```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from xgboost import XGBRegressor
from sklearn.ensemble import RandomForestClassifier
from sklearn.linear_model import LinearRegression
from sklearn.preprocessing import MinMaxScaler
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, LSTM
from tensorflow.keras.callbacks import EarlyStopping,ModelCheckpoint
```

```
store_sales = pd.read_csv("train.csv")
store_sales.head(10)
```

	date	store	item	sales
0	2013-01-01	1	1	13
1	2013-01-02	1	1	11
2	2013-01-03	1	1	14
3	2013-01-04	1	1	13
4	2013-01-05	1	1	10
5	2013-01-06	1	1	12
6	2013-01-07	1	1	10
7	2013-01-08	1	1	9
8	2013-01-09	1	1	12
9	2013-01-10	1	1	9

Double-click (or enter) to edit

```
store_sales.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 913000 entries, 0 to 912999
Data columns (total 4 columns):
 #   Column  Non-Null Count   Dtype
---  ------  --------------   -----
 0   date    913000 non-null  object
 1   store   913000 non-null  int64
 2   item    913000 non-null  int64
```

```
     3   sales   913000 non-null  int64
    dtypes: int64(3), object(1)
    memory usage: 27.9+ MB
```

```
store_sales = store_sales.drop(['store','item'], axis=1)
```

```
store_sales.info()
```

```
    <class 'pandas.core.frame.DataFrame'>
    RangeIndex: 913000 entries, 0 to 912999
    Data columns (total 2 columns):
     #   Column  Non-Null Count   Dtype 
    ---  ------  --------------   ----- 
     0   date    913000 non-null  object
     1   sales   913000 non-null  int64 
    dtypes: int64(1), object(1)
    memory usage: 13.9+ MB
```

```
store_sales['date'] = pd.to_datetime(store_sales['date'])
```

```
store_sales.info()
```

```
    <class 'pandas.core.frame.DataFrame'>
    RangeIndex: 913000 entries, 0 to 912999
    Data columns (total 2 columns):
     #   Column  Non-Null Count   Dtype         
    ---  ------  --------------   -----         
     0   date    913000 non-null  datetime64[ns]
     1   sales   913000 non-null  int64         
    dtypes: datetime64[ns](1), int64(1)
    memory usage: 13.9 MB
```

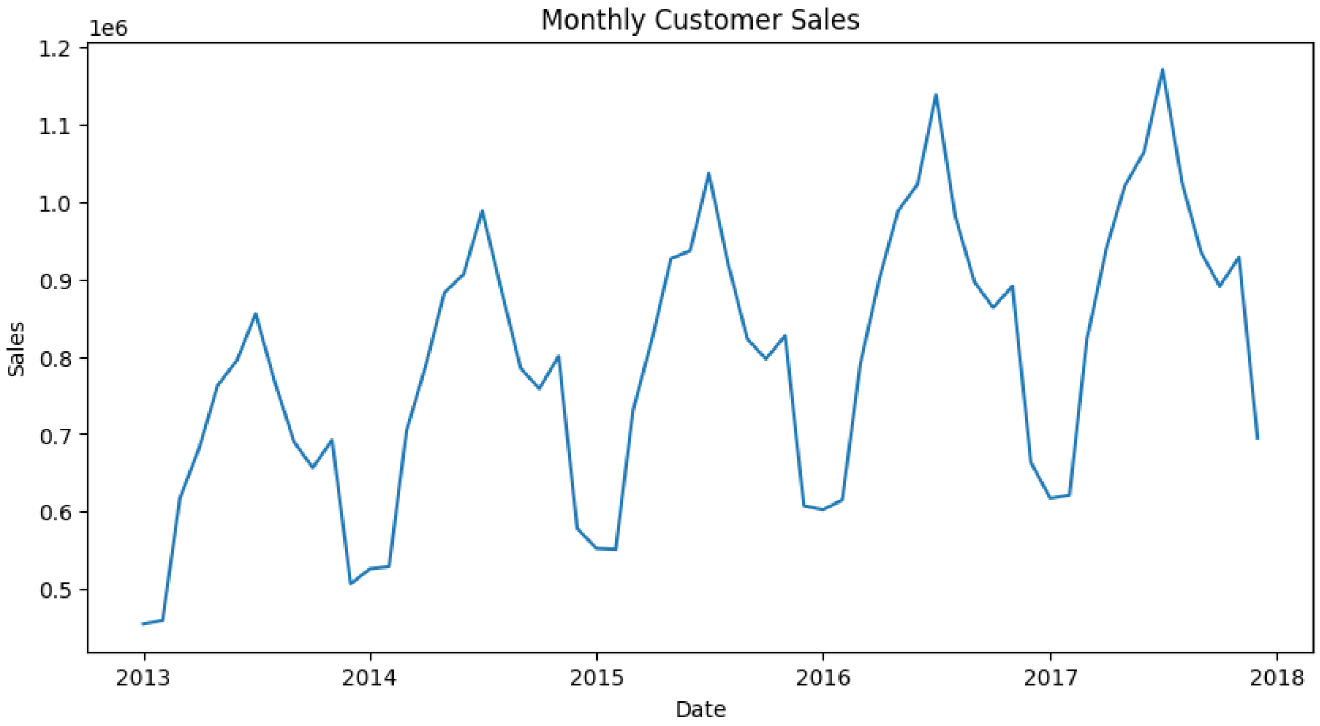
```
store_sales['date'] = store_sales['date'].dt.to_period("M")
monthly_sales = store_sales.groupby('date').sum().reset_index()
```

```
monthly_sales['date'] = monthly_sales['date'].dt.to_timestamp()
```

```
monthly_sales.head(10)
```

	date	sales
0	2013-01-01	454904
1	2013-02-01	459417
2	2013-03-01	617382
3	2013-04-01	682274
4	2013-05-01	763242
5	2013-06-01	795597
6	2013-07-01	855922
7	2013-08-01	766761
8	2013-09-01	689907
9	2013-10-01	656587

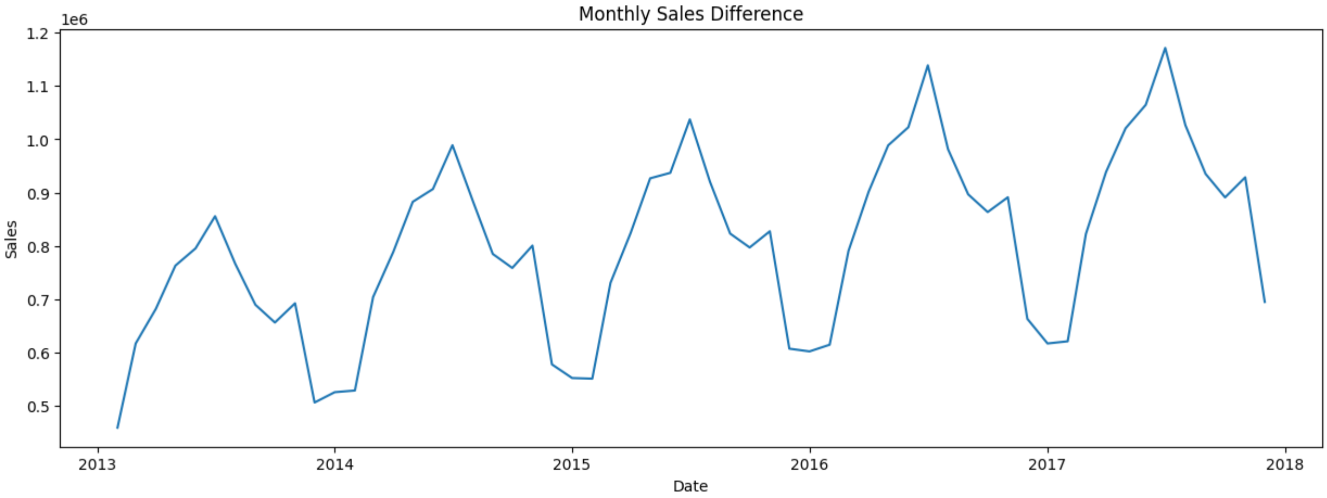
```
plt.figure(figsize = (10,5))
plt.plot(monthly_sales['date'],monthly_sales['sales'])
plt.xlabel("Date")
plt.ylabel("Sales")
plt.title("Monthly Customer Sales")
plt.show()
```



```
monthly_sales['sales_diff'] = monthly_sales['sales'].diff()
monthly_sales = monthly_sales.dropna()
monthly_sales.head(10)
```

	date	sales	sales_diff
1	2013-02-01	459417	4513.0
2	2013-03-01	617382	157965.0
3	2013-04-01	682274	64892.0
4	2013-05-01	763242	80968.0
5	2013-06-01	795597	32355.0
6	2013-07-01	855922	60325.0
7	2013-08-01	766761	-89161.0
8	2013-09-01	689907	-76854.0
9	2013-10-01	656587	-33320.0
10	2013-11-01	692643	36056.0

```
plt.figure(figsize = (15,5))
plt.plot(monthly_sales['date'],monthly_sales['sales'])
plt.xlabel("Date")
plt.ylabel("Sales")
plt.title("Monthly Sales Difference")
plt.show()
```



```
supervised_data = monthly_sales.drop(['date','sales'],axis = 1)
```

```
for i in range(1,13):
  col_name = 'month_' + str(i)
  supervised_data[col_name] = supervised_data['sales_diff'].shift(i)
supervised_data = supervised_data.dropna().reset_index(drop=True)
supervised_data.head(10)
```

	sales_diff	month_1	month_2	month_3	month_4	month_5	month_6	month_7	
0	3130.0	19380.0	-186036.0	36056.0	-33320.0	-76854.0	-89161.0	60325.0	
1	175184.0	3130.0	19380.0	-186036.0	36056.0	-33320.0	-76854.0	-89161.0	
2	84613.0	175184.0	3130.0	19380.0	-186036.0	36056.0	-33320.0	-76854.0	-
3	93963.0	84613.0	175184.0	3130.0	19380.0	-186036.0	36056.0	-33320.0	-
4	23965.0	93963.0	84613.0	175184.0	3130.0	19380.0	-186036.0	36056.0	-
5	82168.0	23965.0	93963.0	84613.0	175184.0	3130.0	19380.0	-186036.0	
6	-103414.0	82168.0	23965.0	93963.0	84613.0	175184.0	3130.0	19380.0	-1
7	-100472.0	-103414.0	82168.0	23965.0	93963.0	84613.0	175184.0	3130.0	
8	-26241.0	-100472.0	-103414.0	82168.0	23965.0	93963.0	84613.0	175184.0	
9	41900.0	-26241.0	-100472.0	-103414.0	82168.0	23965.0	93963.0	84613.0	1

```
train_data = supervised_data[:-12]
test_data = supervised_data[-12:]
print("Train Data Shape: ", train_data.shape)
print("Test Data Shape: ", test_data.shape)
```

```
Train Data Shape:  (35, 13)
Test Data Shape:  (12, 13)
```

```
scaler = MinMaxScaler(feature_range = (-1,1))
scaler.fit(train_data)
train_data = scaler.transform(train_data)
test_data = scaler.transform(test_data)
```

```
x_train,y_train = train_data[:,1:],train_data[:,0:1]
x_test,y_test = test_data[:,1:],test_data[:,0:1]
y_train = y_train.ravel()
y_test = y_test.ravel()
print("x_train shape: ",x_train.shape)
print("y_train shape: ",y_train.shape)
print("x_test shape: ",x_test.shape)
print("y_test shape: ",y_test.shape)
```

```
x_train shape:  (35, 12)
y_train shape:  (35,)
x_test shape:  (12, 12)
y_test shape:  (12,)
```

```
sales_dates = monthly_sales['date'][-12:].reset_index(drop=True)
```

```
act_sales = monthly_sales['sales'][-13:].to_list()
print(act_sales)
```

```
[663411, 617306, 621369, 822667, 938862, 1020686, 1064624, 1171393, 1026403, 935263, 89
```

```
lr_model = LinearRegression()
lr_model.fit(x_train, y_train)
lr_pre = lr_model.predict(x_test)
```

```
lr_pre = lr_pre.reshape(-1,1)
lr_pre_test_set = np.concatenate([lr_pre, x_test],axis=1)
lr_pre_test_set = scaler.inverse_transform(lr_pre_test_set)
```

```
result_list = []
for index in range(0, len(lr_pre_test_set)):
  result_list.append(lr_pre_test_set[index][0] + act_sales[index])
lr_pre_series = pd.Series(result_list,name = "Linear Prediction")
predict_df = predict_df.merge(lr_pre_series,left_index = True,right_index = True)
```

```
lr_mse = np.sqrt(mean_squared_error(predict_df['Linear Prediction'], monthly_sales['sales'][-
lr_mae = mean_absolute_error(predict_df['Linear Prediction'],monthly_sales['sales'][-12:])
lr_r2 = r2_score(predict_df['Linear Prediction'], monthly_sales['sales'][-12:])
print("Linear Reegression MSE: ",lr_mse)
print("Linear Reegression MAE: ",lr_mae)
print("Linear Reegression R2: ",lr_r2)
```

```
Linear Reegression MSE:  16221.272385416869
Linear Reegression MAE:  12433.184266490736
Linear Reegression R2:  0.9906152516380969
```

```
plt.figure(figsize=(15,5))
plt.plot(monthly_sales['date'],monthly_sales['sales'])
plt.plot(predict_df['date'],predict_df['Linear Prediction'])
plt.title("Customer sales Forcast usning LR Model")
plt.xlabel("Date")
```