Stock Market Analysis using CNN-LSTM model

This project is about analysis of Stock Market and providing suggestions and predictions to the stockholders. For this, we used CNN-LSTM approach to create a blank model, then use it to train on stock market data. Further implementation is discussed below...

In [1]:

```
# This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory

import os
#for dirname, _, filenames in os.walk('/kaggle/input'):
#    for filename in filenames:
#        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved outside of the current session
```

Data Preprocessing and Analysis

In [2]:

```
import math
import seaborn as sns
import datetime as dt
from datetime import datetime
sns.set_style("whitegrid")
from pandas.plotting import autocorrelation_plot
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use("ggplot")
```

First we'd read the CSV file and then drop the null columns. Then we'd check the columns (some not all)

In [3]:

```
#1DP18XAREYFRWP4I
import requests
import csv
from tqdm import tqdm
key = "1DP18XAREYFRWP4I"

def request_stock_price_list(symbol, size, token):
    q_string = 'https://www.alphavantage.co/query?function=TIME_SERIES_DAILY_ADJUSTED&symbol={}&outputsize={}&apikey={}'

    print("Retrieving stock price data from Alpha Vantage (This may take a while)...")
    r = requests.get(q_string.format(symbol, size, token))
    print("Data has been successfully downloaded...")
    date = []
    colnames = list(range(0, 7))
    df = pd.DataFrame(columns = colnames)
    print("Sorting the retrieved data into a dataframe...")
    for i in tqdm(r.json()['Time Series (Daily)'].keys()):
        date.append(i)
        row = pd.DataFrame.from_dict(r.json()['Time Series (Daily)'][i], orient='index')
.reset_index().T[1:]
        df = pd.concat([df, row], ignore_index=True)
    df.columns = ["open", "high", "low", "close", "adjusted close", "volume", "dividend
amount", "split cf"]
    df['date'] = date
    return df
```

In [4]:

```
cv1 = request_stock_price_list('IBM', 'full', key)
print(cv1.head)
cv1.to_csv('data.csv')
```

```
Retrieving stock price data from Alpha Vantage (This may take a while)...
Data has been successfully downloaded...
Sorting the retrieved data into a dataframe...
```

```
100%|██████████| 5556/5556 [01:47<00:00, 51.65it/s]
```

```
<bound method NDFrame.head of          open     high     low   close adjusted close     vol
ume  \
0     118.62   119.61  117.53   118.5          118.5   8918702
1      115.0  116.335  114.56  115.81         115.81   3322012
2     116.16   117.27  116.08  116.73         116.73   3220802
3     116.79   117.94  116.04  116.79         116.79   4914995
4      116.0   118.81  115.19  116.47         116.47   6417218
...      ...      ...     ...     ...            ...       ...
5551   92.75    92.94   90.19   90.25  52.2266076272  13737600
5552   94.44    94.44    90.0   91.56  52.9846891341  16697600
5553   95.87    95.94    93.5   94.37  54.6108029006  10369100
5554   96.75    96.81   93.69   94.81  54.8654256968  11105400
5555    98.5    98.81   96.37   96.75  55.9880807527   9551800

     dividend amount split cf        date
0             0.0000      1.0  2021-11-29
1             0.0000      1.0  2021-11-26
2             0.0000      1.0  2021-11-24
3             0.0000      1.0  2021-11-23
4             0.0000      1.0  2021-11-22
...              ...      ...         ...
5551          0.0000      1.0  1999-11-05
5552          0.0000      1.0  1999-11-04
5553          0.0000      1.0  1999-11-03
5554          0.0000      1.0  1999-11-02
5555          0.0000      1.0  1999-11-01

[5556 rows x 9 columns]>
```

In [5]:

```
# For data preprocessing and analysis part
data = pd.read_csv('../input/price-volume-data-for-all-us-stocks-etfs/Stocks/abe.us.txt')
#data = pd.read_csv('../input/nifty50-stock-market-data/COALINDIA.csv')
#data = pd.read_csv('../input/stock-market-data/stock_market_data/nasdaq/csv/ABCO.csv')
#data = pd.read_csv('./data.csv')
# Any CSV or TXT file can be added here....
data.dropna(inplace=True)
data.head()
```

Out[5]:

	Date	Open	High	Low	Close	Volume	OpenInt
0	2005-02-25	6.4987	6.6009	6.4668	6.5753	55766	0
1	2005-02-28	6.6072	6.7669	6.5944	6.6263	49343	0
2	2005-03-01	6.6391	6.6773	6.6072	6.6072	31643	0

	Date	Open	High	Low	Close	Volume	OpenInt
3	2005-03-02	6.5753	6.6072	6.5434	6.5816	27101	0
4	2005-03-03	6.5753	6.6135	6.5562	6.5944	17387	0

In [6]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3190 entries, 0 to 3189
Data columns (total 7 columns):
 #   Column   Non-Null Count  Dtype  
---  ------   --------------  -----  
 0   Date     3190 non-null   object 
 1   Open     3190 non-null   float64
 2   High     3190 non-null   float64
 3   Low      3190 non-null   float64
 4   Close    3190 non-null   float64
 5   Volume   3190 non-null   int64  
 6   OpenInt  3190 non-null   int64  
dtypes: float64(4), int64(2), object(1)
memory usage: 199.4+ KB
```

In [7]:

```
data.describe()
```

Out[7]:

	Open	High	Low	Close	Volume	OpenInt
count	3190.000000	3190.000000	3190.000000	3190.000000	3190.000000	3190.0
mean	11.599416	11.712848	11.484610	11.605599	28444.870846	0.0
std	2.350376	2.365621	2.327065	2.341989	37525.175821	0.0
min	5.860300	5.905000	5.834700	5.841100	106.000000	0.0
25%	10.534000	10.655000	10.413750	10.554000	8147.750000	0.0
50%	11.981000	12.067000	11.899000	11.988500	17741.500000	0.0
75%	13.271000	13.386750	13.189000	13.295750	36167.250000	0.0
max	18.130000	19.151000	17.842000	17.925000	634041.000000	0.0

In [8]:

```
data.isnull().sum()
```

Out[8]:

```
Date       0
Open       0
High       0
Low        0
Close      0
Volume     0
OpenInt    0
dtype: int64
```

In [9]:

```
data.reset_index(drop=True, inplace=True)
data.fillna(data.mean(), inplace=True)
data.head()
```

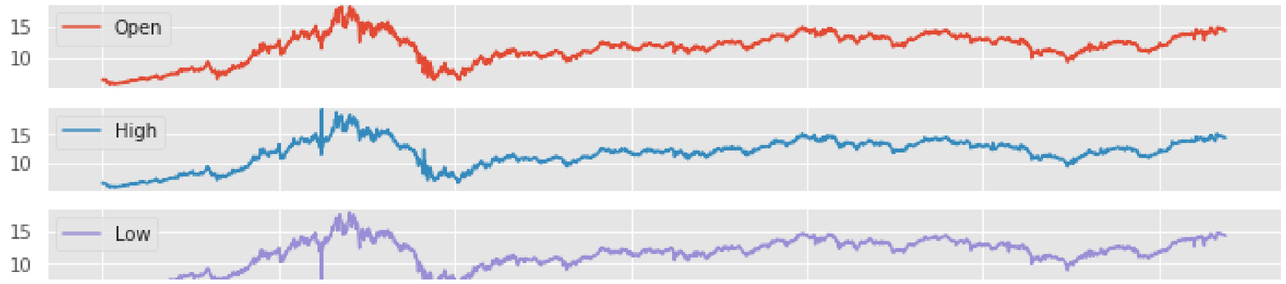
Out[9]:

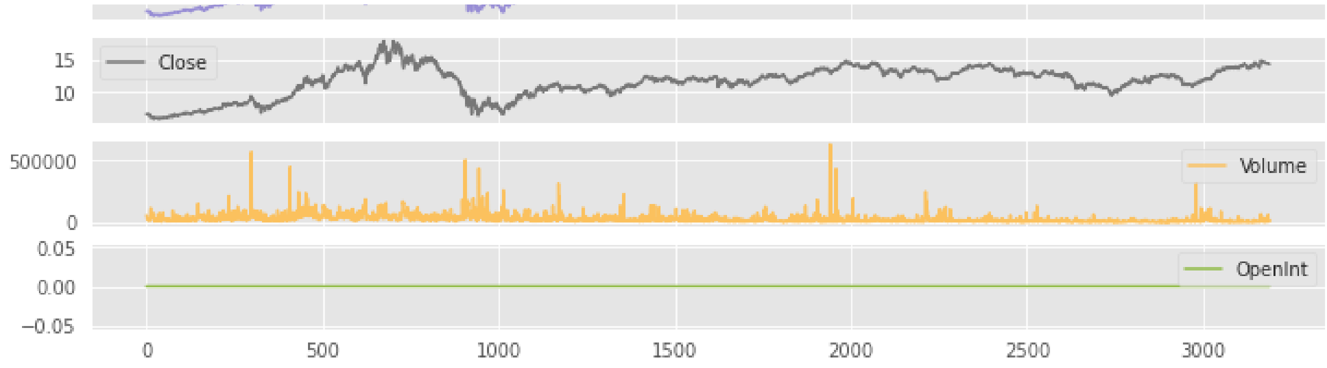
	Date	Open	High	Low	Close	Volume	OpenInt
0	2005-02-25	6.4987	6.6009	6.4668	6.5753	55766	0
1	2005-02-28	6.6072	6.7669	6.5944	6.6263	49343	0

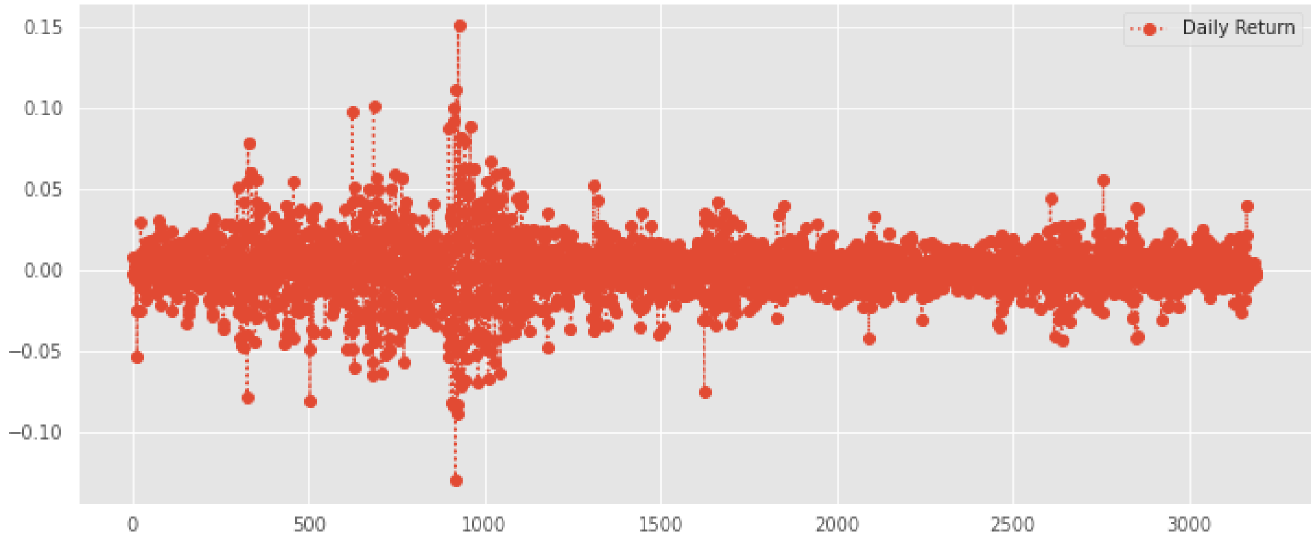
	Date	Open	High	Low	Close	Volume	OpenInt
2	2005-03-01	6.6391	6.6778	6.6072	6.6072	31643	0
3	2005-03-02	6.5753	6.6072	6.5434	6.5816	27101	0
4	2005-03-03	6.5753	6.6135	6.5562	6.5944	17387	0

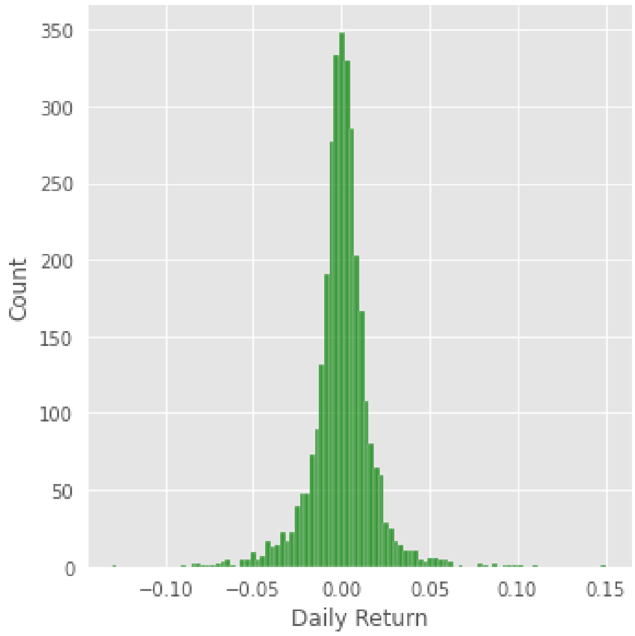
In [10]:

```
data.plot(legend=True,subplots=True, figsize = (12, 6))
plt.show()
#data['Close'].plot(legend=True, figsize = (12, 6))
#plt.show()
#data['Volume'].plot(legend=True,figsize=(12,7))
#plt.show()

data.shape
data.size
data.describe(include='all').T
data.dtypes
data.nunique()
ma_day = [10,50,100]

for ma in ma_day:
    column_name = "MA for %s days" %(str(ma))
    data[column_name]=pd.DataFrame.rolling(data['Close'],ma).mean()

data['Daily Return'] = data['Close'].pct_change()
# plot the daily return percentage
data['Daily Return'].plot(figsize=(12,5),legend=True,linestyle=':',marker='o')
plt.show()

sns.displot(data['Daily Return'].dropna(),bins=100,color='green')
plt.show()

date=pd.DataFrame(data['Date'])
closing_df1 = pd.DataFrame(data['Close'])
close1  = closing_df1.rename(columns={"Close": "data_close"})
close2=pd.concat([date,close1],axis=1)
close2.head()

data.reset_index(drop=True, inplace=True)
data.fillna(data.mean(), inplace=True)
data.head()

data.nunique()

data.sort_index(axis=1,ascending=True)

cols_plot = ['Open', 'High', 'Low','Close','Volume','MA for 10 days','MA for 50 days','MA
for 100 days','Daily Return']
axes = data[cols_plot].plot(marker='.', alpha=0.7, linestyle='None', figsize=(11, 9), su
bplots=True)
for ax in axes:
    ax.set_ylabel('Daily trade')

plt.plot(data['Close'], label="Close price")
plt.xlabel("Timestamp")
plt.ylabel("Closing price")
df = data
print(df)

data.isnull().sum()
```







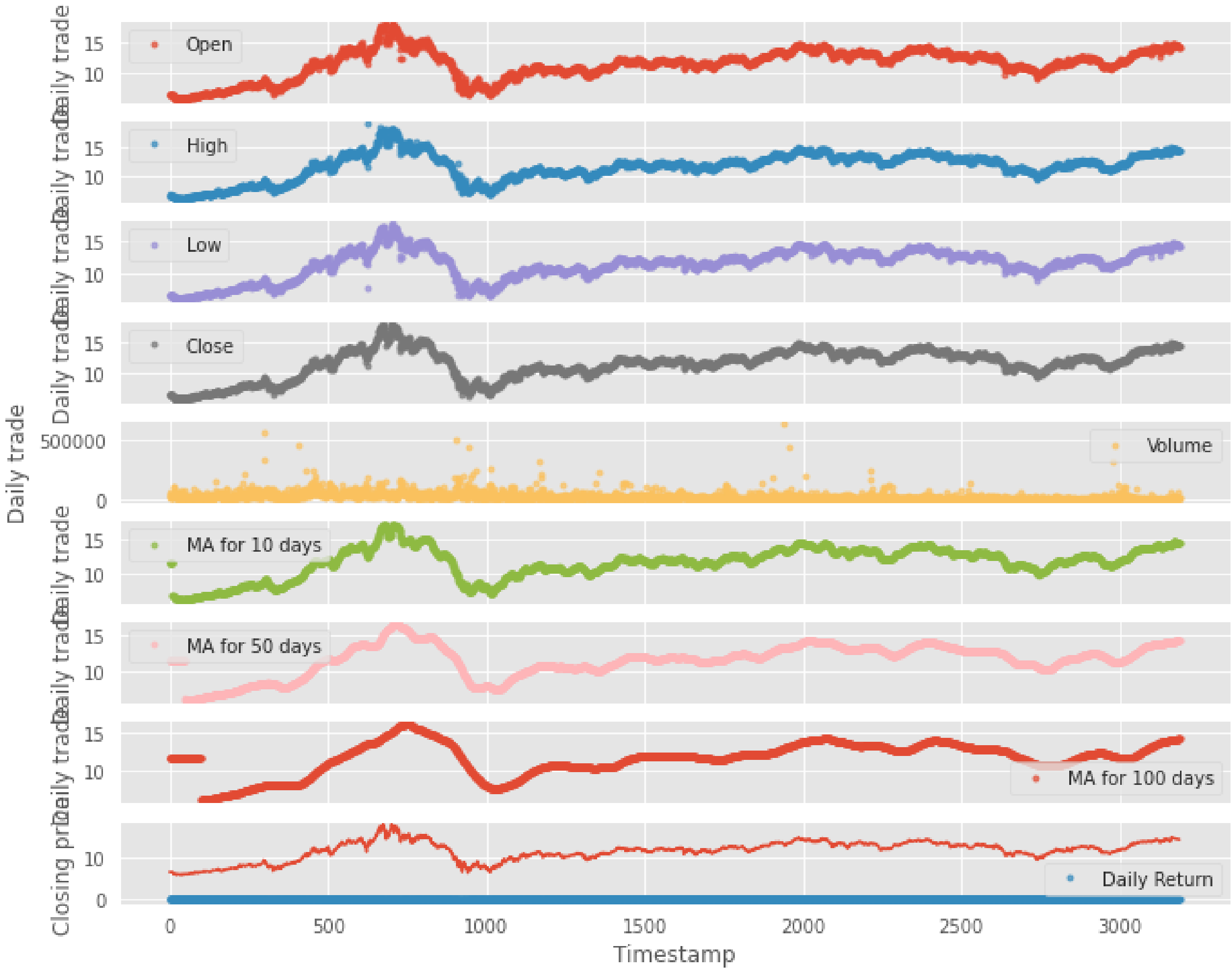


```
            Date     Open     High      Low    Close  Volume  OpenInt  \
0     2005-02-25   6.4987   6.6009   6.4668   6.5753   55766        0
1     2005-02-28   6.6072   6.7669   6.5944   6.6263   49343        0
2     2005-03-01   6.6391   6.6773   6.6072   6.6072   31643        0
3     2005-03-02   6.5753   6.6072   6.5434   6.5816   27101        0
4     2005-03-03   6.5753   6.6135   6.5562   6.5944   17387        0
...          ...      ...      ...      ...      ...     ...      ...
3185  2017-11-06  14.3998  14.4802  14.3900  14.4400   62423        0
3186  2017-11-07  14.4400  14.4400  14.4000  14.4000    6722        0
3187  2017-11-08  14.3400  14.4352  14.3400  14.3781    6304        0
3188  2017-11-09  14.3300  14.3737  14.2800  14.3200   18761        0
3189  2017-11-10  14.2500  14.3000  14.2400  14.3000   10658        0

      MA for 10 days  MA for 50 days  MA for 100 days  Daily Return
0           11.60878       11.625272        11.649354      0.000388
1           11.60878       11.625272        11.649354      0.007756
2           11.60878       11.625272        11.649354     -0.002882
3           11.60878       11.625272        11.649354     -0.003875
4           11.60878       11.625272        11.649354      0.001945
```

```
...            ...          ...            ...          ...
3185      14.44648    14.344662      14.136796     0.003893
3186      14.43071    14.355862      14.142926    -0.002770
3187      14.42077    14.361972      14.150117    -0.001521
3188      14.40677    14.369792      14.155817    -0.004041
3189      14.39377    14.371792      14.160597    -0.001397

[3190 rows x 11 columns]
```

Out[10]:

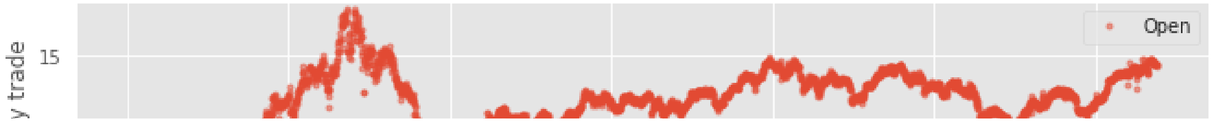
```
Date                   0
Open                   0
High                   0
Low                    0
Close                  0
Volume                 0
OpenInt                0
MA for 10 days         0
MA for 50 days         0
MA for 100 days        0
Daily Return           0
dtype: int64
```

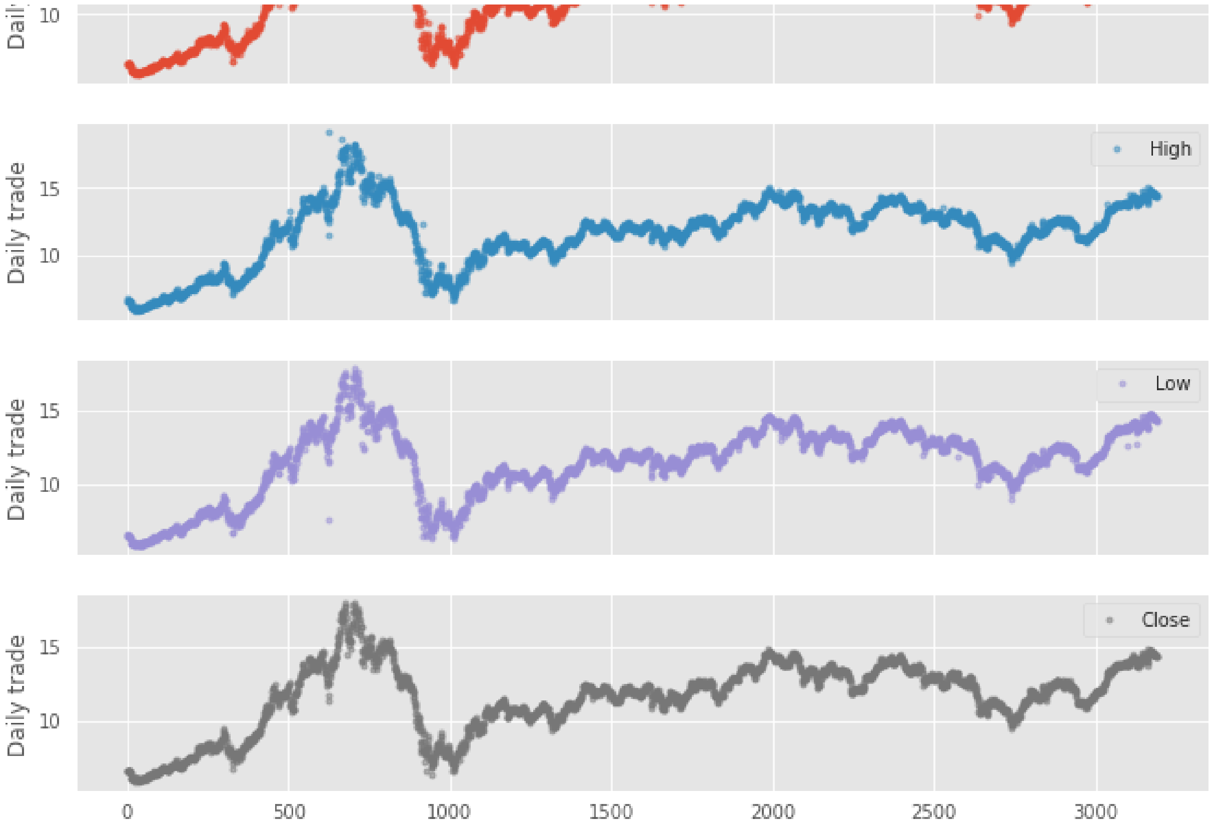


After that, we'll visualize the data for understanding, this is shown below...

In [11]:

```
cols_plot = ['Open', 'High', 'Low','Close']
axes = data[cols_plot].plot(marker='.', alpha=0.5, linestyle='None', figsize=(11, 9), su
bplots=True)
for ax in axes:
    ax.set_ylabel('Daily trade')
```





Then we'd print the data after making changes and dropping null data

In [12]:

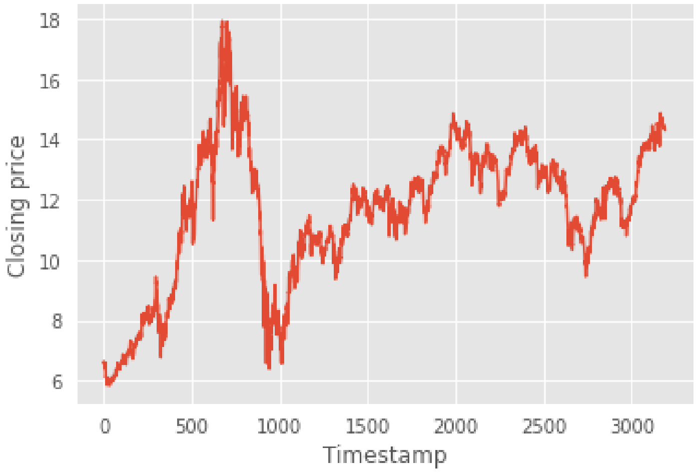
```python
plt.plot(data['Close'], label="Close price")
plt.xlabel("Timestamp")
plt.ylabel("Closing price")
df = data
print(df)

df.describe().transpose()
```

```
            Date     Open     High      Low    Close  Volume  OpenInt  \
0     2005-02-25   6.4987   6.6009   6.4668   6.5753   55766        0
1     2005-02-28   6.6072   6.7669   6.5944   6.6263   49343        0
2     2005-03-01   6.6391   6.6773   6.6072   6.6072   31643        0
3     2005-03-02   6.5753   6.6072   6.5434   6.5816   27101        0
4     2005-03-03   6.5753   6.6135   6.5562   6.5944   17387        0
...          ...      ...      ...      ...      ...     ...      ...
3185  2017-11-06  14.3998  14.4802  14.3900  14.4400   62423        0
3186  2017-11-07  14.4400  14.4400  14.4000  14.4000    6722        0
3187  2017-11-08  14.3400  14.4352  14.3400  14.3781    6304        0
3188  2017-11-09  14.3300  14.3737  14.2800  14.3200   18761        0
3189  2017-11-10  14.2500  14.3000  14.2400  14.3000   10658        0

      MA for 10 days  MA for 50 days  MA for 100 days  Daily Return
0           11.60878       11.625272        11.649354      0.000388
1           11.60878       11.625272        11.649354      0.007756
2           11.60878       11.625272        11.649354     -0.002882
3           11.60878       11.625272        11.649354     -0.003875
4           11.60878       11.625272        11.649354      0.001945
...              ...             ...              ...           ...
3185        14.44648       14.344662        14.136796      0.003893
3186        14.43071       14.355862        14.142926     -0.002770
3187        14.42077       14.361972        14.150117     -0.001521
3188        14.40677       14.369792        14.155817     -0.004041
3189        14.39377       14.371792        14.160597     -0.001397

[3190 rows x 11 columns]
```

Out[12]:

	count	mean	std	min	25%	50%	75%	max

	count	mean	std	min	25%	50%	75%	max
Open	3190.0	11.599416	2.350376	5.860300	10.534000	11.981000	13.271000	18.130000
High	3190.0	11.712848	2.365621	5.905000	10.655000	12.067000	13.386750	19.151000
Low	3190.0	11.484610	2.327065	5.834700	10.413750	11.899000	13.189000	17.842000
Close	3190.0	11.605599	2.341989	5.841100	10.554000	11.988500	13.295750	17.925000
Volume	3190.0	28444.870846	37525.175821	106.000000	8147.750000	17741.500000	36167.250000	634041.000000
OpenInt	3190.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
MA for 10 days	3190.0	11.608780	2.321162	5.963080	10.577125	11.962700	13.297200	17.329400
MA for 50 days	3190.0	11.625272	2.231059	6.037646	10.591696	11.933450	13.269480	16.618460
MA for 100 days	3190.0	11.649354	2.113346	6.221377	10.632551	11.876775	13.200810	16.042560
Daily Return	3190.0	0.000388	0.017010	-0.130345	-0.006439	0.000484	0.007807	0.150503



In [13]:

```
X = data.drop(['Date', 'Close'], axis=1)
Y = data['Close']

X.shape,Y.shape

from mlxtend.feature_selection import SequentialFeatureSelector as sfs
from sklearn.linear_model import LinearRegression

lreg = LinearRegression()
sfs1 = sfs(lreg, k_features=2, forward=False, verbose=2, scoring='neg_mean_squared_error')

sfs1 = sfs1.fit(X, Y)

feat_names = list(sfs1.k_feature_names_)
print(feat_names)

# creating a new dataframe using the above variables and adding the target variable
new_data = data[feat_names]
new_data['Close'] = data['Close']

# first five rows of the new data
new_data.head()

new_data.shape, data.shape

df = new_data
```

```
[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   9 out of   9 | elapsed:    0.1s finished

[2021-11-30 00:29:45] Features: 8/2 -- score: -0.01130510673631423[Parallel(n_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   8 out of   8 | elapsed:    0.1s finished
```

```
[2021-11-30 00:29:45] Features: 7/2 -- score: -0.011114316874792215[Parallel(n_jobs=1)]:
Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   7 out of   7 | elapsed:    0.1s finished

[2021-11-30 00:29:45] Features: 6/2 -- score: -0.011080371541763374[Parallel(n_jobs=1)]:
Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
```

```
['High', 'Low']
```

```
[Parallel(n_jobs=1)]: Done   6 out of   6 | elapsed:    0.1s finished

[2021-11-30 00:29:46] Features: 5/2 -- score: -0.011080371541730121[Parallel(n_jobs=1)]:
Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   5 out of   5 | elapsed:    0.1s finished

[2021-11-30 00:29:46] Features: 4/2 -- score: -0.011086733169734618[Parallel(n_jobs=1)]:
Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   4 out of   4 | elapsed:    0.0s finished

[2021-11-30 00:29:46] Features: 3/2 -- score: -0.011860213917250834[Parallel(n_jobs=1)]:
Using backend SequentialBackend with 1 concurrent workers.
[Parallel(n_jobs=1)]: Done   1 out of   1 | elapsed:    0.0s remaining:    0.0s
[Parallel(n_jobs=1)]: Done   3 out of   3 | elapsed:    0.0s finished

[2021-11-30 00:29:46] Features: 2/2 -- score: -0.014047232655157732/opt/conda/lib/python3
.7/site-packages/ipykernel_launcher.py:19: 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-docs/stable/user_g
uide/indexing.html#returning-a-view-versus-a-copy
```

The data has been analysed but it must be converted into data of shape [100,1] to make it easier for CNN to train on... Else it won't select necessary features and the model will fail

In [14]:

```python
from sklearn.model_selection import train_test_split

X = []
Y = []
window_size=100
for i in range(1 , len(df) - window_size -1 , 1):
    first = df.iloc[i,2]
    temp = []
    temp2 = []
    for j in range(window_size):
        temp.append((df.iloc[i + j, 2] - first) / first)
    temp2.append((df.iloc[i + window_size, 2] - first) / first)
    X.append(np.array(temp).reshape(100, 1))
    Y.append(np.array(temp2).reshape(1, 1))

x_train, x_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, shuffle=True)

train_X = np.array(x_train)
test_X = np.array(x_test)
train_Y = np.array(y_train)
test_Y = np.array(y_test)

train_X = train_X.reshape(train_X.shape[0],1,100,1)
test_X = test_X.reshape(test_X.shape[0],1,100,1)

print(len(train_X))
print(len(test_X))
```

```
2470
618
```

Training part

This part has 2 subparts: CNN and LSTM

For CNN, the layers are created with sizes 64,128,64. In every layer, TimeDistributed function is added to track the features with respect to time. In between them, Pooling layers are added.

After that, it's passed to Bi-LSTM layers

In [15]:

```
# For creating model and training
import tensorflow as tf
from tensorflow.keras.layers import Conv1D, LSTM, Dense, Dropout, Bidirectional, TimeDistributed
from tensorflow.keras.layers import MaxPooling1D, Flatten
from tensorflow.keras.regularizers import L1, L2
from tensorflow.keras.metrics import Accuracy
from tensorflow.keras.metrics import RootMeanSquaredError

model = tf.keras.Sequential()

# Creating the Neural Network model here...
model.add(TimeDistributed(Conv1D(64, kernel_size=1, activation='relu', input_shape=(None, 100, 1))))
model.add(TimeDistributed(MaxPooling1D(2)))
model.add(TimeDistributed(Conv1D(128, kernel_size=1, activation='relu')))
model.add(TimeDistributed(MaxPooling1D(2)))
model.add(TimeDistributed(Conv1D(64, kernel_size=1, activation='relu')))
model.add(TimeDistributed(MaxPooling1D(2)))
model.add(TimeDistributed(Flatten()))
# model.add(Dense(5, kernel_regularizer=L2(0.01)))
model.add(Bidirectional(LSTM(100, return_sequences=True)))
model.add(Dropout(0.25))
model.add(Bidirectional(LSTM(100, return_sequences=False)))
model.add(Dropout(0.5))
model.add(Dense(1, activation='linear'))
model.compile(optimizer='adam', loss='mse', metrics=['mse', 'mae'])

history = model.fit(train_X, train_Y, validation_data=(test_X,test_Y), epochs=40,batch_size=40, verbose=1, shuffle =True)
```

```
2021-11-30 00:29:56.108575: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcudart.so.11.0
2021-11-30 00:30:00.219156: I tensorflow/compiler/jit/xla_cpu_device.cc:41] Not creating XLA devices, tf_xla_enable_xla_devices not set
2021-11-30 00:30:00.222354: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcuda.so.1
2021-11-30 00:30:00.260717: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] successful NUMA node read from SysFS had negative value (-1), but there must be at least one NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.261351: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1720] Found device 0 with properties:
pciBusID: 0000:00:04.0 name: Tesla P100-PCIE-16GB computeCapability: 6.0
coreClock: 1.3285GHz coreCount: 56 deviceMemorySize: 15.90GiB deviceMemoryBandwidth: 681.88GiB/s
2021-11-30 00:30:00.261400: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcudart.so.11.0
2021-11-30 00:30:00.287254: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcublas.so.11
2021-11-30 00:30:00.287344: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcublasLt.so.11
2021-11-30 00:30:00.303409: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcufft.so.10
2021-11-30 00:30:00.312052: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcurand.so.10
2021-11-30 00:30:00.335814: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic library libcusolver.so.10
```

```
2021-11-30 00:30:00.342811: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcusparse.so.11
2021-11-30 00:30:00.346687: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcudnn.so.8
2021-11-30 00:30:00.346865: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.347538: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.349045: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1862] Addi
ng visible gpu devices: 0
2021-11-30 00:30:00.350108: I tensorflow/core/platform/cpu_feature_guard.cc:142] This Ten
sorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the f
ollowing CPU instructions in performance-critical operations:  AVX2 AVX512F FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flag
s.
2021-11-30 00:30:00.350330: I tensorflow/compiler/jit/xla_gpu_device.cc:99] Not creating
XLA devices, tf_xla_enable_xla_devices not set
2021-11-30 00:30:00.350501: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.351080: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1720] Foun
d device 0 with properties:
pciBusID: 0000:00:04.0 name: Tesla P100-PCIE-16GB computeCapability: 6.0
coreClock: 1.3285GHz coreCount: 56 deviceMemorySize: 15.90GiB deviceMemoryBandwidth: 681.
88GiB/s
2021-11-30 00:30:00.351134: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcudart.so.11.0
2021-11-30 00:30:00.351162: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcublas.so.11
2021-11-30 00:30:00.351185: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcublasLt.so.11
2021-11-30 00:30:00.351207: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcufft.so.10
2021-11-30 00:30:00.351244: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcurand.so.10
2021-11-30 00:30:00.351266: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcusolver.so.10
2021-11-30 00:30:00.351290: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcusparse.so.11
2021-11-30 00:30:00.351312: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcudnn.so.8
2021-11-30 00:30:00.351405: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.352021: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:00.352557: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1862] Addi
ng visible gpu devices: 0
2021-11-30 00:30:00.353576: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcudart.so.11.0
2021-11-30 00:30:01.817318: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1261] Devi
ce interconnect StreamExecutor with strength 1 edge matrix:
2021-11-30 00:30:01.817365: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1267]
0
2021-11-30 00:30:01.817375: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1280] 0:
N
2021-11-30 00:30:01.819912: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:01.820628: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:01.821333: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:941] s
uccessful NUMA node read from SysFS had negative value (-1), but there must be at least o
ne NUMA node, so returning NUMA node zero
2021-11-30 00:30:01.821966: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1406] Crea
ted TensorFlow device (/job:localhost/replica:0/task:0/device:GPU:0 with 14957 MB memory)
-> physical GPU (device: 0, name: Tesla P100-PCIE-16GB, pci bus id: 0000:00:04.0, compute
capability: 6.0)
```

```
2021-11-30 00:30:02.252418: I tensorflow/compiler/mlir/mlir_graph_optimization_pass.cc:11
6] None of the MLIR optimization passes are enabled (registered 2)
2021-11-30 00:30:02.262944: I tensorflow/core/platform/profile_utils/cpu_utils.cc:112] CP
U Frequency: 2000140000 Hz
```

```
Epoch 1/40
```

```
2021-11-30 00:30:08.299035: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcublas.so.11
2021-11-30 00:30:09.125495: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcublasLt.so.11
2021-11-30 00:30:09.150856: I tensorflow/stream_executor/platform/default/dso_loader.cc:4
9] Successfully opened dynamic library libcudnn.so.8
```

```
62/62 [==============================] - 15s 44ms/step - loss: 0.0122 - mse: 0.0122 - mae
: 0.0790 - val_loss: 0.0024 - val_mse: 0.0024 - val_mae: 0.0365
Epoch 2/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0025 - mse: 0.0025 - mae:
0.0366 - val_loss: 0.0022 - val_mse: 0.0022 - val_mae: 0.0337
Epoch 3/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0019 - mse: 0.0019 - mae:
0.0327 - val_loss: 0.0020 - val_mse: 0.0020 - val_mae: 0.0320
Epoch 4/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0020 - mse: 0.0020 - mae:
0.0328 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0301
Epoch 5/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0020 - mse: 0.0020 - mae:
0.0326 - val_loss: 0.0024 - val_mse: 0.0024 - val_mae: 0.0364
Epoch 6/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0020 - mse: 0.0020 - mae:
0.0328 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0302
Epoch 7/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0019 - mse: 0.0019 - mae:
0.0321 - val_loss: 0.0019 - val_mse: 0.0019 - val_mae: 0.0310
Epoch 8/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0018 - mse: 0.0018 - mae:
0.0314 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0303
Epoch 9/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0018 - mse: 0.0018 - mae:
0.0302 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0315
Epoch 10/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0018 - mse: 0.0018 - mae:
0.0304 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0304
Epoch 11/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0019 - mse: 0.0019 - mae:
0.0312 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0287
Epoch 12/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0020 - mse: 0.0020 - mae:
0.0325 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0292
Epoch 13/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0019 - mse: 0.0019 - mae:
0.0315 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0309
Epoch 14/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0294 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0304
Epoch 15/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0284 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0300
Epoch 16/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0292 - val_loss: 0.0021 - val_mse: 0.0021 - val_mae: 0.0321
Epoch 17/40
62/62 [==============================] - 1s 13ms/step - loss: 0.0018 - mse: 0.0018 - mae:
0.0309 - val_loss: 0.0019 - val_mse: 0.0019 - val_mae: 0.0321
Epoch 18/40
62/62 [==============================] - 1s 11ms/step - loss: 0.0017 - mse: 0.0017 - mae:
0.0305 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0294
Epoch 19/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0017 - mse: 0.0017 - mae:
0.0304 - val_loss: 0.0019 - val_mse: 0.0019 - val_mae: 0.0332
Epoch 20/40
62/62 [==============================] - 1s 15ms/step - loss: 0.0017 - mse: 0.0017 - mae:
0.0300 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0291
```

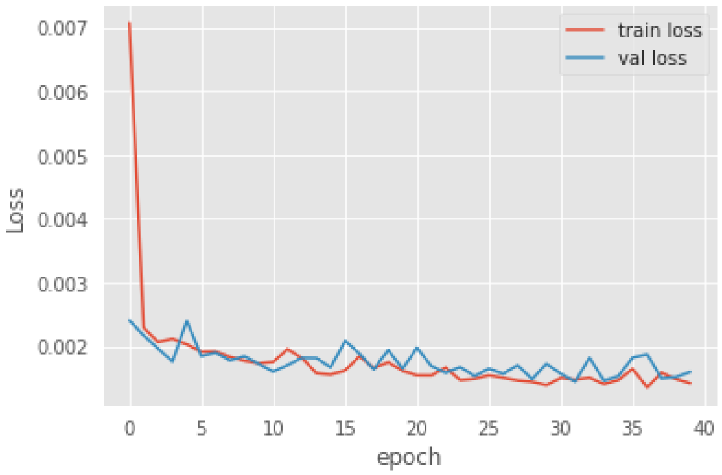
```
Epoch 21/40
62/62 [==============================] - 1s 11ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0292 - val_loss: 0.0020 - val_mse: 0.0020 - val_mae: 0.0336
Epoch 22/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0017 - mse: 0.0017 - mae:
0.0305 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0297
Epoch 23/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0018 - mse: 0.0018 - mae:
0.0310 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0297
Epoch 24/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0289 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0301
Epoch 25/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0278 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0283
Epoch 26/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0286 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0294
Epoch 27/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0279 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0287
Epoch 28/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0286 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0296
Epoch 29/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0288 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0280
Epoch 30/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0271 - val_loss: 0.0017 - val_mse: 0.0017 - val_mae: 0.0313
Epoch 31/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0285 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0297
Epoch 32/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0278 - val_loss: 0.0014 - val_mse: 0.0014 - val_mae: 0.0279
Epoch 33/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0280 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0323
Epoch 34/40
62/62 [==============================] - 1s 13ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0281 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0283
Epoch 35/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0281 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0282
Epoch 36/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0295 - val_loss: 0.0018 - val_mse: 0.0018 - val_mae: 0.0317
Epoch 37/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0014 - mse: 0.0014 - mae:
0.0284 - val_loss: 0.0019 - val_mse: 0.0019 - val_mae: 0.0330
Epoch 38/40
62/62 [==============================] - 1s 11ms/step - loss: 0.0017 - mse: 0.0017 - mae:
0.0307 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0278
Epoch 39/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0290 - val_loss: 0.0015 - val_mse: 0.0015 - val_mae: 0.0289
Epoch 40/40
62/62 [==============================] - 1s 10ms/step - loss: 0.0015 - mse: 0.0015 - mae:
0.0284 - val_loss: 0.0016 - val_mse: 0.0016 - val_mae: 0.0297
```

In [16]:

```
plt.plot(history.history['loss'], label='train loss')
plt.plot(history.history['val_loss'], label='val loss')
plt.xlabel("epoch")
plt.ylabel("Loss")
plt.legend()
```

Out[16]:

```
<matplotlib.legend.Legend at 0x7f48660e1cd0>
```

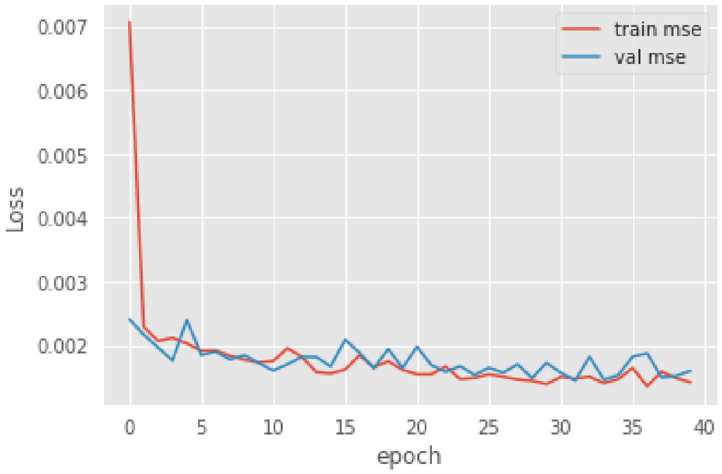


In [17]:

```
plt.plot(history.history['mse'], label='train mse')
plt.plot(history.history['val_mse'], label='val mse')
plt.xlabel("epoch")
plt.ylabel("Loss")
plt.legend()
```

Out[17]:

```
<matplotlib.legend.Legend at 0x7f448d45e510>
```

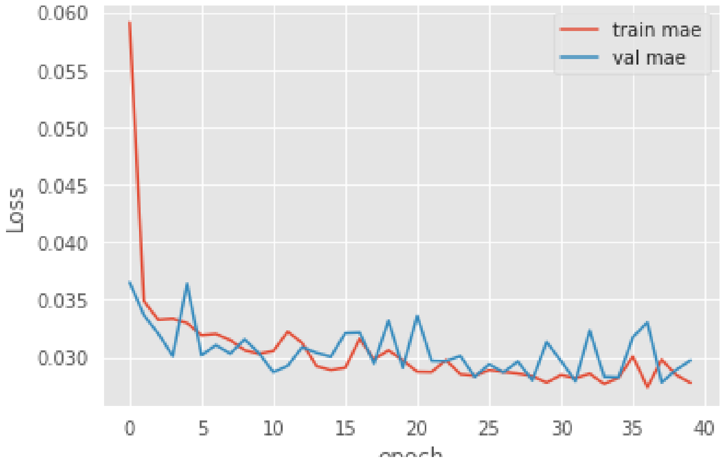


In [18]:

```
plt.plot(history.history['mae'], label='train mae')
plt.plot(history.history['val_mae'], label='val mae')
plt.xlabel("epoch")
plt.ylabel("Loss")
plt.legend()
```

Out[18]:

```
<matplotlib.legend.Legend at 0x7f448d3fff90>
```

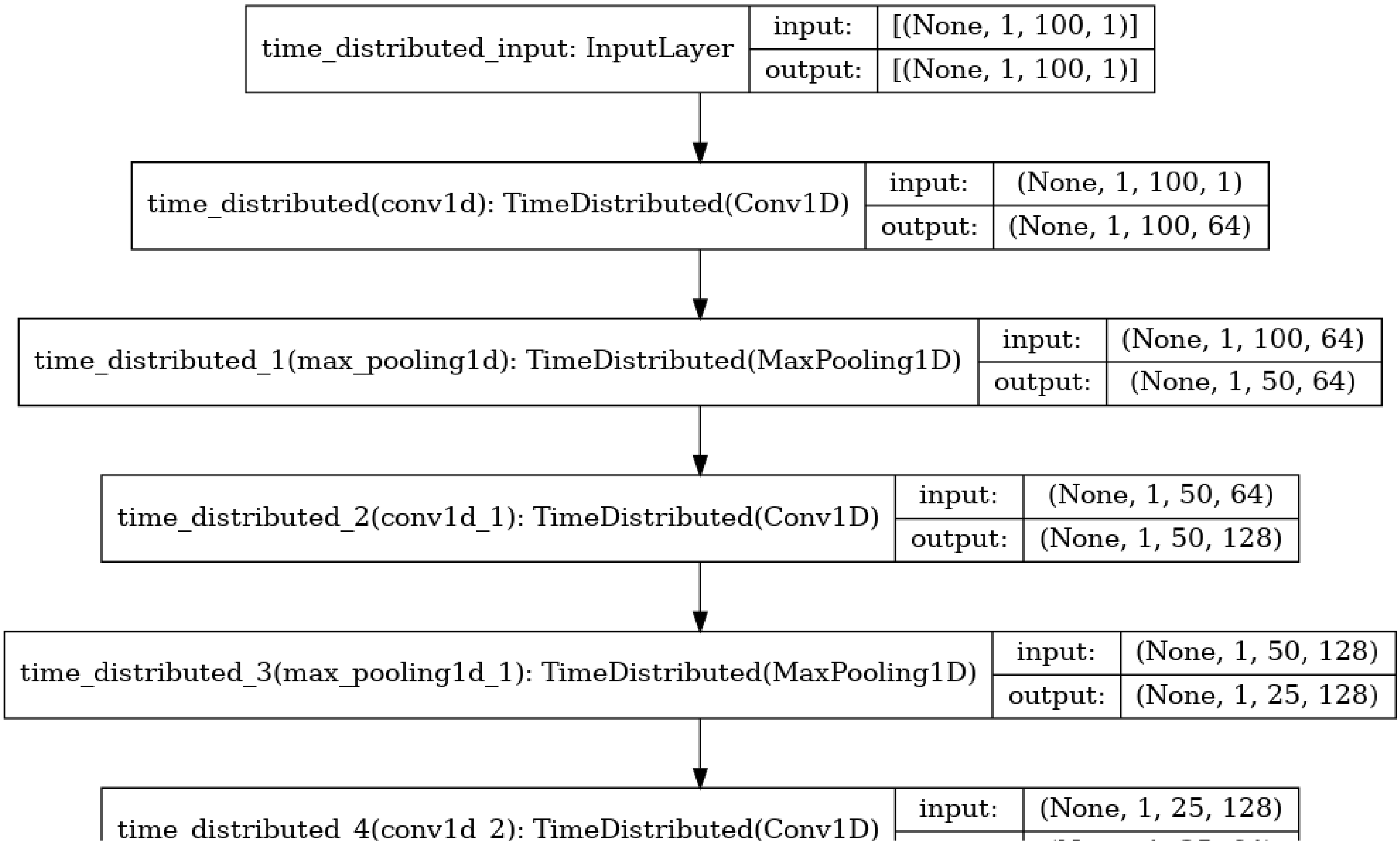


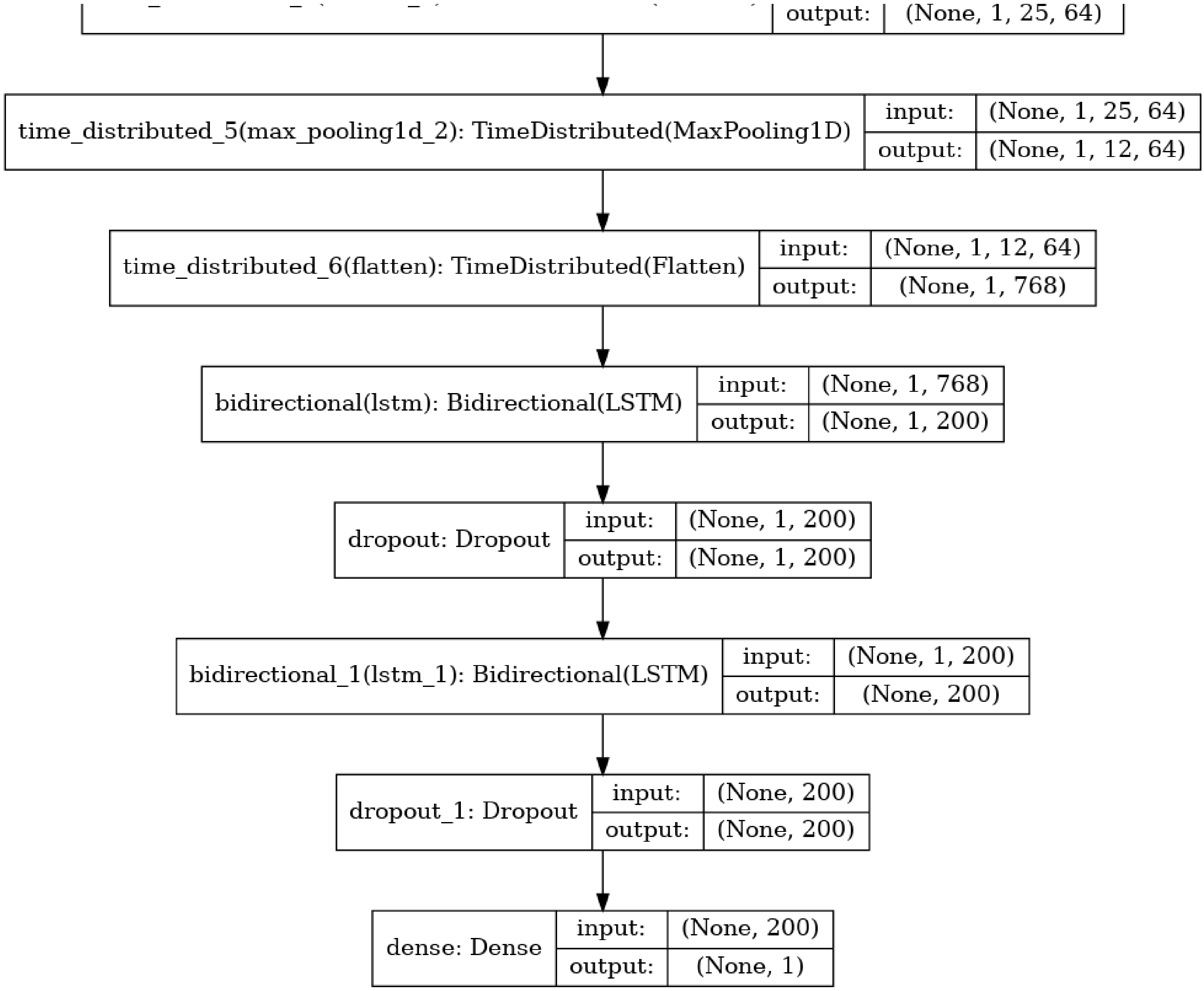
In [19]:

```python
# After the model has been constructed, we need to train
from tensorflow.keras.utils import plot_model
print(model.summary())
plot_model(model, to_file='model.png', show_shapes=True, show_layer_names=True)
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
time_distributed (TimeDistri (None, 1, 100, 64)        128       
_________________________________________________________________
time_distributed_1 (TimeDist (None, 1, 50, 64)         0         
_________________________________________________________________
time_distributed_2 (TimeDist (None, 1, 50, 128)        8320      
_________________________________________________________________
time_distributed_3 (TimeDist (None, 1, 25, 128)        0         
_________________________________________________________________
time_distributed_4 (TimeDist (None, 1, 25, 64)         8256      
_________________________________________________________________
time_distributed_5 (TimeDist (None, 1, 12, 64)         0         
_________________________________________________________________
time_distributed_6 (TimeDist (None, 1, 768)            0         
_________________________________________________________________
bidirectional (Bidirectional (None, 1, 200)            695200    
_________________________________________________________________
dropout (Dropout)            (None, 1, 200)            0         
_________________________________________________________________
bidirectional_1 (Bidirection (None, 200)               240800    
_________________________________________________________________
dropout_1 (Dropout)          (None, 200)               0         
_________________________________________________________________
dense (Dense)                (None, 1)                 201       
=================================================================
Total params: 952,905
Trainable params: 952,905
Non-trainable params: 0
_________________________________________________________________
None
```

Out[19]:


time_distributed_input: InputLayer
input: [(None, 1, 100, 1)]
output: [(None, 1, 100, 1)]
time_distributed(conv1d): TimeDistributed(Conv1D)
input: (None, 1, 100, 1)
output: (None, 1, 100, 64)
time_distributed_1(max_pooling1d): TimeDistributed(MaxPooling1D)
input: (None, 1, 100, 64)
output: (None, 1, 50, 64)
time_distributed_2(conv1d_1): TimeDistributed(Conv1D)
input: (None, 1, 50, 64)
output: (None, 1, 50, 128)
time_distributed_3(max_pooling1d_1): TimeDistributed(MaxPooling1D)
input: (None, 1, 50, 128)
output: (None, 1, 25, 128)
time_distributed_4(conv1d_2): TimeDistributed(Conv1D)
input: (None, 1, 25, 128)



In [20]:

```
model.evaluate(test_X, test_Y)
```

```
20/20 [==============================] - 0s 5ms/step - loss: 0.0016 - mse: 0.0016 - mae:
0.0297
```

Out[20]:

```
[0.001593530410900712, 0.001593530410900712, 0.029720278456807137]
```

In [21]:

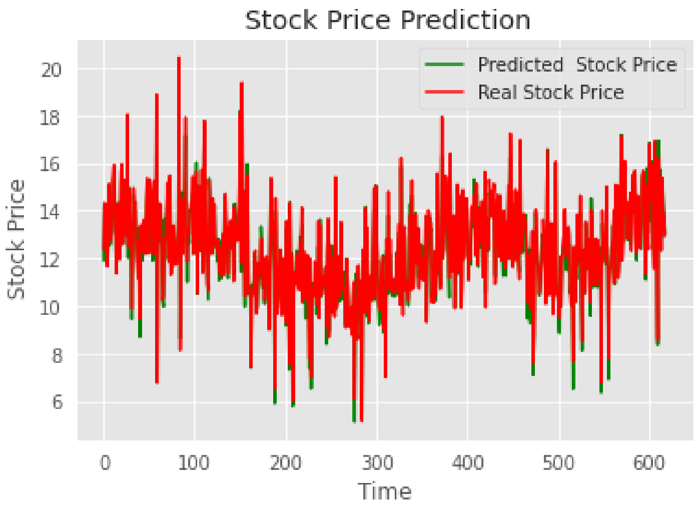
```
from sklearn.metrics import explained_variance_score
from sklearn.metrics import r2_score
from sklearn.metrics import max_error

# predict probabilities for test set
yhat_probs = model.predict(test_X, verbose=0)
# predict crisp classes for test set
yhat_classes = model.predict_classes(test_X, verbose=0)
# reduce to 1d array
yhat_probs = yhat_probs[:, 0]
yhat_classes = yhat_classes[:, 0]

var = explained_variance_score(test_Y.reshape(-1,1), yhat_probs)
print('Variance: %f' % var)

r2 = r2_score(test_Y.reshape(-1,1), yhat_probs)
print('R2 Score: %f' % var)

var2 = max_error(test_Y.reshape(-1,1), yhat_probs)
print('Max Error: %f' % var2)
```

```
Variance: 0.934336
R2 Score: 0.934336
Max Error: 0.184483
```

```
/opt/conda/lib/python3.7/site-packages/tensorflow/python/keras/engine/sequential.py:450:
UserWarning: `model.predict_classes()` is deprecated and will be removed after 2021-01-01
. Please use instead:* `np.argmax(model.predict(x), axis=-1)`,   if your model does multi
-class classification   (e.g. if it uses a `softmax` last-layer activation).* `(model.pre
dict(x) > 0.5).astype("int32")`,   if your model does binary classification   (e.g. if it
uses a `sigmoid` last-layer activation).
  warnings.warn('`model.predict_classes()` is deprecated and '
```

In [22]:

```
predicted  = model.predict(test_X)
test_label = test_Y.reshape(-1,1)
predicted = np.array(predicted[:,0]).reshape(-1,1)
len_t = len(train_X)
for j in range(len_t , len_t + len(test_X)):
    temp = data.iloc[j,3]
    test_label[j - len_t] = test_label[j - len_t] * temp + temp
    predicted[j - len_t] = predicted[j - len_t] * temp + temp
plt.plot(predicted, color = 'green', label = 'Predicted  Stock Price')
plt.plot(test_label, color = 'red', label = 'Real Stock Price')
plt.title(' Stock Price Prediction')
plt.xlabel('Time')
plt.ylabel(' Stock Price')
plt.legend()
plt.show()
```



Testing part

In this part, the model is saved and loaded back again. Then, it's made to train again but with different data to check it's loss and prediction

In [23]:

```
# First we need to save a model
model.save("model.h5")
```

In [24]:

```
# Load model
new_model = tf.keras.models.load_model("./model.h5")
```

In [25]:

```
new_model.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
Layer (type)                 Output Shape              Param #   
=================================================================
time_distributed (TimeDistri (None, 1, 100, 64)        128       
_________________________________________________________________
time_distributed_1 (TimeDist (None, 1, 50, 64)         0         
_________________________________________________________________
time_distributed_2 (TimeDist (None, 1, 50, 128)        8320      
_________________________________________________________________
time_distributed_3 (TimeDist (None, 1, 25, 128)        0         
_________________________________________________________________
time_distributed_4 (TimeDist (None, 1, 25, 64)         8256      
_________________________________________________________________
time_distributed_5 (TimeDist (None, 1, 12, 64)         0         
_________________________________________________________________
time_distributed_6 (TimeDist (None, 1, 768)            0         
_________________________________________________________________
bidirectional (Bidirectional (None, 1, 200)            695200    
_________________________________________________________________
dropout (Dropout)            (None, 1, 200)            0         
_________________________________________________________________
bidirectional_1 (Bidirection (None, 200)               240800    
_________________________________________________________________
dropout_1 (Dropout)          (None, 200)               0         
_________________________________________________________________
dense (Dense)                (None, 1)                 201       
=================================================================
Total params: 952,905
Trainable params: 952,905
Non-trainable params: 0
_________________________________________________________________
```

In [26]:

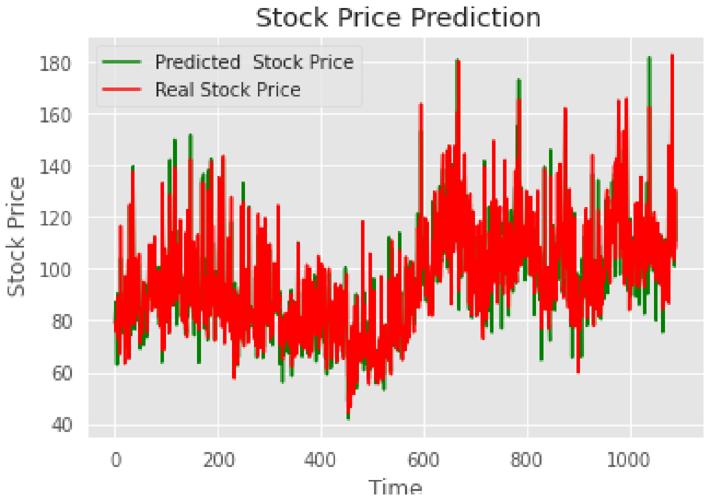
```python
# For data preprocessing and analysis part
#data2 = pd.read_csv('../input/price-volume-data-for-all-us-stocks-etfs/Stocks/aaoi.us.txt')
#data2 = pd.read_csv('../input/nifty50-stock-market-data/SBIN.csv')
#data2 = pd.read_csv('../input/stock-market-data/stock_market_data/nasdaq/csv/ACTG.csv')
data2 = pd.read_csv('./data.csv')
# Any CSV or TXT file can be added here....
data2.dropna(inplace=True)
data2.head()

data2.reset_index(drop=True, inplace=True)
data2.fillna(data.mean(), inplace=True)
data2.head()
df2 = data2.drop('date', axis=1)

print(df2)

X = []
Y = []
window_size=100
for i in range(1 , len(df2) - window_size -1 , 1):
    first = df2.iloc[i,4]
    temp = []
    temp2 = []
    for j in range(window_size):
        temp.append((df2.iloc[i + j, 4] - first) / first)
    # for j in range(week):
    temp2.append((df2.iloc[i + window_size, 4] - first) / first)
    # X.append(np.array(stock.iloc[i:i+window_size,4]).reshape(50,1))
    # Y.append(np.array(stock.iloc[i+window_size,4]).reshape(1,1))
    # print(stock2.iloc[i:i+window_size,4])
    X.append(np.array(temp).reshape(100, 1))
    Y.append(np.array(temp2).reshape(1, 1))

x_train, x_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, shuffle=True)

train_X = np.array(x_train)
test_X = np.array(x_test)
train_Y = np.array(y_train)
```

```
test_Y = np.array(y_test)

train_X = train_X.reshape(train_X.shape[0],1,100,1)
test_X = test_X.reshape(test_X.shape[0],1,100,1)

print(len(train_X))
print(len(test_X))
```

```
      Unnamed: 0    open     high     low   close  adjusted close    volume  \
0              0  118.62  119.610  117.53  118.50      118.500000   8918702
1              1  115.00  116.335  114.56  115.81      115.810000   3322012
2              2  116.16  117.270  116.08  116.73      116.730000   3220802
3              3  116.79  117.940  116.04  116.79      116.790000   4914995
4              4  116.00  118.810  115.19  116.47      116.470000   6417218
...          ...     ...      ...     ...     ...             ...       ...
5551        5551   92.75   92.940   90.19   90.25       52.226608  13737600
5552        5552   94.44   94.440   90.00   91.56       52.984689  16697600
5553        5553   95.87   95.940   93.50   94.37       54.610803  10369100
5554        5554   96.75   96.810   93.69   94.81       54.865426  11105400
5555        5555   98.50   98.810   96.37   96.75       55.988081   9551800

      dividend amount  split cf
0                 0.0       1.0
1                 0.0       1.0
2                 0.0       1.0
3                 0.0       1.0
4                 0.0       1.0
...               ...       ...
5551              0.0       1.0
5552              0.0       1.0
5553              0.0       1.0
5554              0.0       1.0
5555              0.0       1.0

[5556 rows x 9 columns]
4363
1091
```

In [27]:

```
predicted  = model.predict(test_X)
test_label = test_Y.reshape(-1,1)
predicted = np.array(predicted[:,0]).reshape(-1,1)
len_t = len(train_X)
for j in range(len_t , len_t + len(test_X)):
    temp = data2.iloc[j,3]
    test_label[j - len_t] = test_label[j - len_t] * temp + temp
    predicted[j - len_t] = predicted[j - len_t] * temp + temp
plt.plot(predicted, color = 'green', label = 'Predicted  Stock Price')
plt.plot(test_label, color = 'red', label = 'Real Stock Price')
plt.title(' Stock Price Prediction')
plt.xlabel('Time')
plt.ylabel(' Stock Price')
plt.legend()
plt.show()
```



EDA

In [56]:

```
dataX = pd.read_csv('./data.csv')
dataY = pd.read_csv('./data.csv')
dataX.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5556 entries, 0 to 5555
Data columns (total 10 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   Unnamed: 0       5556 non-null   int64  
 1   open             5556 non-null   float64
 2   high             5556 non-null   float64
 3   low              5556 non-null   float64
 4   close            5556 non-null   float64
 5   adjusted close   5556 non-null   float64
 6   volume           5556 non-null   int64  
 7   dividend amount  5556 non-null   float64
 8   split cf         5556 non-null   float64
 9   date             5556 non-null   object 
dtypes: float64(7), int64(2), object(1)
memory usage: 434.2+ KB
```

In [57]:

```
dataX.head()
```

Out[57]:

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf	date
0	0	118.62	119.610	117.53	118.50	118.50	8918702	0.0	1.0	2021-11-29
1	1	115.00	116.335	114.56	115.81	115.81	3322012	0.0	1.0	2021-11-26
2	2	116.16	117.270	116.08	116.73	116.73	3220802	0.0	1.0	2021-11-24
3	3	116.79	117.940	116.04	116.79	116.79	4914995	0.0	1.0	2021-11-23
4	4	116.00	118.810	115.19	116.47	116.47	6417218	0.0	1.0	2021-11-22

In [58]:

```
start_date = '2020-01-01'
end_date = '2021-11-29'

start = '2018-01-01'
end = '2020-01-01'

fill = (dataX['date']>=start_date) & (dataX['date']<=end_date)
dataX = dataX.loc[fill]
dataX
```

Out[58]:

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf	date
0	0	118.62	119.610	117.53	118.50	118.500000	8918702	0.0	1.0	2021-11-29
1	1	115.00	116.335	114.56	115.81	115.810000	3322012	0.0	1.0	2021-11-26
2	2	116.16	117.270	116.08	116.73	116.730000	3220802	0.0	1.0	2021-11-24
3	3	116.79	117.940	116.04	116.79	116.790000	4914995	0.0	1.0	2021-11-23
4	4	116.00	118.810	115.19	116.47	116.470000	6417218	0.0	1.0	2021-11-22
...	...	...	...	...	...	...	...	...	...	...

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf	date
477	477	134.51	135.860	133.92	135.31	117.011071	4345952	0.0	1.0	2020-01-08
478	478	133.69	134.960	133.40	134.19	116.042537	3267592	0.0	1.0	2020-01-07
479	479	133.42	134.240	133.20	134.10	115.964708	2421128	0.0	1.0	2020-01-06
480	480	133.57	134.860	133.56	134.34	116.172251	2373470	0.0	1.0	2020-01-03
481	481	135.00	135.920	134.77	135.42	117.106195	3148461	0.0	1.0	2020-01-02

482 rows × 10 columns

In [59]:

```
fill2 = (dataY['date']>=start) & (dataY['date']<=end)
dataY = dataY.loc[fill2]
dataY
```

Out[59]:

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf	date
482	482	132.53	134.12	132.40	134.04	115.912822	3777504	0.0	1.0	2019-12-31
483	483	135.20	135.30	132.50	132.81	114.849164	4118929	0.0	1.0	2019-12-30
484	484	135.00	135.75	134.87	135.27	116.976481	2752185	0.0	1.0	2019-12-27
485	485	134.98	135.31	134.65	134.91	116.665166	2129654	0.0	1.0	2019-12-26
486	486	135.61	135.62	134.61	134.98	116.725700	1202087	0.0	1.0	2019-12-24
...	...	...	...	...	...	...	...	...	...	...
980	980	162.66	163.91	161.70	163.47	129.027615	5101023	0.0	1.0	2018-01-08
981	981	162.44	162.90	161.10	162.49	128.254097	5162075	0.0	1.0	2018-01-05
982	982	159.65	162.32	159.37	161.70	127.630546	7363843	0.0	1.0	2018-01-04
983	983	157.34	159.81	156.33	158.49	125.096879	9439063	0.0	1.0	2018-01-03
984	984	154.50	154.81	153.54	154.25	121.750227	4195225	0.0	1.0	2018-01-02

503 rows × 10 columns

In [60]:

```
dataX.describe()
```

Out[60]:

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf
count	482.000000	482.000000	482.000000	482.000000	482.000000	482.000000	4.820000e+02	482.000000	482.000000
mean	240.500000	129.382080	130.691720	128.092867	129.364751	117.791043	5.454886e+06	0.027095	1.000095
std	139.285678	11.382857	11.114856	11.592091	11.353678	11.831698	3.339263e+06	0.208783	0.002095
min	0.000000	94.600000	97.740000	90.560000	94.770000	82.819007	1.761122e+06	0.000000	1.000000
25%	120.250000	121.250000	122.623500	120.102500	121.105000	109.567533	3.644222e+06	0.000000	1.000000
50%	240.500000	126.325000	127.320000	125.045000	126.160000	115.419744	4.655173e+06	0.000000	1.000000
75%	360.750000	139.672500	140.467500	138.757500	139.572500	130.352392	6.115408e+06	0.000000	1.000000
max	481.000000	156.820000	158.750000	155.420000	156.760000	141.053047	3.806353e+07	1.640000	1.046000

In [61]:

```
dataY.describe()
```

Out[61]:

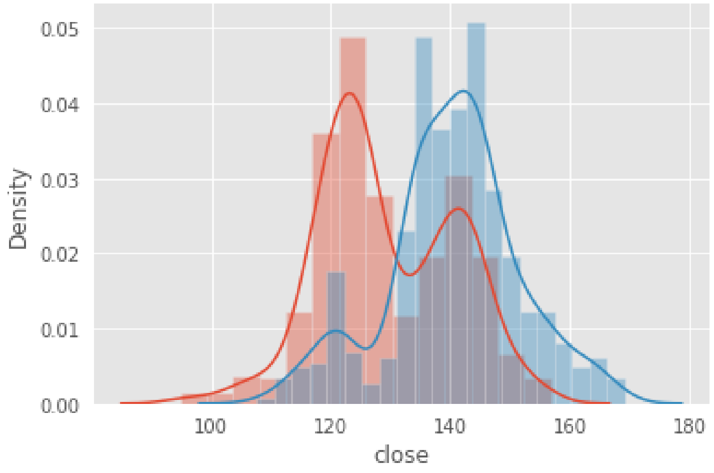
	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf

	Unnamed: 0	open	high	low	close	adjusted close	volume	dividend amount	split cf
count	503.000000	503.000000	503.000000	503.000000	503.000000	503.000000	5.030000e+02	503.000000	503.0
mean	733.000000	140.470239	141.512740	139.348929	140.416143	115.933517	4.590926e+06	0.025129	1.0
std	145.347859	11.156349	11.144803	11.149435	11.121441	7.991439	2.880224e+06	0.197923	0.0
min	482.000000	108.000000	111.000000	105.940000	107.570000	88.768396	1.202087e+06	0.000000	1.0
25%	607.500000	134.485000	135.305000	133.570000	134.360000	114.105468	3.067226e+06	0.000000	1.0
50%	733.000000	140.720000	141.780000	139.790000	140.850000	116.651352	3.783614e+06	0.000000	1.0
75%	858.500000	146.635000	147.300000	145.540000	146.385000	120.536160	5.033500e+06	0.000000	1.0
max	984.000000	170.000000	171.130000	168.150000	169.120000	133.487186	2.206367e+07	1.620000	1.0

In [66]:

```
from statsmodels.stats.outliers_influence import variance_inflation_factor
from sklearn.model_selection import train_test_split,GridSearchCV,RandomizedSearchCV
from sklearn.linear_model import LinearRegression,Ridge,Lasso
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor,GradientBoostingRegressor
from sklearn.metrics import r2_score,mean_squared_error

sns_plot = sns.distplot(dataX['close'])
sns_plot2 = sns.distplot(dataY['close'])
```

```
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



In [67]:

```
fig, ax = plt.subplots(4, 2, figsize = (15, 13))
sns.boxplot(x= dataX["close"], ax = ax[0,0])
sns.distplot(dataX['close'], ax = ax[0,1])
sns.boxplot(x= dataX["open"], ax = ax[1,0])
sns.distplot(dataX['open'], ax = ax[1,1])
sns.boxplot(x= dataX["high"], ax = ax[2,0])
sns.distplot(dataX['high'], ax = ax[2,1])
sns.boxplot(x= dataX["low"], ax = ax[3,0])
sns.distplot(dataX['low'], ax = ax[3,1])
plt.tight_layout()
```

```
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
```

```
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
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tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```
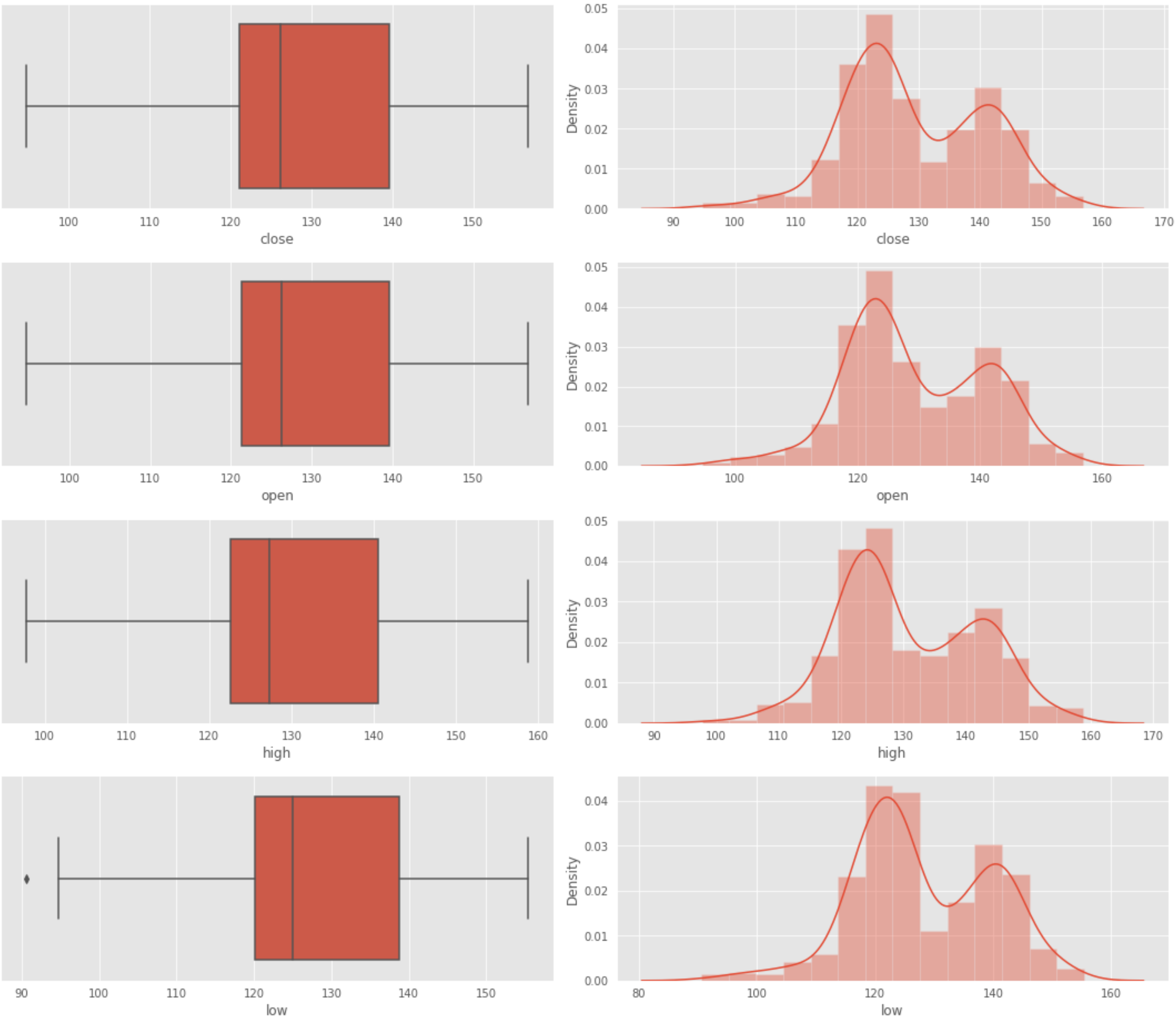
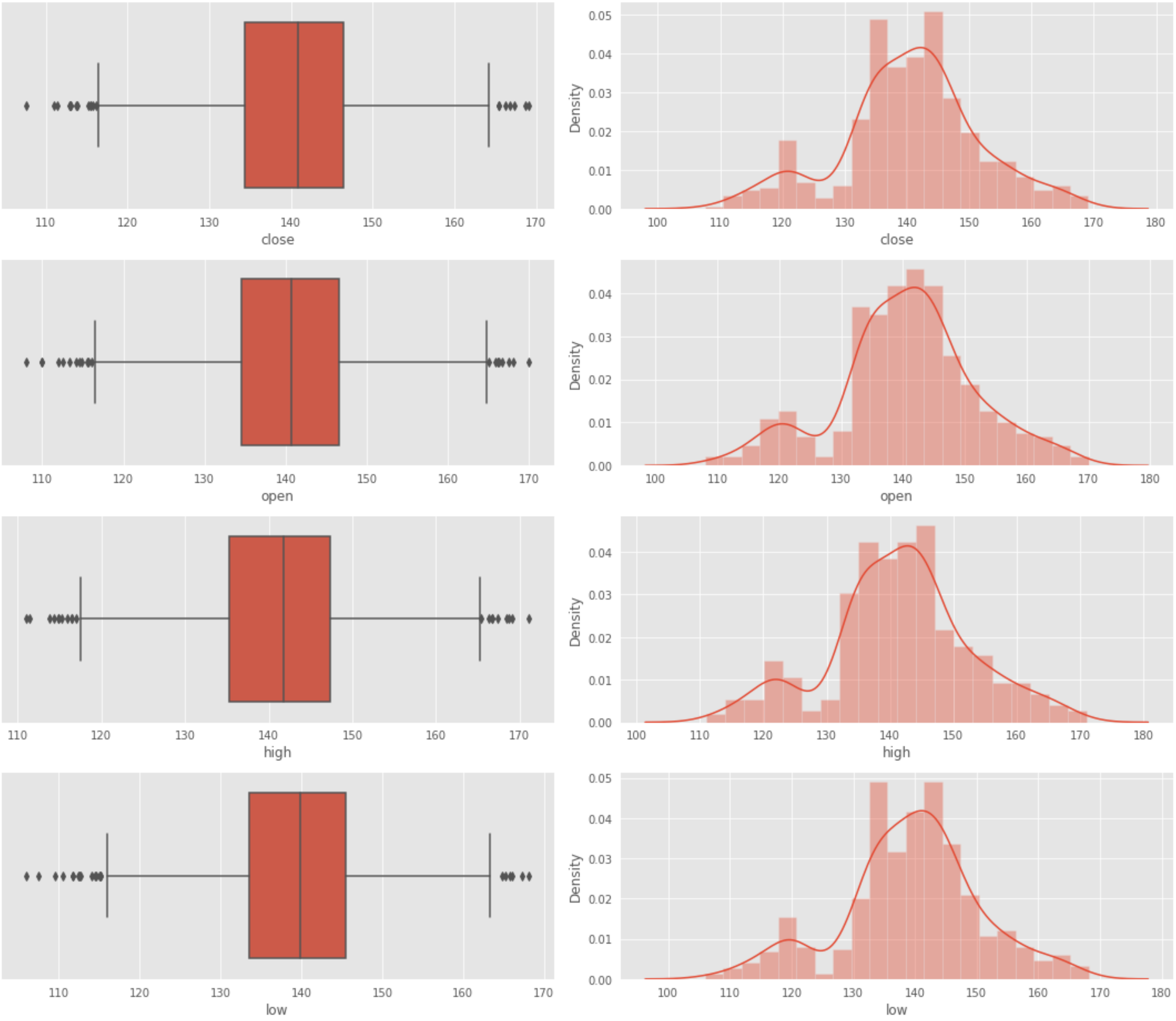



In [68]:

```
fig, ax = plt.subplots(4, 2, figsize = (15, 13))
sns.boxplot(x= dataY["close"], ax = ax[0,0])
sns.distplot(dataY['close'], ax = ax[0,1])
sns.boxplot(x= dataY["open"], ax = ax[1,0])
sns.distplot(dataY['open'], ax = ax[1,1])
sns.boxplot(x= dataY["high"], ax = ax[2,0])
sns.distplot(dataY['high'], ax = ax[2,1])
sns.boxplot(x= dataY["low"], ax = ax[3,0])
sns.distplot(dataY['low'], ax = ax[3,1])
plt.tight_layout()
```

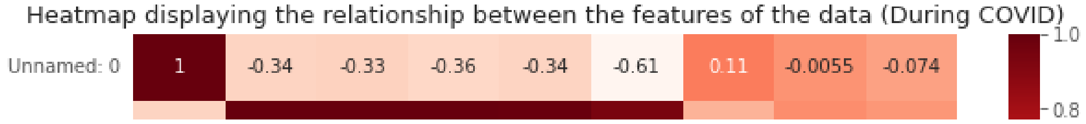
```
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
```

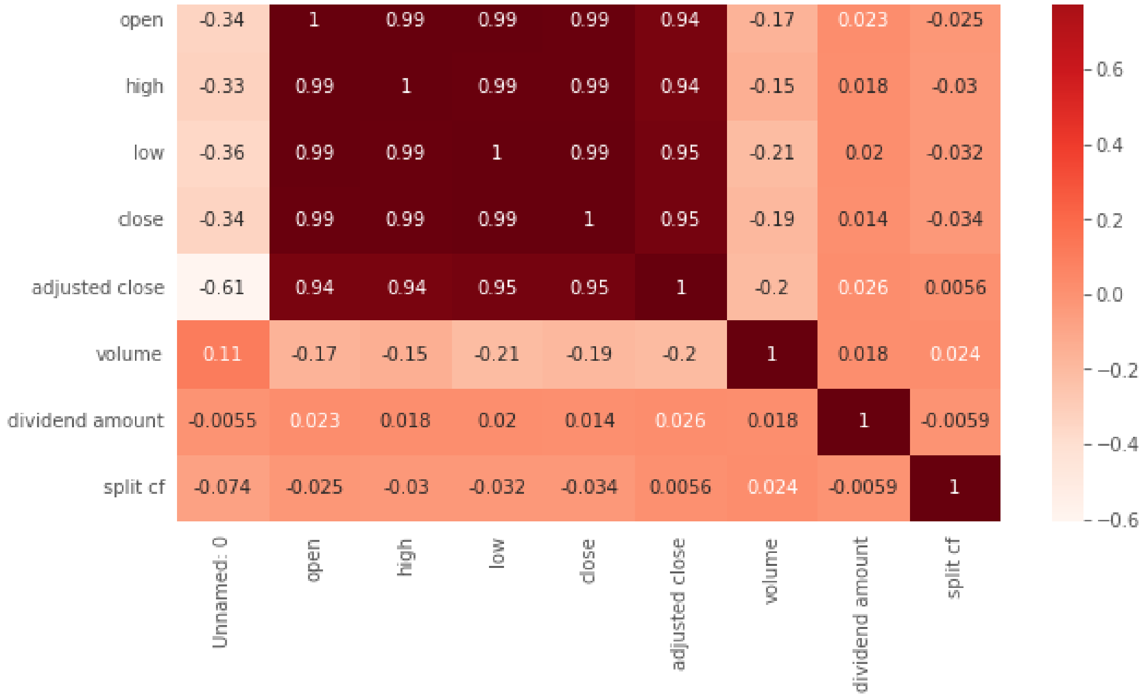
```
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
/opt/conda/lib/python3.7/site-packages/seaborn/distributions.py:2619: FutureWarning: `dis
tplot` is a deprecated function and will be removed in a future version. Please adapt you
r code to use either `displot` (a figure-level function with similar flexibility) or `his
tplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



In [74]:

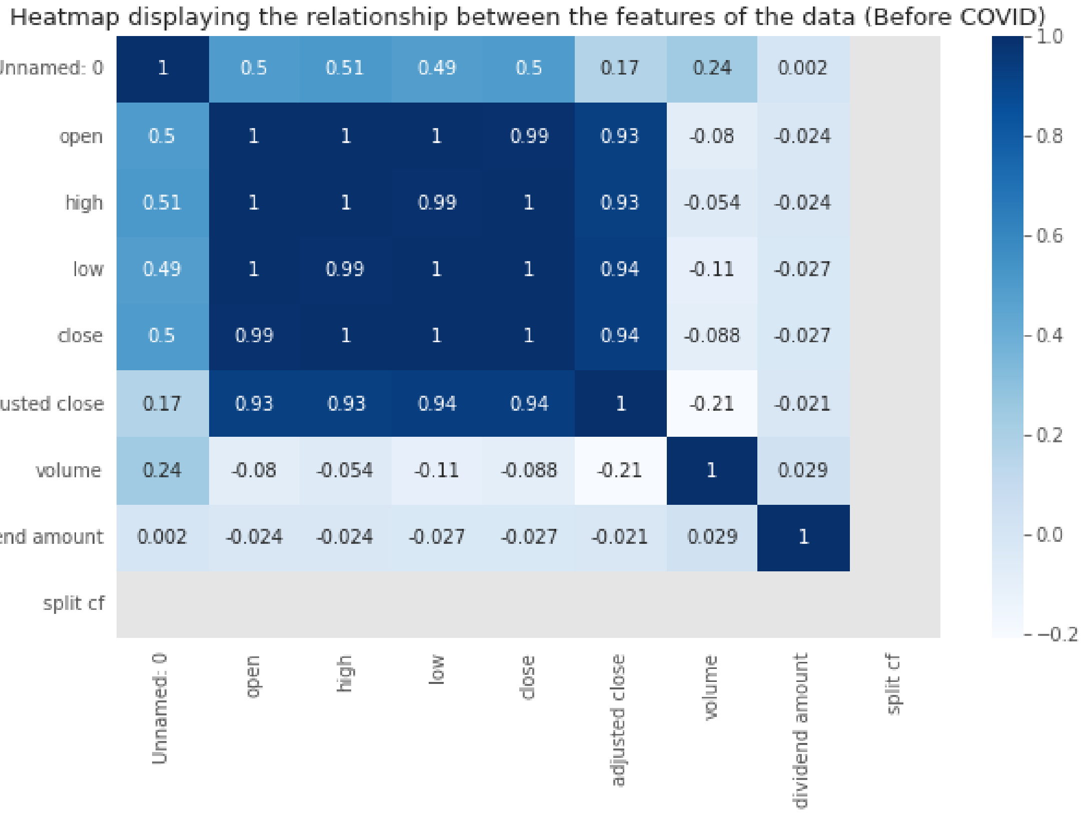
```
plt.figure(figsize=(10,6))
sns.heatmap(dataX.corr(),cmap=plt.cm.Reds,annot=True)
plt.title('Heatmap displaying the relationship between the features of the data (During C
OVID)',
         fontsize=13)
plt.show()
```





In [75]:

```
plt.figure(figsize=(10,6))
sns.heatmap(dataY.corr(),cmap=plt.cm.Blues,annot=True)
plt.title('Heatmap displaying the relationship between the features of the data (Before COVID)',
          fontsize=13)
plt.show()
```



In [ ]: