Oil_Prediction

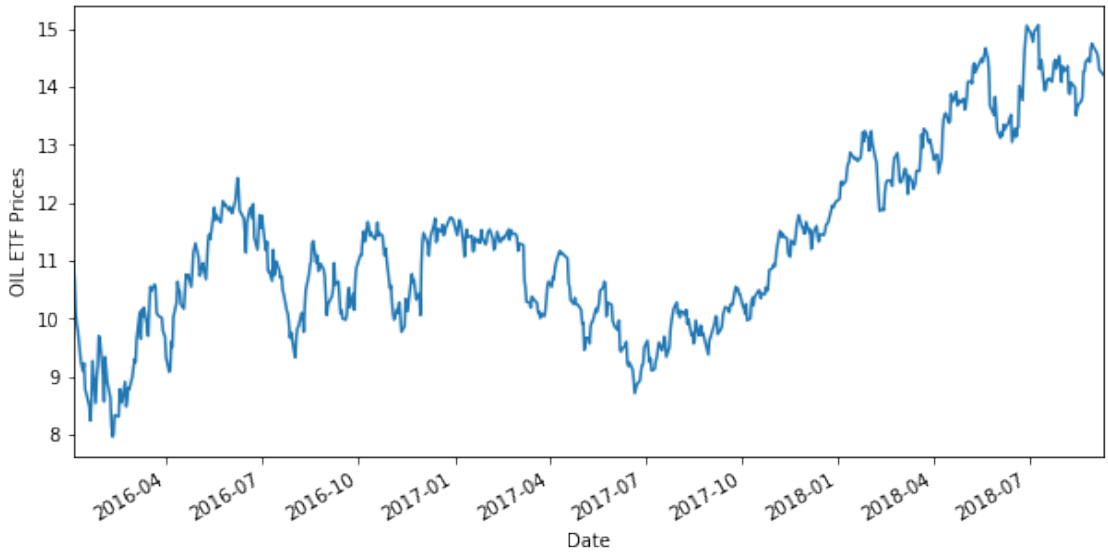
September 29, 2021

1 Oil Price Prediction Using Machine Learning

[1]:
```
# LinearRegression is a machine learning library for linear regression
from sklearn.linear_model import LinearRegression

# pandas and numpy are used for data manipulation
import pandas as pd
import numpy as np

# matplotlib and seaborn are used for plotting graphs
import matplotlib.pyplot as plt
import seaborn as sns

import warnings
warnings.filterwarnings("ignore")

# fix_yahoo_finance is used to fetch data
import yfinance as yf
yf.pdr_override()
```

[2]:
```
# Read data
Df = yf.download('USO','2016-01-01','2018-09-10')

# Only keep close columns
Df=Df[['Close']]

# Drop rows with missing values
Df= Df.dropna()

# Plot the closing price of GLD
Df.Close.plot(figsize=(10,5))
plt.ylabel("OIL ETF Prices")
plt.show()
```

```
[**********************100%**********************]  1 of 1 completed
```



[3]:
```
# Define explanatory variables
Df['S_3'] = Df['Close'].shift(1).rolling(window=3).mean()
Df['S_9']= Df['Close'].shift(1).rolling(window=9).mean()
Df= Df.dropna()
X = Df[['S_3','S_9']]
X.head()
```

[3]:
```
                 S_3       S_9
Date
2016-01-15  9.163333  9.798889
2016-01-19  9.036667  9.555555
2016-01-20  8.836666  9.314444
2016-01-21  8.506667  9.106667
2016-01-22  8.430000  8.957778
```

[4]:
```
# Define dependent variable
y = Df['Close']
y.head()
```

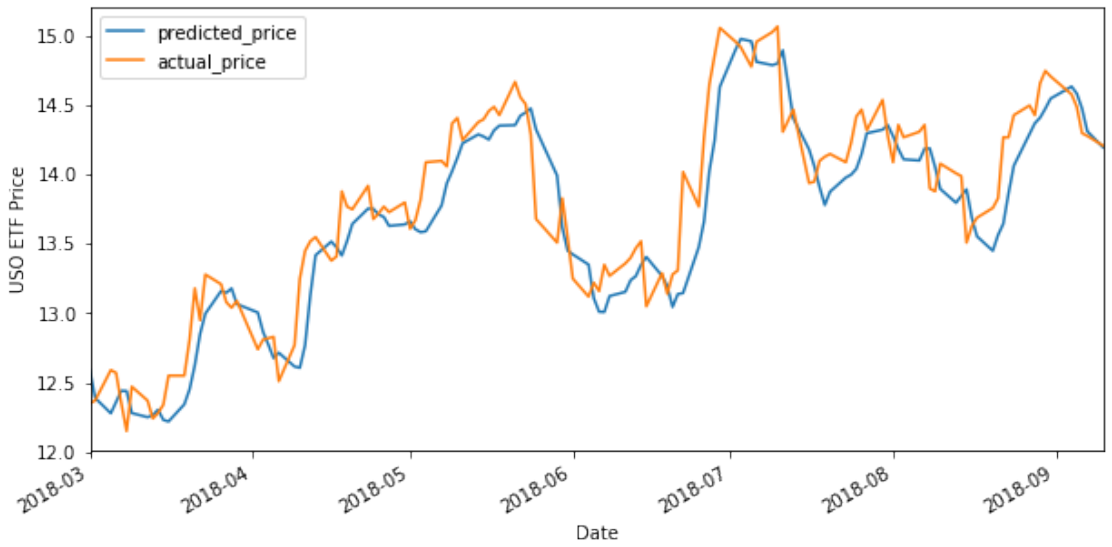
[4]:
```
Date
2016-01-15    8.79
2016-01-19    8.49
2016-01-20    8.24
2016-01-21    8.56
2016-01-22    9.27
Name: Close, dtype: float64
```

[5]:
```
# Split the data into train and test dataset
t=.8
t = int(t*len(Df))

# Train dataset
X_train = X[:t]
y_train = y[:t]

# Test dataset
X_test = X[t:]
y_test = y[t:]
```

[6]:
```
# Create a linear regression model
# Y = m1 * X1 + m2 * X2 + C
# Gold ETF price = m1 * 3 days moving average + m2 * 15 days moving average + c
linear = LinearRegression().fit(X_train,y_train)
print("MJ ETF Price =", round(linear.coef_[0],2), "* 3 Days Moving Average",␣
 ↪round(linear.coef_[1],2), "* 9 Days Moving Average +", round(linear.
 ↪intercept_,2))
```

```
MJ ETF Price = 1.19 * 3 Days Moving Average -0.23 * 9 Days Moving Average + 0.38
```

[7]:
```
# Predicting the Oil ETF prices
predicted_price = linear.predict(X_test)
predicted_price = pd.DataFrame(predicted_price,index=y_test.index,columns =␣
 ↪['price'])
predicted_price.plot(figsize=(10,5))
y_test.plot()
plt.legend(['predicted_price','actual_price'])
plt.ylabel("USO ETF Price")
plt.show()
```



[8]:
```
r2_score = linear.score(X[t:],y[t:])*100
float("{0:.2f}".format(r2_score))
```

[8]:
```
85.81
```

Oil Stock

[9]:
```
Oil_stock = ['PBR', 'VALE', 'RIG', 'WLL']
```

[10]:
```
start = '2016-01-01'
end = '2018-09-10'
df = yf.download(Oil_stock,start,end)
```

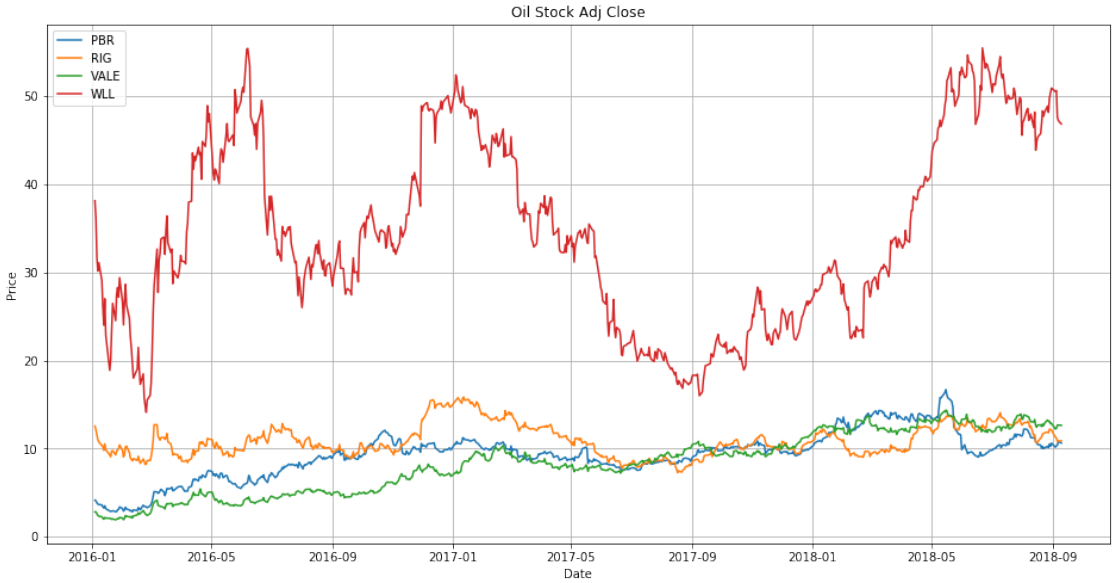
```
[**********************100%**********************]  4 of 4 completed
```

[11]:
```
stocks = pd.DataFrame(df['Adj Close'])
stocks.head()
```

[11]:

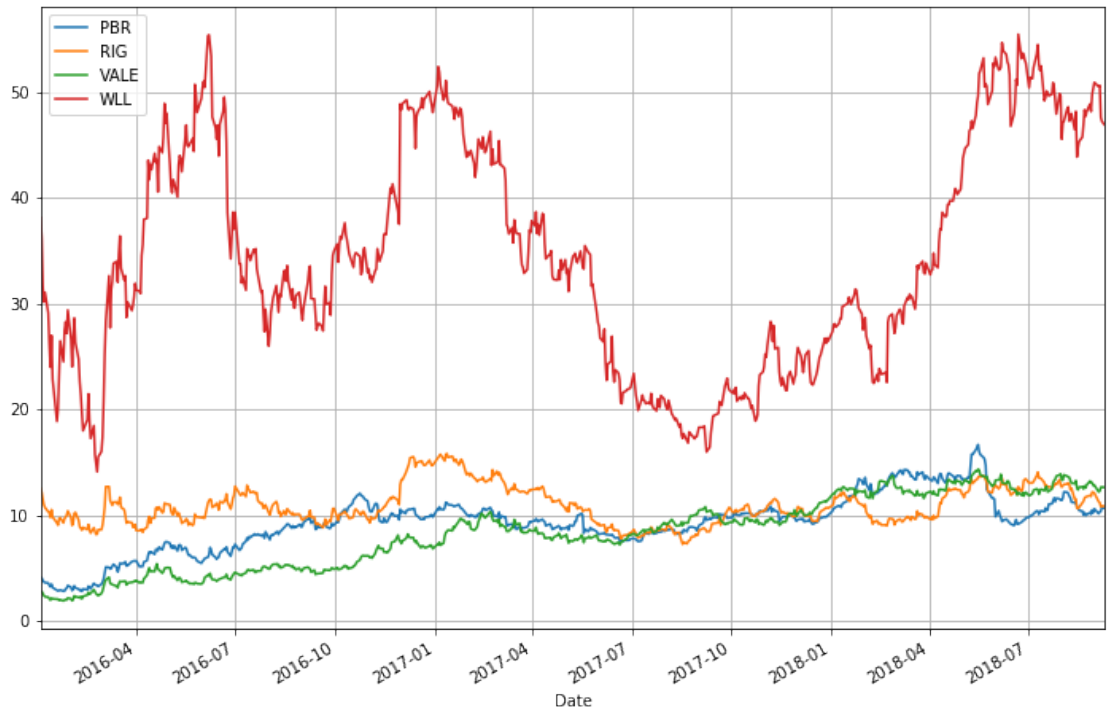
Date	PBR	RIG	VALE	WLL
2016-01-04	4.146681	12.55	2.823366	38.119999
2016-01-05	4.068809	12.15	2.814432	36.160000
2016-01-06	3.844927	11.52	2.599999	31.639999
2016-01-07	3.708651	11.00	2.421305	30.160000
2016-01-08	3.650247	10.75	2.323023	31.080000

[12]:
```
plt.figure(figsize=(16,8))
plt.plot(stocks)
plt.title('Oil Stock Adj Close')
plt.legend(stocks)
plt.grid()
plt.ylabel('Price')
plt.xlabel('Date')
plt.show()
```



[13]:
```
stocks.plot(grid = True, figsize=(12,8))
```

[13]: <matplotlib.axes._subplots.AxesSubplot at 0x26f1cbb5080>



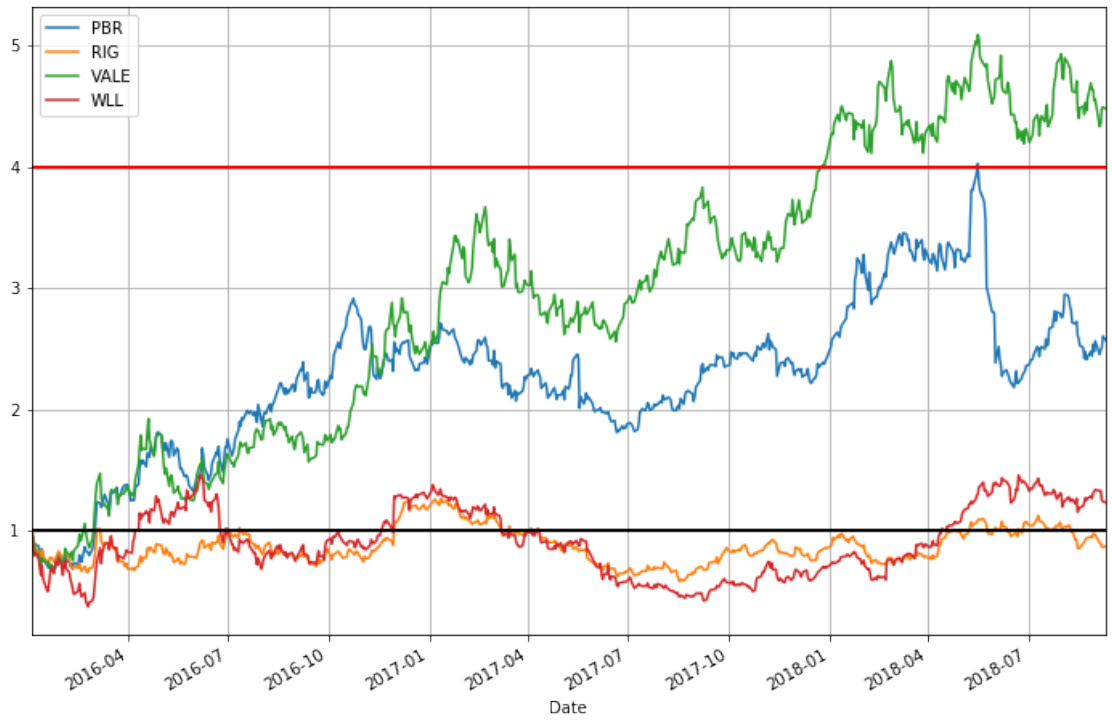
[14]:
```
stock_return = stocks.apply(lambda x: x / x[0])
stock_return.head()
```

[14]:

Date	PBR	RIG	VALE	WLL
2016-01-04	1.000000	1.000000	1.000000	1.000000
2016-01-05	0.981221	0.968127	0.996836	0.948583
2016-01-06	0.927230	0.917928	0.920886	0.830011
2016-01-07	0.894366	0.876494	0.857595	0.791186
2016-01-08	0.880282	0.856574	0.822785	0.815320

[15]:
```
stock_return.plot(grid = True, figsize=(12,8)).axhline(y = 1, color = "black",␣
↪lw = 2)
plt.axhline(y=4, color = 'red', lw=2)
```

[15]:
```
<matplotlib.lines.Line2D at 0x26f1a7549e8>
```



[16]:
```
stock_return = stocks.pct_change(1).dropna()
stock_return.head()
```

[16]:

Date	PBR	RIG	VALE	WLL
2016-01-05	-0.018779	-0.031873	-0.003164	-0.051417

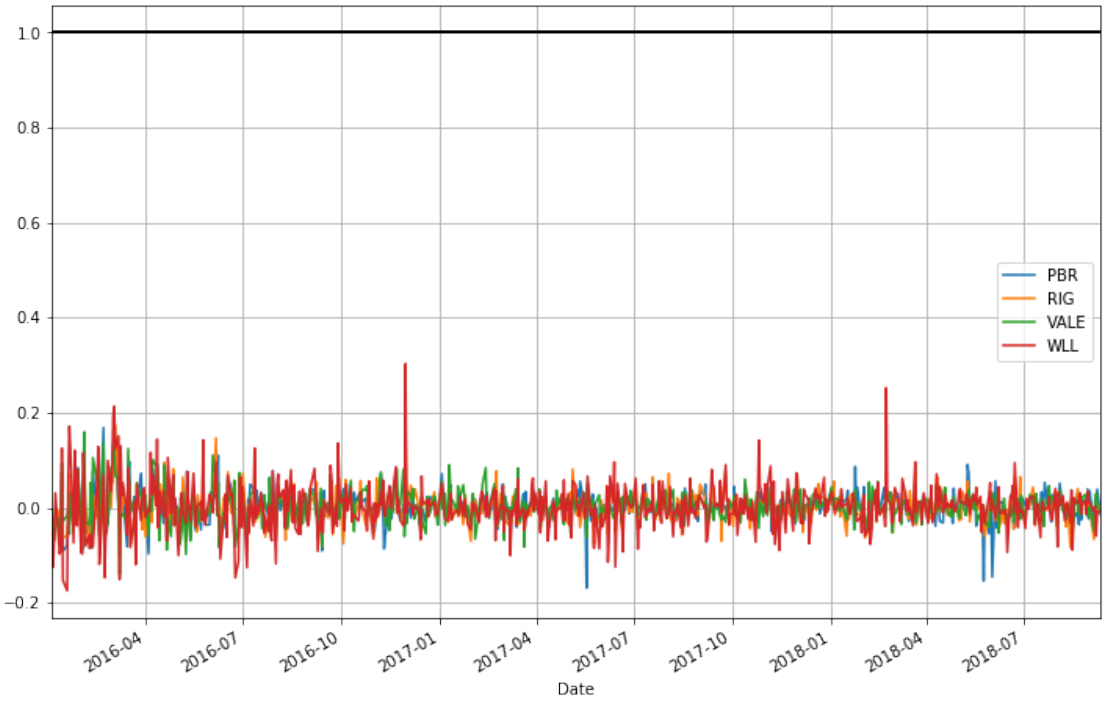
```
2016-01-06 -0.055024 -0.051852 -0.076191 -0.125000
2016-01-07 -0.035443 -0.045139 -0.068728 -0.046776
2016-01-08 -0.015748 -0.022727 -0.040591  0.030504
2016-01-11 -0.010667 -0.038140 -0.023077 -0.063063
```

[17]:
```
stock_return.tail()
```

[17]:
```
                 PBR       RIG      VALE       WLL
Date
2018-09-04 -0.043238 -0.066887 -0.049242 -0.007857
2018-09-05  0.015385 -0.008850  0.005578  0.002376
2018-09-06  0.006629 -0.033036  0.029319 -0.059648
2018-09-07  0.038570  0.001847  0.001540 -0.008192
2018-09-10 -0.014493  0.002765 -0.003075 -0.008047
```

[18]:
```
stock_return.plot(grid = True, figsize=(12,8)).axhline(y = 1, color = "black",␣
↪lw = 2)
```

[18]:
```
<matplotlib.lines.Line2D at 0x26f1c850be0>
```



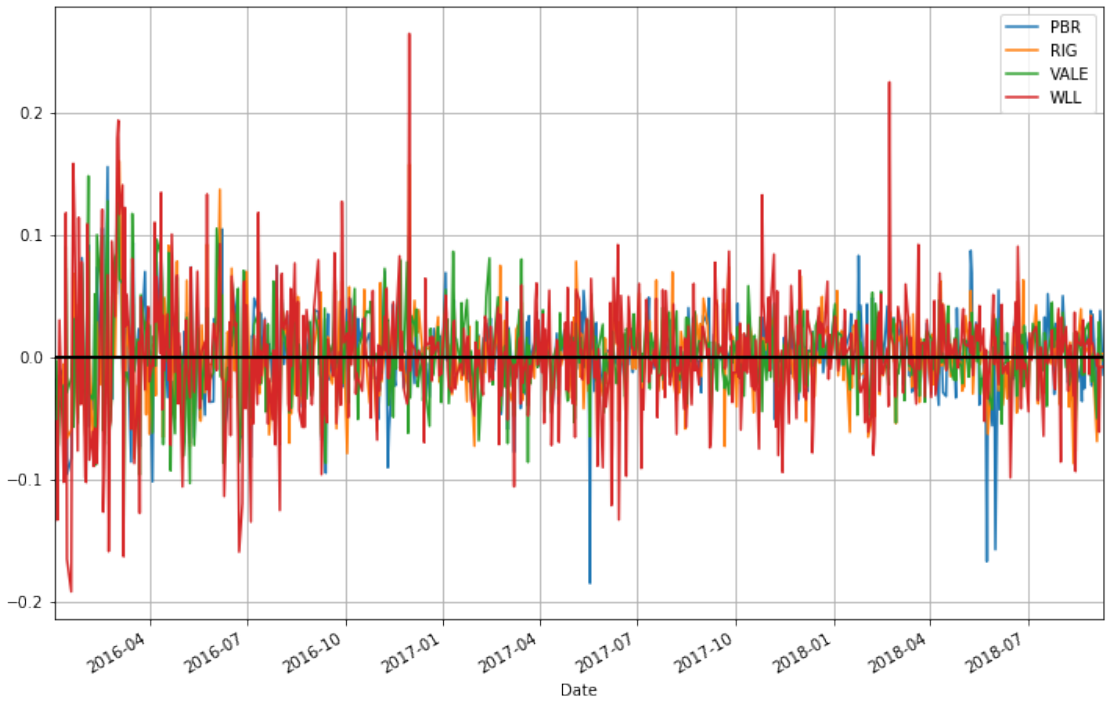
[19]:
```
stock_change = stocks.apply(lambda x: np.log(x) - np.log(x.shift(1))) # shift␣
↪moves dates back by 1.
stock_change.head()
```

[19]:

Date	PBR	RIG	VALE	WLL
2016-01-04	NaN	NaN	NaN	NaN
2016-01-05	-0.018958	-0.032392	-0.003170	-0.052786
2016-01-06	-0.056596	-0.053244	-0.079249	-0.133531
2016-01-07	-0.036086	-0.046189	-0.071204	-0.047906
2016-01-08	-0.015873	-0.022990	-0.041437	0.030048

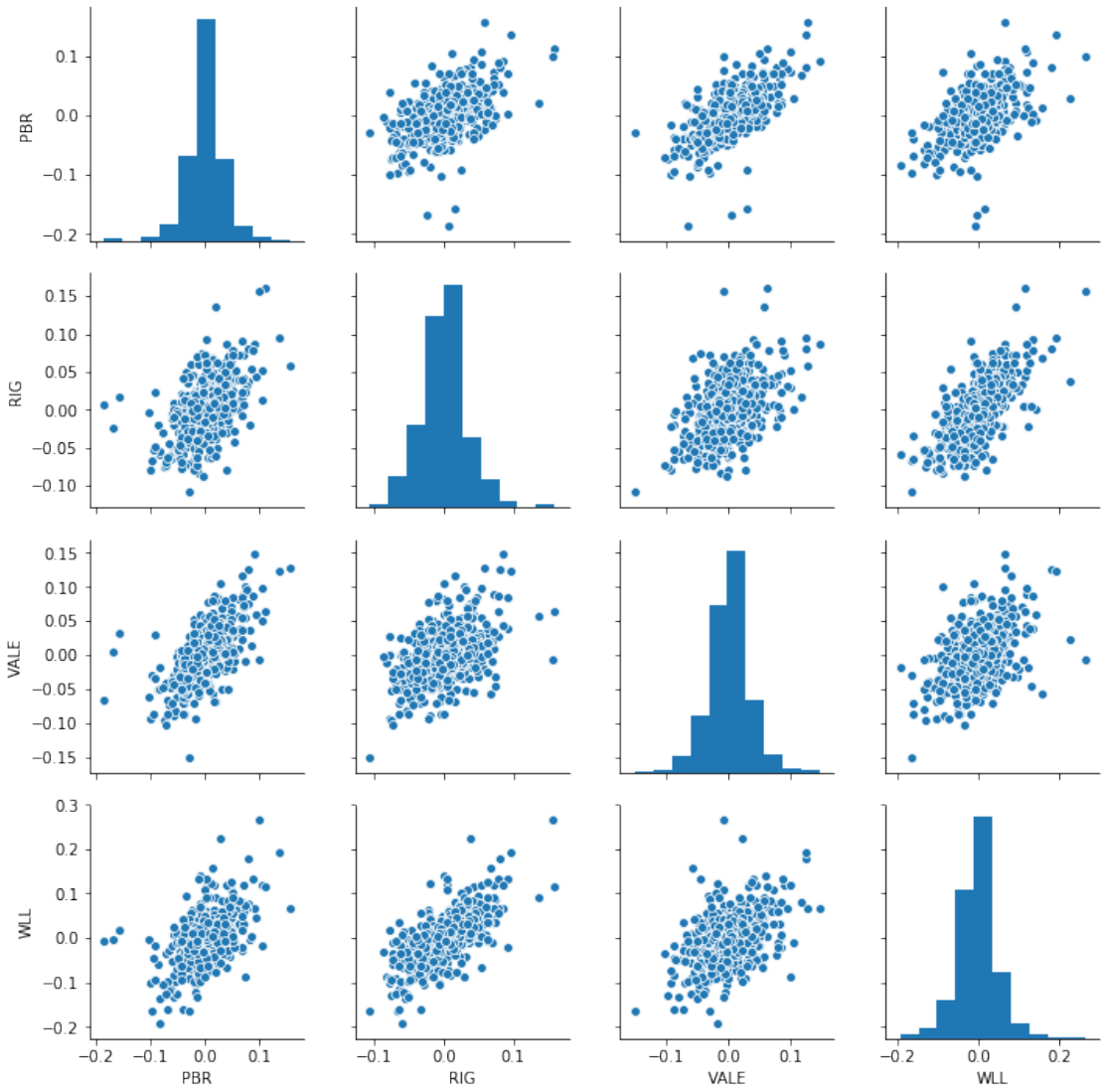
[20]:
```
stock_change.plot(grid = True, figsize=(12,8)).axhline(y = 0, color = "black",␣
↪lw = 2)
```

[20]: <matplotlib.lines.Line2D at 0x26f1cc25e10>



[21]:
```
sns.pairplot(stock_change[1:])
```

[21]: <seaborn.axisgrid.PairGrid at 0x26f1cbbdc88>



[22]:
```
stock_change.idxmin()
```

[22]:
```
PBR     2017-05-18
RIG     2016-03-08
VALE    2016-03-08
WLL     2016-01-19
dtype: datetime64[ns]
```

[23]:
```
stock_change.idxmax()
```

[23]:
```
PBR     2016-02-22
RIG     2016-03-04
VALE    2016-02-04
```

```
WLL    2016-11-30
dtype: datetime64[ns]
```

[24]:
```
stock_change.std()
```

[24]:
```
PBR     0.034028
RIG     0.032970
VALE    0.034200
WLL     0.049428
dtype: float64
```

[25]:
```
# Sharpe Ratio for Each Stocks
N = 252
returns = stocks.pct_change().dropna()
annualised_sharpe = np.sqrt(N) * returns.mean() / returns.std()
annualised_sharpe
```

[25]:
```
PBR     0.920861
RIG     0.159567
VALE    1.294250
WLL     0.486751
dtype: float64
```

[26]:
```
annualised_sharpe.index
```

[26]:
```
Index(['PBR', 'RIG', 'VALE', 'WLL'], dtype='object')
```

[27]:
```
annualised_sharpe.sort_values()
```

[27]:
```
RIG     0.159567
WLL     0.486751
PBR     0.920861
VALE    1.294250
dtype: float64
```

[28]:
```
annualised_sharpe.sort_index()
```

[28]:
```
PBR     0.920861
RIG     0.159567
VALE    1.294250
WLL     0.486751
dtype: float64
```

[29]:
```
# Equity Sharpe - Buy and Hold
N = 252 # Number of trading in a year
risk = 0.01
excess_daily_ret =  returns - (risk * N)
```

```
equity_sharpe = np.sqrt(N) * excess_daily_ret.mean() / excess_daily_ret.std()
equity_sharpe.sort_values()
```

[29]:
```
RIG    -1203.909380
PBR    -1176.186770
VALE   -1161.077579
WLL     -800.577259
dtype: float64
```

[30]:
```
# Market Neutral Sharpe
start = '2016-01-01'
end = '2018-09-10'
market = 'SPY'
ticker = ['PBR', 'VALE', 'RIG', 'WLL']
bench = yf.download(market,start,end)
stocks = yf.download(ticker,start,end)
```

```
[**********************100%**********************]  1 of 1 completed
[**********************100%**********************]  4 of 4 completed
```

[31]:
```
tick = pd.DataFrame(stocks['Adj Close'])
tick.head()
```

[31]:

Date	PBR	RIG	VALE	WLL
2016-01-04	4.146681	12.55	2.823366	38.119999
2016-01-05	4.068809	12.15	2.814432	36.160000
2016-01-06	3.844927	11.52	2.599999	31.639999
2016-01-07	3.708651	11.00	2.421305	30.160000
2016-01-08	3.650247	10.75	2.323023	31.080000

[32]:
```
daily_rets = tick.pct_change().dropna()
daily_rets.head()
```

[32]:

Date	PBR	RIG	VALE	WLL
2016-01-05	-0.018779	-0.031873	-0.003164	-0.051417
2016-01-06	-0.055024	-0.051852	-0.076191	-0.125000
2016-01-07	-0.035443	-0.045139	-0.068728	-0.046776
2016-01-08	-0.015748	-0.022727	-0.040591	0.030504
2016-01-11	-0.010667	-0.038140	-0.023077	-0.063063

[33]:
```
bench_rets = bench['Adj Close'].pct_change().dropna()
bench_rets.head()
```

[33]:
```
Date
2016-01-05    0.001691
```

```
2016-01-06   -0.012614
2016-01-07   -0.023992
2016-01-08   -0.010976
2016-01-11    0.000990
Name: Adj Close, dtype: float64
```

[34]:
```
strat = (daily_rets.sub(bench_rets, axis=0))/2
strat.head()
```

[34]:
```
                PBR       RIG      VALE       WLL
Date
2016-01-05 -0.010235 -0.016782 -0.002428 -0.026554
2016-01-06 -0.021205 -0.019619 -0.031788 -0.056193
2016-01-07 -0.005726 -0.010574 -0.022368 -0.011392
2016-01-08 -0.002386 -0.005875 -0.014807  0.020740
2016-01-11 -0.005828 -0.019565 -0.012033 -0.032026
```

[35]:
```
N = 252
market_neutral_sharpe = np.sqrt(N) * strat.mean() / strat.std()
market_neutral_sharpe.sort_values()
```

[35]:
```
RIG    -0.151505
WLL     0.298990
PBR     0.674417
VALE    1.084921
dtype: float64
```