In [148…

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sb
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from xgboost import XGBClassifier
from sklearn import metrics
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay

import warnings
warnings.filterwarnings('ignore')

dataframe = pd.read_csv("TSLA.csv")
dataframe.head()
```

Out[148]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	1.774667	19245000
1	2011-01-04	1.777333	1.796667	1.734667	1.778000	1.778000	17811000
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	1.788667	21700500
3	2011-01-06	1.788667	1.866667	1.787333	1.858667	1.858667	30918000
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	1.882667	33718500

In [149…

```
dataframe.shape
```

Out[149]:

```
(3270, 7)
```

In [150…

```
dataframe.describe()
```

Out[150]:

	Open	High	Low	Close	Adj Close	Volume
count	3270.000000	3270.000000	3270.000000	3270.000000	3270.000000	3.270000e+03
mean	73.234467	74.848889	71.495915	73.214106	73.214106	9.971839e+07
std	102.605700	104.895721	100.085427	102.525614	102.525614	7.987937e+07
min	1.452000	1.484667	1.407333	1.455333	1.455333	3.594000e+06
25%	12.555000	12.800000	12.275333	12.573500	12.573500	5.019982e+07
50%	17.390000	17.634334	17.051666	17.389334	17.389334	8.388000e+07
75%	134.857498	136.667496	127.264999	134.085831	134.085831	1.257245e+08
max	411.470001	414.496674	405.666656	409.970001	409.970001	9.140820e+08

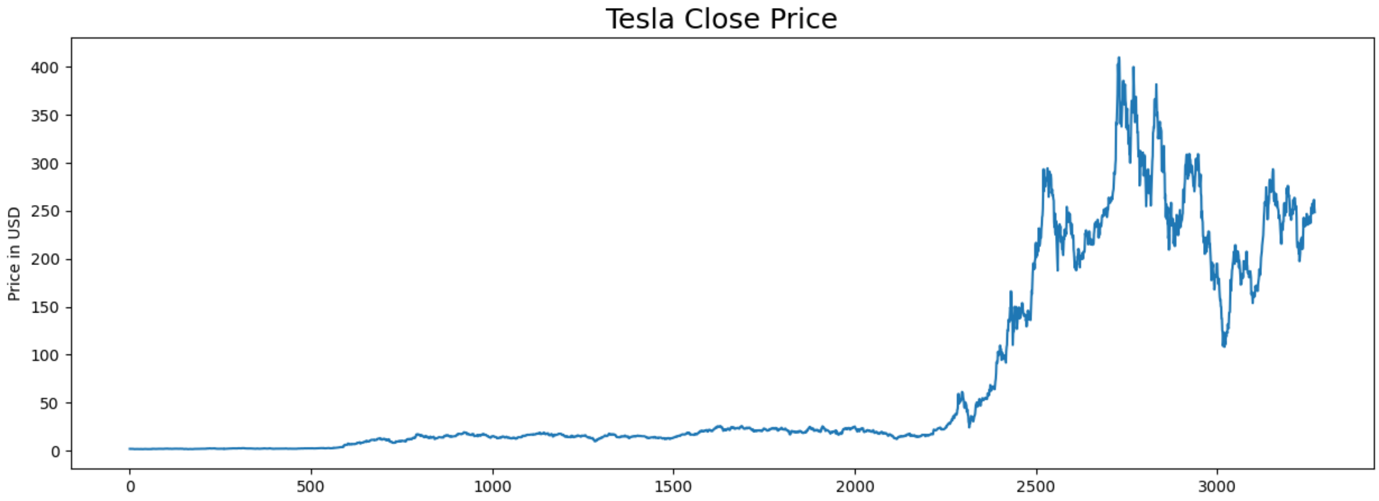
In [151…

```
dataframe.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3270 entries, 0 to 3269
Data columns (total 7 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   Date       3270 non-null   object 
 1   Open       3270 non-null   float64
 2   High       3270 non-null   float64
 3   Low        3270 non-null   float64
 4   Close      3270 non-null   float64
 5   Adj Close  3270 non-null   float64
 6   Volume     3270 non-null   int64
dtypes: float64(5), int64(1), object(1)
memory usage: 179.0+ KB
```

In [152…

```
plt.figure(figsize=(15,5))
plt.plot(dataframe['Close'])
plt.title('Tesla Close Price', fontsize=18)
plt.ylabel('Price in USD')
plt.show()
```



In [153…

```
dataframe.head()
```

Out[153]:

	Date	Open	High	Low	Close	Adj Close	Volume
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	1.774667	19245000
1	2011-01-04	1.777333	1.796667	1.734667	1.778000	1.778000	17811000
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	1.788667	21700500
3	2011-01-06	1.788667	1.866667	1.787333	1.858667	1.858667	30918000
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	1.882667	33718500

In [154…

```
dataframe[dataframe['Close'] == dataframe['Adj Close']].shape
```

Out[154]:

```
(3270, 7)
```

In [155…

```
dataframe = dataframe.drop(['Adj Close'], axis=1)
```

In [156…

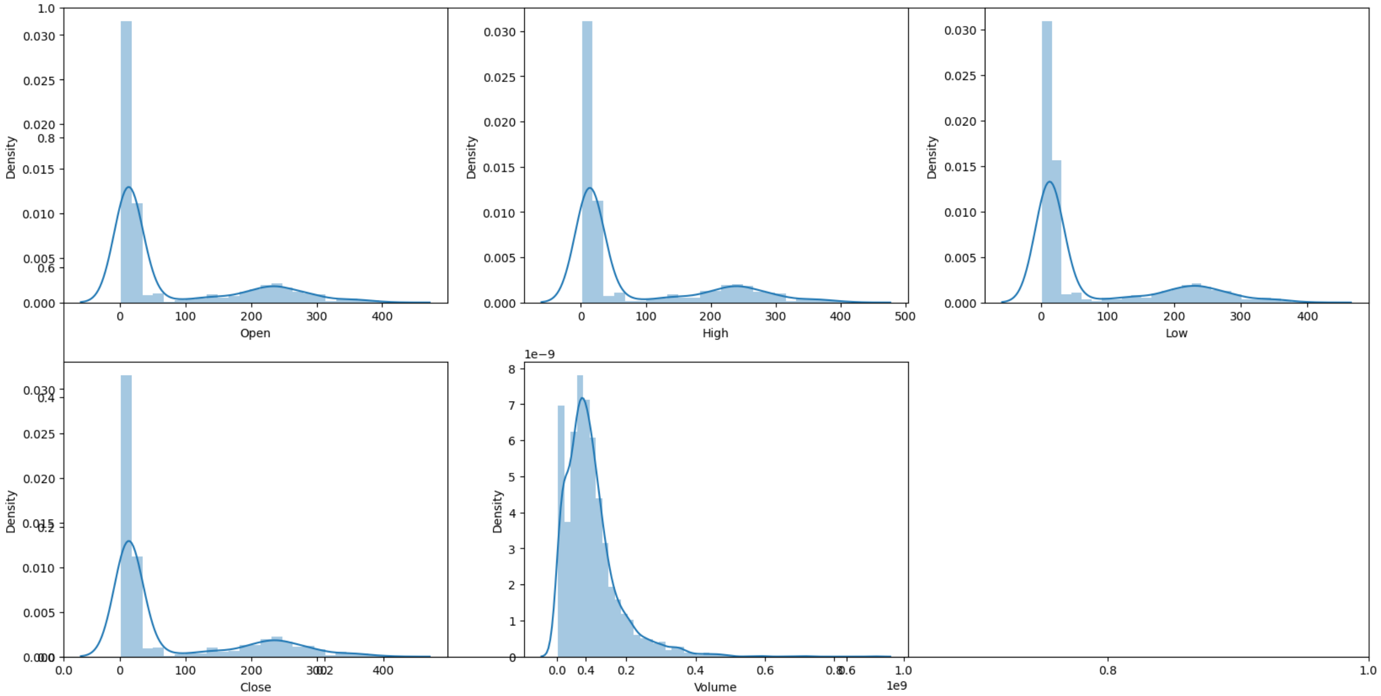
```
dataframe.isnull().sum()
```

Out[156]:

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

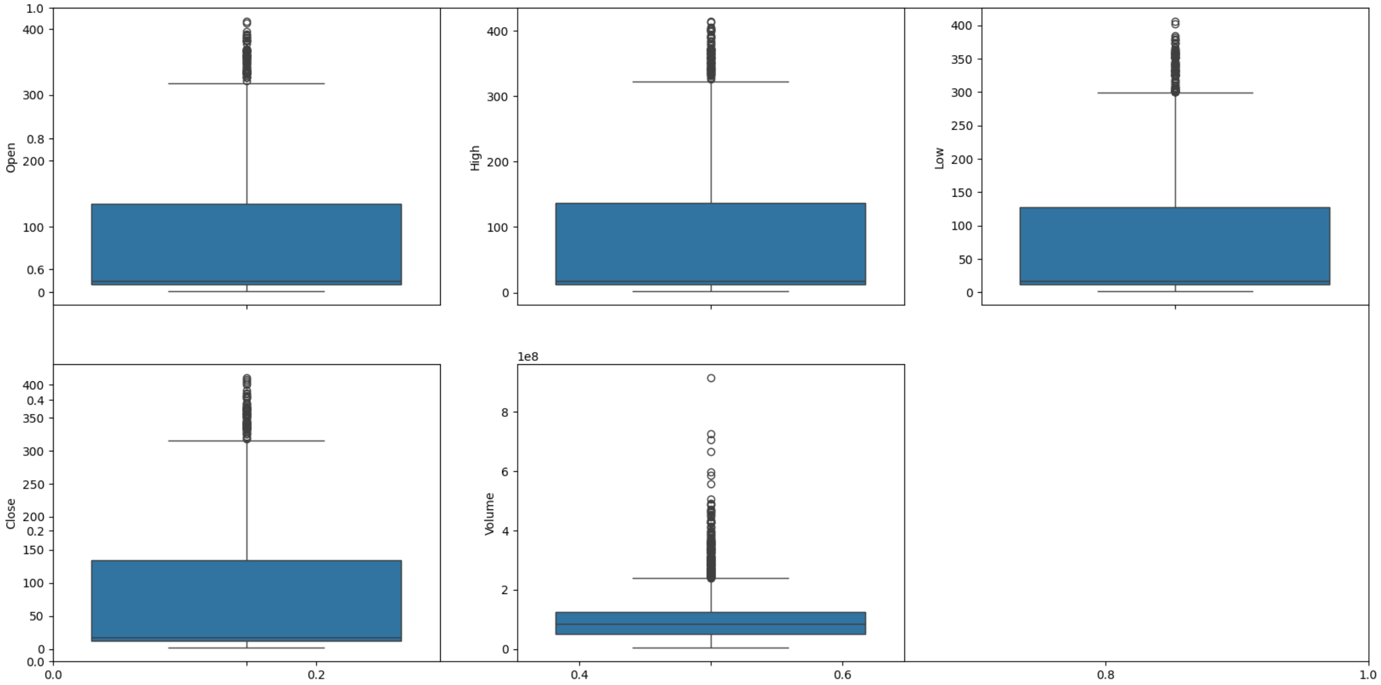
In [157…

```
features = ['Open', 'High', 'Low', 'Close', 'Volume']
plt.subplots(figsize=(20, 10))
for i, col in enumerate(features):
    plt.subplot(2, 3, i + 1)
    sb.distplot(dataframe[col])

plt.show()
```



In [158…

```
plt.subplots(figsize=(20, 10))
for i, col in enumerate(features):
    plt.subplot(2, 3, i + 1)
    sb.boxplot(dataframe[col])

plt.show()
```



In [159…

```
splitted = dataframe['Date'].str.split('-', expand=True)
dataframe['day'] = splitted[2].astype('int')
dataframe['month'] = splitted[1].astype('int')
dataframe['year'] = splitted[0].astype('int')
dataframe.head()
```

Out[159]:

	Date	Open	High	Low	Close	Volume	day	month	year
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	19245000	3	1	2011
1	2011-01-04	1.777333	1.796667	1.734667	1.778000	17811000	4	1	2011
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	21700500	5	1	2011

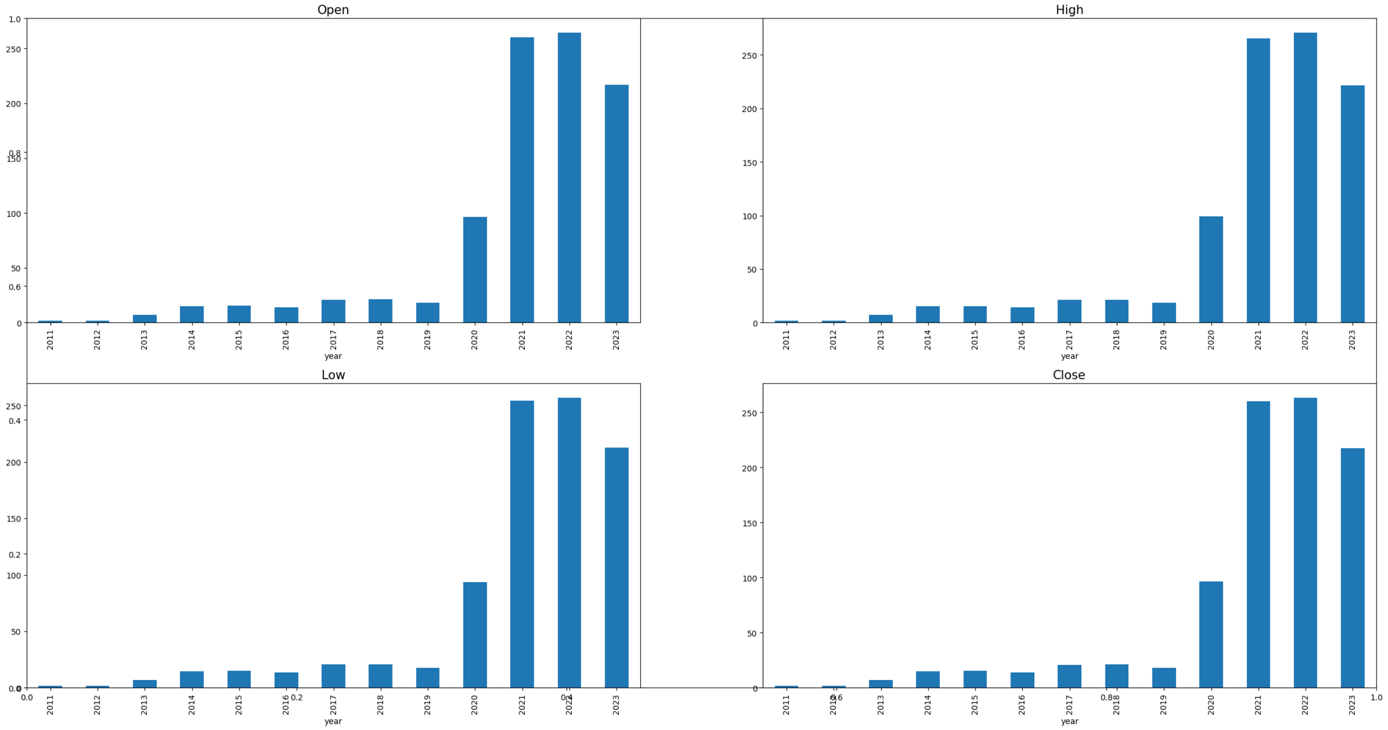
3	2011-01-06	1.788667	1.866667	1.787333	1.858667	30918000	6	1	2011
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	33718500	7	1	2011

In [160…
```
dataframe['is_quarter_end'] = np.where(dataframe['month'] % 3 == 0, 1, 0)
dataframe.head()
```

Out[160]:

	Date	Open	High	Low	Close	Volume	day	month	year	is_quarter_end
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	19245000	3	1	2011	0
1	2011-01-04	1.777333	1.796667	1.734667	1.778000	17811000	4	1	2011	0
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	21700500	5	1	2011	0
3	2011-01-06	1.788667	1.866667	1.787333	1.858667	30918000	6	1	2011	0
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	33718500	7	1	2011	0

In [161…
```
numeric_columns = dataframe.select_dtypes(include=[np.number])
data_grouped = numeric_columns.groupby('year').mean()
plt.subplots(figsize=(30, 15))
for i, col in enumerate(['Open', 'High', 'Low', 'Close']):
    plt.subplot(2, 2, i + 1)
    data_grouped[col].plot.bar()
    plt.title(col, fontsize=15)
plt.show()
```



In [162…
```
quarter_end = dataframe.select_dtypes(include=[np.number])
data_grouped = quarter_end.groupby('is_quarter_end').mean()
dataframe
```

Out[162]:

	Date	Open	High	Low	Close	Volume	day	month	year	is_quarter_end
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	19245000	3	1	2011	0
1	2011-01-04	1.777333	1.796667	1.734667	1.778000	17811000	4	1	2011	0
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	21700500	5	1	2011	0
3	2011-	1.788667	1.866667	1.787333	1.858667	30918000	6	1	2011	0

	01-06									
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	33718500	7	1	2011	0
...	...	...	...	...	...	...	...	...	...	...
3265	2023-12-22	256.760010	258.220001	251.369995	252.539993	93249800	22	12	2023	1
3266	2023-12-26	254.490005	257.970001	252.910004	256.609985	86892400	26	12	2023	1
3267	2023-12-27	258.350006	263.339996	257.519989	261.440002	106494400	27	12	2023	1
3268	2023-12-28	263.660004	265.130005	252.710007	253.179993	113619900	28	12	2023	1
3269	2023-12-29	255.100006	255.190002	247.429993	248.479996	100615300	29	12	2023	1

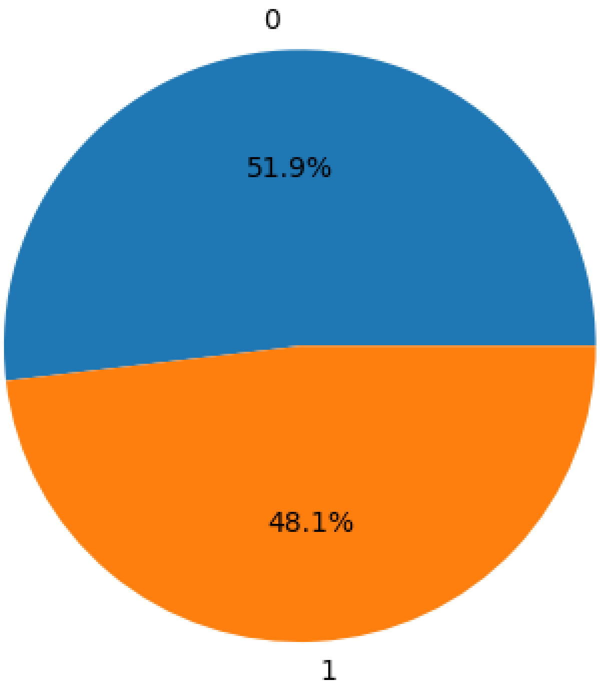
3270 rows × 10 columns

In [163…

```
dataframe['open-close'] = dataframe['Open'] - dataframe['Close']
dataframe['low-high'] = dataframe['Low'] - dataframe['High']
dataframe['target'] = np.where(dataframe['Close'].shift(-1) > dataframe['Close'], 1, 0)

plt.pie(dataframe['target'].value_counts().values, labels=[0, 1], autopct='%1.1f%%')
```

Out[163]:

```
([<matplotlib.patches.Wedge at 0x1768f0920>,
  <matplotlib.patches.Wedge at 0x28837a450>],
 [Text(-0.06442810515018392, 1.0981115695897012, '0'),
  Text(0.06442800233755866, -1.0981115756218909, '1')],
 [Text(-0.03514260280919123, 0.5989699470489278, '51.9%'),
  Text(0.035142546729577444, -0.5989699503392132, '48.1%')])
```



In [164…

```
dataframe
```

Out[164]:

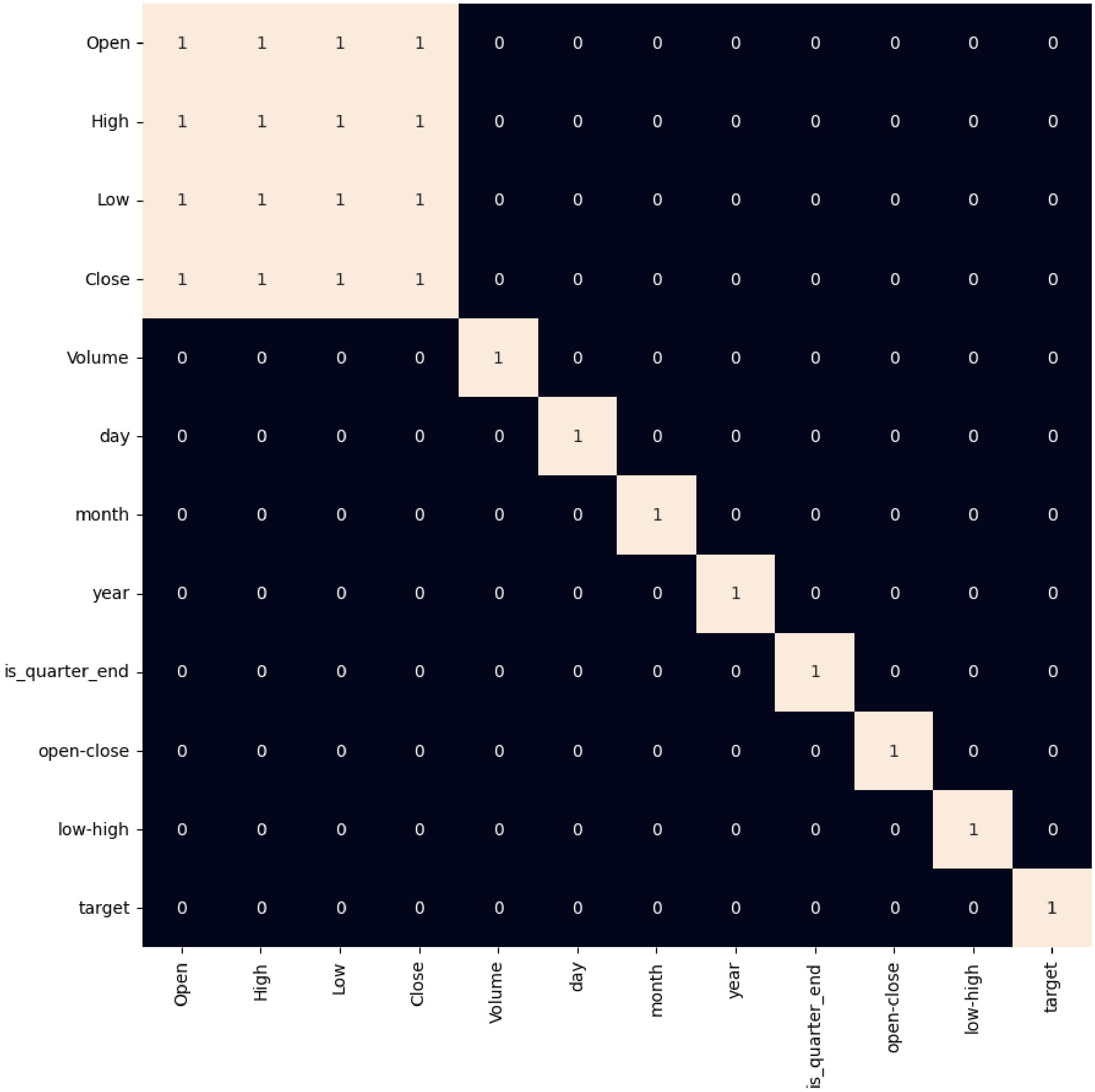
	Date	Open	High	Low	Close	Volume	day	month	year	is_quarter_end
0	2011-01-03	1.789333	1.800000	1.726667	1.774667	19245000	3	1	2011	0

1	2011-01-04	1.777333	1.796667	1.734667	1.778000	17811000	4	1	2011	0
2	2011-01-05	1.765333	1.793333	1.746000	1.788667	21700500	5	1	2011	0
3	2011-01-06	1.788667	1.866667	1.787333	1.858667	30918000	6	1	2011	0
4	2011-01-07	1.866667	1.905333	1.860000	1.882667	33718500	7	1	2011	0
...	...	...	...	...	...	...	...	...	...	...
3265	2023-12-22	256.760010	258.220001	251.369995	252.539993	93249800	22	12	2023	1
3266	2023-12-26	254.490005	257.970001	252.910004	256.609985	86892400	26	12	2023	1
3267	2023-12-27	258.350006	263.339996	257.519989	261.440002	106494400	27	12	2023	1
3268	2023-12-28	263.660004	265.130005	252.710007	253.179993	113619900	28	12	2023	1
3269	2023-12-29	255.100006	255.190002	247.429993	248.479996	100615300	29	12	2023	1

3270 rows × 13 columns

In [165…

```
plt.figure(figsize=(10, 10))
range_except_date = dataframe.loc[:, dataframe.columns != 'Date']
sb.heatmap(range_except_date.corr() > 0.9, annot=True, cbar=False)
plt.show()
```



	Open	High	Low	Close	Volume	day	month	year	is_quarter_end	open-close	low-high	target
Open	1	1	1	1	0	0	0	0	0	0	0	0
High	1	1	1	1	0	0	0	0	0	0	0	0
Low	1	1	1	1	0	0	0	0	0	0	0	0
Close	1	1	1	1	0	0	0	0	0	0	0	0
Volume	0	0	0	0	1	0	0	0	0	0	0	0
day	0	0	0	0	0	1	0	0	0	0	0	0
month	0	0	0	0	0	0	1	0	0	0	0	0
year	0	0	0	0	0	0	0	1	0	0	0	0
is_quarter_end	0	0	0	0	0	0	0	0	1	0	0	0
open-close	0	0	0	0	0	0	0	0	0	1	0	0
low-high	0	0	0	0	0	0	0	0	0	0	1	0
target	0	0	0	0	0	0	0	0	0	0	0	1

In [166…

```
features = dataframe[['open-close', 'low-high', 'is_quarter_end']]
target = dataframe['target']
scaler = StandardScaler()
features = scaler.fit_transform(features)
x_train, x_valid, y_train, y_valid = train_test_split(features, target, test_size = 0.1,
x_train.shape, x_valid.shape
```

Out[166]:

```
((2943, 3), (327, 3))
```

In [167…

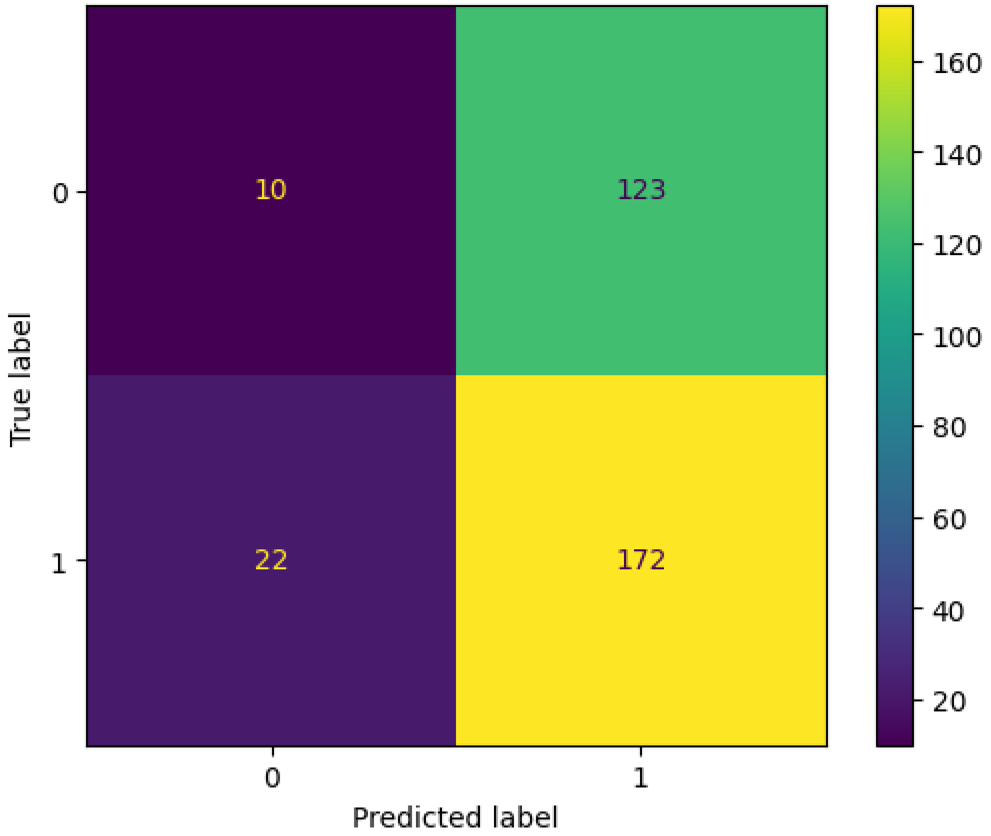
```
models = [LogisticRegression(), SVC(kernel = 'poly', probability = True), XGBClassifier(
for i in range(3):
    models[i].fit(x_train, y_train)
    print(f'{models[i]} : ')
    print('Training Accuracy: ', metrics.roc_auc_score(y_train, models[i].predict_proba(
    print('Validation Accuracy: ', metrics.roc_auc_score(y_valid, models[i].predict_prob
    print()
```

```
LogisticRegression() :
Training Accuracy:  0.5124788507758796
Validation Accuracy:  0.5037206418107123
```

```
SVC(kernel='poly', probability=True) :
Training Accuracy:  0.4962862378267793
Validation Accuracy:  0.5466242926904892

XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, random_state=None, ...) :
Training Accuracy:  0.9037321045915185
Validation Accuracy:  0.5075963103635377
```

In [168…

```python
# metrics.plot_confusion_matrix(models[0], x_valid, y_valid)
# plt.show()

clf = SVC(random_state=0)
clf.fit(x_train, y_train)
predictions = clf.predict(x_valid)
cm = confusion_matrix(y_valid, predictions, labels=clf.classes_)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=clf.classes_)
disp.plot()
plt.show()
```



In [169…

```python
# Based on the confusion matrix above we can see that the:
    # Accuracy = 55.67%
    # Precision = 7.52%
```