Gold Price Prediction

In this notebook we can see how to predict the gold price using the variables like Date, Open,High, Low,Close, Adj Close,Volume, SP_open,SP_high, SP_low,SP_close, SP_Ajclose,SP_volume, DJ_open,DJ_high, DJ_low,DJ_close, DJ_Ajclose,DJ_volume, EG_open,EG_high, EG_low,EG_close, EG_Ajclose,EG_volume, EU_Price,EU_open, EU_high,EU_low, EU_Trend,OF_Price, OF_Open,OF_High, OF_Low,OF_Volume, OF_Trend,OS_Price, OS_Open,OS_High, OS_Low,OS_Trend, SF_Price,SF_Open, SF_High,SF_Low, SF_Volume,SF_Trend, USB_Price,USB_Open, USB_High,USB_Low, USB_Trend,PLT_Price, PLT_Open,PLT_High, PLT_Low,PLT_Trend, PLD_Price,PLD_Open, PLD_High,PLD_Low, PLD_Trend,RHO_PRICE, USDI_Price,USDI_Open, USDI_High,USDI_Low, USDI_Volume,USDI_Trend, GDX_Open,GDX_High, GDX_Low,GDX_Close, GDX_Adj Close,GDX_Volume, USO_Open,USO_High, USO_Low,USO_Close, USO_Adj Close,USO_Volume

Import packages

```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split , GridSearchCV
from sklearn.ensemble import RandomForestRegressor
from sklearn.decomposition import PCA
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import StandardScaler
import matplotlib.pyplot as plt
import seaborn as sns
```

```
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146:
UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this
version of SciPy (detected version 1.23.5
  warnings.warn(f"A NumPy version >={np_minversion} and
<{np_maxversion}"
```

Import Data set

```
data=pd.read_csv("/kaggle/input/gold-price-prediction-dataset/
FINAL_USO.csv")
df=pd.DataFrame(data)
```

Exploratory Data Analysis

```
df.head()
```

```
         Date        Open        High         Low       Close   Adj
Close  \
0  2011-12-15  154.740005  154.949997  151.710007  152.330002
152.330002
1  2011-12-16  154.309998  155.369995  153.899994  155.229996
155.229996
2  2011-12-19  155.479996  155.860001  154.360001  154.869995
154.869995
3  2011-12-20  156.820007  157.429993  156.580002  156.979996
156.979996
4  2011-12-21  156.979996  157.529999  156.130005  157.160004
157.160004

     Volume     SP_open     SP_high      SP_low  ...    GDX_Low
GDX_Close  \
0  21521900  123.029999  123.199997  121.989998  ...  51.570000
51.680000
1  18124300  122.230003  122.949997  121.300003  ...  52.040001
52.680000
2  12547200  122.059998  122.320000  120.029999  ...  51.029999
51.169998
3   9136300  122.180000  124.139999  120.370003  ...  52.369999
52.990002
4  11996100  123.930000  124.360001  122.750000  ...  52.419998
52.959999

   GDX_Adj Close  GDX_Volume   USO_Open   USO_High    USO_Low
USO_Close  \
0      48.973877    20605600  36.900002  36.939999  36.049999
36.130001
1      49.921513    16285400  36.180000  36.500000  35.730000
36.270000
2      48.490578    15120200  36.389999  36.450001  35.930000
36.200001
3      50.215282    11644900  37.299999  37.610001  37.220001
37.560001
4      50.186852     8724300  37.669998  38.240002  37.520000
38.110001

   USO_Adj Close  USO_Volume
0      36.130001    12616700
1      36.270000    12578800
2      36.200001     7418200
3      37.560001    10041600
4      38.110001    10728000

[5 rows x 81 columns]

df.shape
```

```
(1718, 81)

df.describe()

                Open         High          Low        Close    Adj Close
\
count  1718.000000  1718.000000  1718.000000  1718.000000  1718.000000

mean    127.323434   127.854237   126.777695   127.319482   127.319482

std      17.526993    17.631189    17.396513    17.536269    17.536269

min     100.919998   100.989998   100.230003   100.500000   100.500000

25%     116.220001   116.540001   115.739998   116.052502   116.052502

50%     121.915001   122.325001   121.369999   121.795002   121.795002

75%     128.427494   129.087498   127.840001   128.470001   128.470001

max     173.199997   174.070007   172.919998   173.610001   173.610001


              Volume      SP_open      SP_high       SP_low
SP_close  ...  \
count  1.718000e+03  1718.000000  1718.000000  1718.000000
1718.000000  ...
mean   8.446327e+06   204.490023   205.372637   203.487014
204.491222  ...
std    4.920731e+06    43.831928    43.974644    43.618940
43.776999  ...
min    1.501600e+06   122.059998   122.320000   120.029999
120.290001  ...
25%    5.412925e+06   170.392498   170.962506   169.577499
170.397500  ...
50%    7.483900e+06   205.464996   206.459999   204.430000
205.529999  ...
75%    1.020795e+07   237.292500   237.722500   236.147503
236.889996  ...
max    9.380420e+07   293.089996   293.940002   291.809998
293.579987  ...

           GDX_Low    GDX_Close  GDX_Adj Close    GDX_Volume
USO_Open  \
count  1718.000000  1718.000000    1718.000000  1.718000e+03
1718.000000
mean     26.384575    26.715012      25.924624  4.356515e+07
22.113417
std      10.490908    10.603110       9.886570  2.909151e+07
11.431056
min      12.400000    12.470000      12.269618  4.729000e+06
```

```
7.820000
25%      20.355000    20.585000      20.180950  2.259968e+07
11.420000
50%      22.870001    23.054999      22.677604  3.730465e+07
16.450000
75%      26.797500    27.317500      26.478154  5.697055e+07
34.419998
max      56.770000    57.470001      54.617039  2.321536e+08
41.599998

          USO_High      USO_Low    USO_Close  USO_Adj Close
USO_Volume
count  1718.000000  1718.000000  1718.000000    1718.000000
1.718000e+03
mean     22.307148    21.904657    22.109051      22.109051
1.922313e+07
std      11.478671    11.373997    11.432787      11.432787
1.575743e+07
min       8.030000     7.670000     7.960000       7.960000
1.035100e+06
25%      11.500000    11.300000    11.392500      11.392500
6.229500e+06
50%      16.635001    16.040000    16.345000      16.345000
1.613015e+07
75%      34.667499    34.110000    34.417499      34.417499
2.672375e+07
max      42.299999    41.299999    42.009998      42.009998
1.102657e+08

[8 rows x 80 columns]

df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1718 entries, 0 to 1717
Data columns (total 81 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Date           1718 non-null   object
 1   Open           1718 non-null   float64
 2   High           1718 non-null   float64
 3   Low            1718 non-null   float64
 4   Close          1718 non-null   float64
 5   Adj Close      1718 non-null   float64
 6   Volume         1718 non-null   int64
 7   SP_open        1718 non-null   float64
 8   SP_high        1718 non-null   float64
 9   SP_low         1718 non-null   float64
 10  SP_close       1718 non-null   float64
 11  SP_Ajclose     1718 non-null   float64
```

```
 12  SP_volume      1718 non-null   int64
 13  DJ_open        1718 non-null   float64
 14  DJ_high        1718 non-null   float64
 15  DJ_low         1718 non-null   float64
 16  DJ_close       1718 non-null   float64
 17  DJ_Ajclose     1718 non-null   float64
 18  DJ_volume      1718 non-null   int64
 19  EG_open        1718 non-null   float64
 20  EG_high        1718 non-null   float64
 21  EG_low         1718 non-null   float64
 22  EG_close       1718 non-null   float64
 23  EG_Ajclose     1718 non-null   float64
 24  EG_volume      1718 non-null   int64
 25  EU_Price       1718 non-null   float64
 26  EU_open        1718 non-null   float64
 27  EU_high        1718 non-null   float64
 28  EU_low         1718 non-null   float64
 29  EU_Trend       1718 non-null   int64
 30  OF_Price       1718 non-null   float64
 31  OF_Open        1718 non-null   float64
 32  OF_High        1718 non-null   float64
 33  OF_Low         1718 non-null   float64
 34  OF_Volume      1718 non-null   int64
 35  OF_Trend       1718 non-null   int64
 36  OS_Price       1718 non-null   float64
 37  OS_Open        1718 non-null   float64
 38  OS_High        1718 non-null   float64
 39  OS_Low         1718 non-null   float64
 40  OS_Trend       1718 non-null   int64
 41  SF_Price       1718 non-null   int64
 42  SF_Open        1718 non-null   int64
 43  SF_High        1718 non-null   int64
 44  SF_Low         1718 non-null   int64
 45  SF_Volume      1718 non-null   int64
 46  SF_Trend       1718 non-null   int64
 47  USB_Price      1718 non-null   float64
 48  USB_Open       1718 non-null   float64
 49  USB_High       1718 non-null   float64
 50  USB_Low        1718 non-null   float64
 51  USB_Trend      1718 non-null   int64
 52  PLT_Price      1718 non-null   float64
 53  PLT_Open       1718 non-null   float64
 54  PLT_High       1718 non-null   float64
 55  PLT_Low        1718 non-null   float64
 56  PLT_Trend      1718 non-null   int64
 57  PLD_Price      1718 non-null   float64
 58  PLD_Open       1718 non-null   float64
 59  PLD_High       1718 non-null   float64
 60  PLD_Low        1718 non-null   float64
```

```
 61  PLD_Trend      1718 non-null   int64
 62  RHO_PRICE      1718 non-null   int64
 63  USDI_Price     1718 non-null   float64
 64  USDI_Open      1718 non-null   float64
 65  USDI_High      1718 non-null   float64
 66  USDI_Low       1718 non-null   float64
 67  USDI_Volume    1718 non-null   int64
 68  USDI_Trend     1718 non-null   int64
 69  GDX_Open       1718 non-null   float64
 70  GDX_High       1718 non-null   float64
 71  GDX_Low        1718 non-null   float64
 72  GDX_Close      1718 non-null   float64
 73  GDX_Adj Close  1718 non-null   float64
 74  GDX_Volume     1718 non-null   int64
 75  USO_Open       1718 non-null   float64
 76  USO_High       1718 non-null   float64
 77  USO_Low        1718 non-null   float64
 78  USO_Close      1718 non-null   float64
 79  USO_Adj Close  1718 non-null   float64
 80  USO_Volume     1718 non-null   int64
dtypes: float64(58), int64(22), object(1)
memory usage: 1.1+ MB
```

```
df.nunique()
```

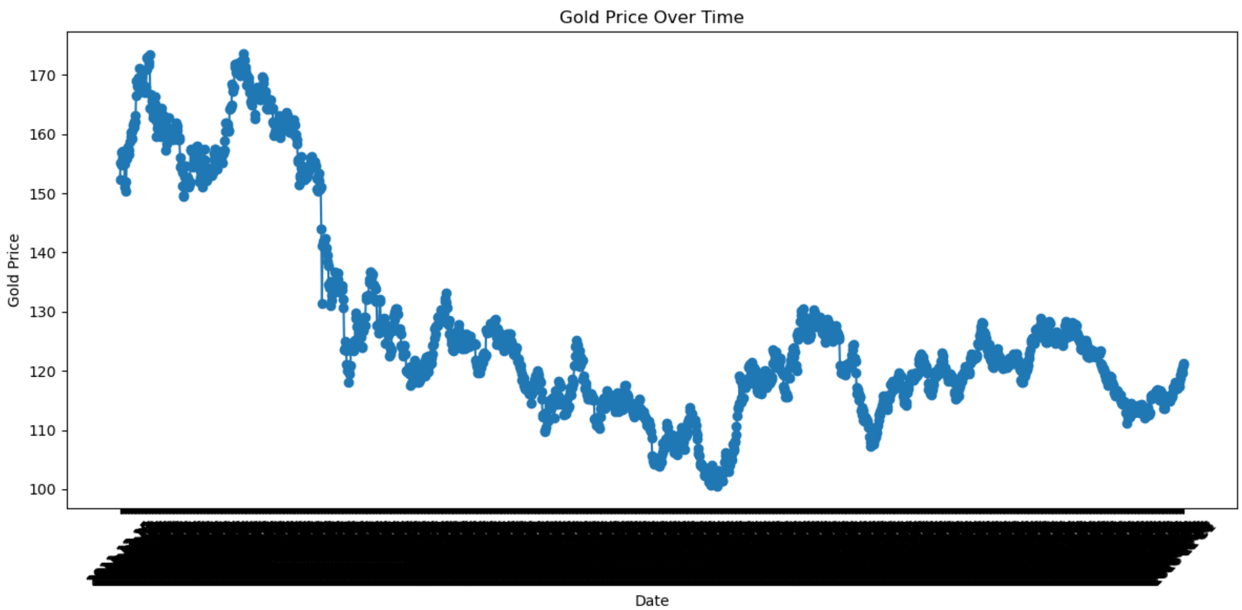
```
Date             1718
Open             1363
High             1368
Low              1356
Close            1384
                 ...
USO_High         1102
USO_Low          1124
USO_Close        1128
USO_Adj Close    1128
USO_Volume       1716
Length: 81, dtype: int64
```

```
X = data.drop(['Date', 'Close'], axis=1)  # Remove 'Date' and 'Close' columns
y = data['Close']
```

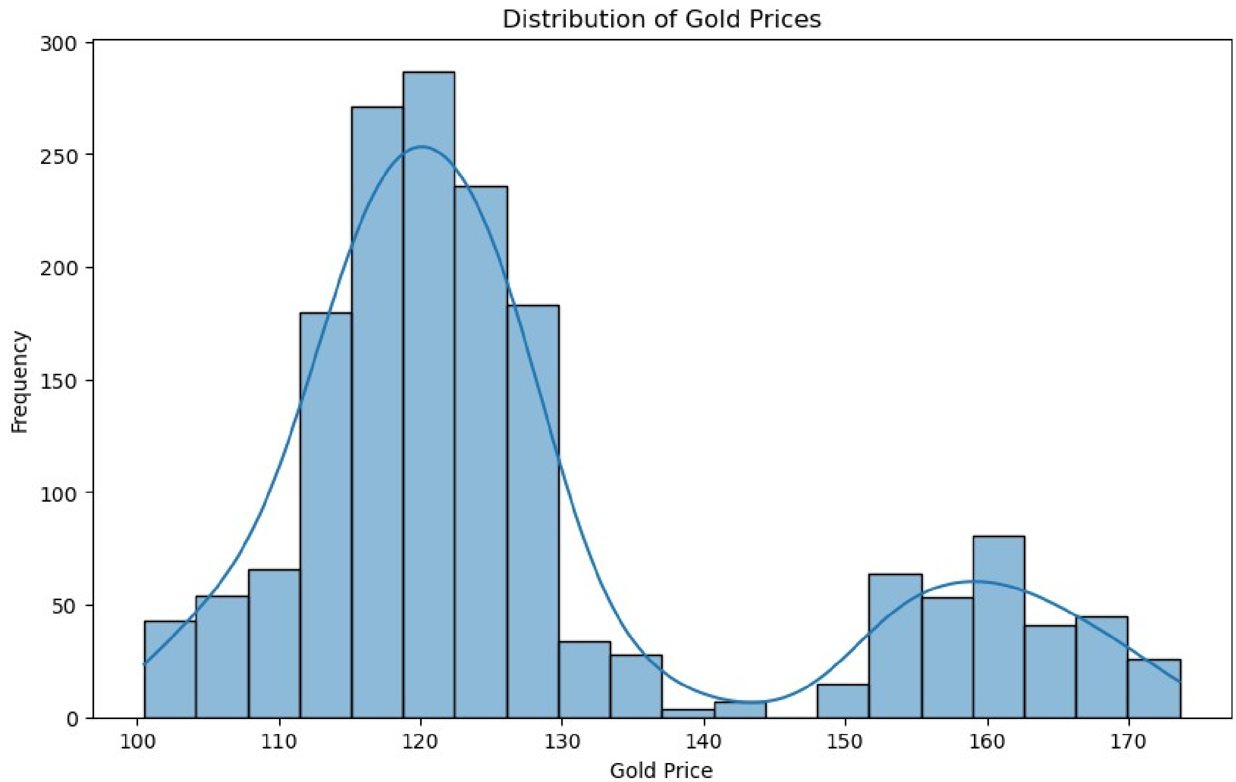
Analysis by Charts

```
# Line Chart - Gold Price over Time
plt.figure(figsize=(12, 6))
plt.plot(data['Date'], data['Close'], marker='o')
plt.xlabel('Date')
```

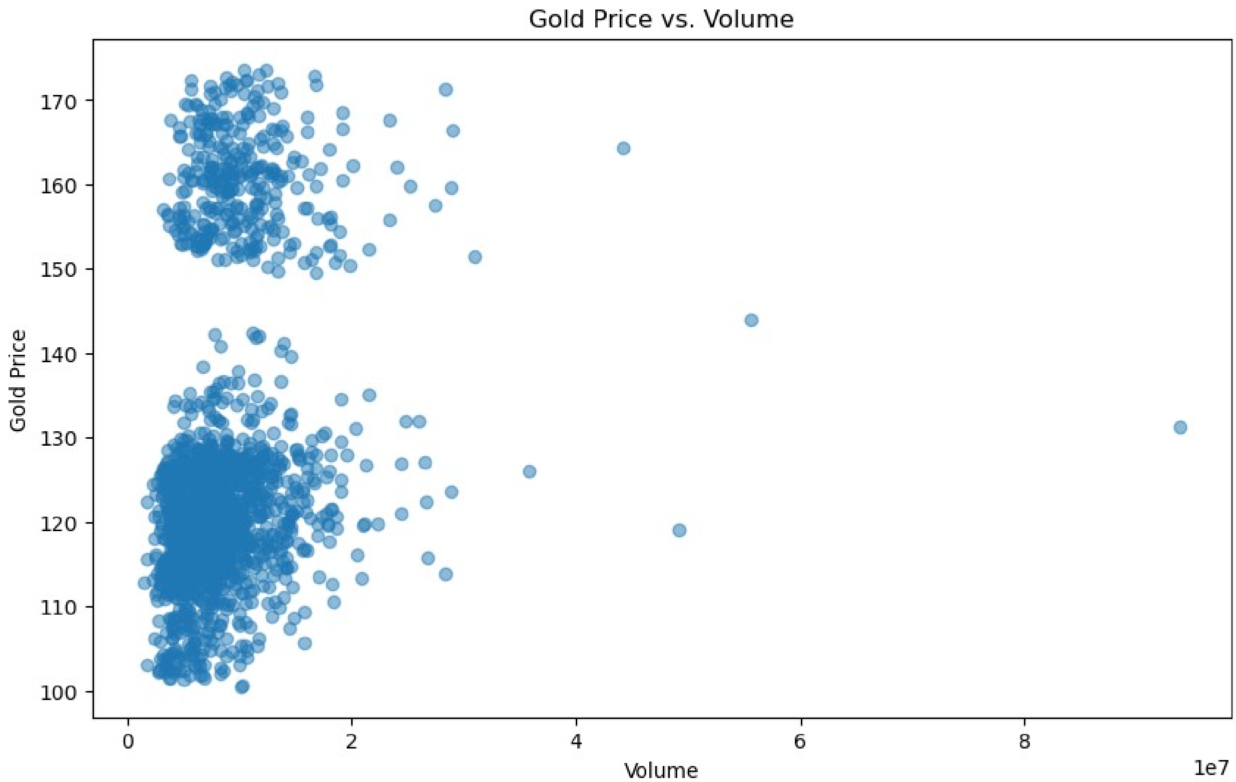
```
plt.ylabel('Gold Price')
plt.title('Gold Price Over Time')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```




```
# Histogram - Distribution of Gold Prices
plt.figure(figsize=(10, 6))
sns.histplot(data['Close'], bins=20, kde=True)
plt.xlabel('Gold Price')
plt.ylabel('Frequency')
plt.title('Distribution of Gold Prices')
plt.show()
```

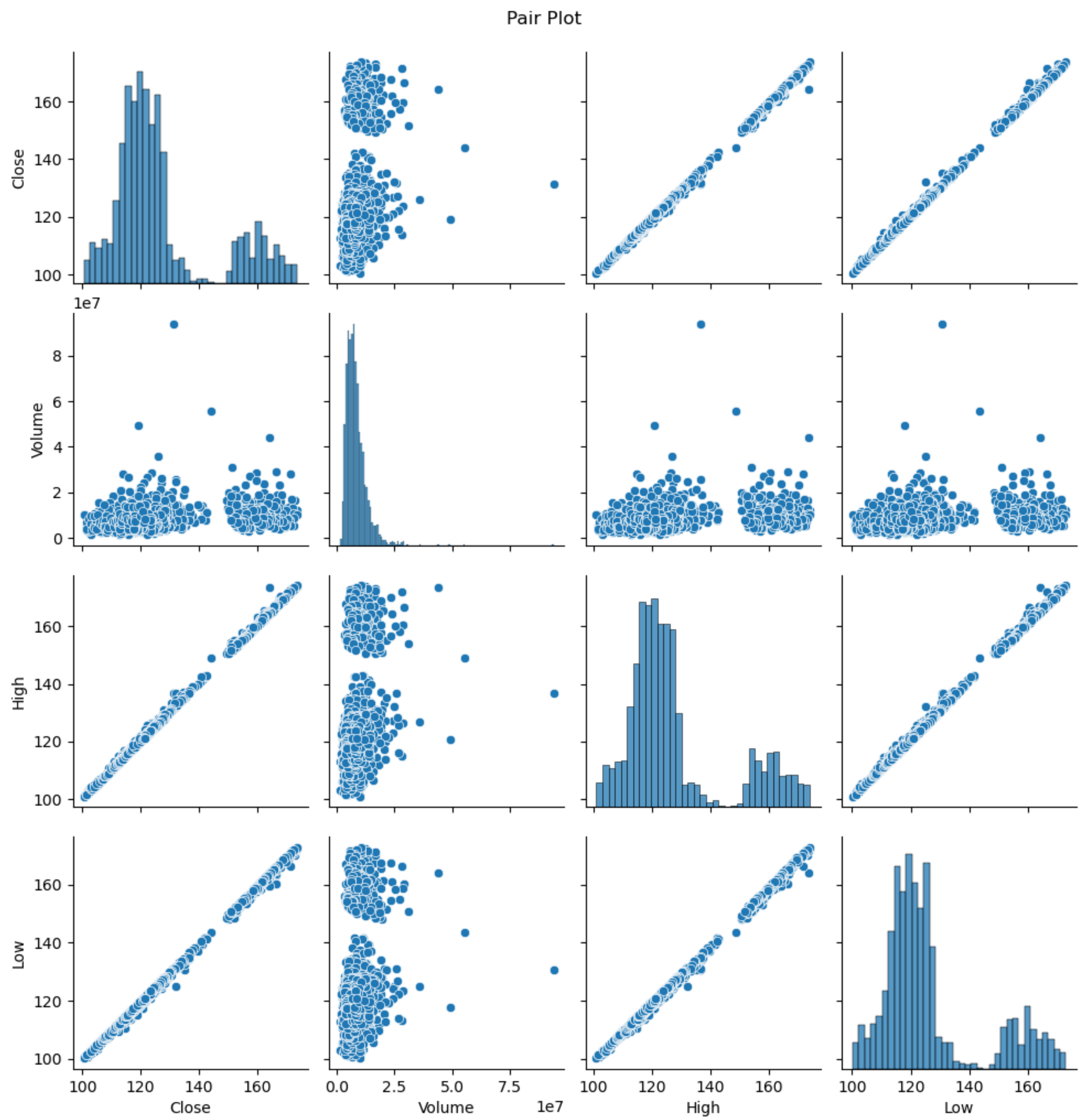



```
# Scatter Plot - Gold Price vs. Volume
plt.figure(figsize=(10, 6))
plt.scatter(data['Volume'], data['Close'], alpha=0.5)
plt.xlabel('Volume')
plt.ylabel('Gold Price')
plt.title('Gold Price vs. Volume')
plt.show()
```

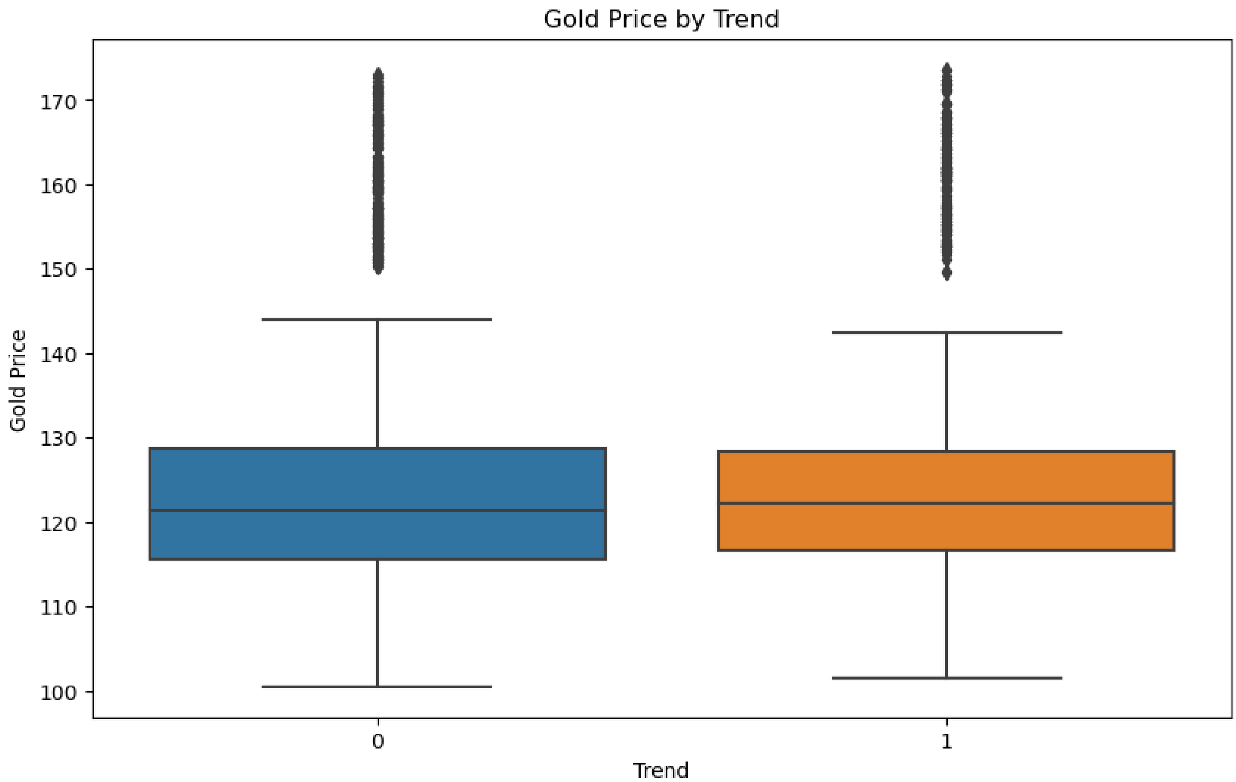



```
# Pair Plot
sns.pairplot(data[['Close', 'Volume', 'High', 'Low']])
plt.suptitle('Pair Plot', y=1.02)
plt.show()
```

```
/opt/conda/lib/python3.10/site-packages/seaborn/axisgrid.py:118:
UserWarning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```




```python
# Box Plot - Gold Price by Trend
plt.figure(figsize=(10, 6))
sns.boxplot(x=data['PLD_Trend'], y=data['Close'])
plt.xlabel('Trend')
plt.ylabel('Gold Price')
plt.title('Gold Price by Trend')
plt.show()
```



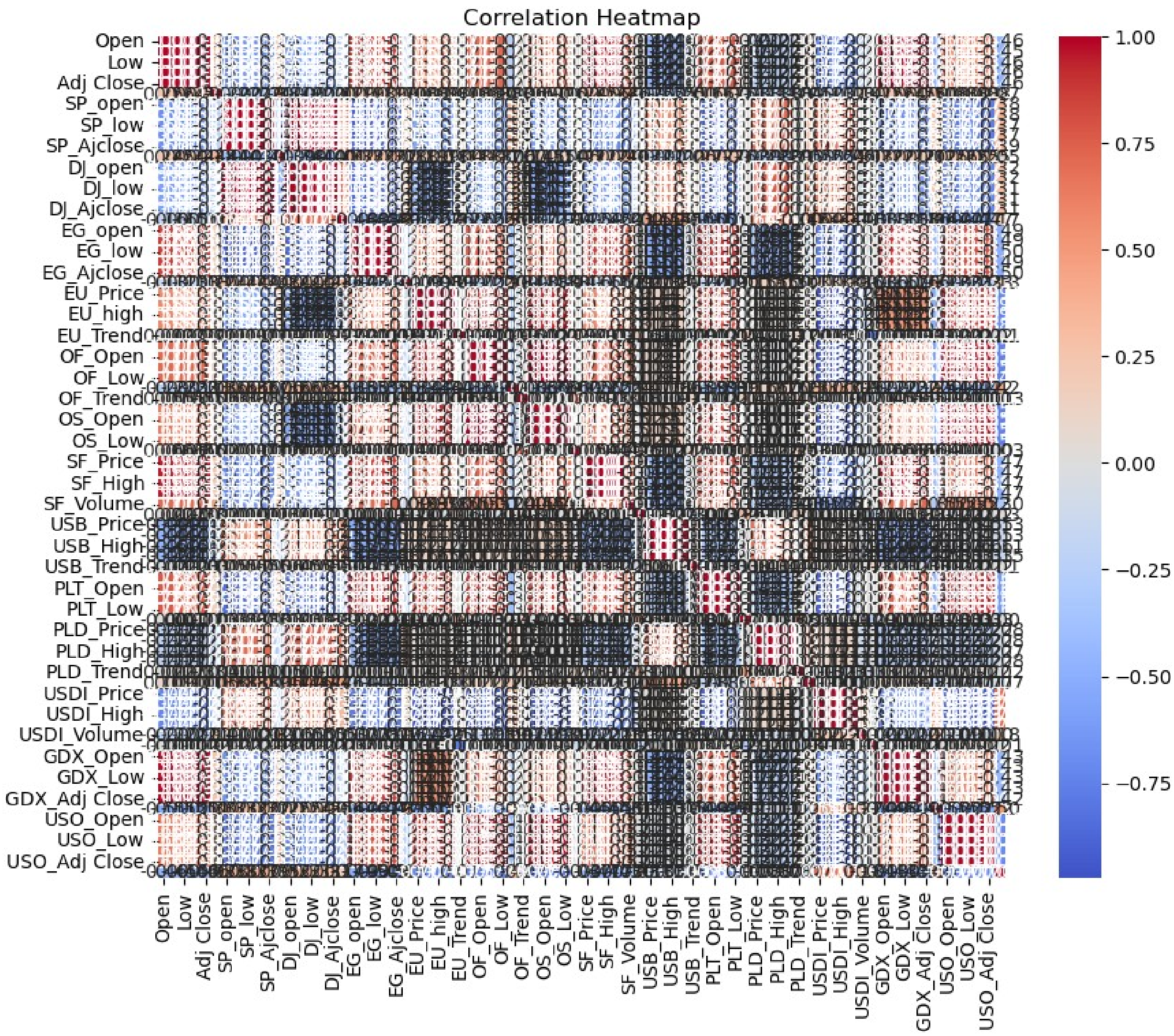
Correlation between the variales

```
# Select only the numeric columns for correlation calculation
numeric_columns = data.select_dtypes(include=[np.number])

# Calculate the correlation matrix
corr_matrix = numeric_columns.corr()
```

HeatMap

```
# Create a heatmap using seaborn
plt.figure(figsize=(10, 8))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt=".2f",
center=0)
plt.title('Correlation Heatmap')
plt.show()
```



Split the data into training and testing sets

```
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=0)
```

Define Preprocessing Step

```
# Scale features
scaler = StandardScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Apply PCA for dimensionality reduction
n_components = 30  # Choose an appropriate number of components
```

```
pca = PCA(n_components=n_components)
X_train_pca = pca.fit_transform(X_train_scaled)
X_test_pca = pca.transform(X_test_scaled)
```

Creating and Training Model

```
param_grid = {
    'n_estimators': [100, 200],
    'max_depth': [None, 10],
    'min_samples_split': [2, 5],
    'min_samples_leaf': [1, 2]
}

grid_search = GridSearchCV(RandomForestRegressor(random_state=0,
n_jobs=-1), param_grid, cv=5)
grid_search.fit(X_train_pca, y_train)
best_model = grid_search.best_estimator_
```

```
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146:
UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this
version of SciPy (detected version 1.23.5
  warnings.warn(f"A NumPy version >={np_minversion} and
<{np_maxversion}"
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146:
UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this
version of SciPy (detected version 1.23.5
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<{np_maxversion}"
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146:
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<{np_maxversion}"
/opt/conda/lib/python3.10/site-packages/scipy/__init__.py:146:
UserWarning: A NumPy version >=1.16.5 and <1.23.0 is required for this
version of SciPy (detected version 1.23.5
  warnings.warn(f"A NumPy version >={np_minversion} and
<{np_maxversion}"
```

Make predictions on the test data

```
y_pred = best_model.predict(X_test_pca)

# Calculate Mean Squared Error
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error: {mse}")
```

```
Mean Squared Error: 1.956613975836765
```

Plot the actual vs. predicted values

```
plt.figure(figsize=(10, 6))
plt.scatter(y_test.index, y_test, color='blue', label='Actual')
plt.scatter(y_test.index, y_pred, color='red', label='Predicted')
plt.xlabel('Index')
plt.ylabel('Gold Price')
plt.title('Gold Price Prediction')
plt.legend()
plt.show()
```