Month_Year'] = pd.to_datetime(data['Month_Year'])
#Aggregate the data by 'Month_Year', summing up the 'Count' column
time_series_data = data.groupby('Month_Year')['Count'].sum().reset_index()
#Sort the data based on 'Month_Year'
time_series_data = time_series_data.sort_values('Month_Year')
#Display the aggregated time series
time_series_data.head()
```

Out[3]:

	Month_Year	Count
0	2023-04-01	169034
1	2023-05-01	185152
2	2023-06-01	191128
3	2023-07-01	188698

In [4]:

```python
#Check the range of dates to confirm if any are missing
date_range = pd.date_range(start=time_series_data['Month_Year'].min(),
                           end=time_series_data['Month_Year'].max(),
                           freq='MS')  # 'MS' stands for Month Start frequency
#Identify if there are any missing months in the data
missing_dates = date_range.difference(time_series_data['Month_Year'])
missing_dates
```

Out[4]:

```
DatetimeIndex([], dtype='datetime64[ns]', freq='MS')
```

In [5]:

```python
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
#Splitting the data: 75% for training and 25% for testing
train_data, test_data = train_test_split(time_series_data, test_size=0.25, shuffle=False)
#Normalizing the data
scaler = MinMaxScaler(feature_range=(0, 1))
train_scaled = scaler.fit_transform(train_data['Count'].values.reshape(-1, 1))
test_scaled = scaler.transform(test_data['Count'].values.reshape(-1, 1))
# Reshaping the data to fit the RNN input requirements
# RNNs require input shape of the form [samples, time steps, features]
# Here, each sample is one month, and we have one feature - the count
#We have only one feature, so we reshape the data to [samples, time steps=1, features=1]
train_scaled = train_scaled.reshape((train_scaled.shape[0], 1, train_scaled.shape[1]))
test_scaled = test_scaled.reshape((test_scaled.shape[0], 1, test_scaled.shape[1]))
#Check the shapes of the processed data
(train_scaled.shape, test_scaled.shape)
```

Out[5]:

```
((3, 1, 1), (1, 1, 1))
```

In [6]:

```python
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, Dense
from tensorflow.keras.callbacks import EarlyStopping
#Define the LSTM model
model = Sequential()
model.add(LSTM(units=8, input_shape=(train_scaled.shape[1], train_scaled.shape[2])))
model.add(Dense(1))
model.compile(optimizer='adam', loss='mean_squared_error', metrics=['mae'])
#Early stopping callback to prevent overfitting
early_stopping = EarlyStopping(monitor='val_loss', patience=10, restore_best_weights=True)
#Train the model with validation split
history = model.fit(
    train_scaled,
    train_scaled[:, :, 0],  # The target is the same as the input in this case
    epochs=200,
    batch_size=1,
    verbose=1,
    validation_split=0.2,  # Use part of the training data for validation
    callbacks=[early_stopping]
)
#Evaluate the model on training data
train_mae = model.evaluate(train_scaled, train_scaled[:, :, 0], verbose=0)[1]
#Evaluate the model on test data
test_mae = model.evaluate(test_scaled, test_scaled[:, :, 0], verbose=0)[1]
print(f'Train MAE: {train_mae}')
print(f'Test MAE: {test_mae}')
```

```
Epoch 1/200
2/2 [==============================] - 2s 586ms/step - loss: 0.1860 - mae: 0.3050 - val_loss: 0.7030 - val_mae: 0.8385
Epoch 2/200
2/2 [==============================] - 0s 40ms/step - loss: 0.1846 - mae: 0.3054 - val_loss: 0.6934 - val_mae: 0.8327
Epoch 3/200
2/2 [==============================] - 0s 30ms/step - loss: 0.1804 - mae: 0.3026 - val_loss: 0.6854 - val_mae: 0.8279
Epoch 4/200
2/2 [==============================] - 0s 41ms/step - loss: 0.1790 - mae: 0.3035 - val_loss: 0.6762 - val_mae: 0.8223
Epoch 5/200
2/2 [==============================] - 0s 33ms/step - loss: 0.1762 - mae: 0.3025 - val_loss: 0.6673 - val_mae: 0.8169
Epoch 6/200
2/2 [==============================] - 0s 13ms/step - loss: 0.1722 - mae: 0.2998 - val_loss: 0.6592 - val_mae: 0.8119
Epoch 7/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1709 - mae: 0.3007 - val_loss: 0.6504 - val_mae: 0.8065
Epoch 8/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1682 - mae: 0.2997 - val_loss: 0.6416 - val_mae: 0.8010
Epoch 9/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1655 - mae: 0.2988 - val_loss: 0.6330 - val_mae: 0.7956
Epoch 10/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1629 - mae: 0.2978 - val_loss: 0.6245 - val_mae: 0.7903
Epoch 11/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1603 - mae: 0.2969 - val_loss: 0.6161 - val_mae: 0.7849
Epoch 12/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1578 - mae: 0.2959 - val_loss: 0.6078 - val_mae: 0.7796
Epoch 13/200
2/2 [==============================] - 0s 34ms/step - loss: 0.1553 - mae: 0.2950 - val_loss: 0.5995 - val_mae: 0.7743
Epoch 14/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1517 - mae: 0.2923 - val_loss: 0.5920 - val_mae: 0.7694
Epoch 15/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1494 - mae: 0.2914 - val_loss: 0.5844 - val_mae: 0.7645
Epoch 16/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1472 - mae: 0.2905 - val_loss: 0.5767 - val_mae: 0.7594
Epoch 17/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1449 - mae: 0.2896 - val_loss: 0.5690 - val_mae: 0.7543
Epoch 18/200
2/2 [==============================] - 0s 16ms/step - loss: 0.1426 - mae: 0.2887 - val_loss: 0.5613 - val_mae: 0.7492
Epoch 19/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1416 - mae: 0.2895 - val_loss: 0.5529 - val_mae: 0.7435
Epoch 20/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1380 - mae: 0.2867 - val_loss: 0.5453 - val_mae: 0.7384
Epoch 21/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1370 - mae: 0.2876 - val_loss: 0.5370 - val_mae: 0.7328
Epoch 22/200
2/2 [==============================] - 0s 40ms/step - loss: 0.1346 - mae: 0.2865 - val_loss: 0.5289 - val_mae: 0.7272
Epoch 23/200
2/2 [==============================] - 0s 24ms/step - loss: 0.1323 - mae: 0.2855 - val_loss: 0.5209 - val_mae: 0.7217
Epoch 24/200
2/2 [==============================] - 0s 33ms/step - loss: 0.1300 - mae: 0.2844 - val_loss: 0.5130 - val_mae: 0.7162
Epoch 25/200
2/2 [==============================] - 0s 33ms/step - loss: 0.1278 - mae: 0.2834 - val_loss: 0.5052 - val_mae: 0.7108
Epoch 26/200
2/2 [==============================] - 0s 33ms/step - loss: 0.1246 - mae: 0.2807 - val_loss: 0.4982 - val_mae: 0.7058
Epoch 27/200
2/2 [==============================] - 0s 29ms/step - loss: 0.1237 - mae: 0.2814 - val_loss: 0.4904 - val_mae: 0.7003
Epoch 28/200
2/2 [==============================] - 0s 29ms/step - loss: 0.1205 - mae: 0.2787 - val_loss: 0.4834 - val_mae: 0.6953
Epoch 29/200
2/2 [==============================] - 0s 48ms/step - loss: 0.1186 - mae: 0.2777 - val_loss: 0.4764 - val_mae: 0.6902
Epoch 30/200
2/2 [==============================] - 0s 23ms/step - loss: 0.1167 - mae: 0.2767 - val_loss: 0.4694 - val_mae: 0.6851
Epoch 31/200
2/2 [==============================] - 0s 36ms/step - loss: 0.1159 - mae: 0.2775 - val_loss: 0.4617 - val_mae: 0.6795
Epoch 32/200
2/2 [==============================] - 0s 15ms/step - loss: 0.1138 - mae: 0.2764 - val_loss: 0.4541 - val_mae: 0.6738
Epoch 33/200
2/2 [==============================] - 0s 16ms/step - loss: 0.1107 - mae: 0.2736 - val_loss: 0.4473 - val_mae: 0.6688
Epoch 34/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1100 - mae: 0.2743 - val_loss: 0.4398 - val_mae: 0.6632
Epoch 35/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1070 - mae: 0.2715 - val_loss: 0.4331 - val_mae: 0.6581
Epoch 36/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1052 - mae: 0.2704 - val_loss: 0.4265 - val_mae: 0.6530
Epoch 37/200
2/2 [==============================] - 0s 47ms/step - loss: 0.1045 - mae: 0.2711 - val_loss: 0.4191 - val_mae: 0.6474
Epoch 38/200
2/2 [==============================] - 0s 31ms/step - loss: 0.1026 - mae: 0.2700 - val_loss: 0.4118 - val_mae: 0.6417
Epoch 39/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0998 - mae: 0.2672 - val_loss: 0.4054 - val_mae: 0.6367
Epoch 40/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0982 - mae: 0.2661 - val_loss: 0.3990 - val_mae: 0.6317
Epoch 41/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0975 - mae: 0.2668 - val_loss: 0.3919 - val_mae: 0.6260
Epoch 42/200
2/2 [==============================] - 0s 47ms/step - loss: 0.0948 - mae: 0.2640 - val_loss: 0.3856 - val_mae: 0.6210
Epoch 43/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0942 - mae: 0.2646 - val_loss: 0.3786 - val_mae: 0.6153
Epoch 44/200
2/2 [==============================] - 0s 43ms/step - loss: 0.0925 - mae: 0.2634 - val_loss: 0.3718 - val_mae: 0.6098
Epoch 45/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0908 - mae: 0.2622 - val_loss: 0.3651 - val_mae: 0.6043
Epoch 46/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0882 - mae: 0.2595 - val_loss: 0.3593 - val_mae: 0.5994
Epoch 47/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0877 - mae: 0.2600 - val_loss: 0.3527 - val_mae: 0.5939
Epoch 48/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0853 - mae: 0.2573 - val_loss: 0.3469 - val_mae: 0.5890
Epoch 49/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0839 - mae: 0.2562 - val_loss: 0.3411 - val_mae: 0.5841
Epoch 50/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0825 - mae: 0.2551 - val_loss: 0.3354 - val_mae: 0.5791
Epoch 51/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0812 - mae: 0.2540 - val_loss: 0.3296 - val_mae: 0.5741
Epoch 52/200
2/2 [==============================] - 0s 24ms/step - loss: 0.0807 - mae: 0.2545 - val_loss: 0.3232 - val_mae: 0.5685
Epoch 53/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0784 - mae: 0.2518 - val_loss: 0.3176 - val_mae: 0.5636
Epoch 54/200
2/2 [==============================] - 0s 16ms/step - loss: 0.0771 - mae: 0.2507 - val_loss: 0.3120 - val_mae: 0.5586
Epoch 55/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0758 - mae: 0.2496 - val_loss: 0.3065 - val_mae: 0.5536
Epoch 56/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0746 - mae: 0.2484 - val_loss: 0.3010 - val_mae: 0.5487
Epoch 57/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0733 - mae: 0.2473 - val_loss: 0.2956 - val_mae: 0.5437
Epoch 58/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0721 - mae: 0.2462 - val_loss: 0.2902 - val_mae: 0.5387
Epoch 59/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0709 - mae: 0.2451 - val_loss: 0.2849 - val_mae: 0.5337
Epoch 60/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0698 - mae: 0.2439 - val_loss: 0.2796 - val_mae: 0.5288
Epoch 61/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0686 - mae: 0.2428 - val_loss: 0.2744 - val_mae: 0.5238
Epoch 62/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0683 - mae: 0.2432 - val_loss: 0.2686 - val_mae: 0.5183
Epoch 63/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0671 - mae: 0.2419 - val_loss: 0.2630 - val_mae: 0.5129
Epoch 64/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0651 - mae: 0.2392 - val_loss: 0.2582 - val_mae: 0.5082
Epoch 65/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0641 - mae: 0.2381 - val_loss: 0.2535 - val_mae: 0.5035
Epoch 66/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0639 - mae: 0.2384 - val_loss: 0.2482 - val_mae: 0.4982
Epoch 67/200
2/2 [==============================] - 0s 26ms/step - loss: 0.0621 - mae: 0.2358 - val_loss: 0.2437 - val_mae: 0.4936
Epoch 68/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0618 - mae: 0.2360 - val_loss: 0.2385 - val_mae: 0.4884
Epoch 69/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0601 - mae: 0.2335 - val_loss: 0.2342 - val_mae: 0.4839
Epoch 70/200
2/2 [==============================] - 0s 38ms/step - loss: 0.0592 - mae: 0.2324 - val_loss: 0.2299 - val_mae: 0.4795
Epoch 71/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0583 - mae: 0.2313 - val_loss: 0.2256 - val_mae: 0.4750
Epoch 72/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0581 - mae: 0.2315 - val_loss: 0.2207 - val_mae: 0.4698
Epoch 73/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0572 - mae: 0.2302 - val_loss: 0.2161 - val_mae: 0.4648
Epoch 74/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0556 - mae: 0.2278 - val_loss: 0.2121 - val_mae: 0.4606
Epoch 75/200
2/2 [==============================] - 0s 46ms/step - loss: 0.0555 - mae: 0.2279 - val_loss: 0.2076 - val_mae: 0.4557
Epoch 76/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0540 - mae: 0.2255 - val_loss: 0.2039 - val_mae: 0.4515
Epoch 77/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0538 - mae: 0.2256 - val_loss: 0.1995 - val_mae: 0.4467
Epoch 78/200
2/2 [==============================] - 0s 14ms/step - loss: 0.0525 - mae: 0.2232 - val_loss: 0.1959 - val_mae: 0.4426
Epoch 79/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0523 - mae: 0.2233 - val_loss: 0.1918 - val_mae: 0.4379
Epoch 80/200
2/2 [==============================] - 0s 16ms/step - loss: 0.0515 - mae: 0.2220 - val_loss: 0.1877 - val_mae: 0.4333
Epoch 81/200
2/2 [==============================] - 0s 17ms/step - loss: 0.0503 - mae: 0.2198 - val_loss: 0.1844 - val_mae: 0.4294
Epoch 82/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0501 - mae: 0.2198 - val_loss: 0.1805 - val_mae: 0.4248
Epoch 83/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0494 - mae: 0.2186 - val_loss: 0.1767 - val_mae: 0.4204
Epoch 84/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0487 - mae: 0.2174 - val_loss: 0.1731 - val_mae: 0.4160
Epoch 85/200
2/2 [==============================] - 0s 37ms/step - loss: 0.0476 - mae: 0.2153 - val_loss: 0.1701 - val_mae: 0.4124
Epoch 86/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0474 - mae: 0.2152 - val_loss: 0.1665 - val_mae: 0.4081
Epoch 87/200
2/2 [==============================] - 0s 28ms/step - loss: 0.0468 - mae: 0.2140 - val_loss: 0.1631 - val_mae: 0.4038
Epoch 88/200
2/2 [==============================] - 0s 27ms/step - loss: 0.0462 - mae: 0.2129 - val_loss: 0.1597 - val_mae: 0.3997
Epoch 89/200
2/2 [==============================] - 0s 35ms/step - loss: 0.0452 - mae: 0.2109 - val_loss: 0.1570 - val_mae: 0.3962
Epoch 90/200
2/2 [==============================] - 0s 35ms/step - loss: 0.0450 - mae: 0.2107 - val_loss: 0.1538 - val_mae: 0.3921
Epoch 91/200
2/2 [==============================] - 0s 27ms/step - loss: 0.0441 - mae: 0.2087 - val_loss: 0.1511 - val_mae: 0.3887
Epoch 92/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0440 - mae: 0.2086 - val_loss: 0.1480 - val_mae: 0.3847
Epoch 93/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0431 - mae: 0.2066 - val_loss: 0.1454 - val_mae: 0.3813
Epoch 94/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0429 - mae: 0.2064 - val_loss: 0.1424 - val_mae: 0.3773
Epoch 95/200
2/2 [==============================] - 0s 37ms/step - loss: 0.0421 - mae: 0.2045 - val_loss: 0.1399 - val_mae: 0.3741
Epoch 96/200
2/2 [==============================] - 0s 18ms/step - loss: 0.0416 - mae: 0.2034 - val_loss: 0.1375 - val_mae: 0.3708
Epoch 97/200
2/2 [==============================] - 0s 41ms/step - loss: 0.0411 - mae: 0.2024 - val_loss: 0.1350 - val_mae: 0.3674
Epoch 98/200
2/2 [==============================] - 0s 21ms/step - loss: 0.0407 - mae: 0.2014 - val_loss: 0.1326 - val_mae: 0.3641
Epoch 99/200
2/2 [==============================] - 0s 19ms/step - loss: 0.0402 - mae: 0.2004 - val_loss: 0.1302 - val_mae: 0.3608
Epoch 100/200
2/2 [==============================] - 0s 17ms/step - loss: 0.0398 - mae: 0.1993 - val_loss: 0.1278 - val_mae: 0.3575
Epoch 101/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0394 - mae: 0.1983 - val_loss: 0.1254 - val_mae: 0.3541
Epoch 102/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0393 - mae: 0.1981 - val_loss: 0.1226 - val_mae: 0.3502
Epoch 103/200
2/2 [==============================] - 0s 48ms/step - loss: 0.0385 - mae: 0.1962 - val_loss: 0.1204 - val_mae: 0.3471
Epoch 104/200
2/2 [==============================] - 0s 35ms/step - loss: 0.0381 - mae: 0.1952 - val_loss: 0.1183 - val_mae: 0.3439
Epoch 105/200
2/2 [==============================] - 0s 22ms/step - loss: 0.0380 - mae: 0.1949 - val_loss: 0.1157 - val_mae: 0.3401
Epoch 106/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0373 - mae: 0.1931 - val_loss: 0.1137 - val_mae: 0.3371
Epoch 107/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0371 - mae: 0.1927 - val_loss: 0.1112 - val_mae: 0.3335
Epoch 108/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0367 - mae: 0.1916 - val_loss: 0.1089 - val_mae: 0.3300
Epoch 109/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0361 - mae: 0.1899 - val_loss: 0.1071 - val_mae: 0.3272
Epoch 110/200
2/2 [==============================] - 0s 23ms/step - loss: 0.0357 - mae: 0.1890 - val_loss: 0.1053 - val_mae: 0.3245
Epoch 111/200
2/2 [==============================] - 0s 20ms/step - loss: 0.0354 - mae: 0.1880 - val_loss: 0.1035 - val_mae: 0.3217
Epoch 112/200
2/2 [==============================] - 0s 19ms/step - loss: 0.0351 - mae: 0.1870 - val_loss: 0.1017 - val_mae: 0.3189
Epoch 113/200
2/2 [==============================] - 0s 20ms/step - loss: 0.0347 - mae: 0.1861 - val_loss: 0.0999 - val_mae: 0.3161
Epoch 114/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0344 - mae: 0.1851 - val_loss: 0.0982 - val_mae: 0.3133
Epoch 115/200
2/2 [==============================] - 0s 38ms/step - loss: 0.0342 - mae: 0.1847 - val_loss: 0.0961 - val_mae: 0.3099
Epoch 116/200
2/2 [==============================] - 0s 21ms/step - loss: 0.0339 - mae: 0.1836 - val_loss: 0.0941 - val_mae: 0.3067
Epoch 117/200
2/2 [==============================] - 0s 35ms/step - loss: 0.0335 - mae: 0.1825 - val_loss: 0.0921 - val_mae: 0.3036
Epoch 118/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0332 - mae: 0.1815 - val_loss: 0.0903 - val_mae: 0.3005
Epoch 119/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0328 - mae: 0.1804 - val_loss: 0.0886 - val_mae: 0.2976
Epoch 120/200
2/2 [==============================] - 0s 25ms/step - loss: 0.0324 - mae: 0.1791 - val_loss: 0.0873 - val_mae: 0.2954
Epoch 121/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0322 - mae: 0.1785 - val_loss: 0.0856 - val_mae: 0.2925
Epoch 122/200
2/2 [==============================] - 0s 18ms/step - loss: 0.0319 - mae: 0.1775 - val_loss: 0.0839 - val_mae: 0.2897
Epoch 123/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0316 - mae: 0.1765 - val_loss: 0.0824 - val_mae: 0.2870
Epoch 124/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0313 - mae: 0.1755 - val_loss: 0.0809 - val_mae: 0.2844
Epoch 125/200
2/2 [==============================] - 0s 24ms/step - loss: 0.0309 - mae: 0.1743 - val_loss: 0.0798 - val_mae: 0.2824
Epoch 126/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0307 - mae: 0.1737 - val_loss: 0.0783 - val_mae: 0.2798
Epoch 127/200
2/2 [==============================] - 0s 19ms/step - loss: 0.0304 - mae: 0.1727 - val_loss: 0.0769 - val_mae: 0.2772
Epoch 128/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0301 - mae: 0.1718 - val_loss: 0.0755 - val_mae: 0.2748
Epoch 129/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0297 - mae: 0.1706 - val_loss: 0.0745 - val_mae: 0.2729
Epoch 130/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0295 - mae: 0.1700 - val_loss: 0.0731 - val_mae: 0.2705
Epoch 131/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0292 - mae: 0.1688 - val_loss: 0.0722 - val_mae: 0.2686
Epoch 132/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0290 - mae: 0.1682 - val_loss: 0.0708 - val_mae: 0.2662
Epoch 133/200
2/2 [==============================] - 0s 40ms/step - loss: 0.0286 - mae: 0.1670 - val_loss: 0.0699 - val_mae: 0.2644
Epoch 134/200
2/2 [==============================] - 0s 28ms/step - loss: 0.0284 - mae: 0.1662 - val_loss: 0.0689 - val_mae: 0.2625
Epoch 135/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0281 - mae: 0.1654 - val_loss: 0.0679 - val_mae: 0.2607
Epoch 136/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0279 - mae: 0.1647 - val_loss: 0.0666 - val_mae: 0.2581
Epoch 137/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0276 - mae: 0.1636 - val_loss: 0.0657 - val_mae: 0.2563
Epoch 138/200
2/2 [==============================] - 0s 21ms/step - loss: 0.0274 - mae: 0.1629 - val_loss: 0.0645 - val_mae: 0.2539
Epoch 139/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0271 - mae: 0.1620 - val_loss: 0.0633 - val_mae: 0.2515
Epoch 140/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0269 - mae: 0.1610 - val_loss: 0.0621 - val_mae: 0.2492
Epoch 141/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0266 - mae: 0.1600 - val_loss: 0.0613 - val_mae: 0.2477
Epoch 142/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0263 - mae: 0.1593 - val_loss: 0.0602 - val_mae: 0.2454
Epoch 143/200
2/2 [==============================] - 0s 28ms/step - loss: 0.0261 - mae: 0.1583 - val_loss: 0.0595 - val_mae: 0.2438
Epoch 144/200
2/2 [==============================] - 0s 43ms/step - loss: 0.0258 - mae: 0.1576 - val_loss: 0.0584 - val_mae: 0.2416
Epoch 145/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0256 - mae: 0.1566 - val_loss: 0.0573 - val_mae: 0.2395
Epoch 146/200
2/2 [==============================] - 0s 40ms/step - loss: 0.0253 - mae: 0.1557 - val_loss: 0.0566 - val_mae: 0.2380
Epoch 147/200
2/2 [==============================] - 0s 157ms/step - loss: 0.0251 - mae: 0.1549 - val_loss: 0.0556 - val_mae: 0.2358
Epoch 148/200
2/2 [==============================] - 0s 115ms/step - loss: 0.0249 - mae: 0.1540 - val_loss: 0.0547 - val_mae: 0.2338
Epoch 149/200
2/2 [==============================] - 0s 107ms/step - loss: 0.0246 - mae: 0.1531 - val_loss: 0.0537 - val_mae: 0.2318
Epoch 150/200
2/2 [==============================] - 0s 102ms/step - loss: 0.0244 - mae: 0.1522 - val_loss: 0.0531 - val_mae: 0.2305
Epoch 151/200
2/2 [==============================] - 0s 128ms/step - loss: 0.0241 - mae: 0.1515 - val_loss: 0.0522 - val_mae: 0.2284
Epoch 152/200
2/2 [==============================] - 0s 112ms/step - loss: 0.0239 - mae: 0.1506 - val_loss: 0.0516 - val_mae: 0.2271
Epoch 153/200
2/2 [==============================] - 0s 99ms/step - loss: 0.0237 - mae: 0.1498 - val_loss: 0.0509 - val_mae: 0.2257
Epoch 154/200
2/2 [==============================] - 0s 112ms/step - loss: 0.0234 - mae: 0.1490 - val_loss: 0.0503 - val_mae: 0.2242
Epoch 155/200
2/2 [==============================] - 0s 126ms/step - loss: 0.0232 - mae: 0.1482 - val_loss: 0.0496 - val_mae: 0.2227
Epoch 156/200
2/2 [==============================] - 0s 109ms/step - loss: 0.0230 - mae: 0.1475 - val_loss: 0.0487 - val_mae: 0.2206
Epoch 157/200
2/2 [==============================] - 0s 127ms/step - loss: 0.0227 - mae: 0.1466 - val_loss: 0.0478 - val_mae: 0.2186
Epoch 158/200
2/2 [==============================] - 0s 113ms/step - loss: 0.0225 - mae: 0.1457 - val_loss: 0.0472 - val_mae: 0.2172
Epoch 159/200
2/2 [==============================] - 0s 111ms/step - loss: 0.0223 - mae: 0.1449 - val_loss: 0.0466 - val_mae: 0.2158
Epoch 160/200
2/2 [==============================] - 0s 96ms/step - loss: 0.0220 - mae: 0.1441 - val_loss: 0.0460 - val_mae: 0.2144
Epoch 161/200
2/2 [==============================] - 0s 106ms/step - loss: 0.0218 - mae: 0.1433 - val_loss: 0.0453 - val_mae: 0.2129
Epoch 162/200
2/2 [==============================] - 0s 122ms/step - loss: 0.0216 - mae: 0.1425 - val_loss: 0.0447 - val_mae: 0.2115
Epoch 163/200
2/2 [==============================] - 0s 118ms/step - loss: 0.0214 - mae: 0.1417 - val_loss: 0.0441 - val_mae: 0.2100
Epoch 164/200
2/2 [==============================] - 0s 116ms/step - loss: 0.0211 - mae: 0.1410 - val_loss: 0.0432 - val_mae: 0.2079
Epoch 165/200
2/2 [==============================] - 0s 100ms/step - loss: 0.0209 - mae: 0.1400 - val_loss: 0.0426 - val_mae: 0.2065
Epoch 166/200
2/2 [==============================] - 0s 109ms/step - loss: 0.0207 - mae: 0.1393 - val_loss: 0.0418 - val_mae: 0.2045
Epoch 167/200
2/2 [==============================] - 0s 108ms/step - loss: 0.0205 - mae: 0.1384 - val_loss: 0.0410 - val_mae: 0.2025
Epoch 168/200
2/2 [==============================] - 0s 101ms/step - loss: 0.0203 - mae: 0.1375 - val_loss: 0.0403 - val_mae: 0.2007
Epoch 169/200
2/2 [==============================] - 0s 131ms/step - loss: 0.0201 - mae: 0.1367 - val_loss: 0.0398 - val_mae: 0.1995
Epoch 170/200
2/2 [==============================] - 0s 145ms/step - loss: 0.0198 - mae: 0.1359 - val_loss: 0.0391 - val_mae: 0.1977
Epoch 171/200
2/2 [==============================] - 0s 123ms/step - loss: 0.0196 - mae: 0.1351 - val_loss: 0.0386 - val_mae: 0.1966
Epoch 172/200
2/2 [==============================] - 0s 109ms/step - loss: 0.0194 - mae: 0.1343 - val_loss: 0.0382 - val_mae: 0.1953
Epoch 173/200
2/2 [==============================] - 0s 118ms/step - loss: 0.0192 - mae: 0.1336 - val_loss: 0.0377 - val_mae: 0.1941
Epoch 174/200
2/2 [==============================] - 0s 112ms/step - loss: 0.0190 - mae: 0.1328 - val_loss: 0.0372 - val_mae: 0.1928
Epoch 175/200
2/2 [==============================] - 0s 143ms/step - loss: 0.0188 - mae: 0.1321 - val_loss: 0.0365 - val_mae: 0.1909
Epoch 176/200
2/2 [==============================] - 0s 103ms/step - loss: 0.0186 - mae: 0.1312 - val_loss: 0.0358 - val_mae: 0.1891
Epoch 177/200
2/2 [==============================] - 0s 102ms/step - loss: 0.0184 - mae: 0.1304 - val_loss: 0.0353 - val_mae: 0.1880
Epoch 178/200
2/2 [==============================] - 0s 151ms/step - loss: 0.0182 - mae: 0.1296 - val_loss: 0.0347 - val_mae: 0.1862
Epoch 179/200
2/2 [==============================] - 0s 107ms/step - loss: 0.0180 - mae: 0.1288 - val_loss: 0.0343 - val_mae: 0.1851
Epoch 180/200
2/2 [==============================] - 0s 25ms/step - loss: 0.0178 - mae: 0.1281 - val_loss: 0.0338 - val_mae: 0.1839
Epoch 181/200
2/2 [==============================] - 0s 19ms/step - loss: 0.0176 - mae: 0.1273 - val_loss: 0.0334 - val_mae: 0.1827
Epoch 182/200
2/2 [==============================] - 0s 34ms/step - loss: 0.0174 - mae: 0.1266 - val_loss: 0.0329 - val_mae: 0.1815
Epoch 183/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0172 - mae: 0.1258 - val_loss: 0.0325 - val_mae: 0.1802
Epoch 184/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0170 - mae: 0.1250 - val_loss: 0.0320 - val_mae: 0.1790
Epoch 185/200
2/2 [==============================] - 0s 33ms/step - loss: 0.0168 - mae: 0.1243 - val_loss: 0.0314 - val_mae: 0.1771
Epoch 186/200
2/2 [==============================] - 0s 37ms/step - loss: 0.0166 - mae: 0.1234 - val_loss: 0.0310 - val_mae: 0.1759
Epoch 187/200
2/2 [==============================] - 0s 18ms/step - loss: 0.0164 - mae: 0.1227 - val_loss: 0.0303 - val_mae: 0.1742
Epoch 188/200
2/2 [==============================] - 0s 29ms/step - loss: 0.0162 - mae: 0.1219 - val_loss: 0.0299 - val_mae: 0.1730
Epoch 189/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0160 - mae: 0.1211 - val_loss: 0.0294 - val_mae: 0.1713
Epoch 190/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0158 - mae: 0.1203 - val_loss: 0.0288 - val_mae: 0.1697
Epoch 191/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0156 - mae: 0.1195 - val_loss: 0.0285 - val_mae: 0.1687
Epoch 192/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0154 - mae: 0.1188 - val_loss: 0.0281 - val_mae: 0.1676
Epoch 193/200
2/2 [==============================] - 0s 22ms/step - loss: 0.0152 - mae: 0.1180 - val_loss: 0.0275 - val_mae: 0.1660
Epoch 194/200
2/2 [==============================] - 0s 54ms/step - loss: 0.0151 - mae: 0.1173 - val_loss: 0.0272 - val_mae: 0.1649
Epoch 195/200
2/2 [==============================] - 0s 30ms/step - loss: 0.0149 - mae: 0.1166 - val_loss: 0.0268 - val_mae: 0.1639
Epoch 196/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0147 - mae: 0.1158 - val_loss: 0.0265 - val_mae: 0.1627
Epoch 197/200
2/2 [==============================] - 0s 23ms/step - loss: 0.0145 - mae: 0.1150 - val_loss: 0.0259 - val_mae: 0.1611
Epoch 198/200
2/2 [==============================] - 0s 32ms/step - loss: 0.0143 - mae: 0.1142 - val_loss: 0.0254 - val_mae: 0.1595
Epoch 199/200
2/2 [==============================] - 0s 54ms/step - loss: 0.0141 - mae: 0.1134 - val_loss: 0.0250 - val_mae: 0.1580
Epoch 200/200
2/2 [==============================] - 0s 31ms/step - loss: 0.0140 - mae: 0.1127 - val_loss: 0.0247 - val_mae: 0.1570
Train MAE: 0.12705300748348236
Test MAE: 0.12359803915023804
```

In [7]:

```python
#Summary in form of a table
summary_results = {
    'Data Split': ['Training', 'Test'],
    'MAE': [train_mae, test_mae]
}
results_table = pd.DataFrame(summary_results)
#Display the results table
print(results_table)
```

```
  Data Split       MAE
0   Training  0.127053
1       Test  0.123598
```

The table displays the Mean Absolute Error (MAE) of the LSTM model on both the training and test data splits. The training data resulted in an MAE of approximately 0.127, while the model achieved a slightly better MAE of approximately 0.124 on the unseen test data, indicating that the model has a consistent performance on both datasets within a close margin.

The LSTM model's performance, as indicated by the Mean Absolute Error (MAE), shows that it has learned to predict the monthly count of offenses with a reasonable level of accuracy given the very limited dataset. The MAE of 0.127 for the training set and 0.124 for the test set suggests that the model is not overfitting, as the test error is slightly lower than the training error. This is a positive outcome, especially considering the challenges posed by the small amount of data available.

In [ ]: