https://colab.research.google.com/drive/11GmF64YVSaUzeuahvPC-hXBOcKctilMi

```
#import packages
import pandas as pd
import numpy as np
import matplotlib.colors as col
from mpl_toolkits.mplot3d import Axes3D
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import datetime
from pathlib import Path
import random
from sklearn.preprocessing import MinMaxScaler
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
from sklearn.ensemble import RandomForestRegressor
from xgboost.sklearn import XGBRegressor
from sklearn.model_selection import KFold, cross_val_score, train_test_split
```

```
from google.colab import drive
drive.mount("/content/drive")
```

```
Mounted at /content/drive
```

```
#df =pd.read_csv("/content/Sales (1).csv")
```

```
df =pd.read_csv("drive/My Drive/IBM_Project/Dataset/Sales (1).csv")
```

```
from datetime import datetime, timedelta
start_date = datetime(2023, 1, 1)
end_date = datetime(2023, 7, 19)

# Create a range of date-time values between start and end dates
date_range = [start_date + timedelta(days=i) for i in range((end_date - start_date).days +
```

```
# Iterate through the columns in the DataFrame
for column in df.columns:
    # Add the date-time values to each column
    df['DateTime'] = date_range
```

```
df
```

| | Date | TV | Radio | Newspaper | Sales | DateTime |
|---|---|---|---|---|---|---|
| **0** | 12-04-2023 | 230.1 | 37.8 | 69.2 | 22.1 | 2023-01-01 |
| **1** | 13-04-2023 | 44.5 | 39.3 | 45.1 | 10.4 | 2023-01-02 |
| **2** | 14-04-2023 | 17.2 | 45.9 | 69.3 | 12.0 | 2023-01-03 |
| **3** | 15-04-2023 | 151.5 | 41.3 | 58.5 | 16.5 | 2023-01-04 |
| **4** | 16-04-2023 | 180.8 | 10.8 | 58.4 | 17.9 | 2023-01-05 |
| **...** | ... | ... | ... | ... | ... | ... |
| **195** | 24-10-2023 | 38.2 | 3.7 | 13.8 | 7.6 | 2023-07-15 |
| **196** | 25-10-2023 | 94.2 | 4.9 | 8.1 | 14.0 | 2023-07-16 |
| **197** | 26-10-2023 | 177.0 | 9.3 | 6.4 | 14.8 | 2023-07-17 |

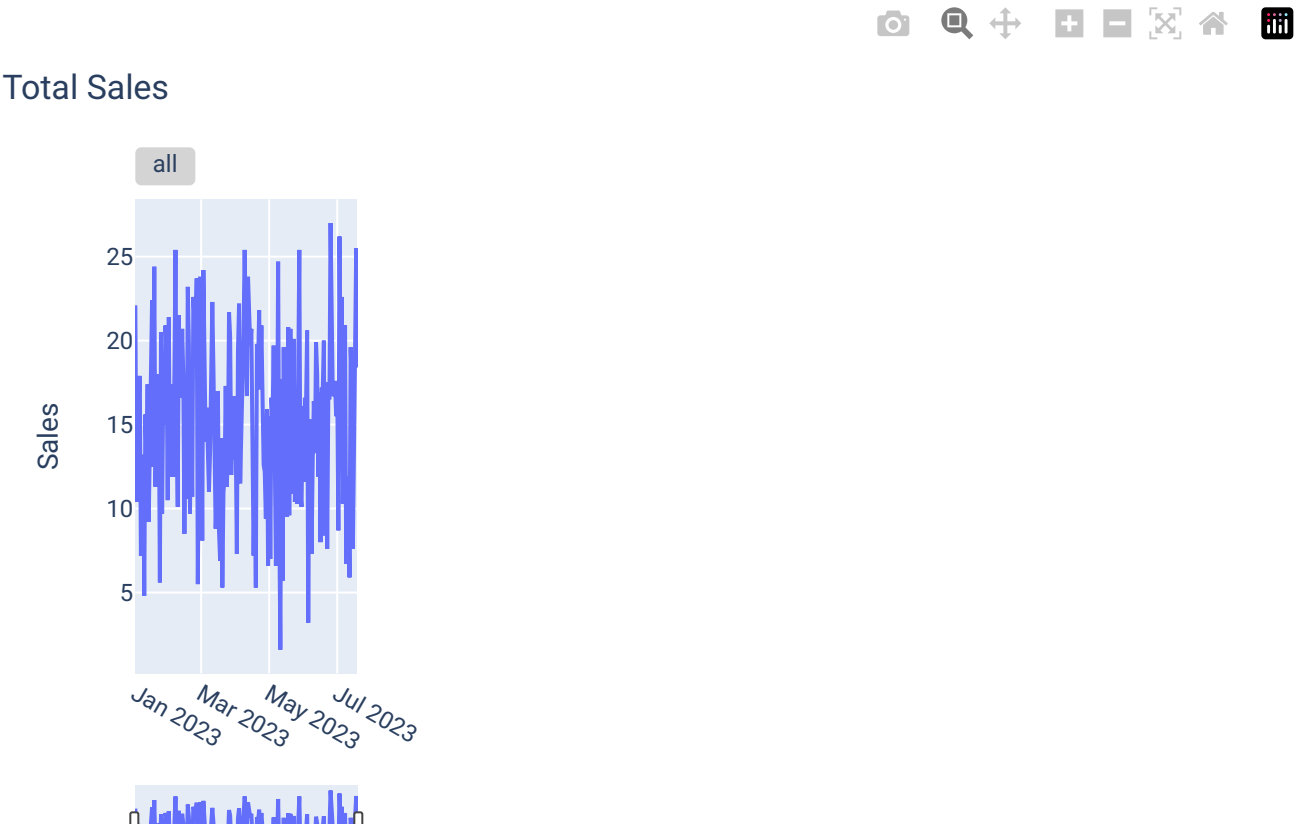
```
df.dtypes
```

```
Date                 object
TV                  float64
Radio               float64
Newspaper           float64
Sales               float64
DateTime     datetime64[ns]
dtype: object
```

```
missing_values = df.isna()
total_missing = missing_values.sum().sum()
total_missing
```

```
0
```

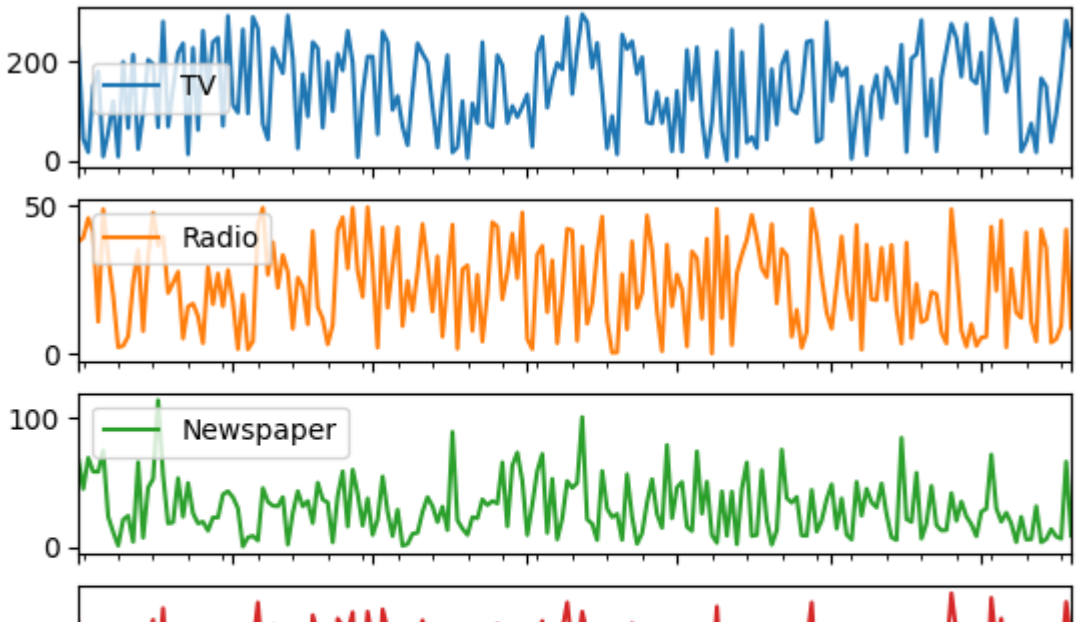
```
import plotly.express as px


fig = px.line(df, x='DateTime', y='Sales', title='Total Sales')

fig.update_xaxes(
    rangeslider_visible=True,
    rangeselector=dict(
        buttons=list([
            dict(step="all")
        ])
    )
)
fig.show()
```




```
el_df=df.set_index('DateTime')
```

```
el_df.plot(subplots=True)
```

```
array([<Axes: xlabel='DateTime'>, <Axes: xlabel='DateTime'>,
       <Axes: xlabel='DateTime'>, <Axes: xlabel='DateTime'>], dtype=object)
```



```
print ("\nMissing values :  ", df.isnull().any())
```

```
Missing values :   Date         False
TV           False
Radio        False
Newspaper    False
Sales        False
DateTime     False
dtype: bool
```

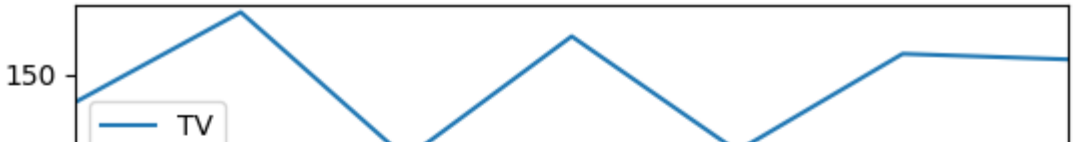
```
el_df.resample('M').mean()
```

```
<ipython-input-19-421011436e0d>:1: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.mean is deprecated. In a
```

| DateTime | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **2023-01-31** | 142.064516 | 24.319355 | 37.841935 | 14.954839 |
| **2023-02-28** | 167.635714 | 24.878571 | 29.460714 | 16.478571 |
| **2023-03-31** | 126.100000 | 25.803226 | 29.780645 | 14.367742 |
| **2023-04-30** | 160.776667 | 21.656667 | 34.086667 | 16.020000 |
| **2023-05-31** | 128.183871 | 25.816129 | 29.877419 | 13.838710 |
| **2023-06-30** | 155.813333 | 19.100000 | 27.806667 | 15.093333 |
| **2023-07-31** | 154.221053 | 19.968421 | 21.400000 | 15.436842 |

```
el_df.resample('M').mean().plot(subplots=True)
```

```
<ipython-input-20-052b9850bc35>:1: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.mean is deprecated. In a

array([<Axes: xlabel='DateTime'>, <Axes: xlabel='DateTime'>,
       <Axes: xlabel='DateTime'>, <Axes: xlabel='DateTime'>], dtype=object)
```




```
final_df=el_df.resample('M').mean()
final_df
```

```
<ipython-input-21-262a0f12b9cd>:1: FutureWarning:

The default value of numeric_only in DataFrameGroupBy.mean is deprecated. In a
```

| DateTime | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **2023-01-31** | 142.064516 | 24.319355 | 37.841935 | 14.954839 |
| **2023-02-28** | 167.635714 | 24.878571 | 29.460714 | 16.478571 |
| **2023-03-31** | 126.100000 | 25.803226 | 29.780645 | 14.367742 |
| **2023-04-30** | 160.776667 | 21.656667 | 34.086667 | 16.020000 |
| **2023-05-31** | 128.183871 | 25.816129 | 29.877419 | 13.838710 |
| **2023-06-30** | 155.813333 | 19.100000 | 27.806667 | 15.093333 |
| **2023-07-31** | 154.221053 | 19.968421 | 21.400000 | 15.436842 |

```
!pip install pmdarima
```

```
Collecting pmdarima
  Downloading pmdarima-2.0.4-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x8
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 2.1/2.1 MB 21.1 MB/s eta 0
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.10/dist-p
Requirement already satisfied: Cython!=0.29.18,!=0.29.31,>=0.29 in /usr/local/l
Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-
Requirement already satisfied: pandas>=0.19 in /usr/local/lib/python3.10/dist-p
Requirement already satisfied: scikit-learn>=0.22 in /usr/local/lib/python3.10/
```

```
      Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-p
      Requirement already satisfied: statsmodels>=0.13.2 in /usr/local/lib/python3.10
      Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packag
      Requirement already satisfied: setuptools!=50.0.0,>=38.6.0 in /usr/local/lib/py
      Requirement already satisfied: packaging>=17.1 in /usr/local/lib/python3.10/dis
      Requirement already satisfied: python-dateutil>=2.8.1 in /usr/local/lib/python3
      Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-p
      Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.1
      Requirement already satisfied: patsy>=0.5.2 in /usr/local/lib/python3.10/dist-p
      Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (
      Installing collected packages: pmdarima
      Successfully installed pmdarima-2.0.4
```

```
import pmdarima as pm
```

```
import statsmodels.tsa.api as smt
import statsmodels.api as sm
from statsmodels.tools.eval_measures import rmse
import pickle
import warnings
```

```
from statsmodels.tsa.stattools import adfuller
```

```
test_result=adfuller(df['Sales'])
```

```
model = pm.auto_arima(final_df['Sales'],
                      m=12, seasonal=False,
                     start_p=0, start_q=0, max_order=4, error_action='ignore',
                          suppress_warnings=True,
                     stepwise=True, trace=True)
```

```
      /usr/local/lib/python3.10/dist-packages/pmdarima/arima/_validation.py:62: UserW

      m (12) set for non-seasonal fit. Setting to 0

      Performing stepwise search to minimize aic
       ARIMA(0,0,0)(0,0,0)[0]             : AIC=59.957, Time=0.06 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(1,0,1)(0,0,0)[0]             : AIC=inf, Time=0.12 sec
       ARIMA(0,0,0)(0,0,0)[0] intercept   : AIC=21.474, Time=0.03 sec
       ARIMA(1,0,0)(0,0,0)[0] intercept   : AIC=20.463, Time=0.07 sec
       ARIMA(2,0,0)(0,0,0)[0] intercept   : AIC=22.433, Time=0.12 sec
       ARIMA(1,0,1)(0,0,0)[0] intercept   : AIC=inf, Time=0.51 sec
       ARIMA(0,0,1)(0,0,0)[0] intercept   : AIC=inf, Time=0.10 sec
       ARIMA(2,0,1)(0,0,0)[0] intercept   : AIC=34.692, Time=0.22 sec

      Best model:  ARIMA(1,0,0)(0,0,0)[0] intercept
      Total fit time: 1.370 seconds
```

```
train=final_df[(final_df.index.get_level_values(0) >= '2023-01-31') & (final_df.index.get_
```

```
test=final_df[(final_df.index.get_level_values(0) > '2023-05-31')]
```

```
test
```

| DateTime | TV | Radio | Newspaper | Sales |
|---|---|---|---|---|
| **2023-06-30** | 155.813333 | 19.100000 | 27.806667 | 15.093333 |
| **2023-07-31** | 154.221053 | 19.968421 | 21.400000 | 15.436842 |

```
model.fit(train['Sales'])
```

```
ARIMA
ARIMA(1,0,0)(0,0,0)[0] intercept
```

```
forecast=model.predict(n_periods=4, return_conf_int=True)
```

```
forecast
```

```
(2023-06-30    16.519554
 2023-07-31    14.269223
 2023-08-31    16.158176
 2023-09-30    14.572567
 Freq: M, dtype: float64,
 array([[15.42250821, 17.61659955],
        [12.83691124, 15.70153389],
        [14.53059205, 17.78576082],
        [12.82041195, 16.32472192]]))
```

```
forecast_df = pd.DataFrame(forecast[0],index = test.index,columns=['Prediction'])
```

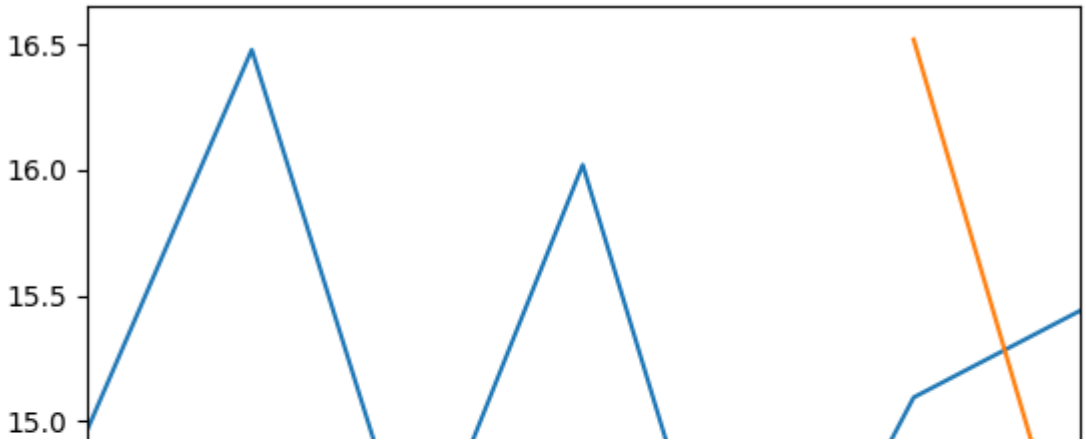
```
forecast_df
```

| DateTime | Prediction |
|---|---|
| **2023-06-30** | 16.519554 |
| **2023-07-31** | 14.269223 |

```
import matplotlib.pyplot as plt
```

```
pd.concat([final_df['Sales'],forecast_df],axis=1).plot()
```

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




```
forecast1=model.predict(n_periods=8, return_conf_int=True)
forecast_range=pd.date_range(start='2023-06-30', periods=8,freq='M')


forecast1_df = pd.DataFrame(forecast1[0],index =forecast_range,columns=['Prediction'])


pd.concat([final_df['Sales'],forecast1_df],axis=1).plot()
```

```
<Axes: >
```