Order Analysis

Importing packages

In [99]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from datetime import datetime,timedelta
```

Reading data into dataframe from the csv

In [100…
```
data = pd.read_csv('Data2.csv')

# Display the first few rows of the dataset

data.head()
```

Out[100…

	Created Date	Country	City	Restaurant ID	Restaurant Name	Order State	Cancel Reason	Cuisin
0	28.02.2020	Portugal	Lisbon	7238	Chirashi - Alvalade	delivered	NaN	Sush
1	28.02.2020	Portugal	Lisbon	12758	Istanbul Kebab Pizza - Alameda	delivered	NaN	Pizz
2	28.02.2020	Portugal	Lisbon	6631	A-100 - Lisboa	delivered	NaN	Burger
3	28.02.2020	Portugal	Lisbon	10535	La Paparrucha - Parrilla Argentina	delivered	NaN	Sout America
4	28.02.2020	Portugal	Lisbon	9695	Choupana Caffe	delivered	NaN	Brunc

Checking for datatypes

In [101…
```
data.dtypes
```

Out[101…
```
Created Date              object
Country                   object
City                      object
Restaurant ID              int64
Restaurant Name           object
Order State               object
Cancel Reason             object
Cuisine                   object
Platform                  object
Payment Method            object
Card Issuer               object
Products in Order          int64
Order Value € (Gross)     object
Delivery Fee             float64
Delivery Time            float64
dtype: object
```

Need to fix Column "Created Date" datatype to datetime

Need to extract order value from "Order Value € (Gross)" column and convert the type to float.

In [102…
```
data["Created Date"] = pd.to_datetime(data["Created Date"], format='%d.%m
```

In [103…
```
data['Order Value(Gross)'] = data['Order Value € (Gross)'].str.replace('€

# df['Order Value € (Gross)'] = df['Order Value € (Gross)'].astype(float)
```

In [104…
```
# replace null values with none

data['Cancel Reason'] = data['Cancel Reason'].fillna('none')

# check for non null values

data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 99618 entries, 0 to 99617
Data columns (total 16 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   Created Date          99618 non-null  datetime64[ns]
 1   Country               99618 non-null  object
 2   City                  99618 non-null  object
 3   Restaurant ID         99618 non-null  int64
 4   Restaurant Name       99618 non-null  object
 5   Order State           99618 non-null  object
 6   Cancel Reason         99618 non-null  object
 7   Cuisine               99291 non-null  object
 8   Platform              87684 non-null  object
 9   Payment Method        99618 non-null  object
 10  Card Issuer           86906 non-null  object
 11  Products in Order     99618 non-null  int64
 12  Order Value € (Gross)  97936 non-null  object
 13  Delivery Fee          97936 non-null  float64
 14  Delivery Time         97936 non-null  float64
 15  Order Value(Gross)    97936 non-null  float64
dtypes: datetime64[ns](1), float64(3), int64(2), object(10)
memory usage: 12.2+ MB
```

Data Type are fixed and data is clean for consumption

Answer the questions shown below:

1. Do we have any seasonality in the countries shown?
2. Use your knowledge to predict with the available data, how many orders we will have in March 2020 in each country shown?
3. Please tell us any other valuable insight that you can extract from the data available and what would you do to solve it

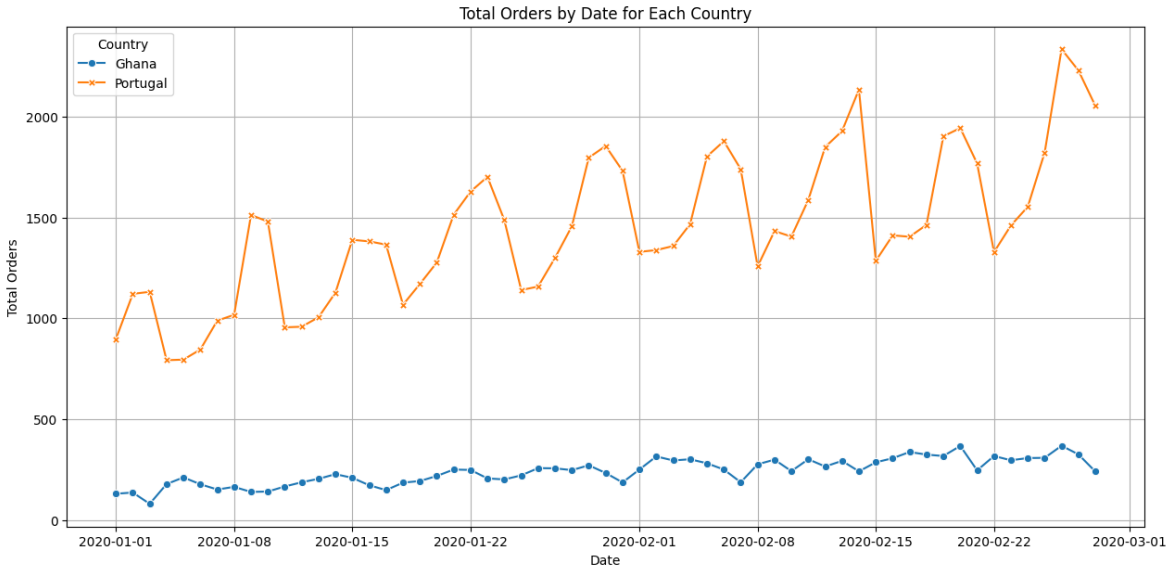
---------- Ans 1 ----------

Checking the trend of total order Day on Day

In [105…

```
# Aggregate data by Country and Created Date for the total order count
datewise_order_data = data.groupby(['Country', 'Created Date']).size().re

# Creating a line plot for total orders by date for each country
plt.figure(figsize=(15, 7))
sns.lineplot(data=datewise_order_data,
             x='Created Date',
             y='Total Orders',
             hue='Country',
             style='Country',
             markers=True,
```

```
            dashes=False)

plt.title('Total Orders by Date for Each Country')
plt.xlabel('Date')
plt.ylabel('Total Orders')
plt.legend(title='Country')
plt.grid(True)
plt.show()
```



Insights

Trend is visible in Portugal, But not able to visualize Ghana trend properly.

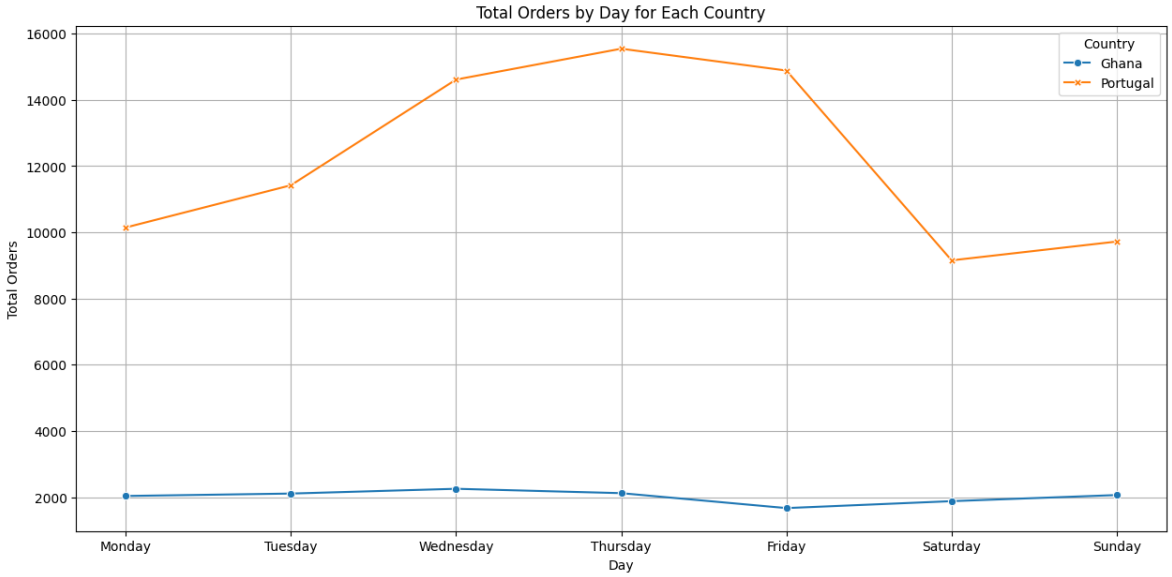
Creating a new plot for Ghana individually.

Checking the busiest day of the week

In [106…
```
# creating a column with day of the week
data['day'] = data['Created Date'].dt.day_name()

# Aggregate data by Country and Created Date for the total order count
day_order_data = data.groupby(['Country', 'day']).size().reset_index(name

# Sort the DataFrame by 'column_to_sort' in descending order
day_order_data = day_order_data.sort_values(by=['Total Orders'], ascendin
```

In [107…
```
# Define the order of the days
days_order = ["Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Sa

# Convert 'day' column to a categorical type with the specified order
day_order_data['day'] = pd.Categorical(day_order_data['day'], categories=

# Now Creating the Plot Below
plt.figure(figsize=(15, 7))
sns.lineplot(data=day_order_data,
             x='day',
             y='Total Orders',
             hue='Country',
             style='Country',
```

```
                markers=True,
                dashes=False)

plt.title('Total Orders by Day for Each Country')
plt.xlabel('Day')
plt.ylabel('Total Orders')
plt.legend(title='Country')
plt.grid(True)
plt.show()
```



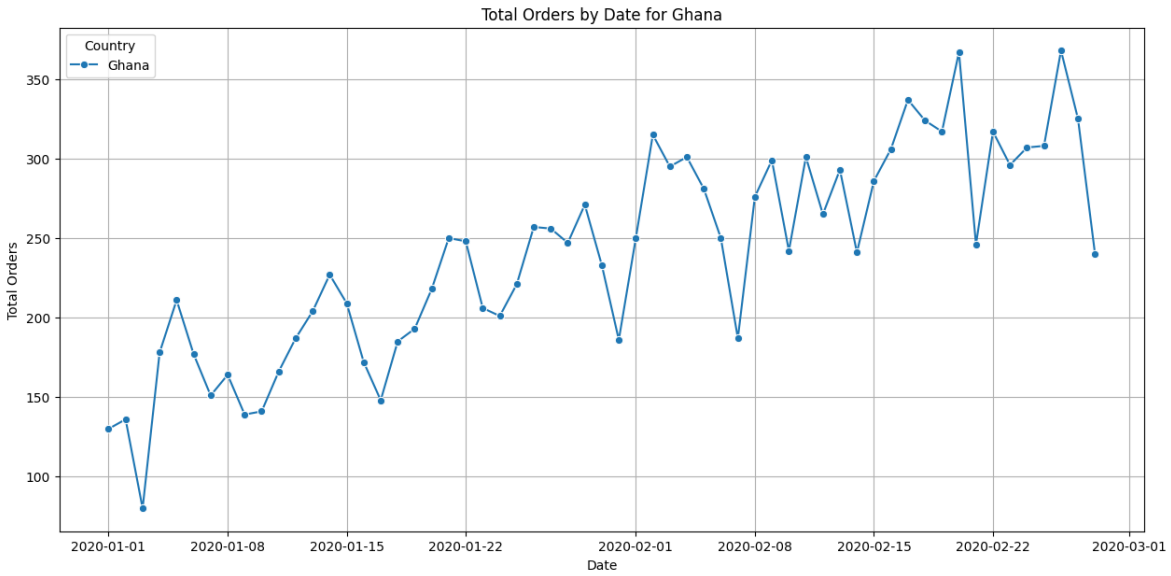
Insight

From the above graph we can deduce that the busiest days of the week are "Wednesday","Thursday","Friday" in Portugal.

Checking trend for Ghana

In [108…

```
# Aggregate data by Country and Created Date for the total order count
datewise_order_data = data.groupby(['Country', 'Created Date']).size().re

# fitler dataframe for Ghana
datewise_order_data_ghana = datewise_order_data[datewise_order_data['Coun

# Creating a line plot for total orders by date for each country
plt.figure(figsize=(15, 7))
sns.lineplot(data=datewise_order_data_ghana, x='Created Date', y='Total O
             style='Country', markers=True, dashes=False)

plt.title('Total Orders by Date for Ghana')
plt.xlabel('Date')
plt.ylabel('Total Orders')
plt.legend(title='Country')
plt.grid(True)
plt.show()
```

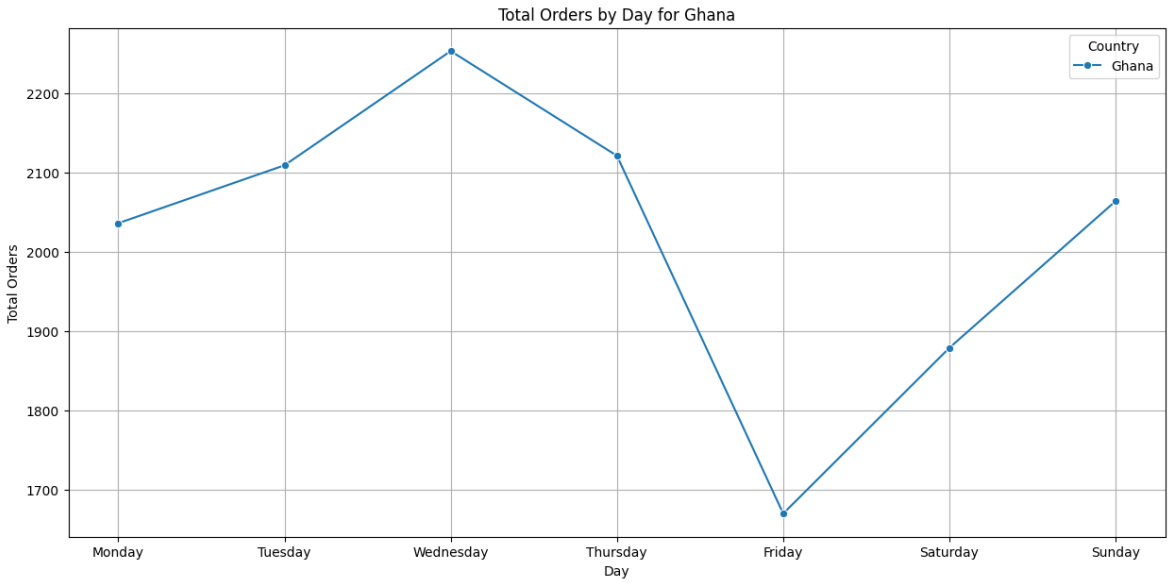


Checking the busiest day of the week

In [113…

```
# Define the order of the days
days_order = ["Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Sa


# Filtering the dataframe for Ghana
day_order_data_ghana = day_order_data[day_order_data['Country'] == 'Ghana

# Convert 'day' column to a categorical type with the specified order
day_order_data_ghana['day'] = pd.Categorical(day_order_data_ghana['day'],

# Now Creating the Plot Below
plt.figure(figsize=(15, 7))
sns.lineplot(data=day_order_data_ghana,
             x='day',
             y='Total Orders',
             hue='Country',
             style='Country',
             markers=True,
             dashes=False)

plt.title('Total Orders by Day for Ghana')
plt.xlabel('Day')
plt.ylabel('Total Orders')
plt.legend(title='Country')
plt.grid(True)
plt.show()
```

```
/tmp/ipykernel_351589/26850105.py:9: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  day_order_data_ghana['day'] = pd.Categorical(day_order_data_ghana['da
y'], categories=days_order, ordered=True)
```



Insights:

Ghana has usually busier on "Tuesday","Wednesday","Thursday"

---------- Ans 2 ----------

Time Series Forcasting

In [119…
```
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt
%matplotlib inline

import io
import requests
```

In [120…
```
url="https://raw.githubusercontent.com/Mavericky007/Streamlit/main/Bolt/d
s=requests.get(url).content
data=pd.read_csv(io.StringIO(s.decode('utf-8')))
```

In [121…
```
data["Created Date"] = pd.to_datetime(data["Created Date"], format='%d.%m
data['Order Value(Gross)'] = data['Order Value € (Gross)'].str.replace('€
data['Cancel Reason'] = data['Cancel Reason'].fillna('none')
```

In [122…
```
data.head()
```

Out[122…

	Created Date	Country	City	Restaurant ID	Restaurant Name	Order State	Cancel Reason	Cuisine
0	2020-02-28	Portugal	Lisbon	7238	Chirashi - Alvalade	delivered	none	Sushi
1	2020-02-28	Portugal	Lisbon	12758	Istanbul Kebab Pizza - Alameda	delivered	none	Pizza
2	2020-02-28	Portugal	Lisbon	6631	A-100 - Lisboa	delivered	none	Burgers
3	2020-02-28	Portugal	Lisbon	10535	La Paparrucha - Parrilla Argentina	delivered	none	South American
4	2020-02-28	Portugal	Lisbon	9695	Choupana Caffe	delivered	none	Brunch

In [125…
```
order_data = data.groupby(['Created Date']).size().reset_index(name='Tota
order_data.head()
```

Out[125…

	Created Date	Total Orders
0	2020-01-01	1027
1	2020-01-02	1257
2	2020-01-03	1211
3	2020-01-04	970
4	2020-01-05	1006

In [127…
```
## Cleaning up the data
order_data.columns=["date","orders"]
order_data.head()
```

Out[127…

	date	orders
0	2020-01-01	1027
1	2020-01-02	1257
2	2020-01-03	1211
3	2020-01-04	970
4	2020-01-05	1006

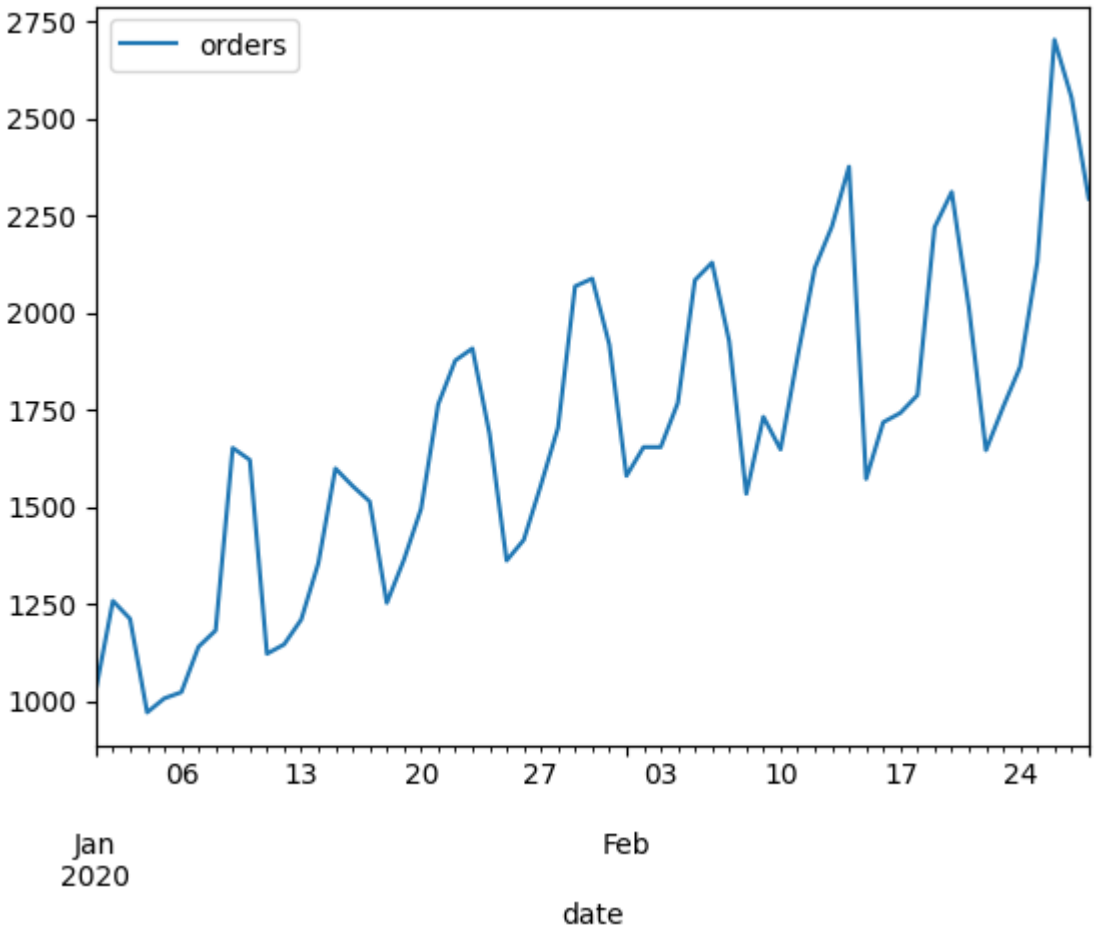
In [128…
```
order_data.set_index('date',inplace=True)
order_data.head()
```

Out[128…

date	orders
2020-01-01	1027
2020-01-02	1257
2020-01-03	1211
2020-01-04	970
2020-01-05	1006

In [129…
```
order_data.plot()
```

Out[129… <Axes: xlabel='date'>



Testing for Stationary

In [131…
```
from statsmodels.tsa.stattools import adfuller
```

In [133…
```
test_result=adfuller(order_data['orders'])
```

In [136…
```
#Ho: It is non stationary
#H1: It is stationary

def adfuller_test(orders):
    result=adfuller(orders)
```

```
    labels = ['ADF Test Statistic','p-value','#Lags Used','Number of Obse
    for value,label in zip(result,labels):
        print(label+' : '+str(value) )
    if result[1] <= 0.05:
        print("strong evidence against the null hypothesis(Ho), reject th
    else:
        print("weak evidence against null hypothesis, time series has a u
```

In [137…
```
adfuller_test(order_data['orders'])
```

```
ADF Test Statistic : -1.5475383144763235
p-value : 0.5098776053757463
#Lags Used : 7
Number of Observations Used : 51
weak evidence against null hypothesis, time series has a unit root, indica
ting it is non-stationary
```

Differencing

In [139…
```
order_data['Order First Difference'] = order_data['orders'] - order_data[
```

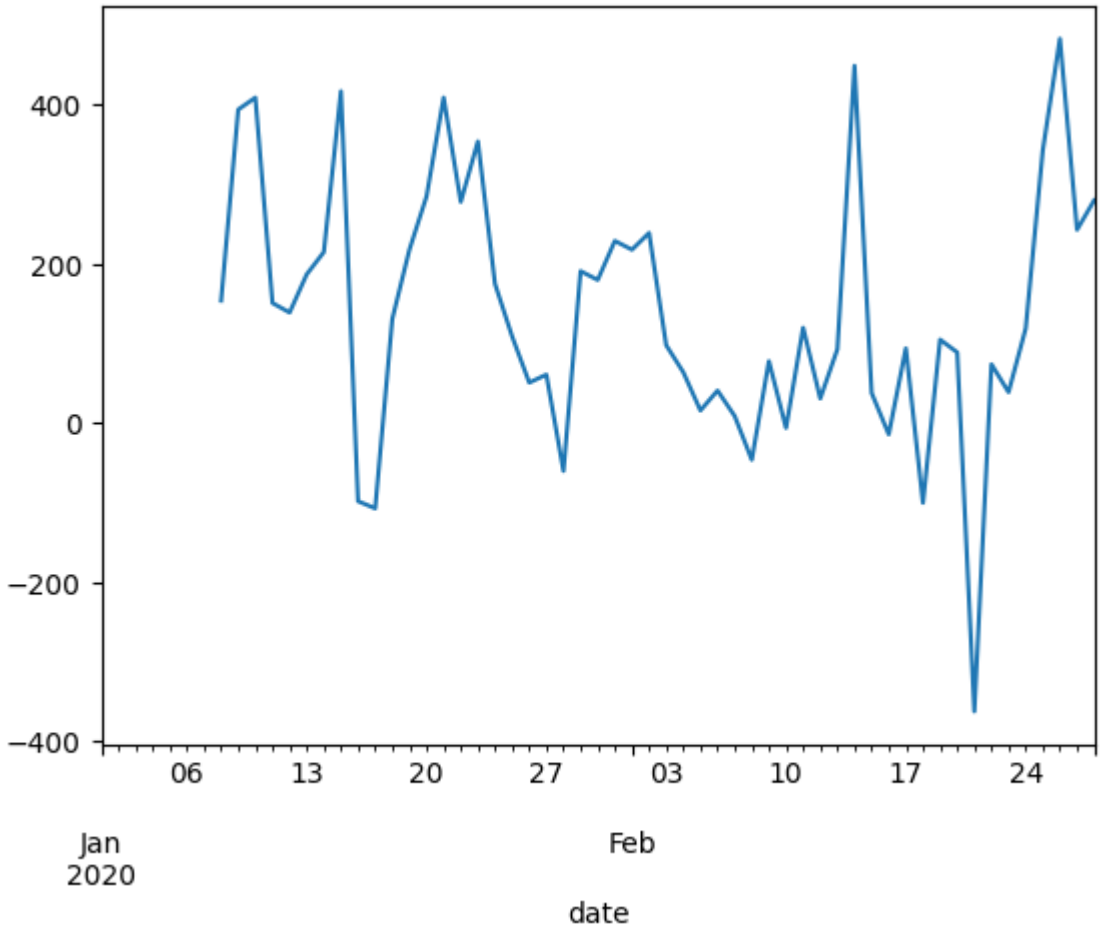
In [259…
```
order_data['Seasonal First Difference']=order_data['orders']-order_data['
```

In [260…
```
## Again test dickey fuller test
adfuller_test(order_data['Seasonal First Difference'].dropna())
```

```
ADF Test Statistic : -3.633783431207566
p-value : 0.005147053756572822
#Lags Used : 3
Number of Observations Used : 48
strong evidence against the null hypothesis(Ho), reject the null hypothesi
s. Data has no unit root and is stationary
```

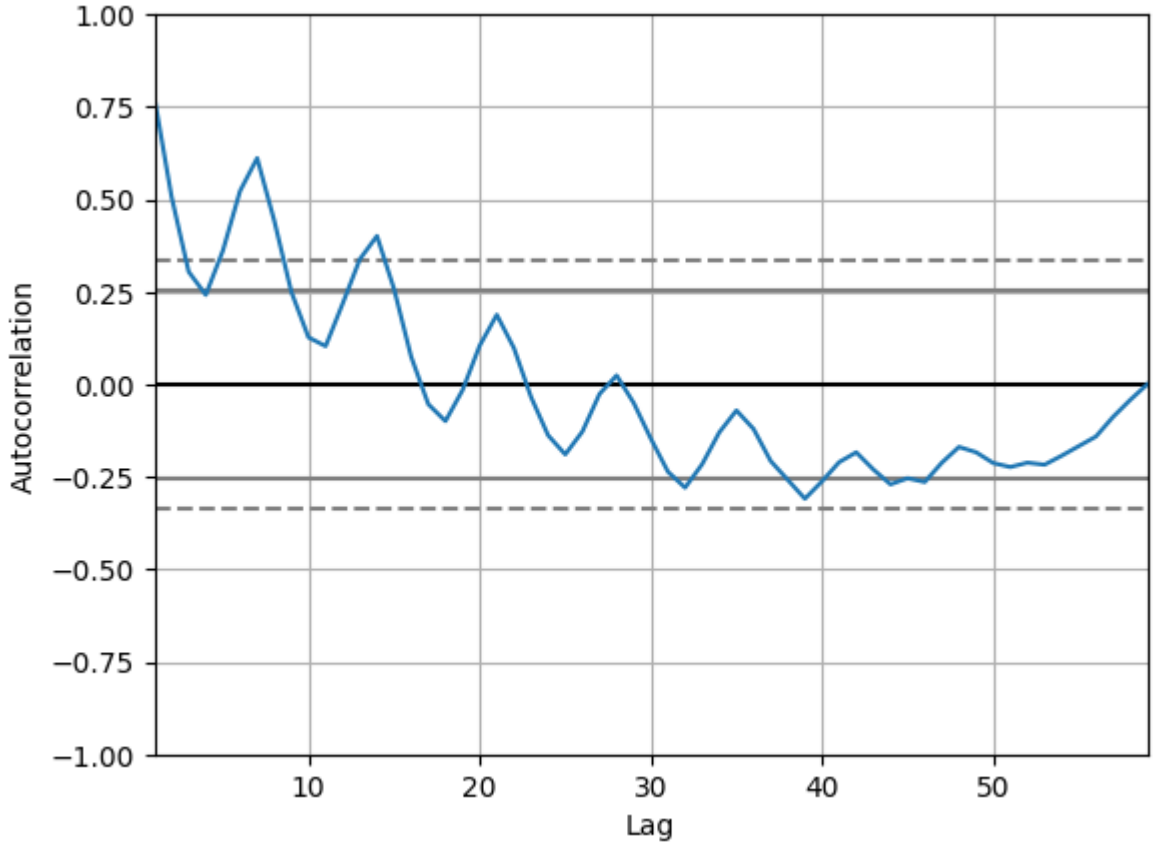
In [261…
```
order_data['Seasonal First Difference'].plot()
```

Out[261… <Axes: xlabel='date'>



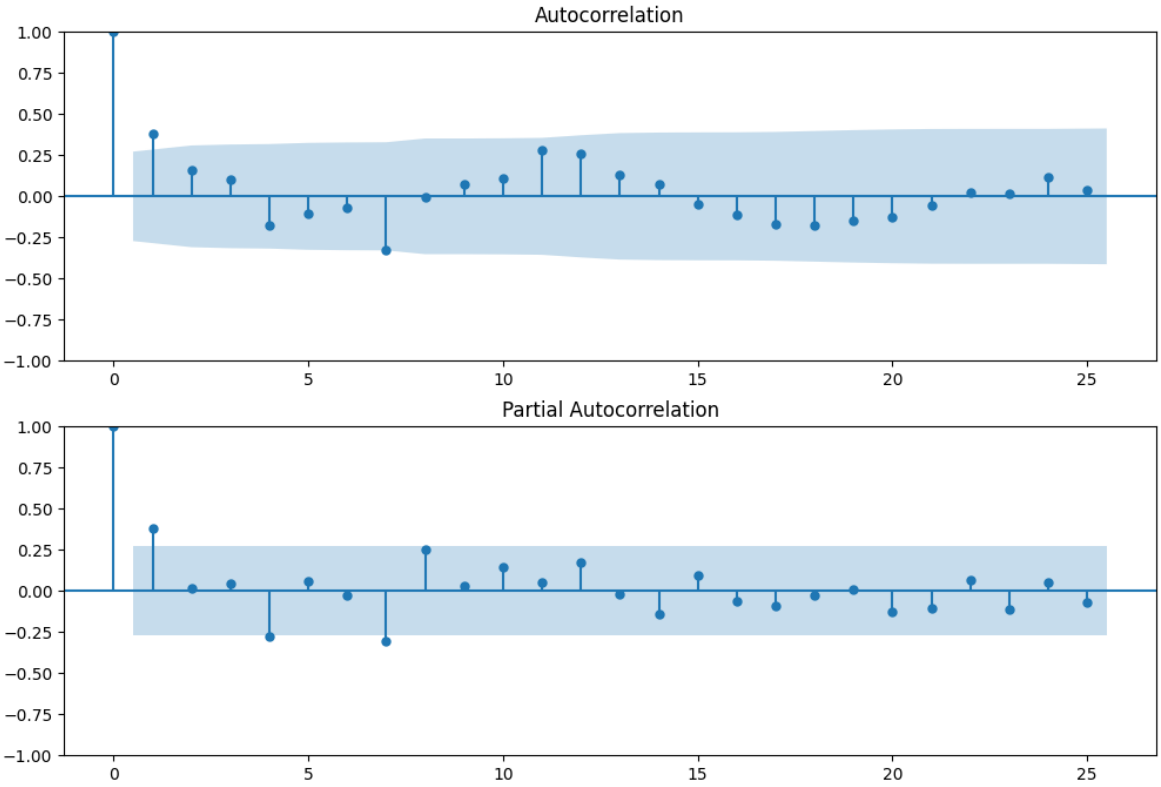
Auto Regressive Model

In [262…
```
from pandas.plotting import autocorrelation_plot
autocorrelation_plot(order_data['orders'])
plt.show()
```



In [263…
```
import statsmodels.api as sm
from statsmodels.graphics.tsaplots import plot_acf,plot_pacf
```

In [264…
```
fig = plt.figure(figsize=(12,8))
ax1 = fig.add_subplot(211)
fig = sm.graphics.tsa.plot_acf(order_data['Seasonal First Difference'].il
ax2 = fig.add_subplot(212)
fig = sm.graphics.tsa.plot_pacf(order_data['Seasonal First Difference'].i
```



In [265…

```
# For non-seasonal data
#p=1, d=1, q=0 or 1
from statsmodels.tsa.arima.model import ARIMA
```

In [266…

```
model=ARIMA(order_data['orders'],order=(2,1,0))
model_fit=model.fit()
```

```
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: No f
requency information was provided, so inferred frequency D will be used.
  self._init_dates(dates, freq)
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: No f
requency information was provided, so inferred frequency D will be used.
  self._init_dates(dates, freq)
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: No f
requency information was provided, so inferred frequency D will be used.
  self._init_dates(dates, freq)
```

In [267…

```
model_fit.summary()
```

Out[267…

SARIMAX Results

Dep. Variable:	orders	**No. Observations:**	59
Model:	ARIMA(2, 1, 0)	**Log Likelihood**	-399.212
Date:	Sun, 14 Jan 2024	**AIC**	804.423
Time:	04:58:47	**BIC**	810.605
Sample:	01-01-2020	**HQIC**	806.831
	- 02-28-2020		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.1433	0.144	0.993	0.321	-0.139	0.426
ar.L2	-0.2293	0.169	-1.356	0.175	-0.561	0.102
sigma2	5.669e+04	8611.259	6.583	0.000	3.98e+04	7.36e+04

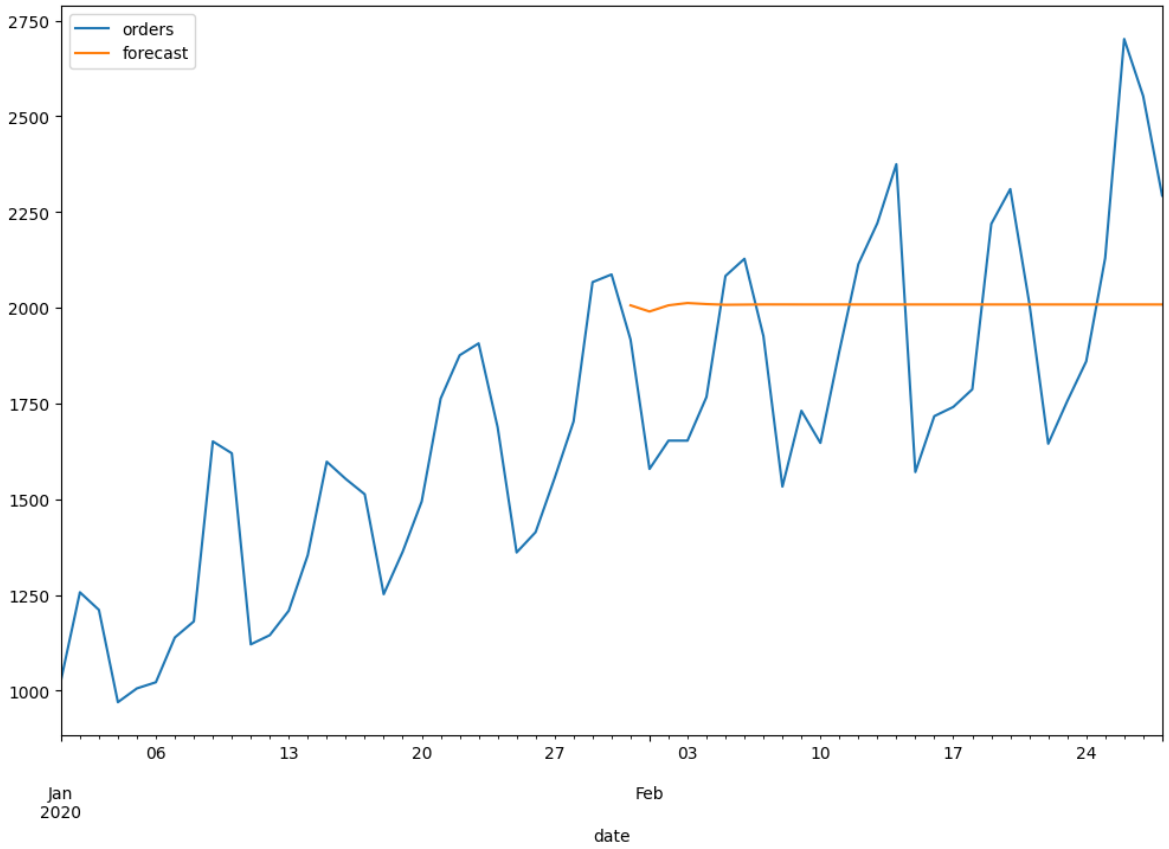
Ljung-Box (L1) (Q):	0.42	**Jarque-Bera (JB):**	7.47
Prob(Q):	0.52	**Prob(JB):**	0.02
Heteroskedasticity (H):	2.54	**Skew:**	-0.53
Prob(H) (two-sided):	0.05	**Kurtosis:**	4.41

Warnings:
[1] Covariance matrix calculated using the outer product of gradients (complex-step).

In [276…

```
order_data['forecast']=model_fit.predict(start=30,end=60,dynamic=True)
order_data[['orders','forecast']].plot(figsize=(12,8))
```

Out[276… <Axes: xlabel='date'>



In [305…
```
model=sm.tsa.statespace.SARIMAX(order_data['orders'],order=(2, 1, 2),seas
results=model.fit()
```

```
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: No f
requency information was provided, so inferred frequency D will be used.
  self._init_dates(dates, freq)
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/base/tsa_model.py:473: ValueWarning: No f
requency information was provided, so inferred frequency D will be used.
  self._init_dates(dates, freq)
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/statespace/sarimax.py:997: UserWarning: N
on-stationary starting seasonal autoregressive Using zeros as starting par
ameters.
  warn('Non-stationary starting seasonal autoregressive'
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/tsa/statespace/sarimax.py:1009: UserWarning:
Non-invertible starting seasonal moving average Using zeros as starting pa
rameters.
  warn('Non-invertible starting seasonal moving average'
 This problem is unconstrained.
```

```
RUNNING THE L-BFGS-B CODE

           * * *

Machine precision = 2.220D-16
 N =            9     M =           10

At X0         0 variables are exactly at the bounds

At iterate    0    f=  5.62846D+00    |proj g|=  3.50428D-01

At iterate    5    f=  5.51137D+00    |proj g|=  6.92147D-02

At iterate   10    f=  5.49369D+00    |proj g|=  3.06313D-03

At iterate   15    f=  5.49290D+00    |proj g|=  2.49541D-03

At iterate   20    f=  5.49203D+00    |proj g|=  1.95604D-02

At iterate   25    f=  5.47730D+00    |proj g|=  2.54674D-02

At iterate   30    f=  5.47471D+00    |proj g|=  1.76538D-03

At iterate   35    f=  5.47464D+00    |proj g|=  2.79248D-03

At iterate   40    f=  5.47396D+00    |proj g|=  6.76328D-03

At iterate   45    f=  5.47379D+00    |proj g|=  1.84412D-03

At iterate   50    f=  5.47367D+00    |proj g|=  6.43588D-04

           * * *

Tit   = total number of iterations
Tnf   = total number of function evaluations
Tnint = total number of segments explored during Cauchy searches
Skip  = number of BFGS updates skipped
Nact  = number of active bounds at final generalized Cauchy point
Projg = norm of the final projected gradient
F     = final function value

           * * *

   N    Tit     Tnf  Tnint  Skip  Nact     Projg        F
    9     50     56      1     0     0   6.436D-04   5.474D+00
  F =   5.4736654705959946

STOP: TOTAL NO. of ITERATIONS REACHED LIMIT
```

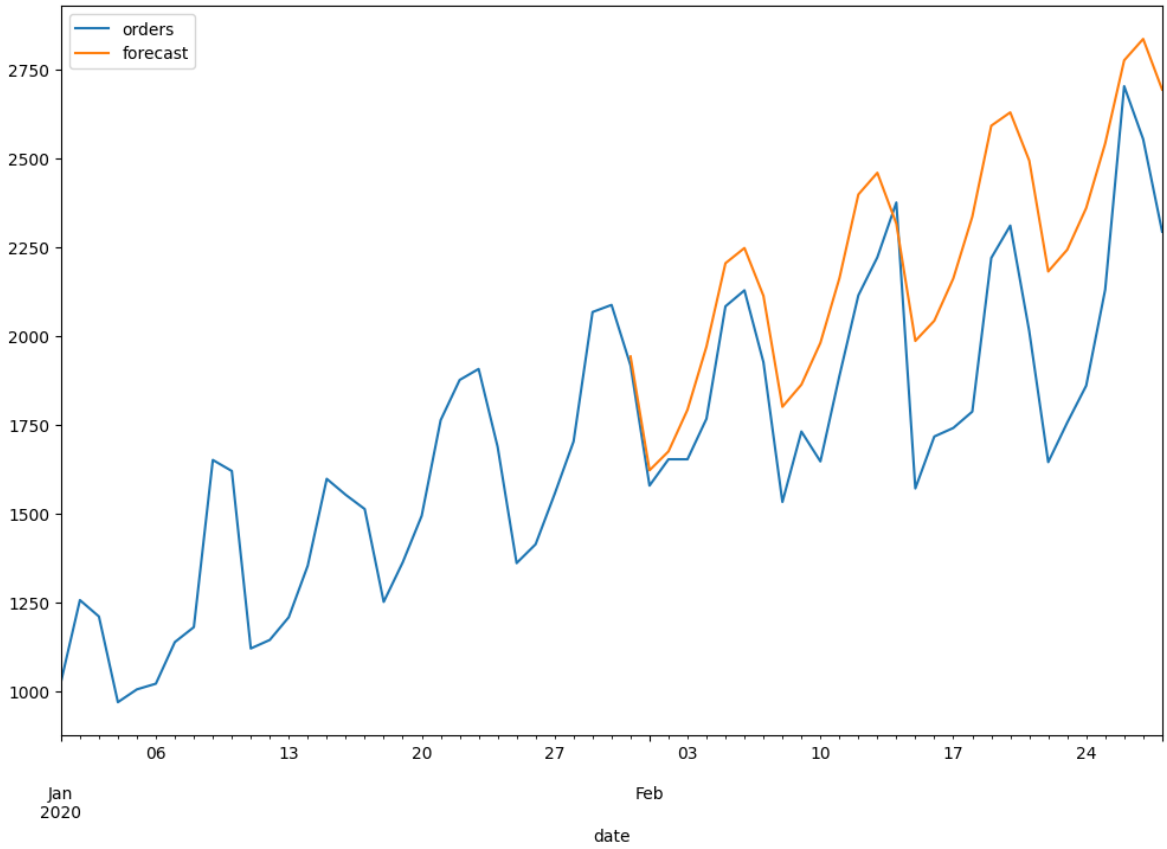
```
/dsw/snapshots/de58d158-6501-49dd-b30a-8ebfbbd41e7a/python310/lib/python3.
10/site-packages/statsmodels/base/model.py:607: ConvergenceWarning: Maximu
m Likelihood optimization failed to converge. Check mle_retvals
  warnings.warn("Maximum Likelihood optimization failed to "
```

In [306…

```
order_data['forecast']=results.predict(start=30,end=60,dynamic=True)
order_data[['orders','forecast']].plot(figsize=(12,8))
```

Out[306…

```
<Axes: xlabel='date'>
```



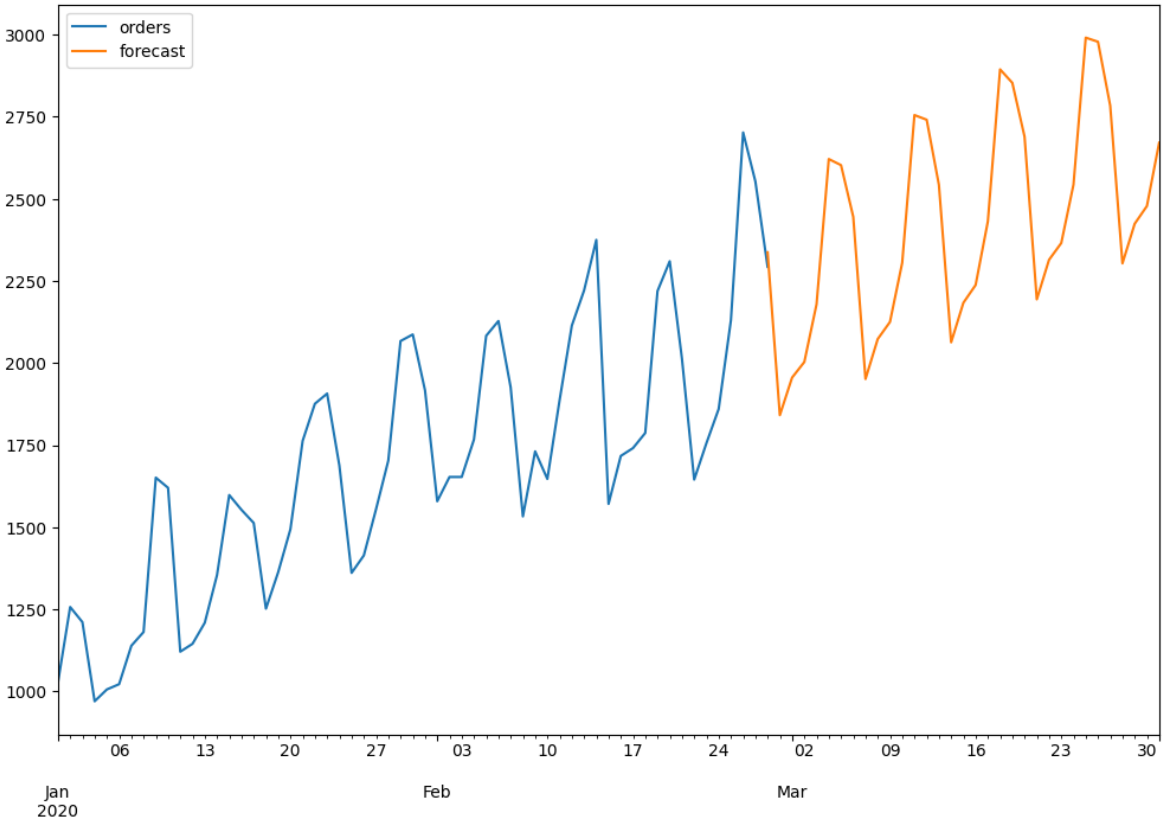
In [307…
```
from pandas.tseries.offsets import DateOffset
future_dates=[order_data.index[-1]+ DateOffset(days=x)for x in range(0,33
```

In [308…
```
future_datest_df=pd.DataFrame(index=future_dates[1:],columns=df.columns)
```

In [309…
```
future_df=pd.concat([order_data,future_datest_df])
```

In [317…
```
future_df['forecast'] = results.predict(start = 58, end = 90, dynamic= Tr
future_df[['orders', 'forecast']].plot(figsize=(12, 8))
```

Out[317… <Axes: >



In [318…
```
predicted_data = future_df[['orders', 'forecast']]
predicted_data.tail()
```

Out[318…

	orders	forecast
2020-03-27	NaN	2783.853690
2020-03-28	NaN	2303.415816
2020-03-29	NaN	2423.998825
2020-03-30	NaN	2478.067997
2020-03-31	NaN	2670.830410

In [343…
```
value = predicted_data['forecast'].loc['2020-03-01':'2020-03-31'].sum()
```

In [394…
```
from IPython.display import Markdown, display

display(Markdown("## The Expected total number of orders in March are : *
```

The Expected total number of orders in March are : 75,698.29!