Technical Report of BP PLC

1. Technical Analysis of Stock Market

BP PLC is listed on the London Stock Exchange on 29 March 1954 with a market capitalization of £94,148m (London Stock Exchange website). With 110 years of experience in the energy sector, BP PLC operates in hydrocarbon energy, and Gas and low carbon energy. Specifically, the company strategy focuses on getting net zero and caring for the planet, BP business is divided into three main sectors including gas and low carbon energy, oil production and operations, and customers and products (BP website).

Main competitor of BP PLC on London Stock Exchange market is SHELL. SHELL is issued on the London Stock Exchange Market on 20 July 2005 with a market capitalization of £166,561m (London Stock Exchange website). Same as BP PLC, SHELL also aims at achieving net zero emissions and protecting nature. Their business is divided into three main sectors which are upstream (crude oil, natural gas and natural gas liquids), Integrated Gas and Renewables and Energy Solutions, and downstream (conventional fuels for road, aviation and shipping, low-carbon fuels) (SHELL website).

The author applied the theory of Sharda in 2017 about the Descriptive Statistics for Descriptive Analytics in this part while analyzing results.

1.1. Descriptive Analysis

1.1.1. Statistics analysis

	BP		**SHELL**		**FTSE**	
	Adj Close	**Return**	**Adj Close**	**Return**	**Adj Close**	**Return**
count	469	468	469	468	469	468
mean	271.237	0.0005	34.993	0.0009	6591.872	0.0003
std	38.333	0.0302	6.376	0.0324	569.512	0.0143
min	171.186	-0.1948	19.443	-0.1717	4993.899	-0.1087

25%	249.370	-0.0151	29.823	-0.0136	6090.000	-0.0048
50%	273.861	-0.0003	36.199	0.0006	6675.500	0.0007
75%	291.632	0.0150	38.915	0.0146	7086.399	0.0070
max	375.173	0.2158	49.291	0.1967	7589.700	0.0905
Return to risk	0.01947		0.02962		0.02607	

Table 1. Statistics analysis result

As can be seen from the statistics results, BP PLC has a lower mean (by 0.0004) and standard deviation (by 0.0022) than SHELL return, which means that investors investing money in BP stock can have lower risk but also lower returns.

If investors are willing to take risks, they can get 1.9% of return potential from BP stock compared to 2.9% from SHELL stock.

Therefore, if investors care more about the long-term investment, they should take BP stock because it is more stable and safer. On the other hand, if investors want to use the Scalping trading method and make a fast profit off reselling, SHELL stock is better.

1.1.2. Descriptive Analysis of Stock Prices

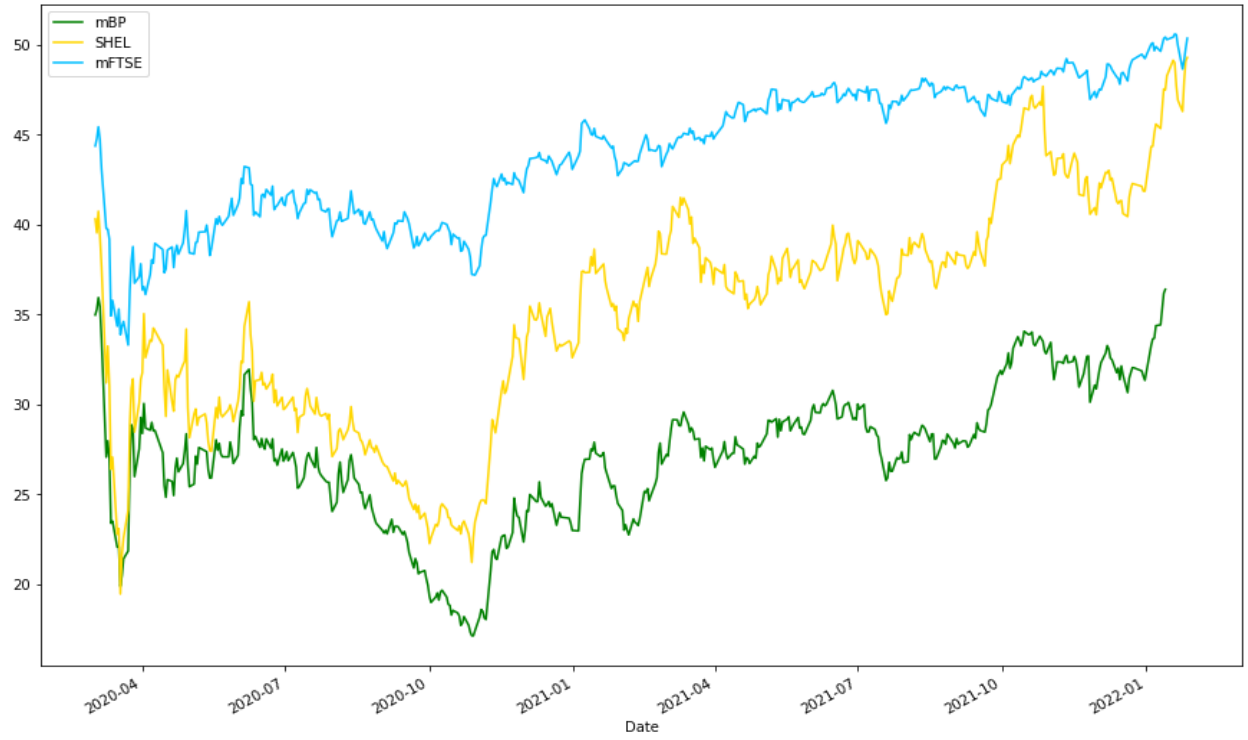

Figure 1. Daily price of BP, SHELL and FTSE stock

The line chart demonstrates the adjusted closing price of BP PLC (BP), SHELL (SHEL) and FTSE 100 (FTSE), in which the FTSE 100 (mFTSE) and BP PLC (mBP) adjusted closing price are modified because the author only compared the trend of the stocks price not the value of the stocks price. Therefore, the mFTSE and mBP is used to shorten the differences.

The stocks price of the market and the oil industry witnessed the deepest drop in April 2020 and another drop in November 2020. This can be explained by the event when the oil price went to negative values for the first time on April 20, 2020, due to oversupply of crude oil and disagreements among OPEC and other countries (Engebretsen, 2020). The price in this period also response to fears about the rapid spread of COVID-19 in 2020 (Baur, 2020).

After that, the stock price of BP, SHELL and FTSE 100 began to recover with an overall uptrend.

1.1.3. Descriptive Analysis of Stock Returns

Comparison of DLG, ADM, and FTSE100 returns

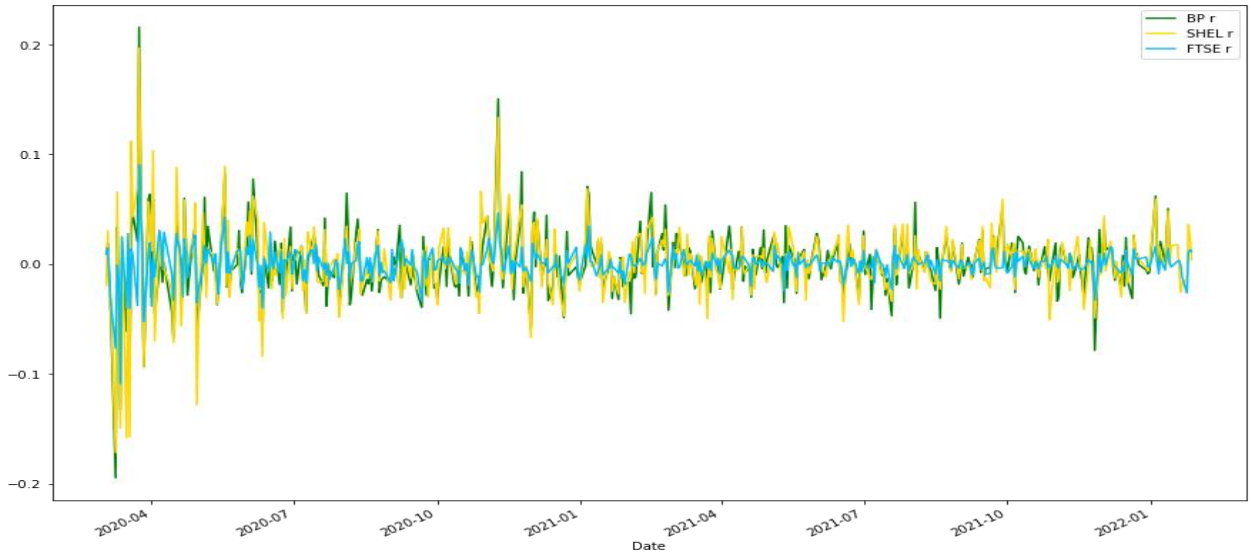

Figure 2. Daily return of BP, SHELL and FTSE stock

The graph indicates the change in the return of BP, SHELL and FTSE stocks every day. The first quarter of 2020 witnessed the highest volatility where the return range of BP can differ from –20% to 20%. This means that investors can either lose 20% or gain 20% at that point. Compared to the FTSE stock (the market), BP and SHELL stocks (the industry) appeared to be more variable, which also fits with the standard deviation result.

Empirical Rules

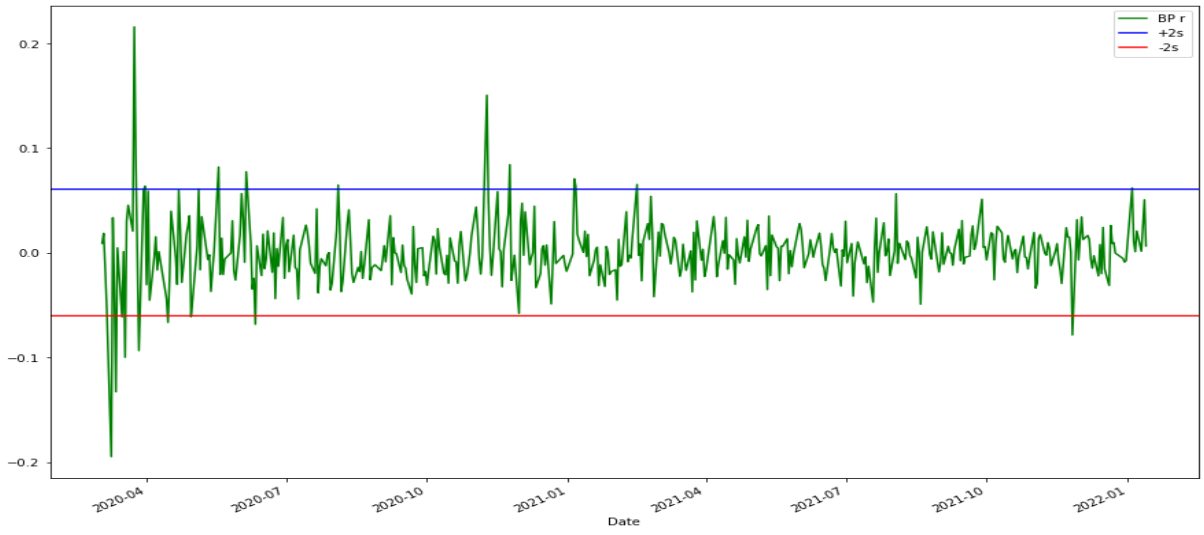

Figure 3. Empirical Rules of BP stock price

The author used the second empirical rule where approximately 95% falls within two standard deviations of the mean ($\mu \pm 2s$). The chart shows that the return of BP stock is volatile, especially in between March and April, 2020. BP stock return was the lowest on March 09, 2020 with –0.19 and the highest on March 24, 2020 with 0.21. in a 2-year period. However, the number of points over the positive edge is 12 while the number of points under the negative edge is 9 , which means investors can still gain more than loss if they invest their money in BP in this period.

Box Plot

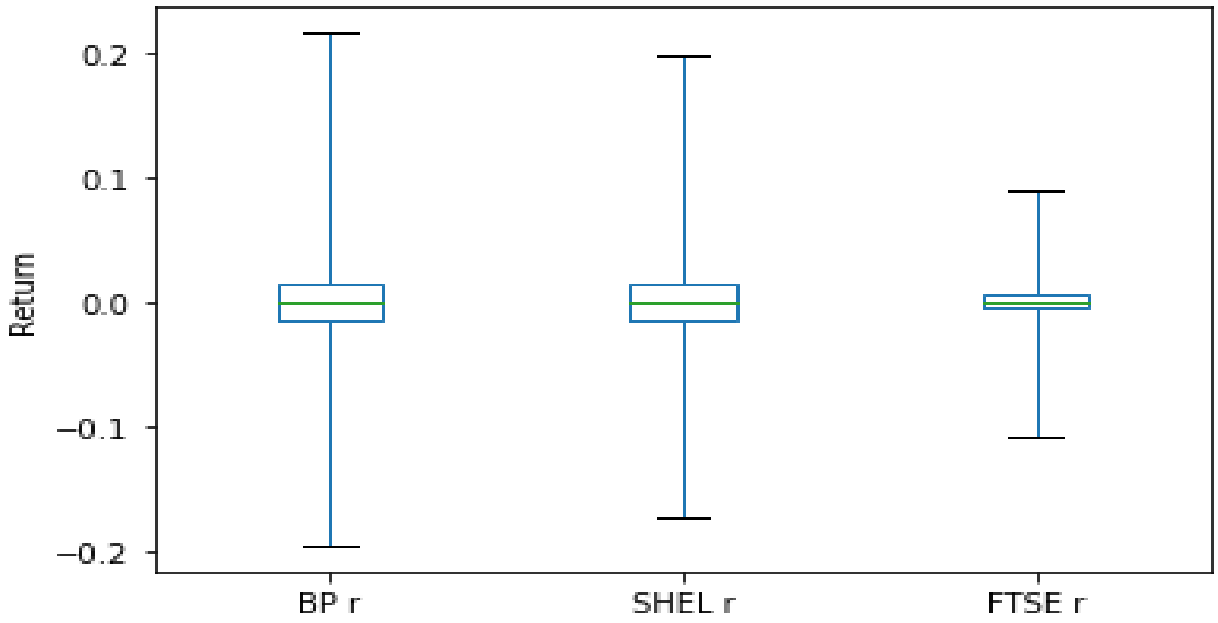

Figure 4. Box Plot result of Daily Returns

Box plot graph gives insights about distribution of a set of data. When comparing daily returns of three stocks, the result shows that all of them have normal distributions around 0.

The longer the box, the more dispersed the data and vice versa. Therefore, the return of BP and SHELL stocks are more variable compared to the stability of FTSE stock.

Histogram

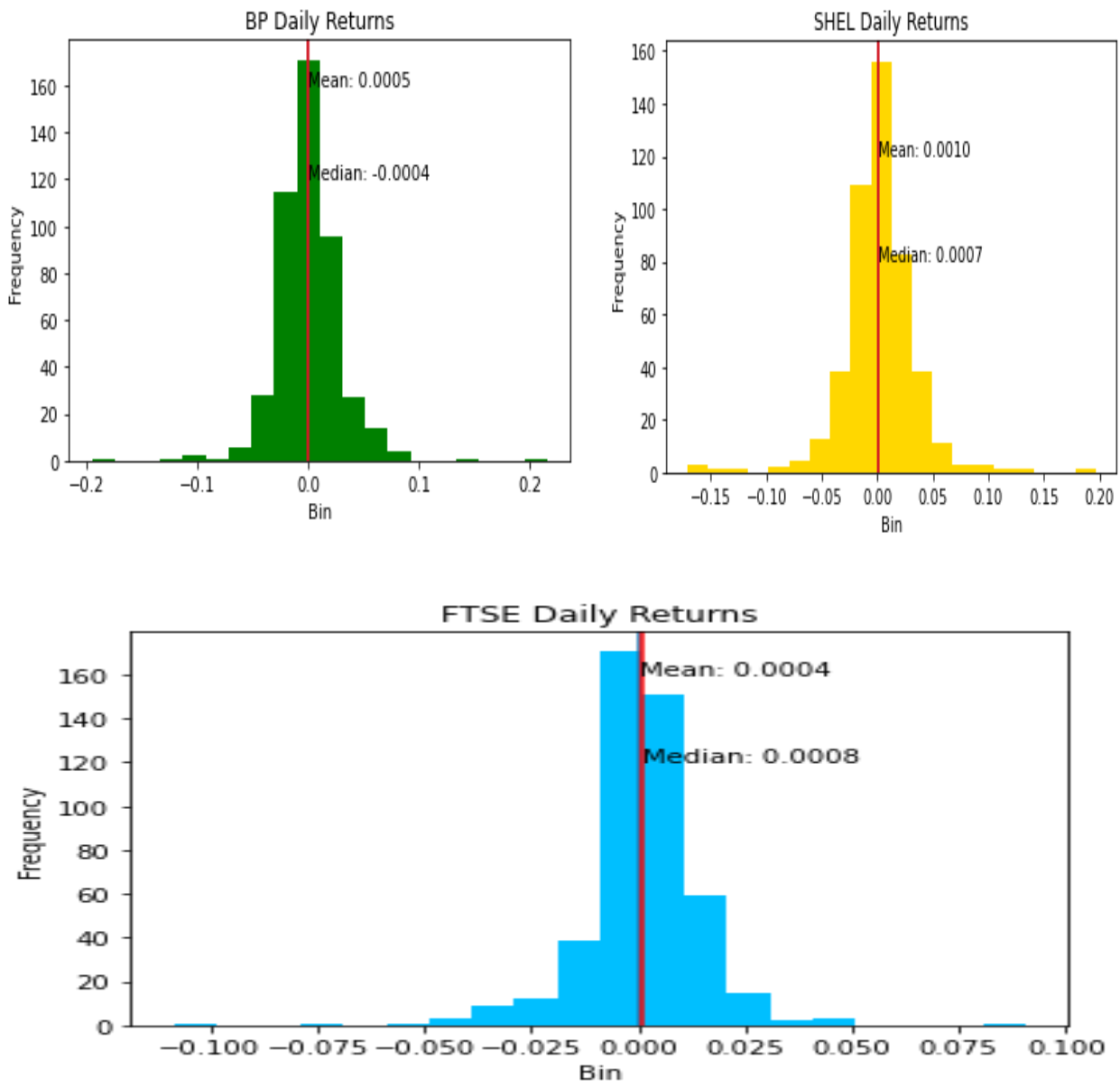

Figure 5. Histogram result of Daily Returns

The histogram graphs prove how daily returns of three stocks are distributed. The daily returns of BP and SHELL stocks are positively skewed (mean<median<mode) while the daily return of FTSE is negatively skewed (mode<median<mean). This means that an investor may expect frequent smaller losses and larger gains from the investment of BP and SHELL stocks.

The shade of three histogram graphs is thin, which indicates most of the returns value are close to the average mean.

1.2. Correlation and Regression Analysis

1.2.1. Correlation Analysis

Correlation between Stock Prices

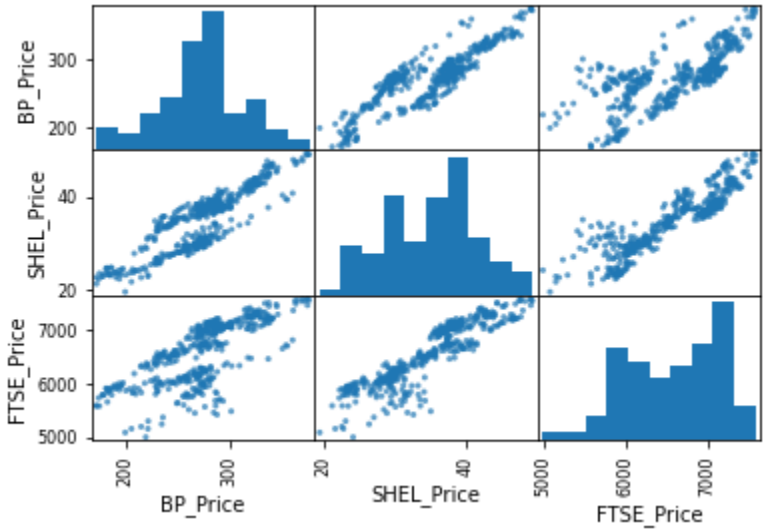

Figure 6. Correlation between Stock Prices

	BP Price	**SHELL Price**	**FTSE Price**
BP Price	1.000000	0.872739	0.722383
SHELL Price	0.872739	1.000000	0.897449
FTSE Price	0.722383	0.897449	1.000000

Table 2. Correlation between Stock Prices

From the scatterplot, the correlation between BP stock price and SHELL stock price is higher than the correlation between BP stock price and FTSE stock price. Therefore, the price of BP stock is more dependent on the price of SHELL stock than on the price of FTSE.

1.2.2. Regression Analysis

BP Price vs SHELL Price

Dep. Variable:	BP_Price	**R-squared:**	0.762
Model:	OLS	**Adj. R-squared:**	0.761
Method:	Least Squares	**F-statistic:**	1492.
Date:	Fri, 28 Apr 2023	**Prob (F-statistic):**	1.57e-147
Time:	15:16:44	**Log-Likelihood:**	-2062.2
No. Observations:	469	**AIC:**	4128.
Df Residuals:	467	**BIC:**	4137.
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	79.9797	5.077	15.752	0.000	70.002	89.957
SHEL_Price	5.5147	0.143	38.633	0.000	5.234	5.795

Omnibus:	7.327	**Durbin-Watson:**	0.053
Prob(Omnibus):	0.026	**Jarque-Bera (JB):**	5.175
Skew:	0.121	**Prob(JB):**	0.0752
Kurtosis:	2.546	**Cond. No.**	199.

Figure 7. OLS analysis of BP and SHELL price

Again, the OLS regression suggests a high correlation between BP and SHELL stock price with a β = 5.5147. The p-value is less than 0,05 (0,0000), which also confirms a link between BP stock price and its competitor price. The r-squared is equal to 0.762 which means that approximately 76% of the variation in BP stock price can be explained by SHELL stock price.

BP Return vs FTSE Return

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	-2.903e-05	0.001	-0.033	0.973	-0.002	0.002
FTSE_Return	1.6497	0.061	27.239	0.000	1.531	1.769

Omnibus:	53.221	**Durbin-Watson:**	1.847
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	122.174
Skew:	0.606	**Prob(JB):**	2.95e-27
Kurtosis:	5.190	**Cond. No.**	69.5

Figure 8. OLS analysis of BP and FTSE returns

Meanwhile, the second OLS regression suggests a lower correlation between BP and FTSE stock returns - β = 1.6497. The p-value is less than 0,05 (0,0000), which also confirms a link between BP stock return and the market return. The r-squared is equal to 0.641 which means that approximately 64% of the variation in BP stock return can be explained by the market return.

Multiple Regression

Dep. Variable:	BP_Price	**R-squared:**	0.781
Model:	OLS	**Adj. R-squared:**	0.780
Method:	Least Squares	**F-statistic:**	829.5
Date:	Fri, 28 Apr 2023	**Prob (F-statistic):**	2.88e-154
Time:	15:16:47	**Log-Likelihood:**	-2042.7
No. Observations:	469	**AIC:**	4091.
Df Residuals:	466	**BIC:**	4104.
Df Model:	2		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	163.7657	14.048	11.657	0.000	136.160	191.371
SHEL_Price	7.2883	0.311	23.454	0.000	6.678	7.899
FTSE_Price	-0.0221	0.003	-6.359	0.000	-0.029	-0.015

Omnibus:	5.750	**Durbin-Watson:**	0.078
Prob(Omnibus):	0.056	**Jarque-Bera (JB):**	4.237
Skew:	-0.102	**Prob(JB):**	0.120
Kurtosis:	2.582	**Cond. No.**	1.06e+05

Figure 9. OLS Regression Results of Multiple Regression

The multiple regression presents both the correlations of SHELL and FTSE prices towards BP price. P-value equal to 0.000 (less than 0.05) shows a link between BP versus SHELL and FTSE. The adjusted R-squared equals to 0.78, which means that SHELL and FTSE price accounted for 78% in changes in variability of BP price.

1.3. Time series analysis

1.3.1. Moving Average

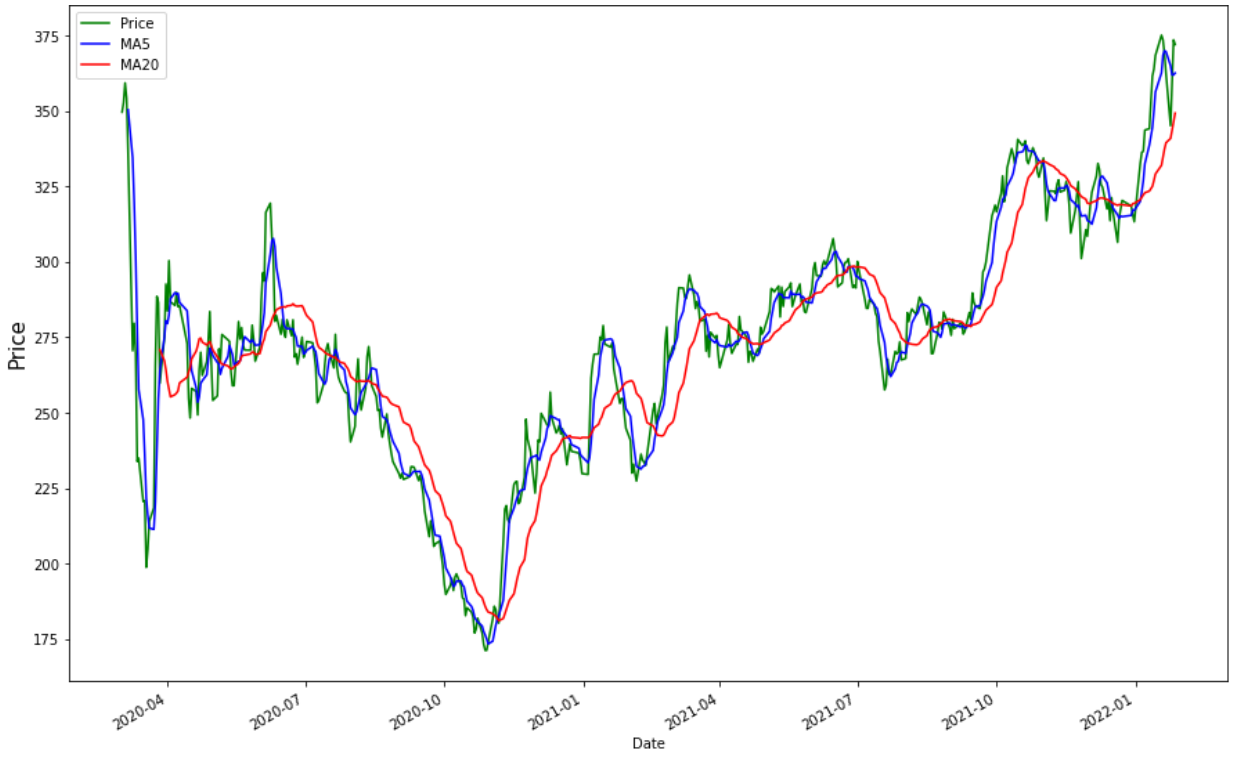

Figure 10. Moving Average result

The golden cross is when the MA5 line crosses the MA20 line and goes up, so the price will go up in the future and investors should buy as many shares as they can. Meanwhile, the death cross is when the MA5 line crosses the MA20 line and goes down, so the price will go down and investors should sell shares that they owned. For example, the death cross happened from January 2021 when the MA5 line crossed MA20 line and went down while the MA20 line still went up. In January 2022, the MA5 line crossed the MA20 line and went up, so at this time, investors could gain profit if they bought BP stock.

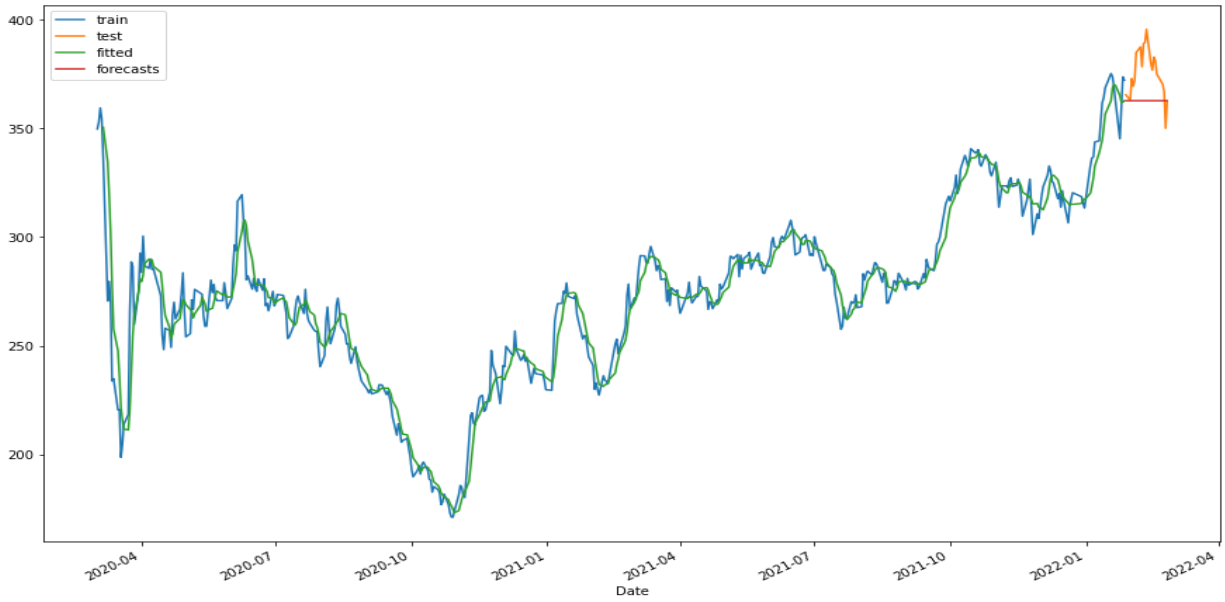

Figure 11. 5-day Moving Average result

The 5-day Moving average prediction forecasts the trend of BP stock price for training set and test set. As can be seen from the graph, the forecast prices go sideways while the actual prices vary up and down.

MAE: 14.2207 MSE: 285.4089

1.3.2. Single Exponential Smoothing

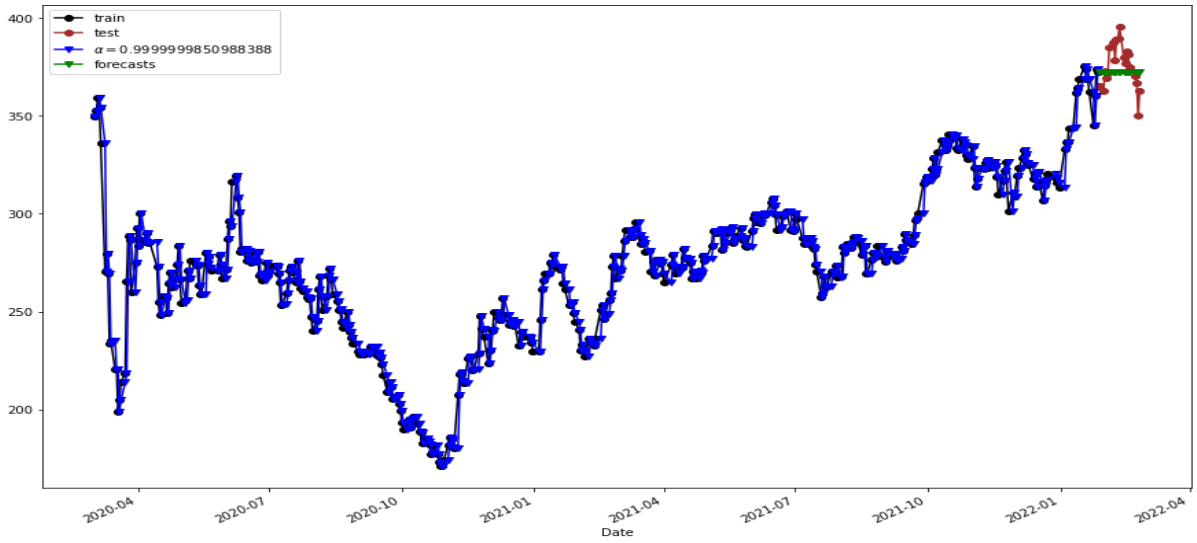

Figure 12. Single Exponential Smoothing

MAE: 9.2485 MSE: 129.9569

1.3.3. Double Exponential Smoothing

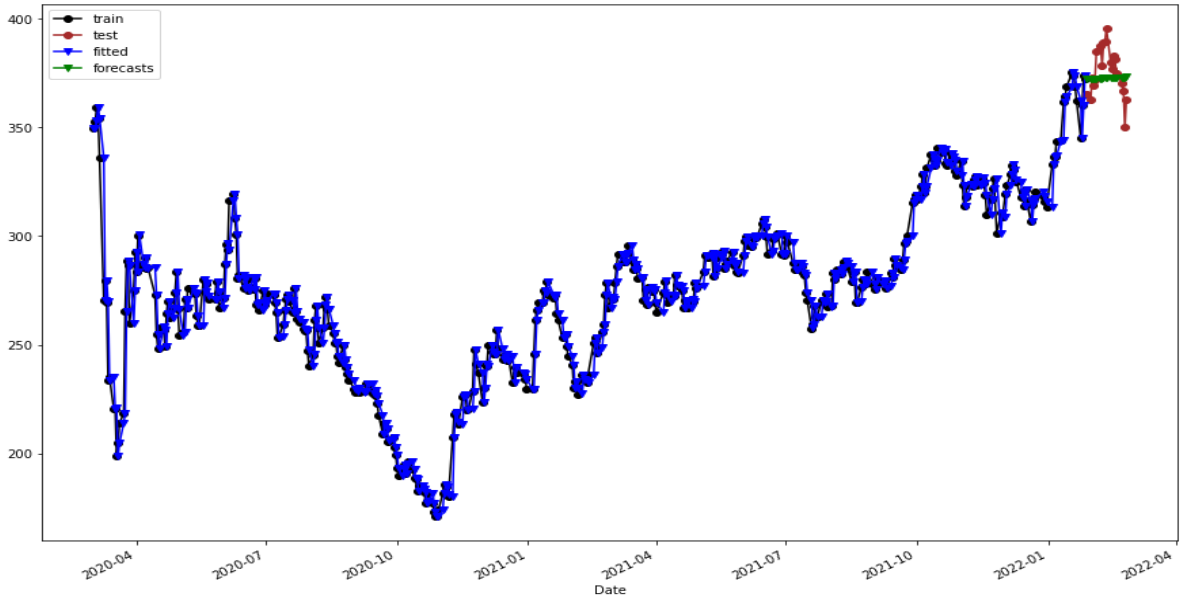

Figure 13. Double Exponential Smoothing

MAE: 9.1614 MSE: 127.8570

1.3.4. Holt's Winter (Additive)

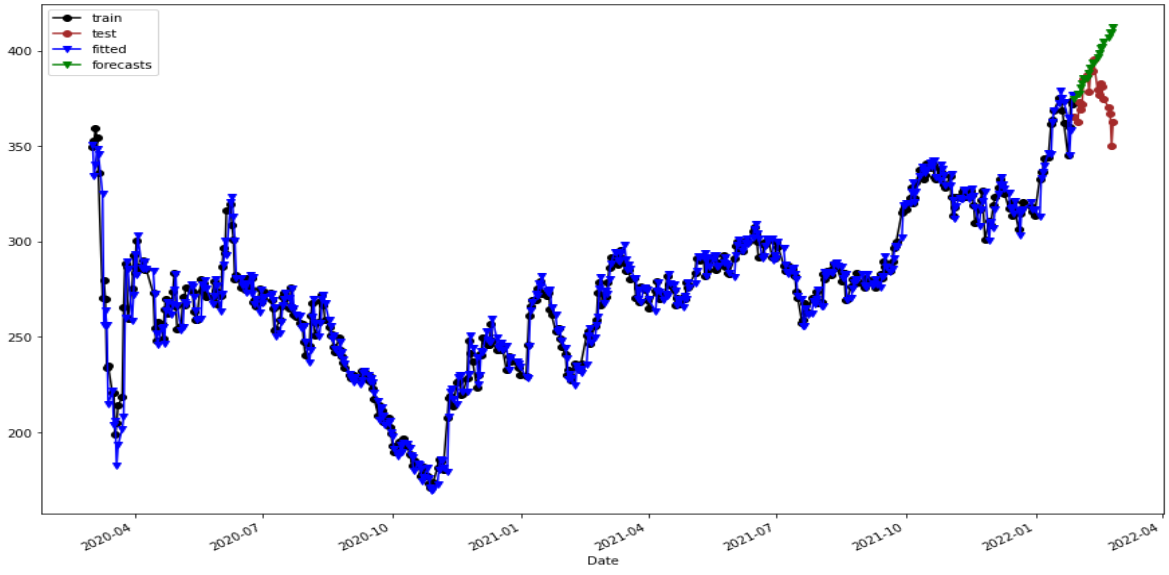

Figure 14. Holt's Winters Method (Addictive)

MAE: 18.4161 MSE: 617.7395

1.3.5. Holt's Winter (Multiplicative)

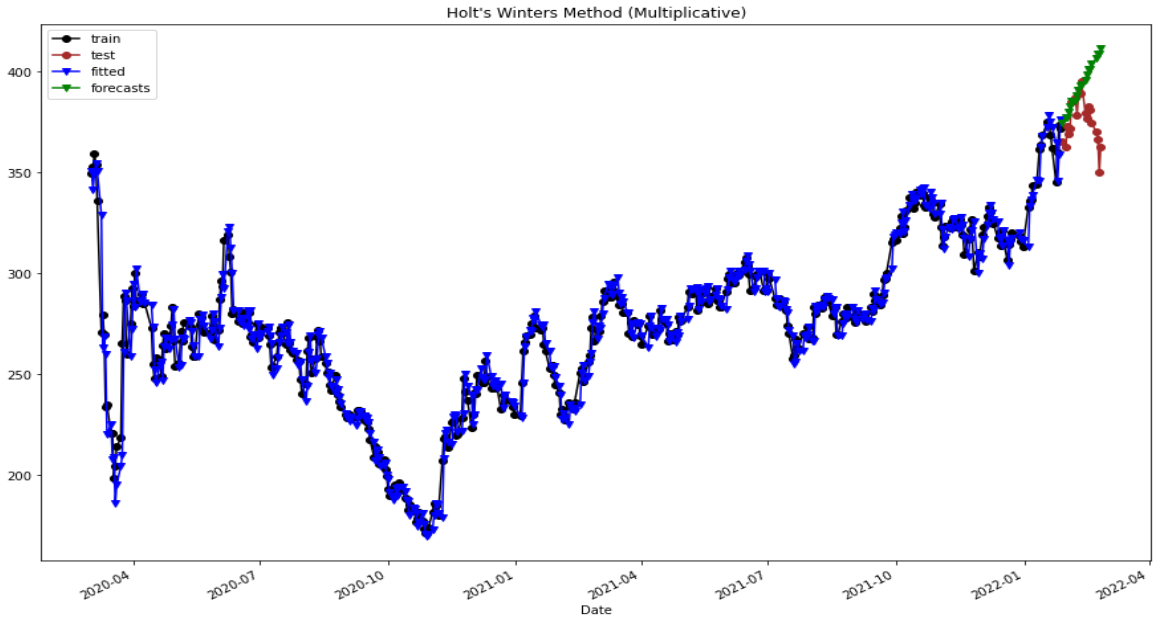

Figure 15. Holt's Winters Method (Multiplicative)

MAE: 18.2272 MSE: 604.4337

Summary

In this case, the Double Exponential Smoothing method provides the most accurate prediction due to the lowest MAE and MSE value. Regarding the recovery in price of BP stock, the author suggests that investors should keep buying BP stock in a short period of time and keep testing the forecast model or taking fundamental analysis to consider their investment strategy in the long term.