In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from datetime import *
from sklearn.preprocessing import *
import tensorflow as tf
from sklearn.model_selection import *
from sklearn.metrics import *
import joblib
```

```
WARNING:tensorflow:From C:\Users\amith\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src\losses.py:2976: The name tf.losses.sparse_softmax_cross_entropy is deprecated. Please use tf.compat.v1.losses.sparse_softmax_cross_entropy instead.
```

In [2]:
```
df = pd.read_csv("ETH_1H.csv")
df.head()
```

Out[2]:

	Unix Timestamp	Date	Symbol	Open	High	Low	Close	Volume
0	1586995200000	2020-04-16 00:00:00	ETHUSD	152.94	152.94	150.39	150.39	650.188125
1	1586991600000	2020-04-15 23:00:00	ETHUSD	155.81	155.81	151.39	152.94	4277.567299
2	1586988000000	2020-04-15 22:00:00	ETHUSD	157.18	157.30	155.32	155.81	106.337279
3	1586984400000	2020-04-15 21:00:00	ETHUSD	158.04	158.31	157.16	157.18	55.244131
4	1586980800000	2020-04-15 20:00:00	ETHUSD	157.10	158.10	156.87	158.04	144.262622

In [3]:
```
len(df)
```

Out[3]: 34497

In [4]:
```
df.nunique()
```

Out[4]:
```
Unix Timestamp    34497
Date              34497
Symbol                1
Open              20189
High              19276
Low               19259
Close             20189
Volume            31404
dtype: int64
```

In [5]:
```
df_1 = df.drop(columns=["Symbol","Unix Timestamp"])
df_1.head()
```

Out[5]:

	Date	Open	High	Low	Close	Volume
0	2020-04-16 00:00:00	152.94	152.94	150.39	150.39	650.188125
1	2020-04-15 23:00:00	155.81	155.81	151.39	152.94	4277.567299
2	2020-04-15 22:00:00	157.18	157.30	155.32	155.81	106.337279
3	2020-04-15 21:00:00	158.04	158.31	157.16	157.18	55.244131
4	2020-04-15 20:00:00	157.10	158.10	156.87	158.04	144.262622

In [6]:
```
df_2 = df_1.copy()
df_2["Date"] = pd.to_datetime(df_2["Date"])
df_2["Date"] = df_2["Date"].dt.date

grp_mean = df_2.groupby(by="Date").mean().round(2)
grp_min = df_2.groupby(by="Date").min().round(2)
grp_max = df_2.groupby(by="Date").max().round(2)

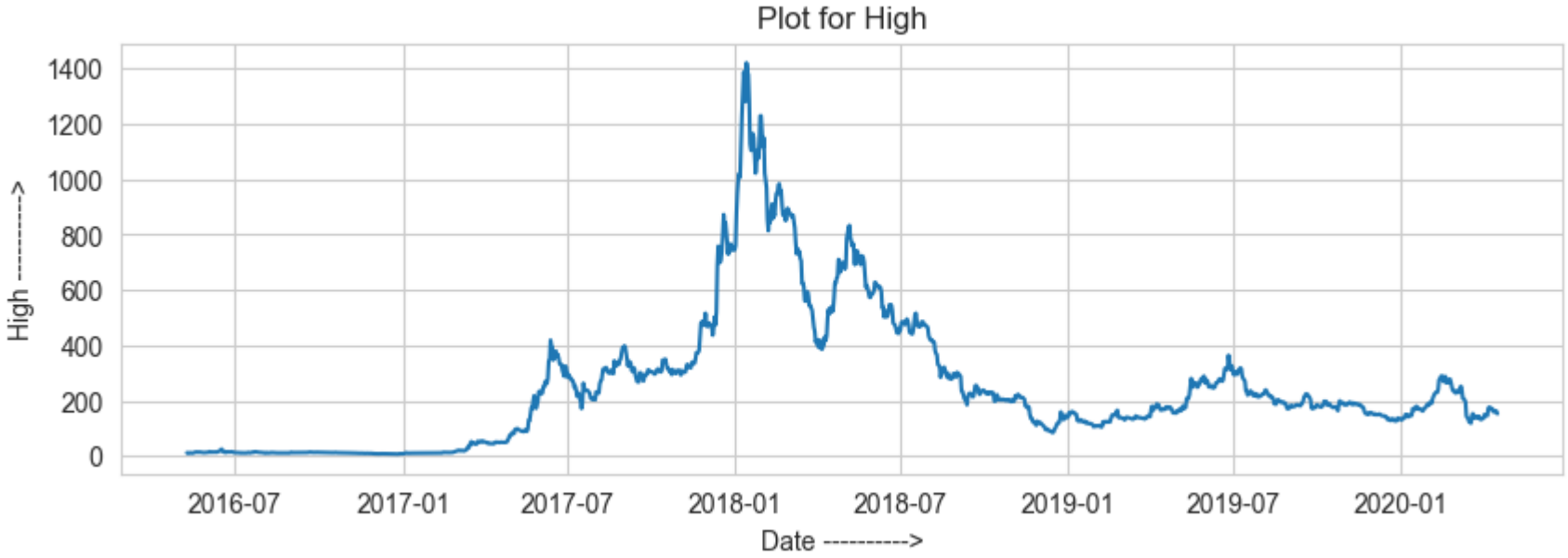
df_3 = pd.DataFrame(columns=df_2.columns[1:],index=grp_mean.index)
df_3[["Open","Close","Volume"]] = grp_mean[["Open","Close","Volume"]].copy()
df_3["Low"] = grp_min["Low"].copy()
df_3["High"] = grp_max["High"].copy()

df_3.head()
```

Out[6]:

Date	Open	High	Low	Close	Volume
2016-05-09	8.86	12.00	0.00	9.71	122.08
2016-05-10	9.58	9.96	9.36	9.59	26.96
2016-05-11	9.90	10.47	9.68	9.93	127.19
2016-05-12	10.51	12.00	9.92	10.50	86.36
2016-05-13	10.70	11.59	10.20	10.73	76.56

In [7]:
```
for i in df_3:
    plt.subplots(figsize=(10,3))
    sns.lineplot(df_3[i])
    plt.xlabel("Date ---------->")
    plt.ylabel(i+" ---------->")
    plt.title("Plot for "+i)
    plt.show()
```

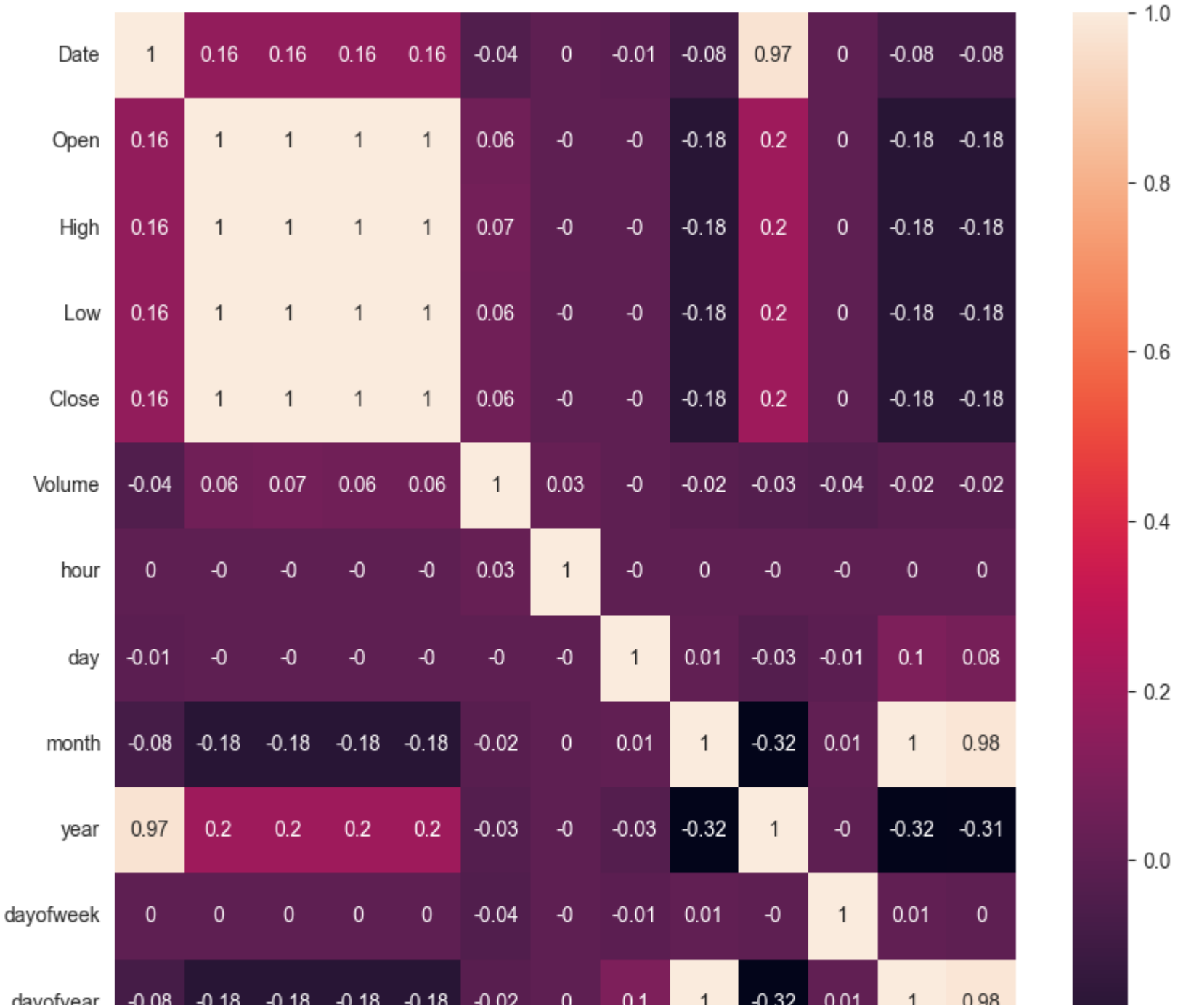

Plot for High
High ---------->
1400
1200
1000
800
600
400
200
0
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
Date ---------->
Plot for Low
Low ---------->
1200
1000
800
600
400
200
0
2016-07
2017-01
2017-07
2018-01
2018-07
2019-01
2019-07
2020-01
Date ---------->

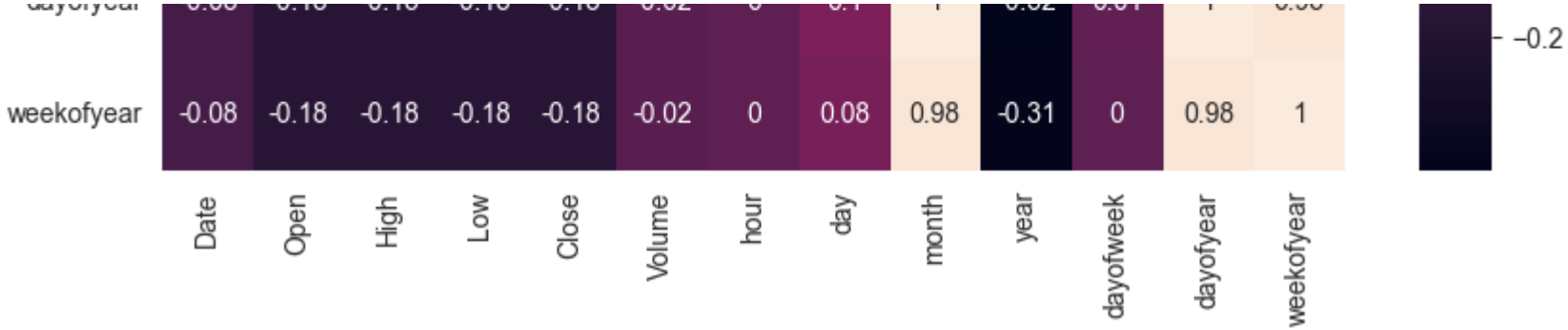
In [8]:
```
df_4 = df_1.copy()
df_4["Date"] = pd.to_datetime(df_4["Date"])
```

```
df_4["hour"] = df_4["Date"].dt.hour
df_4["day"] = df_4["Date"].dt.day
df_4["month"] = df_4["Date"].dt.month
df_4["year"] = df_4["Date"].dt.year
df_4["dayofweek"] = df_4["Date"].dt.dayofweek
df_4["dayofyear"] = df_4["Date"].dt.dayofyear
df_4["weekofyear"] = df_4["Date"].dt.isocalendar().week
```

In [9]:
```
plt.subplots(figsize=(10,10))
sns.heatmap(df_4.corr().round(2), annot=True)
```

Out[9]: <Axes: >


Date 1 0.16 0.16 0.16 0.16 -0.04 0 -0.01 -0.08 0.97 0 -0.08 -0.08
Open 0.16 1 1 1 1 0.06 -0 -0 -0.18 0.2 0 -0.18 -0.18
High 0.16 1 1 1 1 0.07 -0 -0 -0.18 0.2 0 -0.18 -0.18
Low 0.16 1 1 1 1 0.06 -0 -0 -0.18 0.2 0 -0.18 -0.18
Close 0.16 1 1 1 1 0.06 -0 -0 -0.18 0.2 0 -0.18 -0.18
Volume -0.04 0.06 0.07 0.06 0.06 1 0.03 -0 -0.02 -0.03 -0.04 -0.02 -0.02
hour 0 -0 -0 -0 -0 0.03 1 -0 0 -0 -0 0 0
day -0.01 -0 -0 -0 -0 -0 -0 1 0.01 -0.03 -0.01 0.1 0.08
month -0.08 -0.18 -0.18 -0.18 -0.18 -0.02 0 0.01 1 -0.32 0.01 1 0.98
year 0.97 0.2 0.2 0.2 0.2 -0.03 -0 -0.03 -0.32 1 -0 -0.32 -0.31
dayofweek 0 0 0 0 0 -0.04 -0 -0.01 0.01 -0 1 0.01 0
dayofyear -0.08 -0.18 -0.18 -0.18 -0.18 -0.02 0 0.1 1 -0.32 0.01 1 0.98
1.0
0.8
0.6
0.4
0.2
0.0



In [10]:
```
df_5 = df_4.sort_values(by="Date", ascending=True).reset_index(drop=True)
df_5.head()
```

Out[10]:

	Date	Open	High	Low	Close	Volume	hour	day	month	year	dayofweek	dayofyear	weekofyear
0	2016-05-09 13:00:00	0.00	12.00	0.00	9.55	432.562115	13	9	5	2016	0	130	19
1	2016-05-09 14:00:00	9.55	10.00	9.55	10.00	235.774075	14	9	5	2016	0	130	19
2	2016-05-09 15:00:00	10.00	10.00	9.99	9.99	10.973567	15	9	5	2016	0	130	19
3	2016-05-09 16:00:00	9.99	9.99	9.79	9.83	62.379450	16	9	5	2016	0	130	19
4	2016-05-09 17:00:00	9.83	9.83	9.48	9.49	329.553213	17	9	5	2016	0	130	19

Accuracy of Model

In [11]:
```
close = df_5["Close"]
no_of_window_samples = 240

close_length_iterate = close.shape[0] - no_of_window_samples

window = []
target = []
dates = []

for i in range(close_length_iterate):
    ini = i
```

```
    fin = i + no_of_window_samples
    window.append(close[ini:fin])
    target.append(close[fin])
    dates.append(df_5.loc[fin,"Date"])

window = np.array(window)
target = np.array(target)
dates = np.array(dates)
```

In [12]:
```
window
```

Out[12]:
```
array([[  9.55,  10.  ,   9.99, ...,  14.21,  13.99,  14.3 ],
       [ 10.  ,   9.99,   9.83, ...,  13.99,  14.3 ,  14.1 ],
       [  9.99,   9.83,   9.49, ...,  14.3 ,  14.1 ,  13.68],
       ...,
       [143.51, 143.04, 144.77, ..., 157.1 , 158.04, 157.18],
       [143.04, 144.77, 144.31, ..., 158.04, 157.18, 155.81],
       [144.77, 144.31, 143.91, ..., 157.18, 155.81, 152.94]])
```

In [13]:
```
target
```

Out[13]:
```
array([ 14.1 ,  13.68,  13.98, ..., 155.81, 152.94, 150.39])
```

In [14]:
```
np.savez("app/closing price window and target.npz",window=window,target=target,window_size=no_of_window_samples)
```

In [15]:
```
mms = MinMaxScaler()

window_1 = mms.fit_transform(window)
target_1 = mms.fit_transform(target.reshape(-1,1))
dates_1 = dates.copy()
```

In [16]:
```
window_1.shape
```

Out[16]:
```
(34257, 240)
```

In [17]:
```
window_1
```

Out[17]:
```
array([[0.00244431, 0.00276314, 0.00275605, ..., 0.0057459 , 0.00559004,
        0.00580967],
       [0.00276314, 0.00275605, 0.00264269, ..., 0.00559004, 0.00580967,
        0.00566797],
       [0.00275605, 0.00264269, 0.0024018 , ..., 0.00580967, 0.00566797,
        0.0053704 ],
       ...,
       [0.09735447, 0.09702148, 0.09824718, ..., 0.10698294, 0.10764893,
        0.10703962],
       [0.09702148, 0.09824718, 0.09792127, ..., 0.10764893, 0.10703962,
        0.10606898],
       [0.09824718, 0.09792127, 0.09763787, ..., 0.10703962, 0.10606898,
        0.10403559]])
```

In [18]:
```
val_test_threshold = round(0.8 * window_1.shape[0])

train_val_threshold = round(0.8 * val_test_threshold)

window_train = window_1[:train_val_threshold,:]
window_val = window_1[train_val_threshold:val_test_threshold,:]
window_test = window_1[val_test_threshold:,:]

target_train = target_1[:train_val_threshold,:]
target_val = target_1[train_val_threshold:val_test_threshold,:]
target_test = target_1[val_test_threshold:,:]

target_train_1 = target[:train_val_threshold]
target_val_1 = target[train_val_threshold:val_test_threshold]
target_test_1 = target[val_test_threshold:]

train_dates = dates_1[:train_val_threshold]
val_dates = dates_1[train_val_threshold:val_test_threshold]
test_dates = dates_1[val_test_threshold:]

no_of_train_rows = window_train.shape[0]
no_of_val_rows = window_val.shape[0]
no_of_test_rows = window_test.shape[0]

window_train = window_train.reshape(no_of_train_rows,1,no_of_window_samples)
```

```
window_val = window_val.reshape(no_of_val_rows,1,no_of_window_samples)
window_test = window_test.reshape(no_of_test_rows,1,no_of_window_samples)
```

In [19]:
```
window
```

Out[19]:
```
array([[  9.55,  10.  ,   9.99, ...,  14.21,  13.99,  14.3 ],
       [ 10.  ,   9.99,   9.83, ...,  13.99,  14.3 ,  14.1 ],
       [  9.99,   9.83,   9.49, ...,  14.3 ,  14.1 ,  13.68],
       ...,
       [143.51, 143.04, 144.77, ..., 157.1 , 158.04, 157.18],
       [143.04, 144.77, 144.31, ..., 158.04, 157.18, 155.81],
       [144.77, 144.31, 143.91, ..., 157.18, 155.81, 152.94]])
```

In [20]:
```
window_train.shape
```

Out[20]:
```
(21925, 1, 240)
```

In [21]:
```
model = tf.keras.models.Sequential(layers=[
    tf.keras.layers.LSTM(units=100,input_shape=(1,no_of_window_samples)),
    tf.keras.layers.Dropout(rate=0.25),
    tf.keras.layers.Dense(1,activation="linear")
])
```

```
WARNING:tensorflow:From C:\Users\amith\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src\layers\rnn\lstm.py:1
48: The name tf.executing_eagerly_outside_functions is deprecated. Please use tf.compat.v1.executing_eagerly_outside_functions
instead.
```

In [22]:
```
model.compile(optimizer=tf.keras.optimizers.Adam(),loss=tf.keras.losses.mean_squared_error)
```

In [23]:
```
model.fit(window_train,target_train,validation_data=(window_val,target_val),epochs=100,batch_size=32,verbose=1,shuffle=True,ca
```

```
Epoch 1/100
WARNING:tensorflow:From C:\Users\amith\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src\utils\tf_utils.py:49
2: The name tf.ragged.RaggedTensorValue is deprecated. Please use tf.compat.v1.ragged.RaggedTensorValue instead.
686/686 [==============================] - 6s 5ms/step - loss: 0.0017 - val_loss: 2.1562e-04
Epoch 2/100
686/686 [==============================] - 2s 3ms/step - loss: 8.5940e-04 - val_loss: 1.8946e-05
Epoch 3/100
686/686 [==============================] - 3s 4ms/step - loss: 6.5494e-04 - val_loss: 2.0908e-05
Epoch 4/100
686/686 [==============================] - 2s 3ms/step - loss: 5.5638e-04 - val_loss: 6.5350e-05
```

Out[23]: <keras.src.callbacks.History at 0x2368e655490>

In [24]:
```
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 lstm (LSTM)                 (None, 100)               136400

 dropout (Dropout)           (None, 100)               0

 dense (Dense)               (None, 1)                 101

=================================================================
Total params: 136501 (533.21 KB)
Trainable params: 136501 (533.21 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

In [25]:
```
target_pred_p = model.predict(window_test,verbose=0)
target_pred = mms.inverse_transform(target_pred_p)
root_mean_squared_error = np.round(np.sqrt(mean_squared_error(target_test,target_pred)),2)
root_mean_squared_error
```

Out[25]: 198.56

In [26]:
```
plt.subplots(figsize=(10,3))
sns.lineplot(x=dates,y=target)
test_dates = np.reshape(test_dates,(1,-1))[0]
target_pred = np.reshape(target_pred,(1,-1))[0]
sns.lineplot(x=test_dates,y=target_pred)
```

Out[26]: <Axes: >

Prediction of Future Values

In [27]:
```
mms_2 = MinMaxScaler()
window_scaled_2 = mms_2.fit_transform(window)
target_scaled_2 = mms_2.fit_transform(target.reshape(-1,1))

joblib.dump(value=mms_2,filename="app/scaler.joblib")
```

Out[27]:
```
['app/scaler.joblib']
```

In [28]:
```
train_val_threshold_2 = round(0.8 * window.shape[0])
no_of_window_samples_2 = 240

window_train_2 = window_scaled_2[:train_val_threshold_2]
target_train_2 = target_scaled_2[:train_val_threshold_2]

window_val_2 = window_scaled_2[train_val_threshold_2:]
target_val_2 = target_scaled_2[train_val_threshold_2:]

no_of_train_rows_2 = window_train_2.shape[0]
no_of_val_rows_2 = window_val_2.shape[0]
```

```
window_train_2 = window_train_2.reshape(no_of_train_rows_2,1,no_of_window_samples_2)
window_val_2 = window_val_2.reshape(no_of_val_rows_2,1,no_of_window_samples_2)
```

In [29]:
```
model_2 = tf.keras.models.Sequential(layers=[
    tf.keras.layers.LSTM(units=100,input_shape=(1,no_of_window_samples_2)),
    tf.keras.layers.Dropout(rate=0.25),
    tf.keras.layers.Dense(1,activation="linear")
])
model_2.save("app/model.keras")
```

In [30]:
```
model_2.compile(optimizer=tf.keras.optimizers.Adam(),loss=tf.keras.losses.mean_squared_error)
```

In [31]:
```
model_2.fit(window_train_2,target_train_2,validation_data=(window_val_2,target_val_2),epochs=100,batch_size=32,verbose=1,shuff
```

```
Epoch 1/100
857/857 [==============================] - 6s 5ms/step - loss: 0.0013 - val_loss: 3.3252e-04
Epoch 2/100
857/857 [==============================] - 2s 3ms/step - loss: 6.7147e-04 - val_loss: 2.0959e-05
Epoch 3/100
857/857 [==============================] - 3s 3ms/step - loss: 4.7571e-04 - val_loss: 1.7273e-05
Epoch 4/100
857/857 [==============================] - 3s 3ms/step - loss: 5.0406e-04 - val_loss: 1.0921e-05
Epoch 5/100
857/857 [==============================] - 3s 3ms/step - loss: 4.1389e-04 - val_loss: 3.8903e-05
Epoch 6/100
857/857 [==============================] - 3s 3ms/step - loss: 3.8213e-04 - val_loss: 9.3301e-06
Epoch 7/100
857/857 [==============================] - 3s 3ms/step - loss: 3.9695e-04 - val_loss: 2.9929e-05
Epoch 8/100
857/857 [==============================] - 3s 3ms/step - loss: 3.4147e-04 - val_loss: 2.8437e-05
```

Out[31]:
```
<keras.src.callbacks.History at 0x236900e08d0>
```

In [33]:
```
future_start_date = "2020-04-16 01:00:00"
future_end_date = pd.to_datetime("2020-05-17 01:00:00")

future_dates = pd.date_range(start=future_start_date,end=future_end_date,freq="h").values
```

In [34]:
```
window_test_2 = []
target_test_2 = []
```

```
input_arr_2 = np.array(window_scaled_2[-1,1:].tolist() + [target_scaled_2[-1][0]])
output_2 = model.predict(input_arr_2.reshape(1,1,-1),verbose=0)[0][0]
window_test_2.append(input_arr_2)
target_test_2.append(output_2)
i = 0
print((i+1),":",len(future_dates))

for i in range(1,len(future_dates)):
    current_window_2 = window_test_2[i-1]
    input_arr_2 = np.array(current_window_2[1:].tolist() + [target_test_2[i-1]])
    output_2 = model_2.predict(input_arr_2.reshape(1,1,-1))[0][0]
    window_test_2.append(input_arr_2)
    target_test_2.append(output_2)
    print((i+1),":",len(future_dates))

window_test_2 = np.array(window_test_2)
target_test_2 = np.array(target_test_2)
```

```
1 : 745
1/1 [==============================] - 0s 460ms/step
2 : 745
1/1 [==============================] - 0s 20ms/step
3 : 745
1/1 [==============================] - 0s 21ms/step
4 : 745
1/1 [==============================] - 0s 20ms/step
5 : 745
1/1 [==============================] - 0s 20ms/step
6 : 745
1/1 [==============================] - 0s 32ms/step
7 : 745
1/1 [==============================] - 0s 20ms/step
8 : 745
1/1 [==============================] - 0s 50ms/step
9 : 745
1/1 [==============================] - 0s 20ms/step
10 : 745
1/1 [==============================] - 0s 18ms/step
11 : 745
1/1 [==============================] - 0s 23ms/step
12 : 745
1/1 [==============================] - 0s 17ms/step
13 : 745
1/1 [==============================] - 0s 17ms/step
14 : 745
1/1 [==============================] - 0s 37ms/step
15 : 745
1/1 [==============================] - 0s 37ms/step
16 : 745
1/1 [==============================] - 0s 25ms/step
17 : 745
1/1 [==============================] - 0s 26ms/step
18 : 745
1/1 [==============================] - 0s 25ms/step
19 : 745
1/1 [==============================] - 0s 24ms/step
20 : 745
1/1 [==============================] - 0s 33ms/step
21 : 745
```

```
1/1 [==============================] - 0s 29ms/step
22 : 745
1/1 [==============================] - 0s 27ms/step
23 : 745
1/1 [==============================] - 0s 25ms/step
24 : 745
1/1 [==============================] - 0s 24ms/step
25 : 745
1/1 [==============================] - 0s 30ms/step
26 : 745
1/1 [==============================] - 0s 28ms/step
27 : 745
1/1 [==============================] - 0s 25ms/step
28 : 745
1/1 [==============================] - 0s 23ms/step
29 : 745
1/1 [==============================] - 0s 55ms/step
30 : 745
1/1 [==============================] - 0s 21ms/step
31 : 745
1/1 [==============================] - 0s 23ms/step
32 : 745
1/1 [==============================] - 0s 22ms/step
33 : 745
1/1 [==============================] - 0s 28ms/step
34 : 745
1/1 [==============================] - 0s 58ms/step
35 : 745
1/1 [==============================] - 0s 24ms/step
36 : 745
1/1 [==============================] - 0s 21ms/step
37 : 745
1/1 [==============================] - 0s 24ms/step
38 : 745
1/1 [==============================] - 0s 20ms/step
39 : 745
1/1 [==============================] - 0s 23ms/step
40 : 745
1/1 [==============================] - 0s 28ms/step
41 : 745
1/1 [==============================] - 0s 24ms/step
```

```
42 : 745
1/1 [==============================] - 0s 24ms/step
43 : 745
1/1 [==============================] - 0s 27ms/step
44 : 745
1/1 [==============================] - 0s 20ms/step
45 : 745
1/1 [==============================] - 0s 29ms/step
46 : 745
1/1 [==============================] - 0s 27ms/step
47 : 745
1/1 [==============================] - 0s 29ms/step
48 : 745
1/1 [==============================] - 0s 41ms/step
49 : 745
1/1 [==============================] - 0s 22ms/step
50 : 745
1/1 [==============================] - 0s 23ms/step
51 : 745
1/1 [==============================] - 0s 21ms/step
52 : 745
1/1 [==============================] - 0s 21ms/step
53 : 745
1/1 [==============================] - 0s 26ms/step
54 : 745
1/1 [==============================] - 0s 29ms/step
55 : 745
1/1 [==============================] - 0s 23ms/step
56 : 745
1/1 [==============================] - 0s 22ms/step
57 : 745
1/1 [==============================] - 0s 19ms/step
58 : 745
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```

In [35]:
```
target_pred_2 = mms.inverse_transform(target_test_2.reshape(-1,1))
target_pred_2
```

Out[35]:
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```

In [36]:
```
plt.subplots(figsize=(10,3))
sns.lineplot(x=dates,y=target)
test_dates = np.reshape(test_dates,(1,-1))[0]
target_pred = np.reshape(target_pred,(1,-1))[0]
sns.lineplot(x=test_dates,y=target_pred)
sns.lineplot(x=future_dates,y=target_pred_2.reshape(1,-1)[0])
```

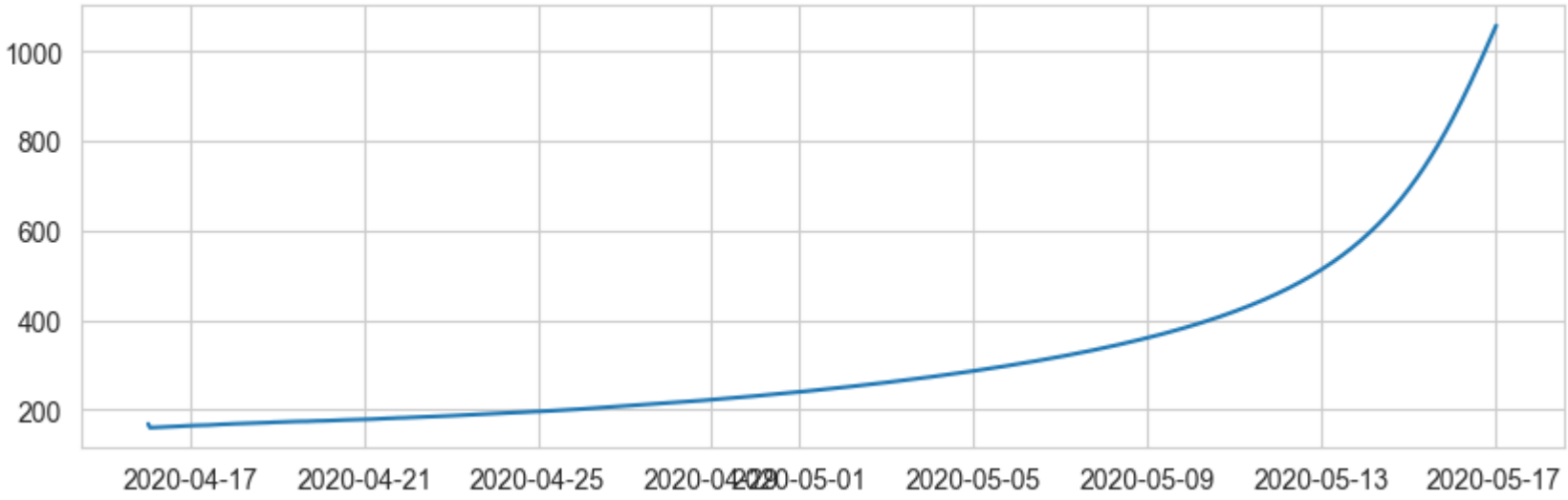
Out[36]: <Axes: >

In [37]:
```
plt.subplots(figsize=(10,3))
test_dates = np.reshape(test_dates,(1,-1))[0]
target_pred = np.reshape(target_pred,(1,-1))[0]
sns.lineplot(x=test_dates,y=target_pred)
sns.lineplot(x=future_dates,y=target_pred_2.reshape(1,-1)[0])
```

Out[37]: <Axes: >

In [38]:
```
plt.subplots(figsize=(10,3))
test_dates = np.reshape(test_dates,(1,-1))[0]
target_pred = np.reshape(target_pred,(1,-1))[0]
sns.lineplot(x=future_dates,y=target_pred_2.reshape(1,-1)[0])
```

Out[38]: <Axes: >



In [39]:
```
f = np.load(file="app/closing price window and target.npz")
f
```

Out[39]:
```
NpzFile 'app/closing price window and target.npz' with keys: window, target, window_size
```

In [40]:
```
w = f["window"]
t = f["target"]
ws = f["window_size"]
```

In [41]:
```
w
```

Out[41]:
```
array([[  9.55,  10.  ,   9.99, ...,  14.21,  13.99,  14.3 ],
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       ...,
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       [144.77, 144.31, 143.91, ..., 157.18, 155.81, 152.94]])
```

In [ ]: