time_series1

January 4, 2024

[4]:

```
import pandas as pd
df = pd.read_csv('/Users/thutranghoa/Code/Data_analysis/Data/gold_price_data.
 ↪csv')
df.head(10)
```

[4]:

```
        Date          SPX        GLD        USO        SLV   EUR/USD
0   1/2/2008  1447.160034  84.860001  78.470001  15.180000  1.471692
1   1/3/2008  1447.160034  85.570000  78.370003  15.285000  1.474491
2   1/4/2008  1411.630005  85.129997  77.309998  15.167000  1.475492
3   1/7/2008  1416.180054  84.769997  75.500000  15.053000  1.468299
4   1/8/2008  1390.189941  86.779999  76.059998  15.590000  1.557099
5   1/9/2008  1409.130005  86.550003  75.250000  15.520000  1.466405
6  1/10/2008  1420.329956  88.250000  74.019997  16.061001  1.480100
7  1/11/2008  1401.020020  88.580002  73.089996  16.077000  1.479006
8  1/14/2008  1416.250000  89.540001  74.250000  16.280001  1.486900
9  1/15/2008  1380.949951  87.989998  72.779999  15.834000  1.480210
```

[5]:

```
df.info()
```

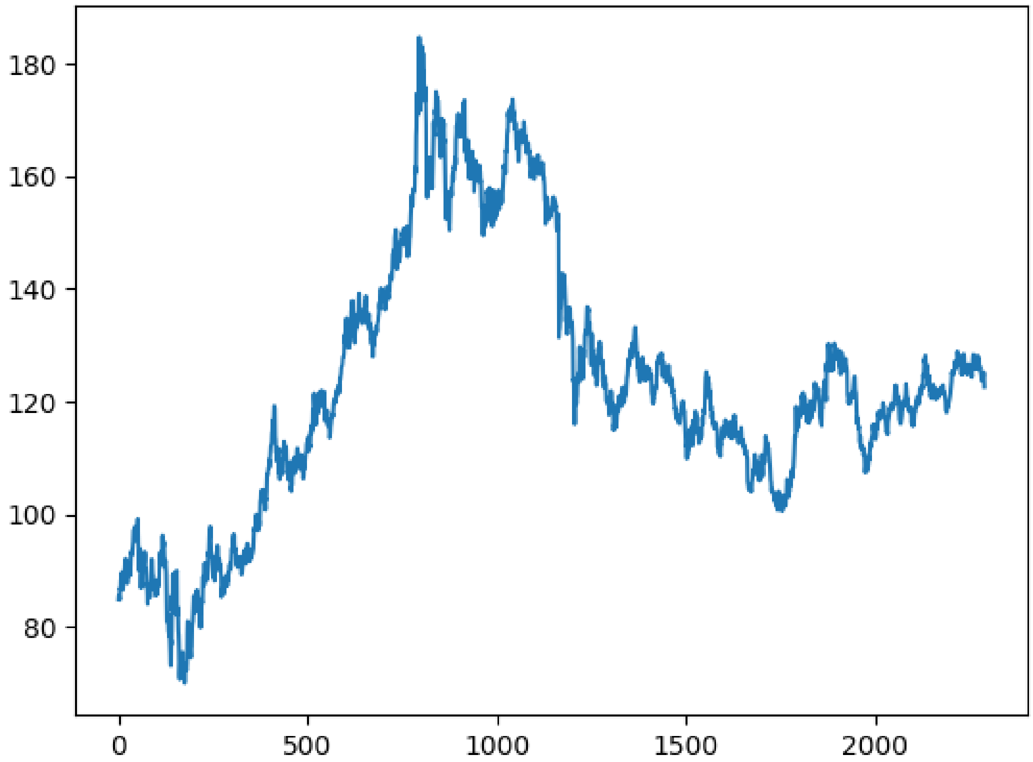
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2290 entries, 0 to 2289
Data columns (total 6 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   Date     2290 non-null   object
 1   SPX      2290 non-null   float64
 2   GLD      2290 non-null   float64
 3   USO      2290 non-null   float64
 4   SLV      2290 non-null   float64
 5   EUR/USD  2290 non-null   float64
dtypes: float64(5), object(1)
memory usage: 107.5+ KB
```

[6]:

```
df['GLD'].plot()
```

[6]:

```
<Axes: >
```



[7]:

```
X = df.drop(['Date', 'GLD'], axis= 1)
Y = df['GLD']
```

[8]:

```
X
```

[8]:

```
                SPX        USO      SLV   EUR/USD
0     1447.160034  78.470001  15.1800  1.471692
1     1447.160034  78.370003  15.2850  1.474491
2     1411.630005  77.309998  15.1670  1.475492
3     1416.180054  75.500000  15.0530  1.468299
4     1390.189941  76.059998  15.5900  1.557099
…             …          …        …         …
2285  2671.919922  14.060000  15.5100  1.186789
2286  2697.790039  14.370000  15.5300  1.184722
2287  2723.070068  14.410000  15.7400  1.191753
2288  2730.129883  14.380000  15.5600  1.193118
2289  2725.780029  14.405800  15.4542  1.182033

[2290 rows x 4 columns]
```

[9]:

```
from sklearn.model_selection import train_test_split
```

```
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.2,␣
 ↪random_state=44)
```

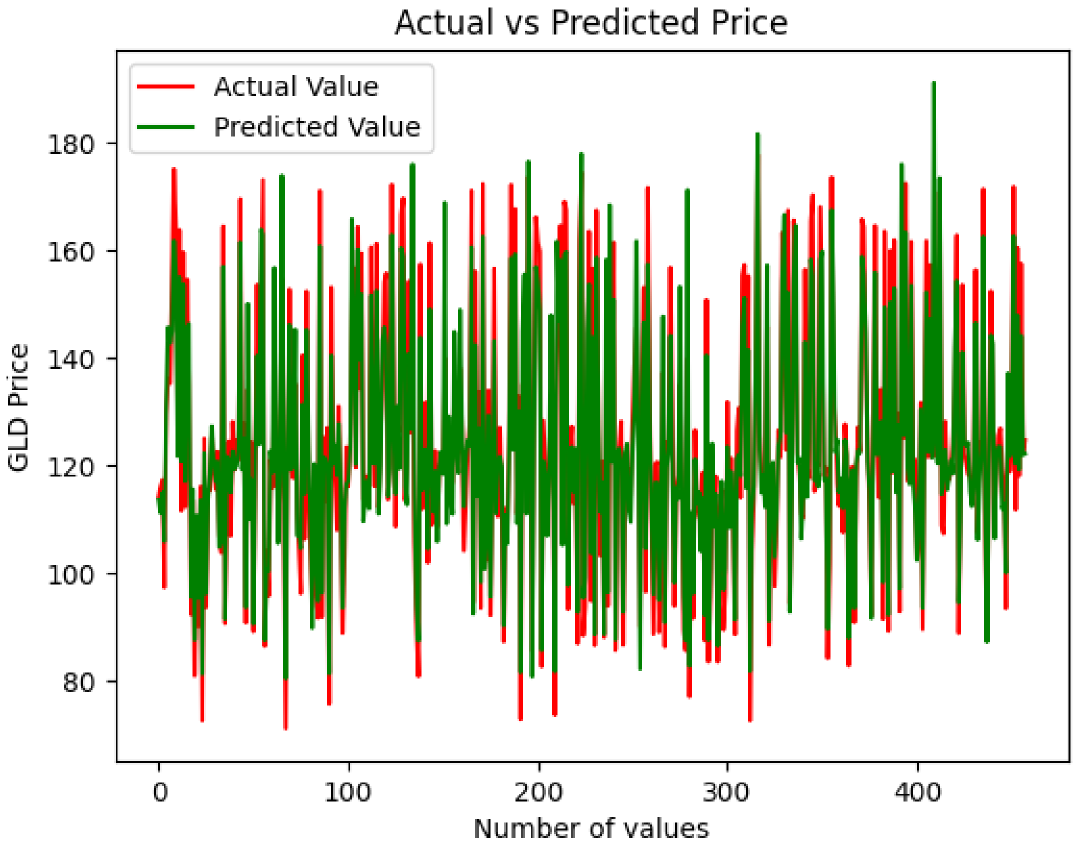
[10]:

```
'1 - Linear Regressor'

from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error , r2_score

LR = LinearRegression()
LR.fit(X_train, y_train)
predictions_LR = LR.predict(X_test)

print ('MSE of LinearRegression= ', mean_squared_error(y_test, predictions_LR))
print ('R2_score of Linear Regression= ', r2_score(y_test, predictions_LR))
```

```
MSE of LinearRegression=  60.085117843236624
R2_score of Linear Regression=  0.8914634840439626
```

[12]:

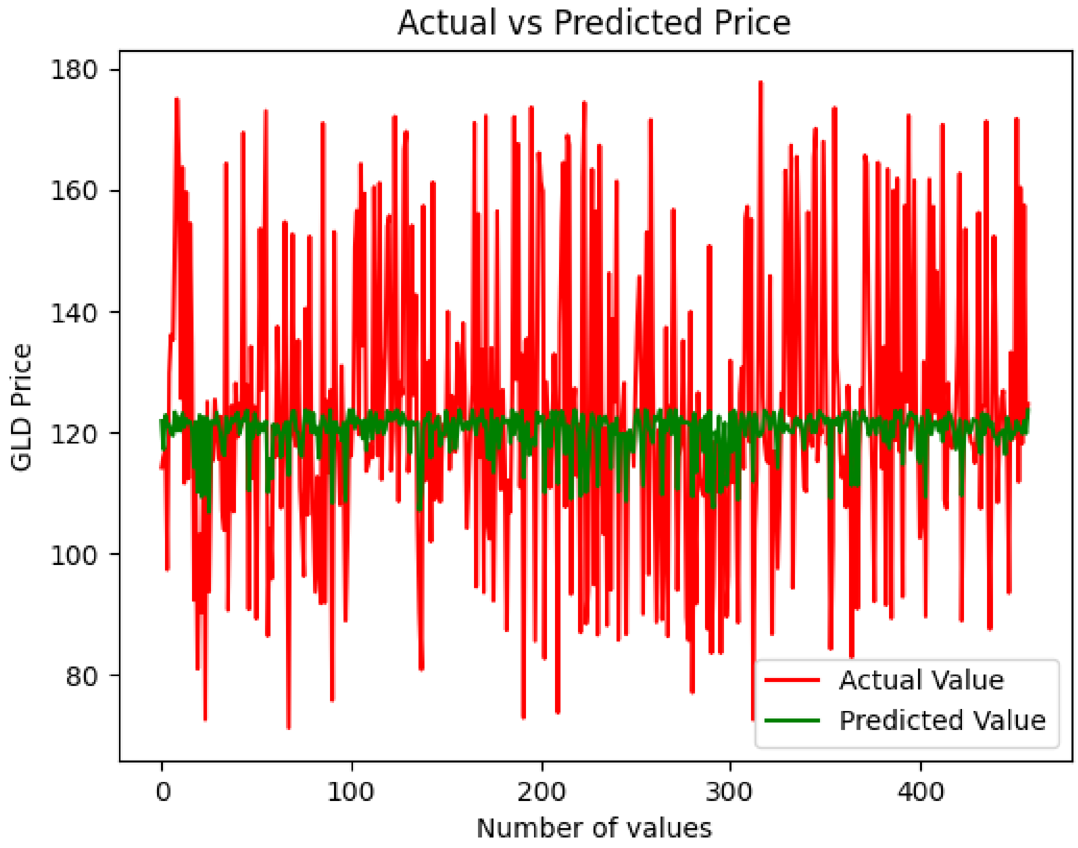
```
import matplotlib.pyplot as plt

y_test = list(y_test)

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(predictions_LR, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```



[14]:
```
'2 - SVM'
from sklearn.svm import SVR


svr = SVR(kernel = 'rbf')
svr.fit(X_train, y_train)
predictions_svr = svr.predict(X_test)

print ('MSE of SVM= ', mean_squared_error(y_test, predictions_svr))
print ('R2_score of SVM= ', r2_score(y_test, predictions_svr))
```

```
MSE of SVM=  491.1864116160978
R2_score of SVM=  0.11273101035017286
```

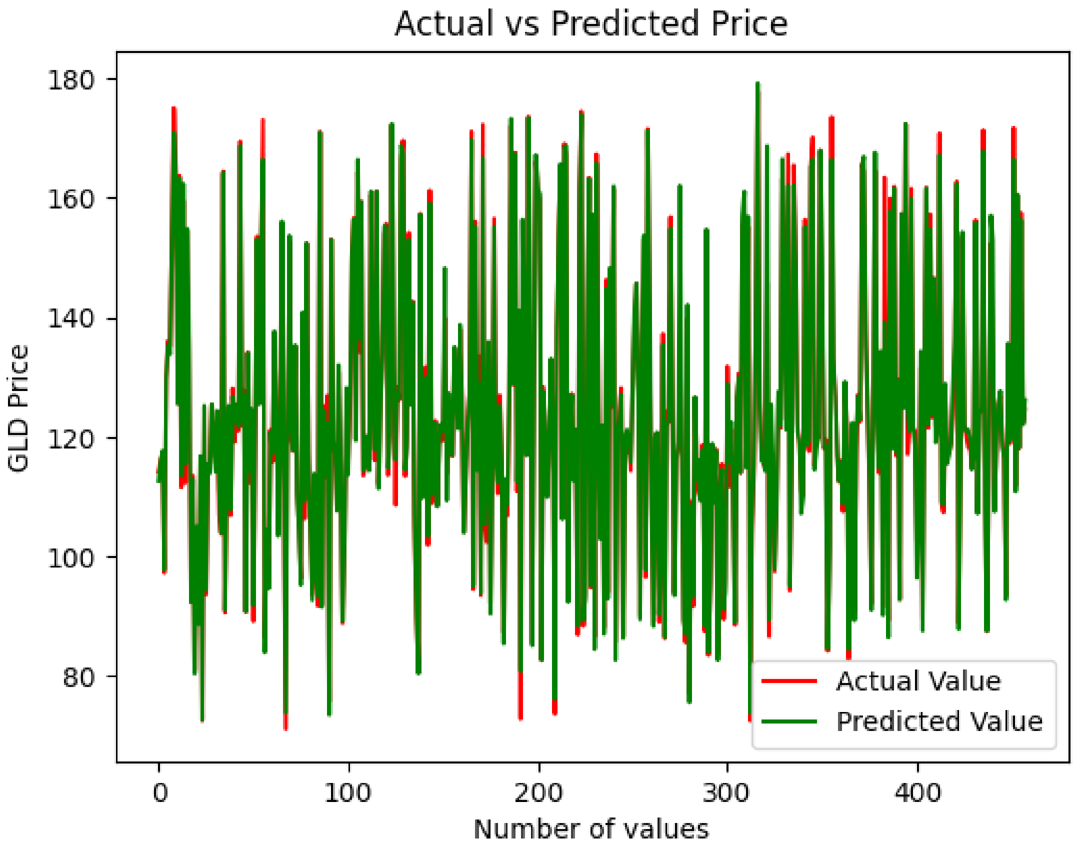
[15]:
```
plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(predictions_svr, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```



[19]:

```
'3 - Decision Tree'
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import mean_squared_error , r2_score

regr = DecisionTreeRegressor()

regr.fit(X_train, y_train)

pred_DT = regr.predict(X_test)

print ('MSE of DT= ', mean_squared_error(y_test, pred_DT))
print ('R2_score DecisionTree = ', r2_score(y_test, pred_DT))

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_DT, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

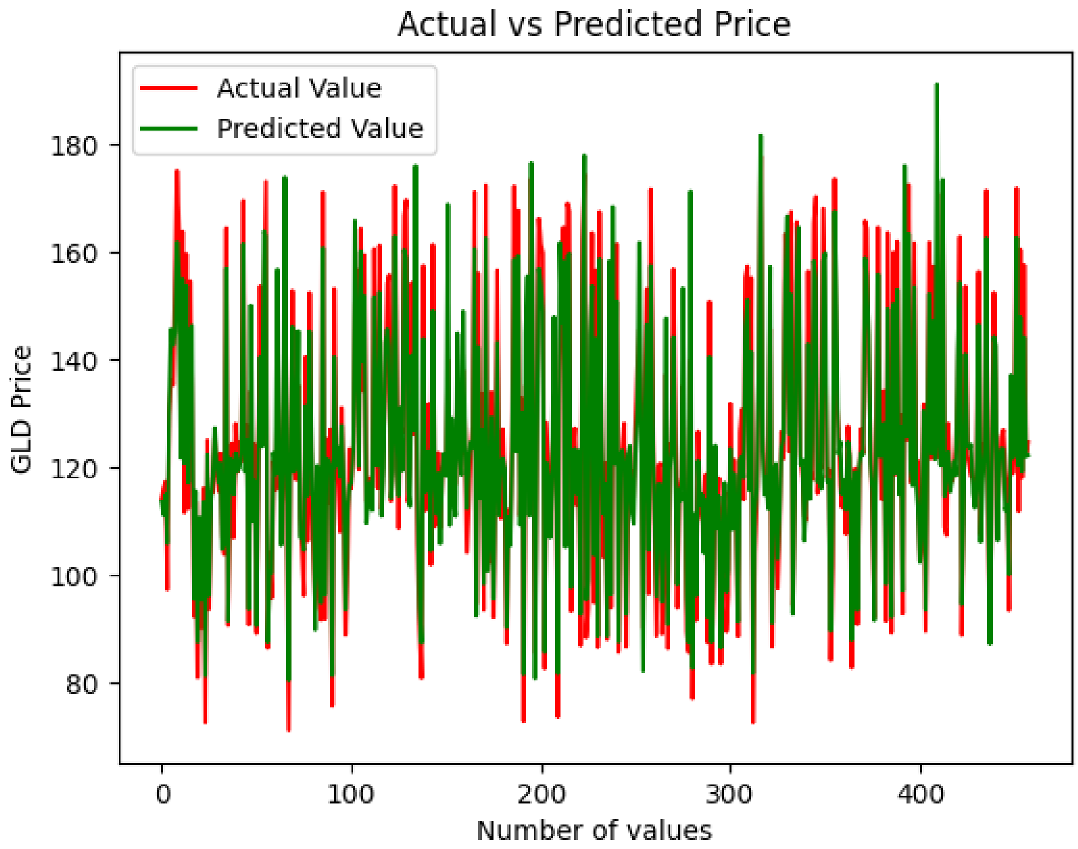
```
MSE of DT=  10.47317237876113
R2_score DecisionTree =  0.9810814777136084
```



[29]:
```
'4 - Gauss'
from sklearn.gaussian_process import GaussianProcessRegressor
from sklearn.metrics import mean_squared_error , r2_score
from sklearn.gaussian_process.kernels import RBF
import numpy as np

kernel = 1.0 * RBF(length_scale=1.0)

# Create a Gaussian Process Regressor with the defined kernel
gp = GaussianProcessRegressor(kernel=kernel, n_restarts_optimizer=10)

pred_Gauss= regr.predict(X_test)
```

```python
gp.fit(X_train, y_train)

print ('MSE of DT= ', mean_squared_error(y_test, pred_Gauss))
print ('R2_score DecisionTree = ', r2_score(y_test, pred_Gauss))

# Make predictions on the test data
plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_Gauss, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

```
MSE of DT=  60.08511784323661
R2_score DecisionTree =  0.8914634840439626
```

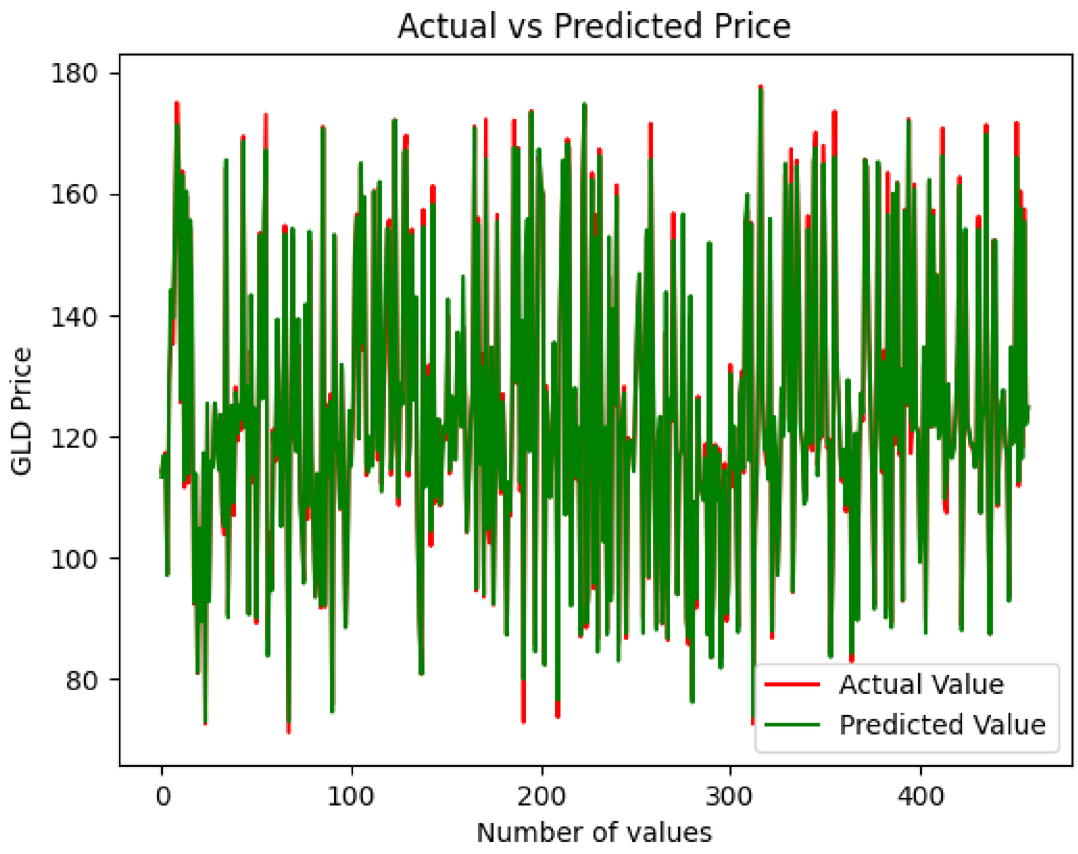


[20]:

```python
'5 - Random forest'
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error , r2_score
```

```
regr = RandomForestRegressor(n_estimators=100)

regr.fit(X_train, y_train)

pred_RF = regr.predict(X_test)

print ('MSE of RF = ', mean_squared_error(y_test, pred_RF))
print ('R2_score RF = ', r2_score(y_test, pred_RF))

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_RF, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

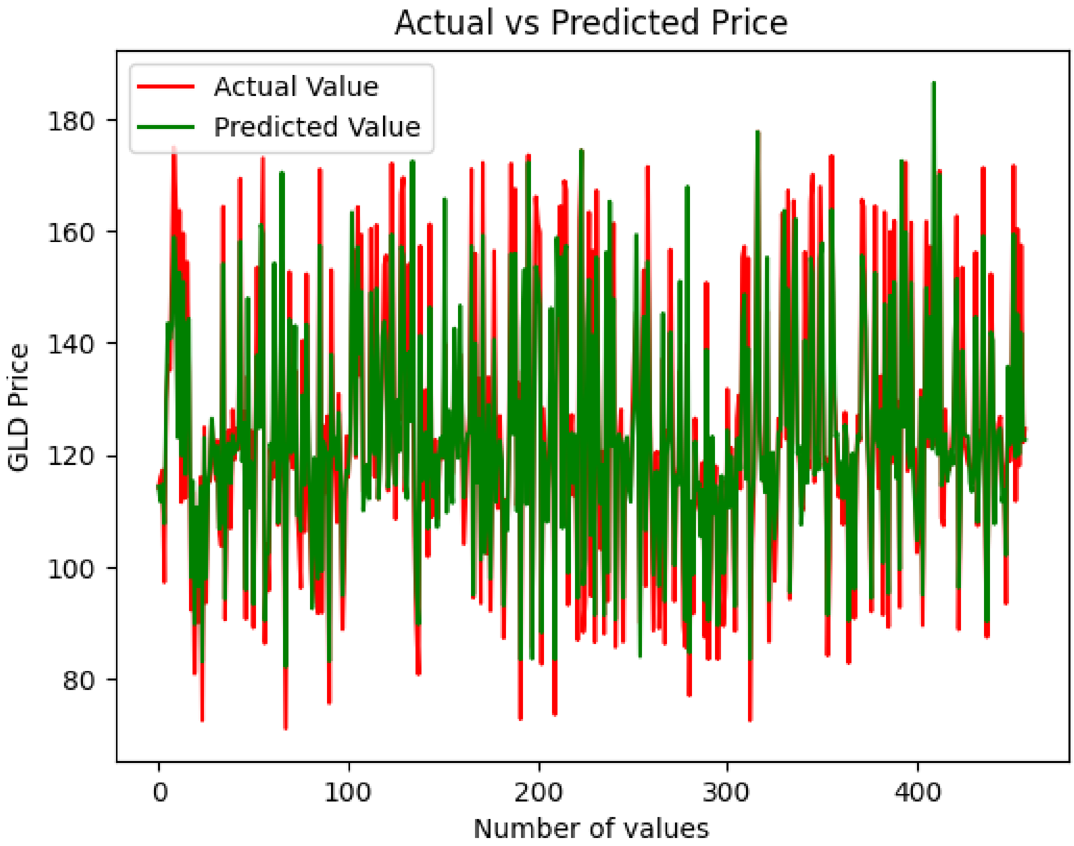
```
MSE of RF =  7.280161740612861
R2_score RF =  0.9868492661862773
```



[21]:

```
'6 - Lasso regression'
from sklearn.linear_model import  Lasso
from sklearn.metrics import mean_squared_error , r2_score


regr = Lasso(alpha = 10)

regr.fit(X_train, y_train)

pred_lasso = regr.predict(X_test)

print ('MSE of RF = ', mean_squared_error(y_test, pred_lasso))
print ('R2_score RF = ', r2_score(y_test, pred_lasso))

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_lasso, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

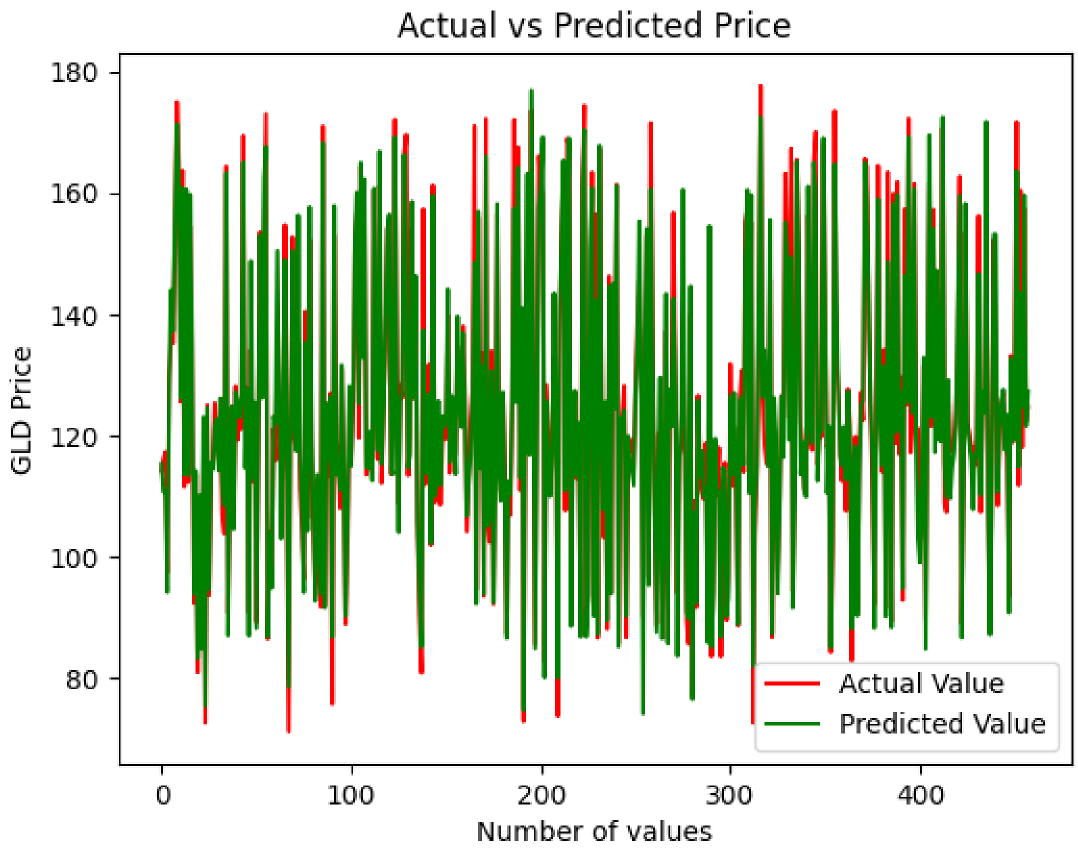
```
MSE of RF =  65.45341202772158
R2_score RF =  0.8817663082985273
```



[23]:

```
'6 - Lasso regression'
from sklearn.neighbors import KNeighborsRegressor
from sklearn.metrics import mean_squared_error , r2_score


regr = KNeighborsRegressor()

regr.fit(X_train, y_train)

pred_knn = regr.predict(X_test)

print ('MSE of KNN = ', mean_squared_error(y_test, pred_knn))
print ('R2_score KNN = ', r2_score(y_test, pred_knn))

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_knn, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

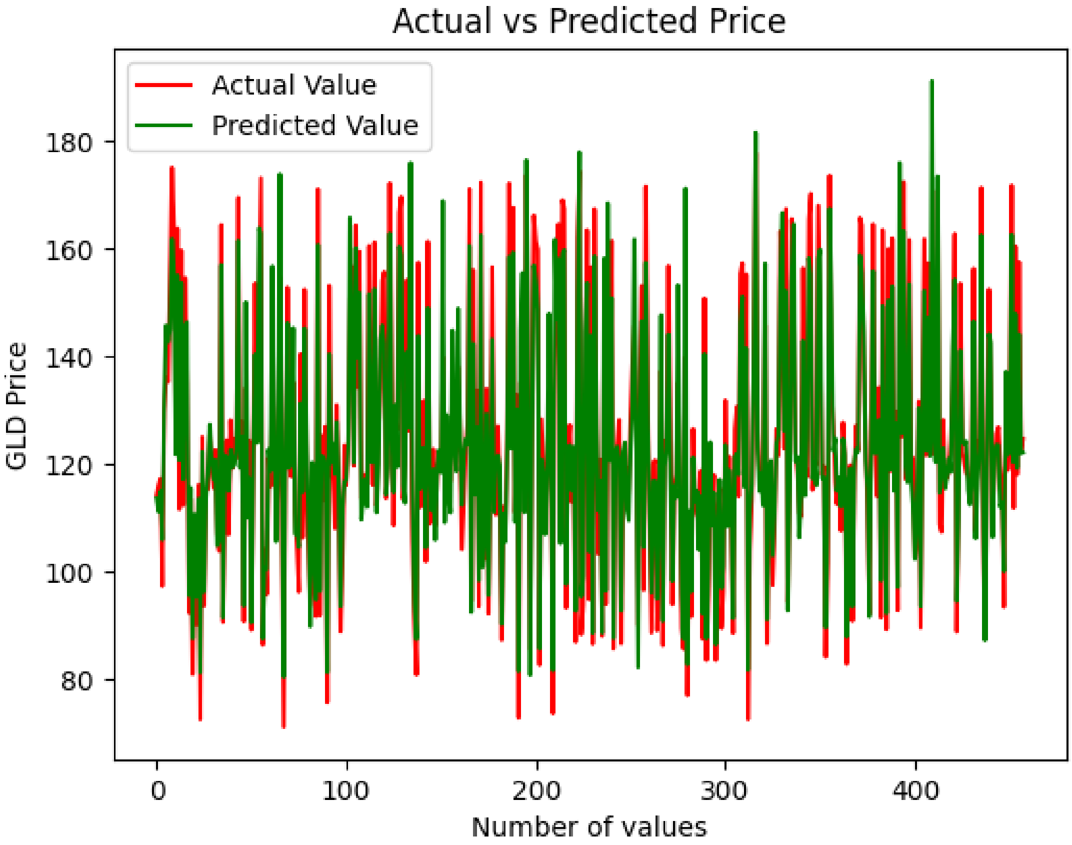
```
MSE of KNN =  30.1285796185479
R2_score KNN =  0.9455763560116017
```



[26]:

```
'8 - Ridge'
from sklearn.linear_model import Ridge
regr = Ridge(alpha=1e-15)

regr.fit(X_train, y_train)

pred_ridge = regr.predict(X_test)

print ('MSE of KNN = ', mean_squared_error(y_test, pred_ridge))
print ('R2_score KNN = ', r2_score(y_test, pred_ridge))

plt.plot(y_test, color='red', label = 'Actual Value')
plt.plot(pred_ridge, color='green', label='Predicted Value')
plt.title('Actual vs Predicted Price')
plt.xlabel('Number of values')
plt.ylabel('GLD Price')
plt.legend()
plt.show()
```

```
MSE of KNN =  60.08511784323661
R2_score KNN =  0.8914634840439626
```


Actual vs Predicted Price
Actual Value
Predicted Value
GLD Price
Number of values