FE 511 - FINAL PROJECT
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Regression between S&P 500 and Apple Inc

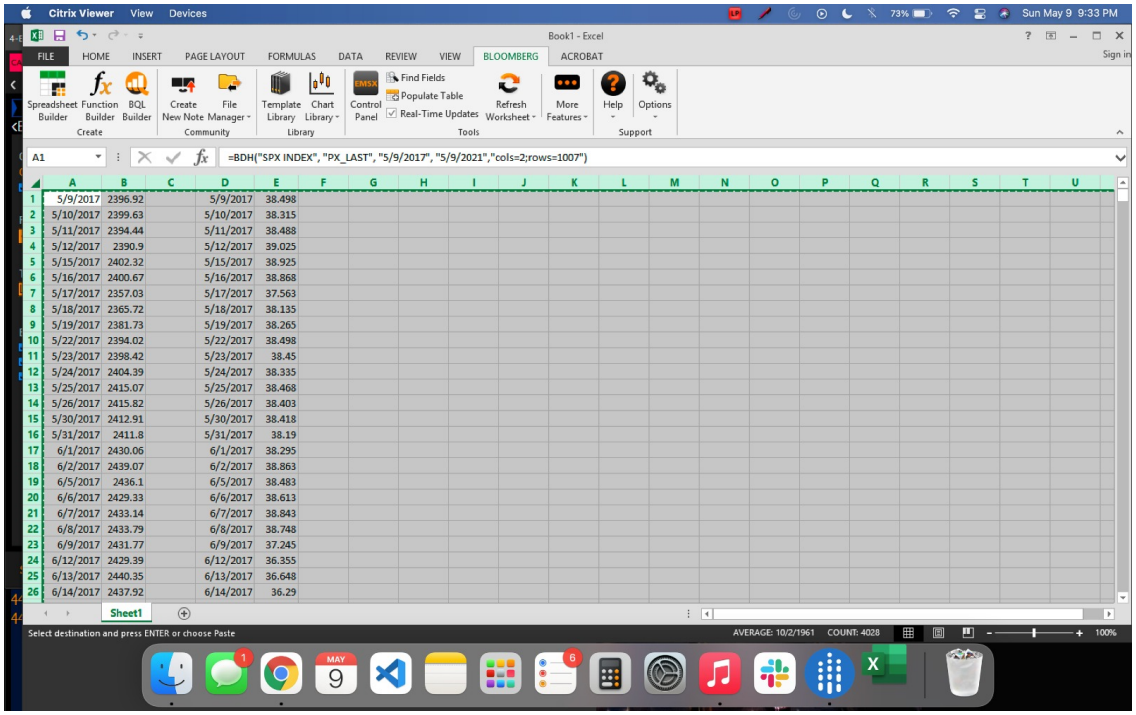
MOTIVATION AND RESEARCH QUESTION

The objective of this project is to analyse how the Apple stock returns react to the overall movement of the market. As the benchmark for the market I am considering S&P500 index returns. The research question here would be what is the relation between Apple Stock returns and S&P 500.

Apple is one of the major Tech stocks and is the first publicly traded US company to achieve a trillion dollar valuation. It is interesting to compare it with the overall market as it has the capacity to swing it either way. The recent events of rising interest rates and the slow recovery from ongoing pandemic makes the study of this tech stock even more interesting.

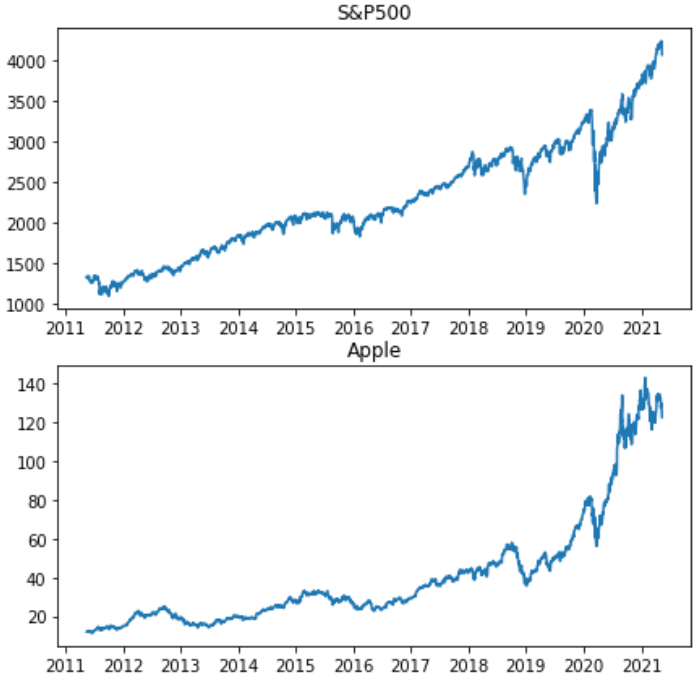
DATA RETRIEVAL

The price and the index data for both Apple (AAPL) and S&P500 is taken from the excel add in of the Bloomberg terminal. The last price (PX_LAST) of both these assets is considered here. The data ranges for a period of 10 years (end period: May 09, 2021). The return is calculated in the Python code using these last prices.

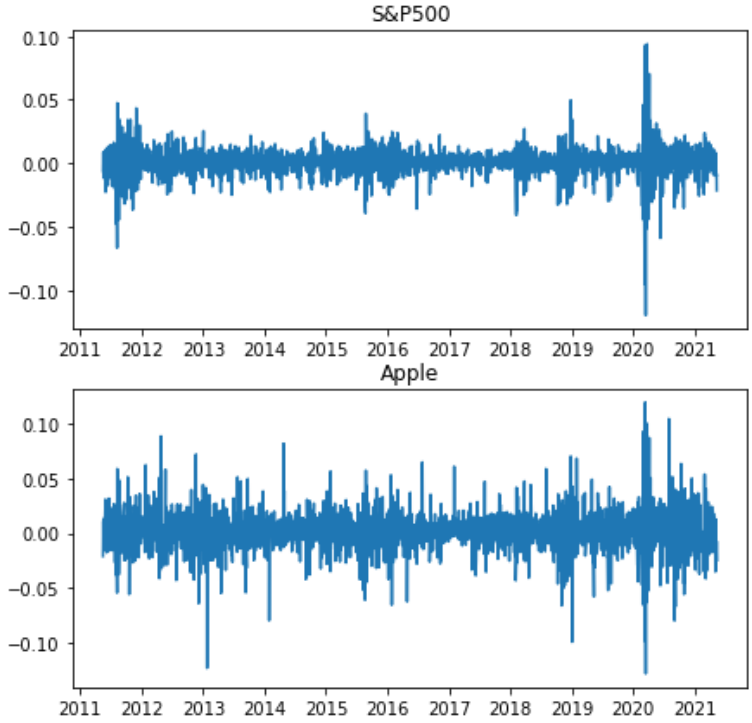


EXPLORATORY DATA ANALYSIS

- **Time Series Plot of S&P and Apple Price (a)**



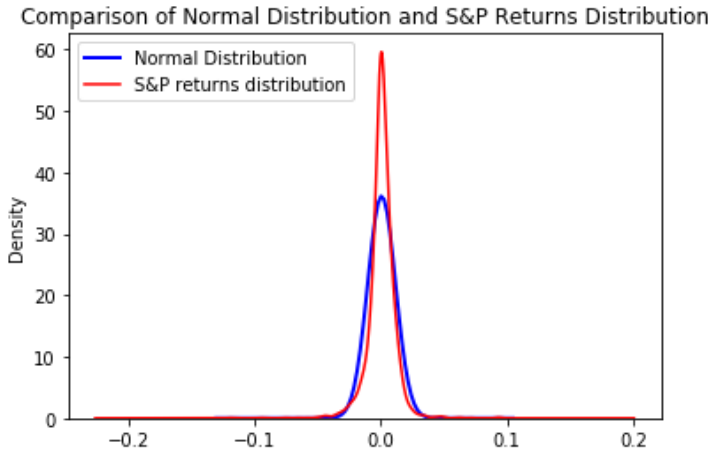
- **Time Series Plot of S&P and Apple Returns (b)**

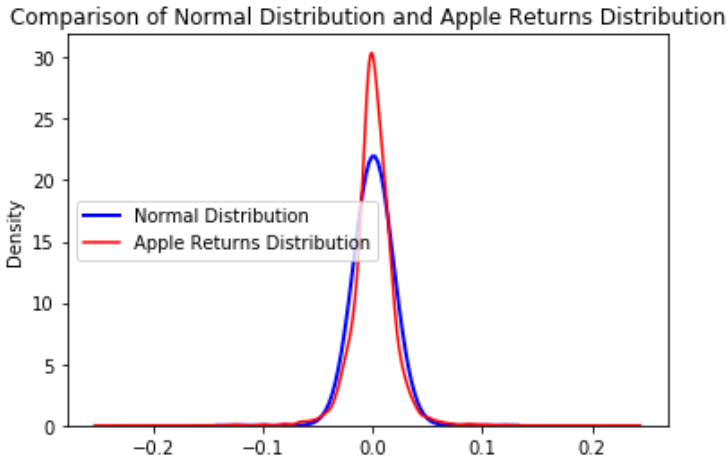


In chart (a) above we can see that the prices show an upward increasing trend, hinting that the mean and variance of these time series is not constant over time. These series indicate non-stationarity which is a common attribute of stock prices. Modelling regression on non-stationary series can give spurious results and thus in my project I am considering the returns of these assets as returns tend to be stationary in nature. It can be seen from the chart(b) that the returns seem stationary.

- **Comparison of Returns Distribution with a Normal Distribution**

Next I decided to compare a normal distribution to the distribution of the returns. The idea behind this analysis was to see if the returns are skewed or have fat tails. Since, the returns here are in the range of -0.2 to 0.2, it is difficult to compare it with just visualization. From both the comparative charts below we can see that the returns have high kurtosis and have comparatively fatter tails if seen minutely. These observations indicate that the returns are not normally distributed.





DATA ANALYSIS

Since the data was fetched from Bloomberg directly I had no case of missing values or skipped dates. The next part of my analysis was to perform a regression where S&P 500 returns is the independent X variable and Apple returns is the dependent Y variable.

Regression Results:

OLS Regression Results

Dep. Variable:	Apple Returns	R-squared:	0.431
Model:	OLS	Adj. R-squared:	0.431
Method:	Least Squares	F-statistic:	1907.
Date:	Sat, 15 May 2021	Prob (F-statistic):	1.68e-310
Time:	13:36:26	Log-Likelihood:	7227.3
No. Observations:	2515	AIC:	-1.445e+04
Df Residuals:	2513	BIC:	-1.444e+04
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0005	0.000	1.984	0.047	6.34e-06	0.001
S&P 500 Returns	1.0789	0.025	43.672	0.000	1.030	1.127

Omnibus:	372.809	Durbin-Watson:	1.917
Prob(Omnibus):	0.000	Jarque-Bera (JB):	5606.036
Skew:	-0.062	Prob(JB):	0.00
Kurtosis:	10.313	Cond. No.	90.6

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

Observations:
The constant term for the regression equation is 0.0005 with a p-value of 0.047. At 95% significance level we can reject the null hypothesis that the coefficient is not significant as 0.047 < 0.05. The constant term is thus significant in the equation.

For the S&P 500 returns term (beta), the computed coefficient is 1.079 with a p-value of 0. At 95% significance level we can reject the null hypothesis and conclude that the beta is significant.

The final regression equation is thus:

Apple Returns = 0.0005 + 1.079 * S&P 500 Returns

That is, a one unit change in the S&P returns results in a 1.079 increase in the Apple returns.
The R square term of the regression is still very low at 0.431, meaning that the S&P returns explain only 43.1% variation in the Apple returns.

Overall, from this regression I can say that a positive variation in S&P has a positive effect on Apple and vice versa.

The correlation of these two returns is given below, confirming the above deductions that S&P and Apple are positively correlated.

	S&P 500 Returns	Apple Returns
S&P 500 Returns	1.000000	0.656869
Apple Returns	0.656869	1.000000

CONCLUSION AND FUTURE WORK

S&P 500 and Apple Returns are positively correlated. Any change in the overall market has a proportionate change in the Apple returns. This regression model only helps us to estimate the approximate effect of these changes. The beta of 1.079 indicates the amount of change. This model can be equated to a Capital Asset Pricing Model (CAPM) model if we consider Risk Free Rate as 0.

The drawback of this model would be that the R2 is very low plus it cannot model the leverage effect. Leverage effect indicates that a negative change has more impact on the stock as compared to a positive change.This model can be improved by doing Vector Autoregressive models (VAR) ahead or by implementing other sophisticated regression algorithms.

Overall, it can be said that this model effectively evaluates the relation between Apple and S&P 500.