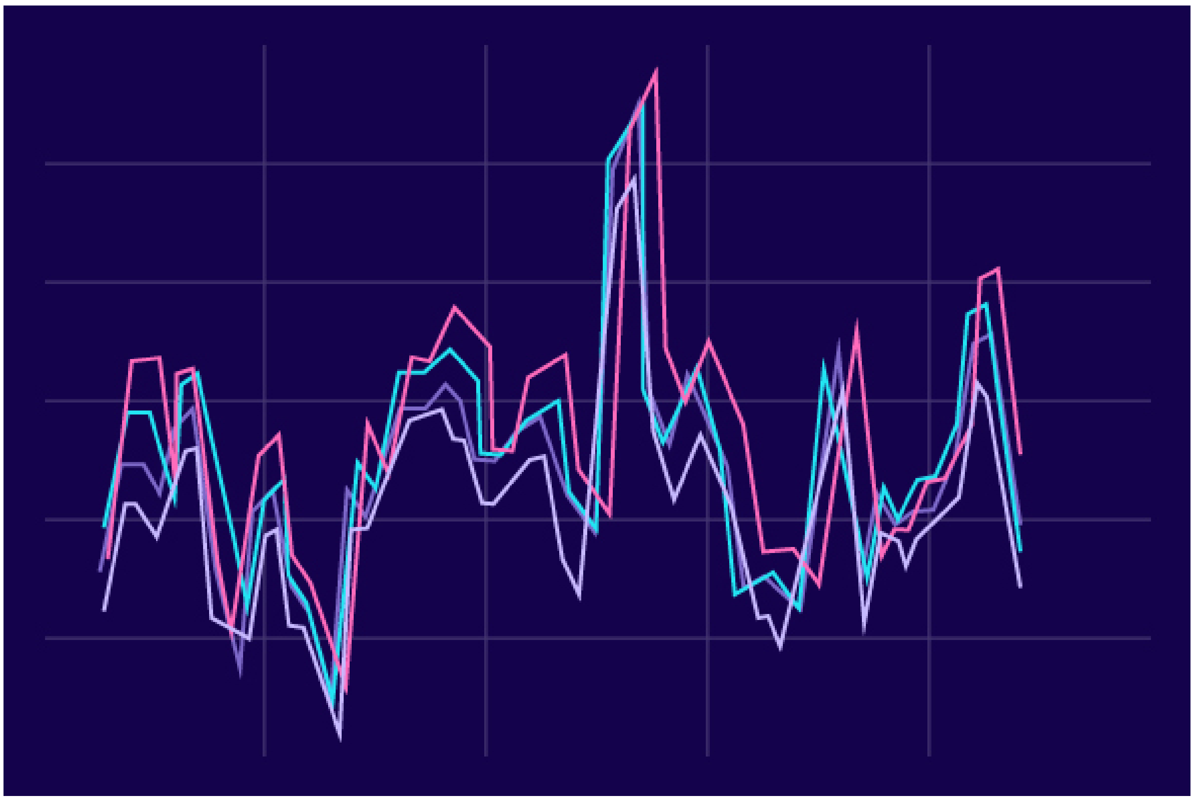
Time Series Analysis

Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. While regression analysis is often employed in such a way as to test relationships between one or more different time series, this type of analysis is not usually called "time series analysis", which refers in particular to relationships between different points in time within a single series. Interrupted time series analysis is used to detect changes in the evolution of a time series from before to after some intervention which may affect the underlying variable.



In [83]:
```
#Install the Standard libraries
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
```

In [84]:
```
#Let load the dataset
data=pd.read_csv('AMZN.csv')
data.head()
```

Out[84]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	2005-01-03	2.2475	2.2720	2.2105	2.2260	2.2260	208930000
1	2005-01-04	2.1335	2.1630	2.0750	2.1070	2.1070	388370000
2	2005-01-05	2.0785	2.1380	2.0780	2.0885	2.0885	167084000
3	2005-01-06	2.0905	2.1125	2.0450	2.0525	2.0525	174018000
4	2005-01-07	2.0690	2.1345	2.0580	2.1160	2.1160	196732000

In [3]:
```
data.shape
```
Out[3]:
```
(4480, 7)
```

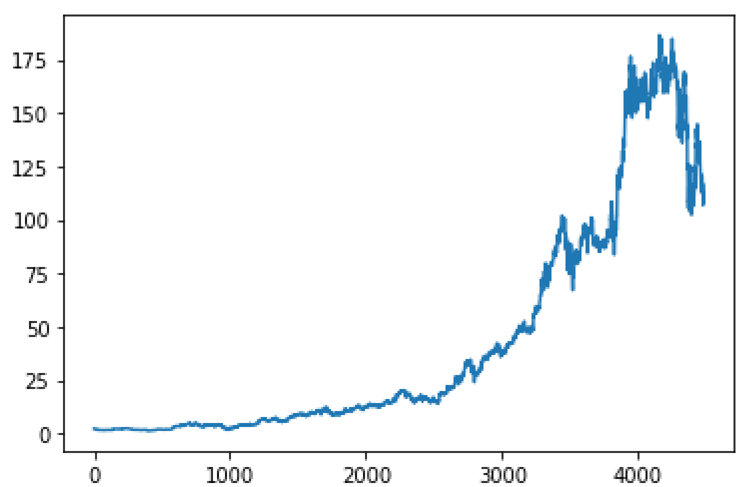
In [4]:
```
#data columns
data.columns
```
Out[4]:
```
Index(['Date', 'Open', 'High', 'Low', 'Close', 'Adj Close', 'Volume'], dtype
='object')
```

In [5]:
```
#Remove the unwanted columns
data=data.drop(['Date','Adj Close'],axis=1)
```

In [6]:
```
data.head()
```
Out[6]:

	Open	High	Low	Close	Volume
0	2.2475	2.2720	2.2105	2.2260	208930000
1	2.1335	2.1630	2.0750	2.1070	388370000
2	2.0785	2.1380	2.0780	2.0885	167084000
3	2.0905	2.1125	2.0450	2.0525	174018000
4	2.0690	2.1345	2.0580	2.1160	196732000

In [7]:
```
plt.plot(data.Close)
```
Out[7]:
```
[<matplotlib.lines.Line2D at 0x7faa665922e0>]
```



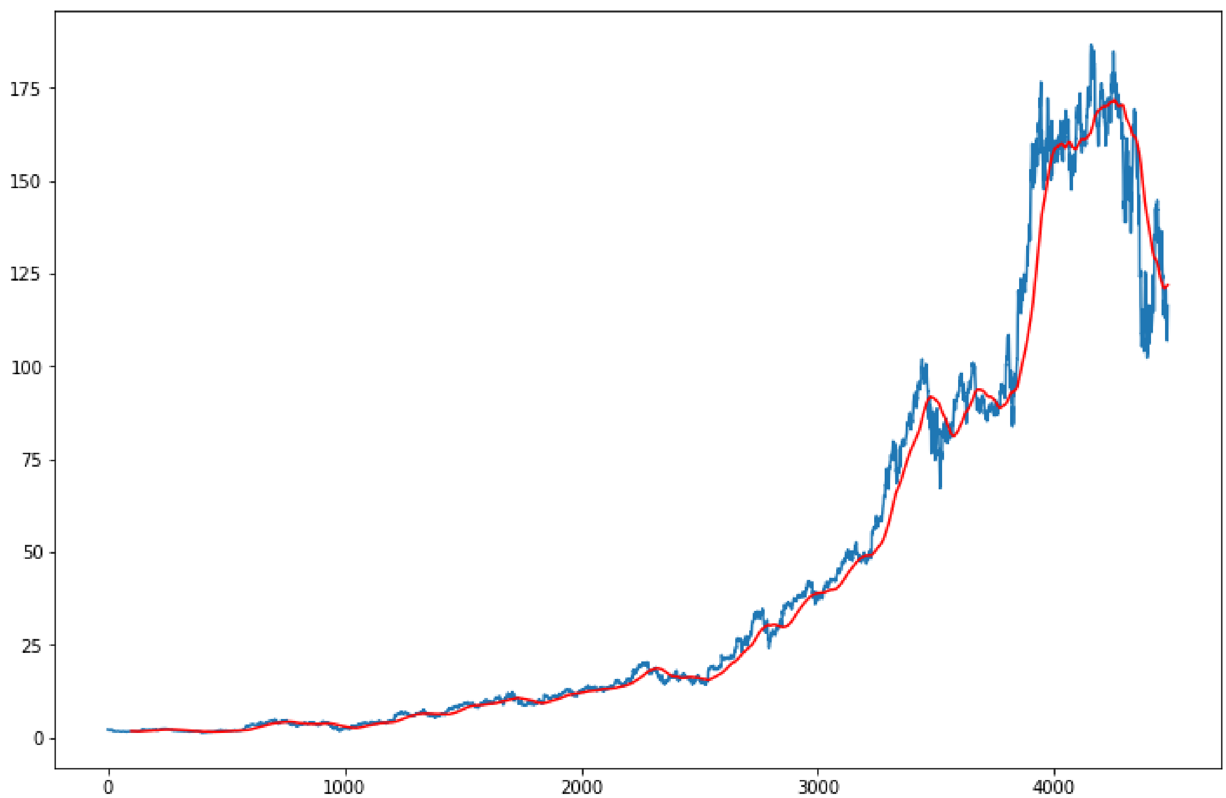
In [8]:
```
#To view the last 100 values mean
max100=data.Close.rolling(100).mean()
```

```
max100
```

Out[8]:
```
0              NaN
1              NaN
2              NaN
3              NaN
4              NaN
           ...
4475    121.634915
4476    121.684305
4477    121.677735
4478    121.774635
4479    121.870485
Name: Close, Length: 4480, dtype: float64
```

In [9]:
```
#Let's visualize the it
plt.figure(figsize=(12,8))
plt.plot(data.Close)
plt.plot(max100,'red')
```

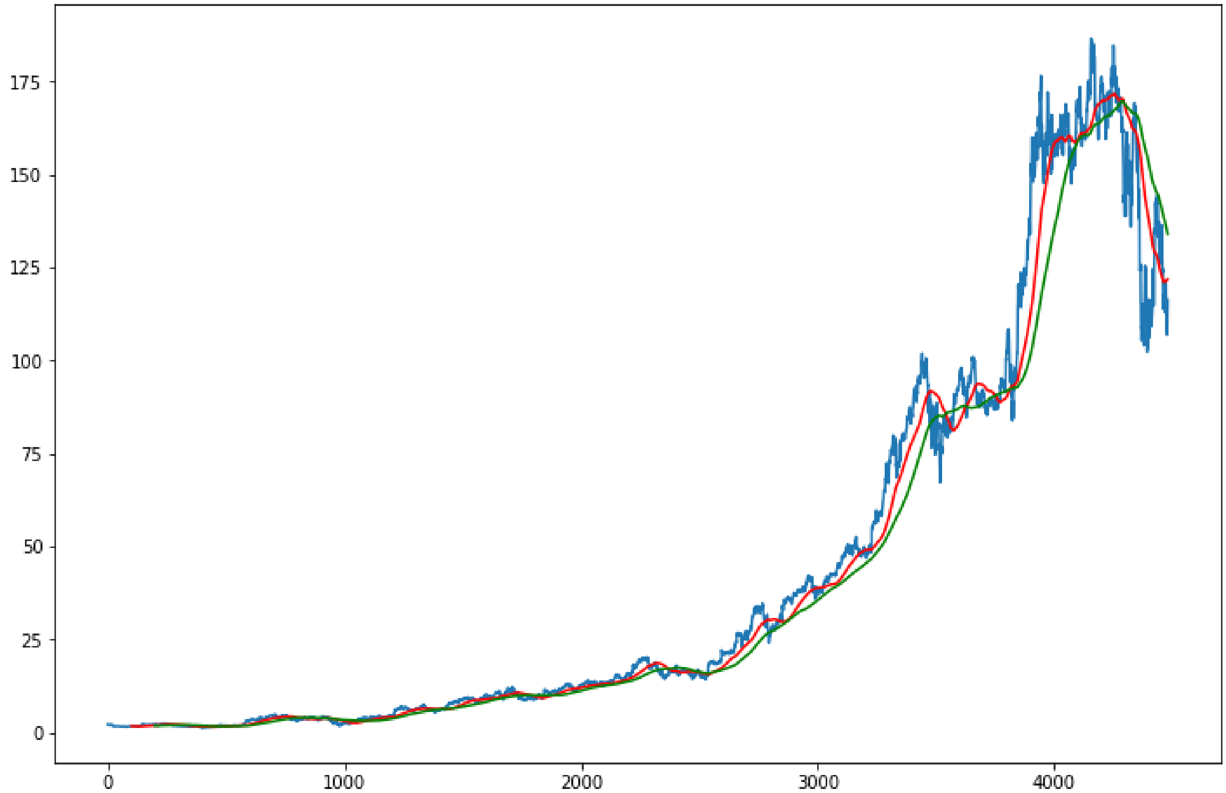
Out[9]: [<matplotlib.lines.Line2D at 0x7faa6649c430>]



In [10]:
```
max200=data.Close.rolling(200).mean()
```

In [11]:
```
plt.figure(figsize=(12,8))
plt.plot(data.Close)
plt.plot(max100,'red')
plt.plot(max200,'green')
```

Out[11]: [<matplotlib.lines.Line2D at 0x7faa6641c730>]



In [12]:
```
data.shape
```

Out[12]:
```
(4480, 5)
```

Divided the data into training and testing

In [13]:
```
# We take the 70 training data
# and 30% per testing data
data_training=pd.DataFrame(data['Close'][0:int(len(data)*0.7)])
data_testing=pd.DataFrame(data['Close'][int(len(data)*0.70): int(len(data))])
```

In [14]:
```
#check the shape
print(data_training.shape)
print(data_testing.shape)
```

```
(3136, 1)
(1344, 1)
```

In [15]:
```
#Scalling the values using the MinMaxScaler
from sklearn.preprocessing import MinMaxScaler
scaler=MinMaxScaler(feature_range=(0,1))
data_training_array=scaler.fit_transform(data_training)
```

In [16]:
```
data_training_array
```

Out[16]:
```
array([[0.01872583],
       [0.01631025],
       [0.01593472],
       ...,
       [0.96460871],
       [0.95212478],
       [0.97601675]])
```

In [17]:
```
x_train=[]
y_train=[]
#create for loop for feature prediction for next 100 days
for i in range(100,data_training_array.shape[0]):
    x_train.append(data_training_array[i-100:i])
    y_train.append(data_training_array[i,0])
```

In [18]:
```
x_train,y_train=np.array(x_train),np.array(y_train)
```

In [19]:
```
x_train.shape
```

Out[19]:
```
(3036, 100, 1)
```

Model buliding using the LSTM

In [20]:
```
#import the kreas libreris
from keras.layers import Dense,Dropout,LSTM
from keras.models import Sequential
```

```
2022-10-19 20:18:27.267787: I tensorflow/core/util/util.cc:169] oneDNN custom
operations are on. You may see slightly different numerical results due to flo
ating-point round-off errors from different computation orders. To turn them o
ff, set the environment variable `TF_ENABLE_ONEDNN_OPTS=0`.
2022-10-19 20:18:27.271831: W tensorflow/stream_executor/platform/default/dso_
loader.cc:64] Could not load dynamic library 'libcudart.so.11.0'; dlerror: lib
cudart.so.11.0: cannot open shared object file: No such file or directory
2022-10-19 20:18:27.271847: I tensorflow/stream_executor/cuda/cudart_stub.cc:2
9] Ignore above cudart dlerror if you do not have a GPU set up on your machin
e.
```

In [40]:
```
model=Sequential()
#add first layer
model.add(LSTM(units=50,activation='relu',return_sequences=True,input_shape=(x
model.add(Dropout(0.2))
#add second layer
model.add(LSTM(units=80,activation='relu',return_sequences=True))
model.add(Dropout(0.5))
#add thired layers
model.add(LSTM(units=100,activation='relu',return_sequences=True))
model.add(Dropout(0.4))
#add fourth layer
model.add(LSTM(units=120,activation='relu'))
model.add(Dropout(0.8))
#add dence layer
model.add(Dense(units=1))
```

In [41]:
```
model.summary()
```

```
Model: "sequential_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #   
=================================================================
 lstm_4 (LSTM)               (None, 100, 50)           10400     
                                                                 
 dropout_4 (Dropout)         (None, 100, 50)           0         
                                                                 
 lstm_5 (LSTM)               (None, 100, 80)           41920     
                                                                 
 dropout_5 (Dropout)         (None, 100, 80)           0         
                                                                 
 lstm_6 (LSTM)               (None, 100, 100)          72400     
                                                                 
 dropout_6 (Dropout)         (None, 100, 100)          0         
                                                                 
 lstm_7 (LSTM)               (None, 120)               106080    
                                                                 
 dropout_7 (Dropout)         (None, 120)               0         
                                                                 
 dense_1 (Dense)             (None, 1)                 121       
                                                                 
=================================================================
Total params: 230,921
Trainable params: 230,921
Non-trainable params: 0
_________________________________________________________________
```

In [42]:

```
#Compile the model with adam optimizer and loss function then finally compile
model.compile(optimizer='adam',loss='mean_squared_error')
model.fit(x_train,y_train,epochs=20)
```

```
Epoch 1/20
95/95 [==============================] - 15s 128ms/step - loss: 0.0220
Epoch 2/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0108
Epoch 3/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0094
Epoch 4/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0080
Epoch 5/20
95/95 [==============================] - 12s 123ms/step - loss: 0.0072
Epoch 6/20
95/95 [==============================] - 12s 125ms/step - loss: 0.0077
Epoch 7/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0070
Epoch 8/20
95/95 [==============================] - 12s 123ms/step - loss: 0.0062
Epoch 9/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0058
Epoch 10/20
95/95 [==============================] - 12s 125ms/step - loss: 0.0062
Epoch 11/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0056
Epoch 12/20
95/95 [==============================] - 12s 125ms/step - loss: 0.0057
Epoch 13/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0060
Epoch 14/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0065
Epoch 15/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0060
Epoch 16/20
95/95 [==============================] - 12s 123ms/step - loss: 0.0060
Epoch 17/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0059
Epoch 18/20
95/95 [==============================] - 12s 125ms/step - loss: 0.0063
Epoch 19/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0061
Epoch 20/20
95/95 [==============================] - 12s 124ms/step - loss: 0.0053
```

Out[42]: <keras.callbacks.History at 0x7fa9a94a5100>

In [43]:
```
model.save('LSTM_1.h5')
```

In [44]:
```
data_testing.head()
```

Out[44]:

	Close
3136	49.758499
3137	49.629501
3138	50.111500
3139	50.064999
3140	50.187000

In [45]:
```
past_100_days=data_training.tail()
final_df=past_100_days.append(data_testing,ignore_index=True)
```

```
final_df.head()
```

```
/tmp/ipykernel_19127/2619201730.py:2: FutureWarning: The frame.append method i
s deprecated and will be removed from pandas in a future version. Use pandas.c
oncat instead.
  final_df=past_100_days.append(data_testing,ignore_index=True)
```

Out[45]:

	Close
0	48.245499
1	49.039501
2	48.823502
3	48.208500
4	49.385502

In [46]:

```
input_data=scaler.fit_transform(final_df)
input_data
```

Out[46]:

```
array([[0.00942061],
       [0.01510666],
       [0.01355983],
       ...,
       [0.42945996],
       [0.47880094],
       [0.49720535]])
```

In [47]:

```
input_data.shape
```

Out[47]:

```
(1349, 1)
```

In [48]:

```
x_test=[]
y_test=[]
for i in range(100,input_data.shape[0]):
    x_test.append(input_data[i-100:i])
    y_test.append(input_data[i,0])
```

In [49]:

```
x_test,y_test=np.array(x_test),np.array(y_test)
print(x_test.shape)
print(y_test.shape)
```

```
(1249, 100, 1)
(1249,)
```

In [50]:

```
y_predicted=model.predict(x_test)
```

```
40/40 [==============================] - 2s 35ms/step
```

In [51]:

```
y_predicted
```

Out[51]:

```
array([[0.03578457],
       [0.03621086],
       [0.03677611],
       ...,
       [0.5205482 ],
       [0.51724565],
       [0.5138284 ]], dtype=float32)
```

In [52]:

```
print(y_predicted.shape)
```

```
print(y_test.shape)
```

```
(1249, 1)
(1249,)
```

In [53]:
```
y_test
```

Out[53]:
```
array([0.05910891, 0.05572165, 0.0619448 , ..., 0.42945996, 0.47880094,
       0.49720535])
```

In [54]:
```
y_predicted
```

Out[54]:
```
array([[0.03578457],
       [0.03621086],
       [0.03677611],
       ...,
       [0.5205482 ],
       [0.51724565],
       [0.5138284 ]], dtype=float32)
```

In [55]:
```
scaler.scale_
```

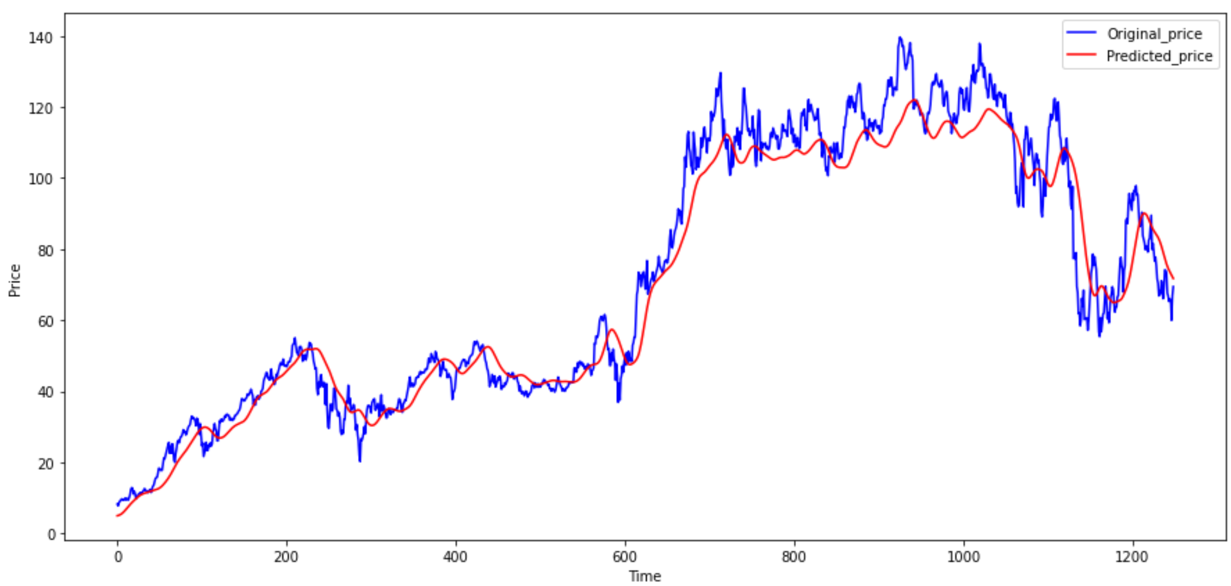
Out[55]:
```
array([0.00716125])
```

In [56]:
```
scale_factor=1/0.00716125
y_prediction=y_predicted*scale_factor
y_test=y_test*scale_factor
```

In [57]:
```
y_prediction.shape
```

Out[57]:
```
(1249, 1)
```

In [58]:
```
plt.figure(figsize=(15,7))
plt.plot(y_test,'blue',label="Original_price")
plt.plot(y_prediction,'red',label="Predicted_price")
plt.xlabel("Time")
plt.ylabel("Price")
plt.legend()
plt.show()
```



In [59]:
```
import plotly.express as px
```

In [78]:
```
y_pred=y_prediction.reshape(-1,)
y_pred.shape
```

Out[78]: (1249,)

In [79]:
```
y_test.shape
```

Out[79]: (1249,)

In [85]:
```
date=data["Date"]
```

In [86]:
```
import plotly.graph_objects as go

fig = go.Figure()
fig.add_trace(go.Scatter(x=date, y=y_test, name="Test", mode="lines"))
fig.add_trace(go.Scatter(x=date, y=y_pred, name="Prediction", mode="lines"))
fig.update_layout(
    title="Amazon stock prices", xaxis_title="Date", yaxis_title="Close"
)
fig.show()
```

In [ ]:

In [ ]:

```

```