Comparison between Time Series Analysis Vs Fundamental Analysis for Apple Inc.

Part-A-Time Series Analysis

(Seasonal Auto-Regressive Moving Average (SARIMA) & Facebook Prophet)

Data

We start with exploring the data we collected.

We collected our data from Yahoo Finance ranging from April 2012 to Dec 2019 roughly counting to 2011 instances of data.

Data Describtion :-

Date : Date of trading

Open : Price at which security first trades

High : Highest Price of the trading day

Low : Lowest Price of the trading day

Close : Last Price the stock traded during the trading day

Adj Close : Price that is adjusts Coroporate Actions on Closing Price

Volume : Number of Shares that changed hands during the trading day

Data Snapshot: -

	Date	Open	High	Low	Close	Adj Close	Volume
0	2012-01-03	58.485714	58.928570	58.428570	58.747143	50.765709	75555200
1	2012-01-04	58.571430	59.240002	58.468571	59.062859	51.038536	65005500
2	2012-01-05	59.278572	59.792858	58.952858	59.718571	51.605175	67817400
3	2012-01-06	59.967144	60.392857	59.888573	60.342857	52.144630	79573200
4	2012-01-09	60.785713	61.107143	60.192856	60.247143	52.061932	98506100

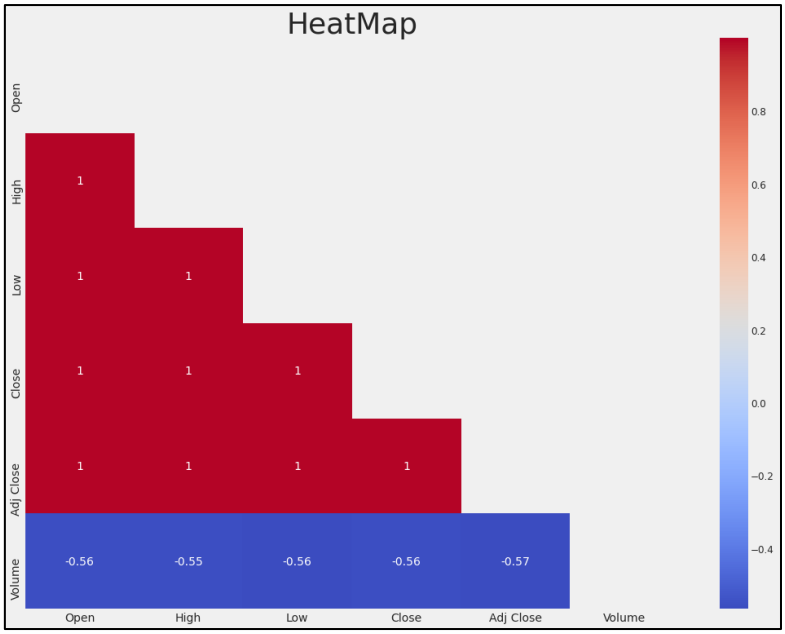
Summary Statistics: -

	Open	High	Low	Close	Adj Close	Volume
count	2011.000000	2011.000000	2011.000000	2011.000000	2011.000000	2.011000e+03
mean	126.707469	127.827594	125.580258	126.741235	119.505548	5.949670e+07
std	50.483753	50.926301	50.124940	50.578369	52.438444	4.683856e+07
min	55.424286	57.085712	55.014286	55.790001	48.921928	1.136200e+07
25%	85.882858	86.717858	85.056427	86.202145	75.056679	2.758565e+07
50%	113.050003	114.190002	111.870003	113.050003	105.222908	4.346900e+07
75%	165.190002	167.409996	163.424995	165.245002	160.047111	7.471030e+07
max	291.119995	293.970001	288.119995	291.519989	289.522614	3.765300e+08

Data Pre-Processing: -

We did the following Steps: -

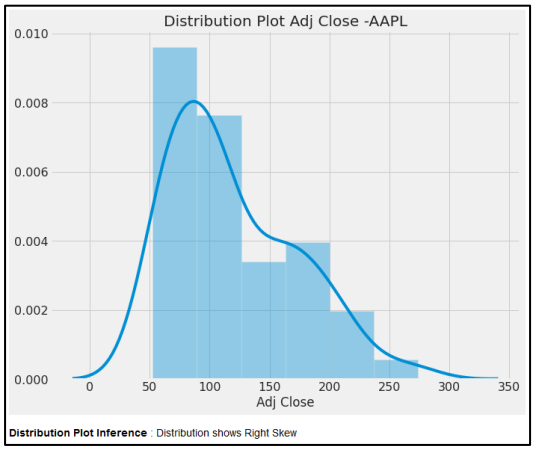
1.) Convert Date into Date Time Index
2.) Checked if there were any missing values
3.) Eliminated Features like “Open”,”High”,”Close” as they were Multicollinear with “Adj Close”. We consider “Adj Close” as our target variables as it accounts for all corporate decisions like stock split and dividends. Volume filtered out as it was less correlated to target variable.



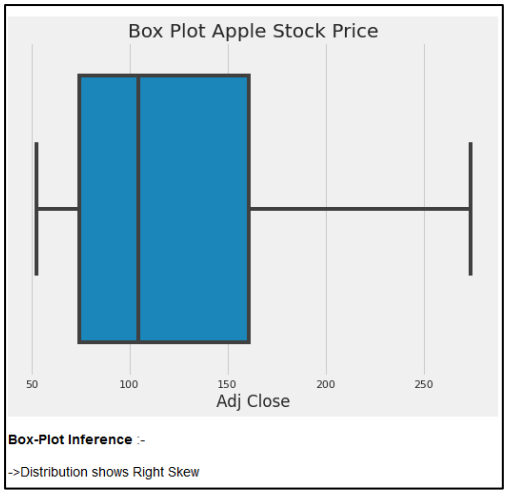
Inference: We detected multicollinearity by checking the Heatmap.

4.) Resampled Data into Monthly Frequency

Exploratory Data Analysis

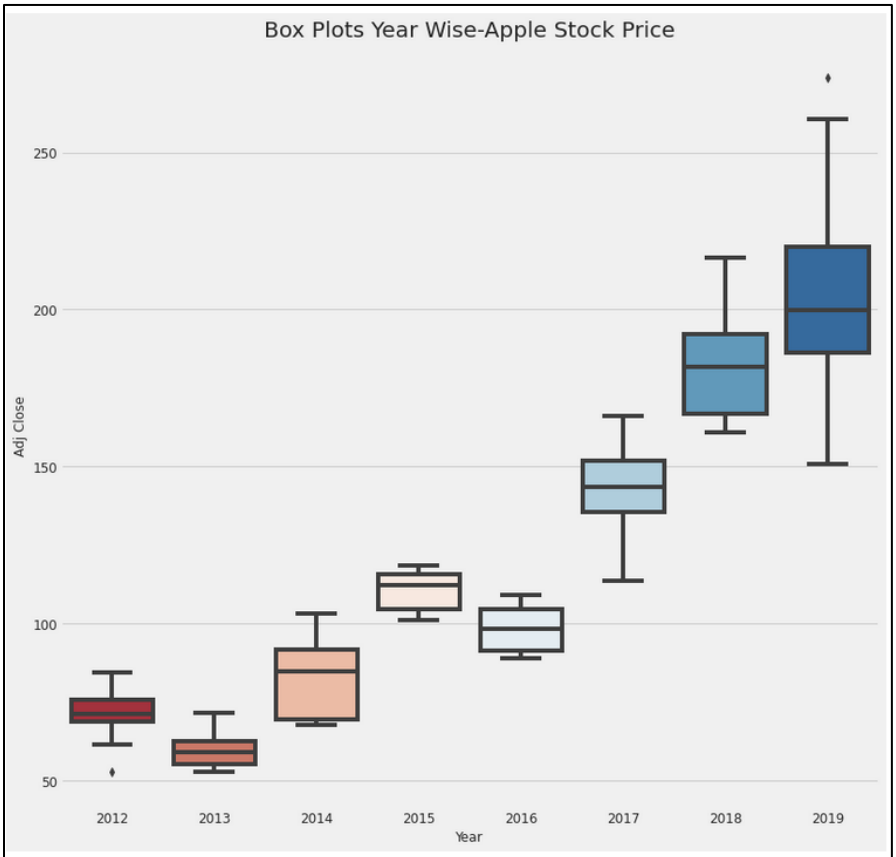


Distribution Plot Inference : Distribution shows Right Skew



Box-Plot Inference :-

->Distribution shows Right Skew



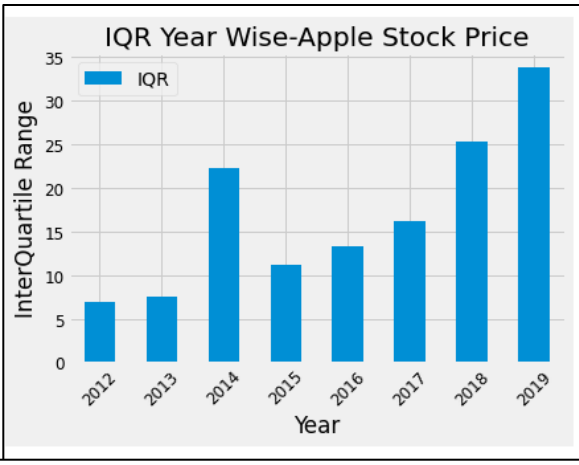
Inferences Box Plot

->Outliers Present in Year 2012 and 2019

->Lot of Variability in Years 2014, 2017-19

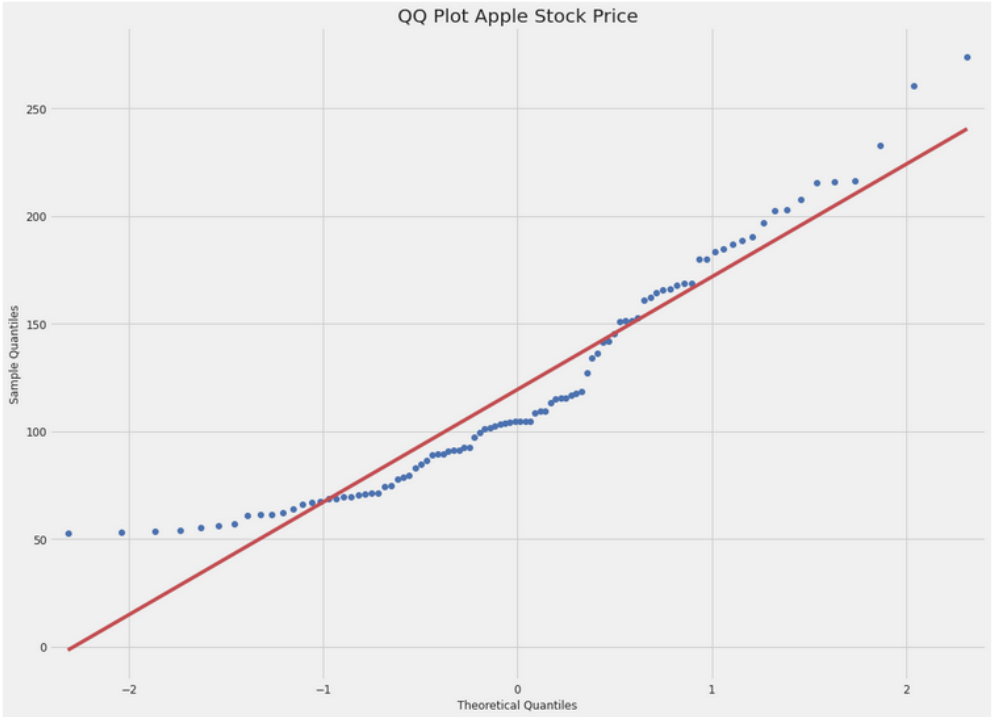
->2019 most volatile year among all years

->Upward Rising Trend is shown



->When Data is Not Normal Inter-Quartile Range(IQR) is Better Variability Metric than Standard Deviation as IQR is not affected by outliers.

->As observed with BoxPlot 2014 and 2019 are the most volatile Years for Apple Stock

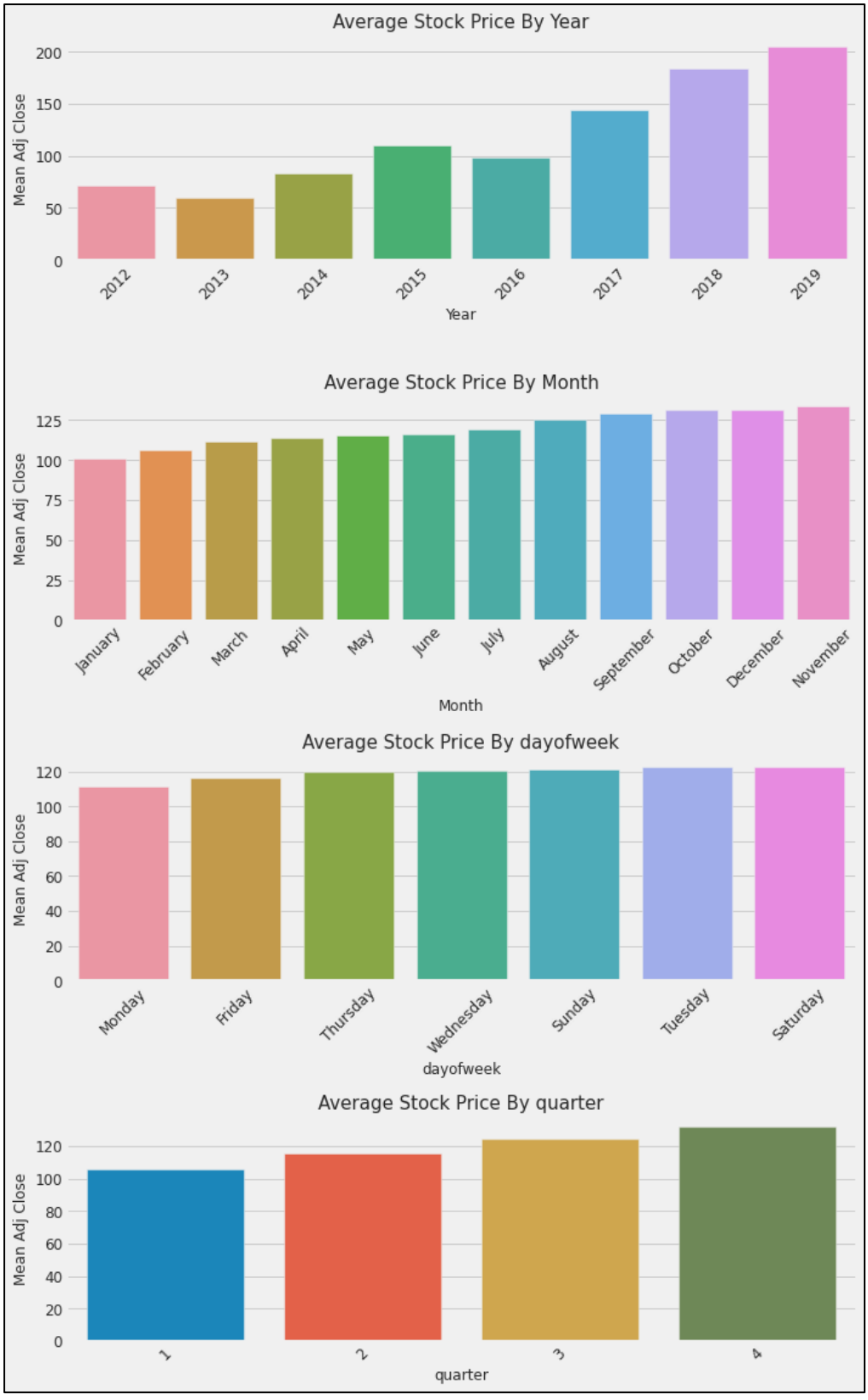


QQ plot Inference :-

->Heavy Tailed Distribution-Curve at Extremities

-> Shows extent of both right and left skews

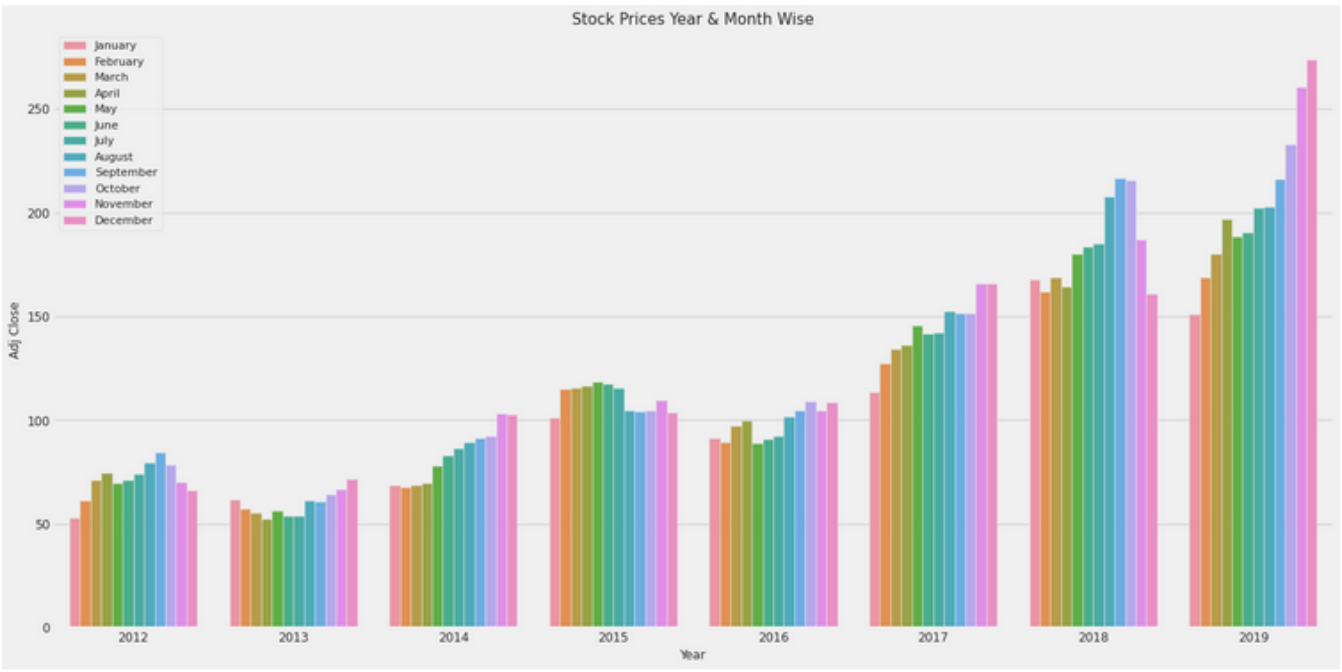
->Shows Distribution is Not following Gaussian Normal Distribution



Inferences: -

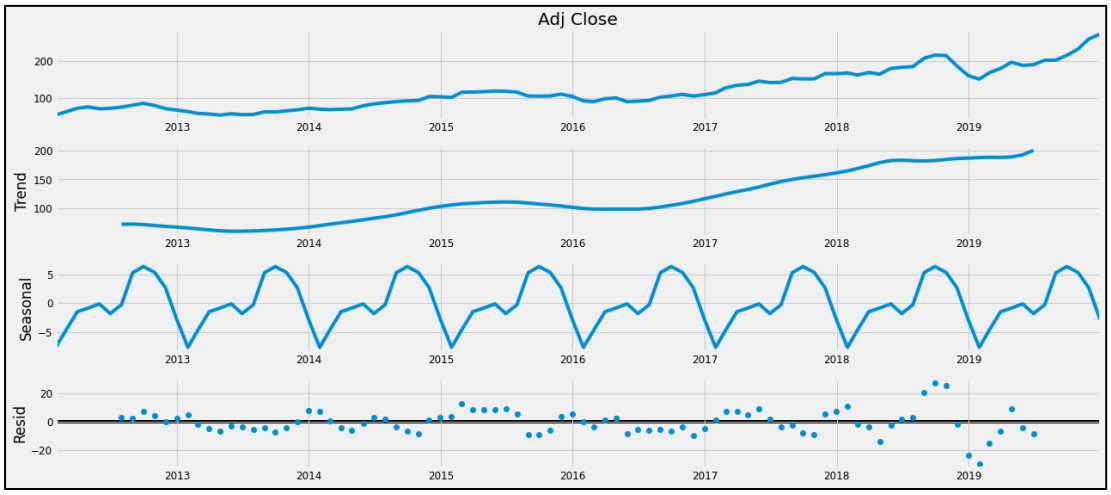
- According to Mean price by Years, 2013 and 2016 are the only years where Mean price is lower than previous Year.
- Average Stock Price is lower at start of the week in comparison to the end of the week.

- The Average Price is Highest in the Month of November.
- Q4 is the best for Apple according to average stock price. By sales figures Q4 has always been strong for Apple since the new product cycle takes place and it's the Holiday period. We also observe this as a seasonal effect for Apple.



Above figure shows that the Period from July-September seems to push stock price above in comparision to other months. The primary reason for this is as Apple has a product cycle release date during this time,the Wallstreet is excited about upcoming products .

Decomposition of Time Series: -



Inferences by Decomposition: -

- Trend: Overall an Upward Trend
- Seasonality: There appears to be seasonality, Apple has rallied during the Holiday season as expected. Since Holiday period has good sales for Apple Over the Years.

Checking Stationarity of Time Series: -

We can check stationarity of Time Series using Augmented Dickey-Fuller (ADF) Test, a statistical test.

ADF Test: -

Null Hypothesis: Time series has a unit root -*It is non-stationary*

Alternate Hypothesis: Time series does not have a unit root -*It is stationary*

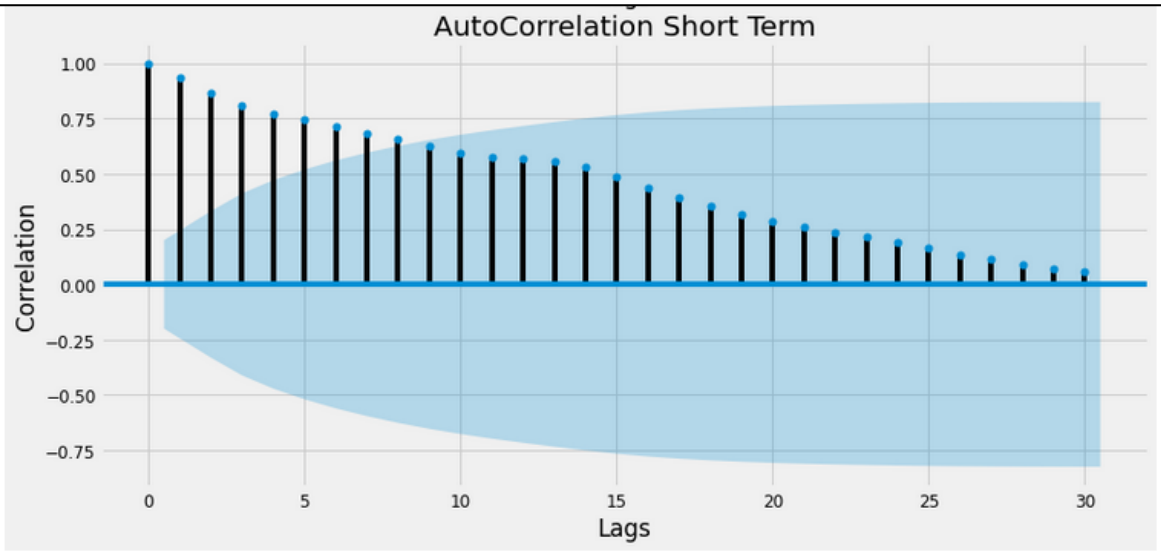
Time Series is Stationary if we have constant mean, constant variance and No Trend and Seasonality.

```
ADF Statistic: 1.339253
p-value: 0.996820
Critical Values:
        1%: -3.504
        5%: -2.894
        10%: -2.584
Failed to Reject Ho-Time Series is Non-Stationary
```

Time Series is Not Stationary as observed earlier also by Decomposition(Trend and Seasonality Present)

Statistically verified by ADF Test

Autocorrelation (ACF) & Partial Auto-Correlation Plot (PACF)

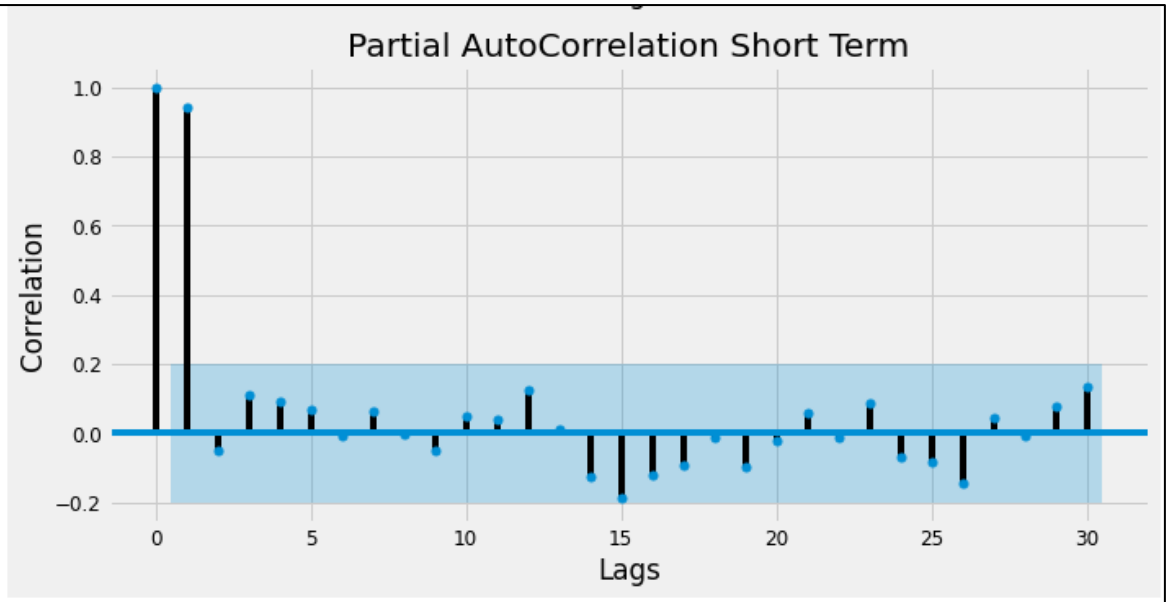


Interpreting ACF Plot :-

->Slow Decay of correlation values indicates that the future values are heavily dependent on the lagged values . This shows that the series is not random and good for time series modelling .

->Also tells us series is Non-stationary

->It indicates a MA(1) process

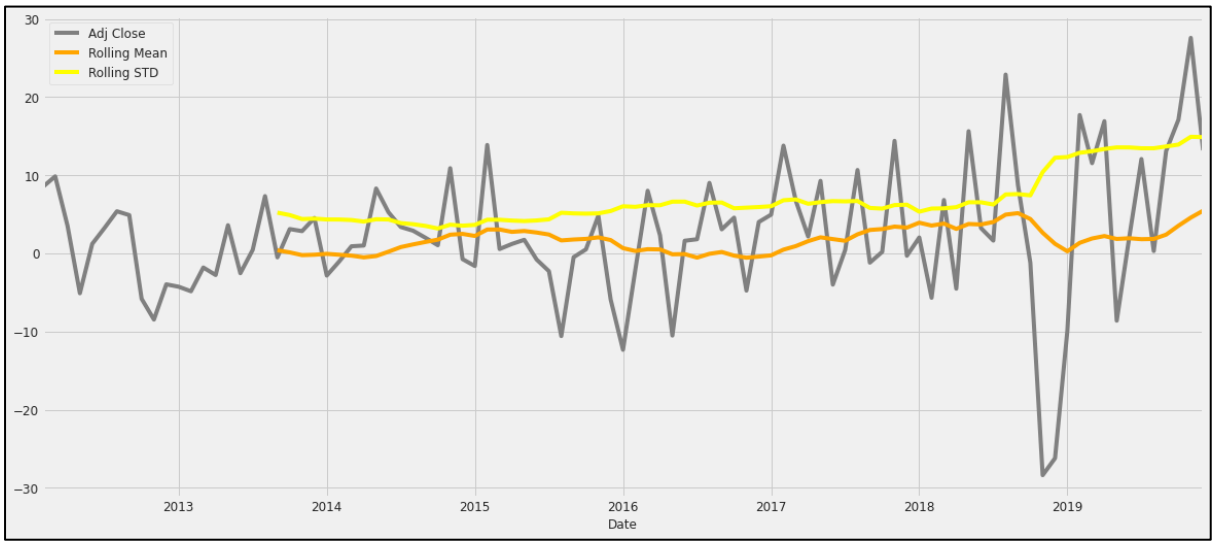


Interpreting PACF Plot :-

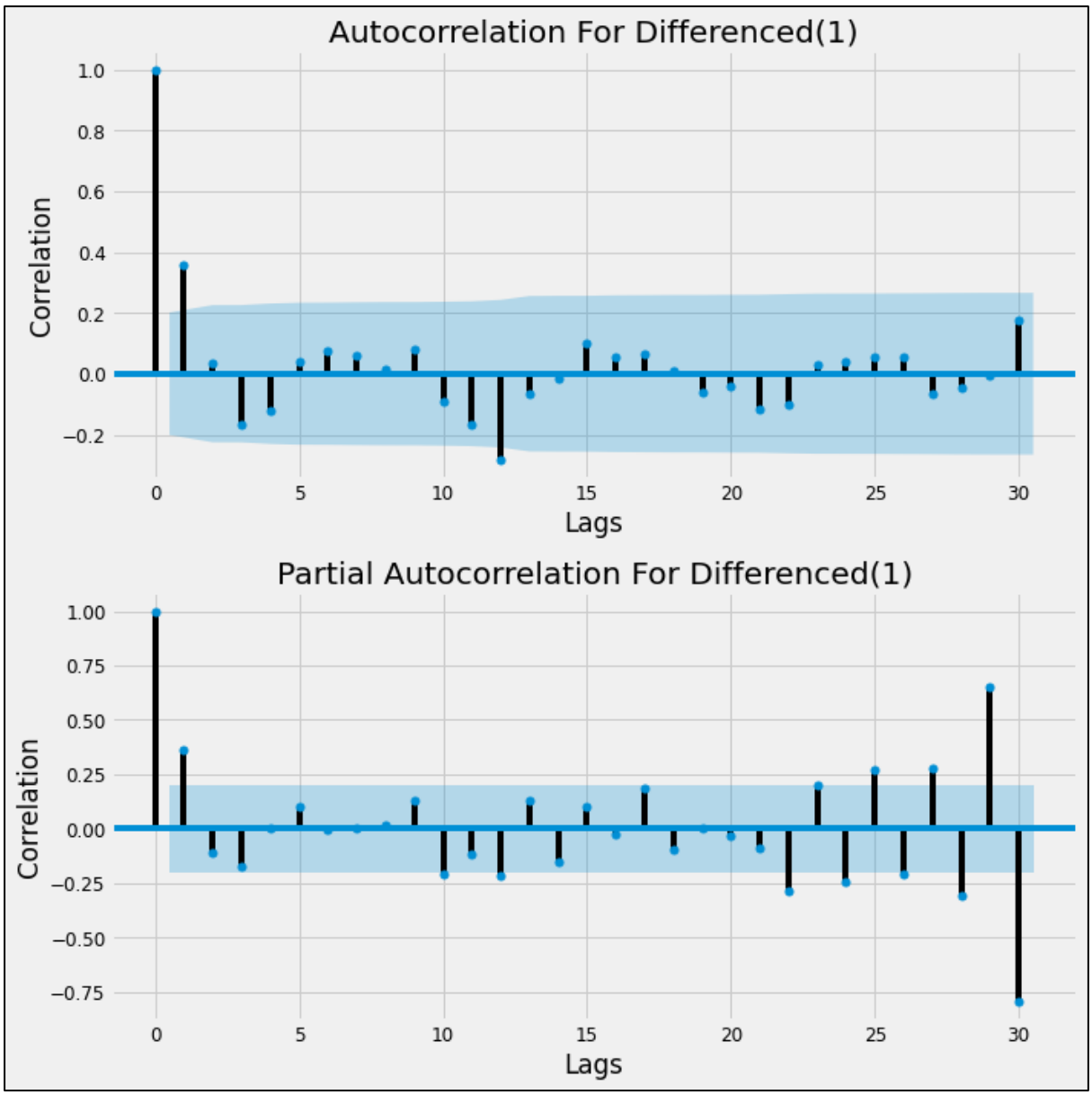
->Sudden Decay at Lag-1

->Order of series seems AR(1)

Transforming Series for Stationarity



After Differencing by Lag 1



From ACF and PACF we can observe that series has become kind of stationary.

To statistically verify we conduct ADF Test.

```
ADF Statistic: -6.501865
p-value: 0.000000
Critical Values:
        1%: -3.502
        5%: -2.893
        10%: -2.583
Reject Null Hypothesis(Ho)-Time Series is Stationary
```

Carrying out Grid Search to Select Parameters especially for Seasonal Component of the Time Series.

Parameters for Series already indicate Non-Seasonality Part with Order (1,1,1).

- (p)-Auto-Regressive (1) derived by the PACF plot
- (q)-Moving Average (1) derived by the ACF Plot
- (d)-Differencing (1) derived by differencing and observing stationarity.

ARIMA(1, 1, 1)x(1, 1, 0, 12)12 - AIC:350.75081385350666

ARIMA(1, 1, 1)x(1, 1, 1, 12)12 - AIC:332.11071968501557

ARIMA(1, 1, 1)x(1, 2, 0, 12)12 - AIC:300.4957600928522

ARIMA(1, 1, 1)x(1, 2, 1, 12)12 - AIC:286.2126039361744

ARIMA(1, 1, 1)x(2, 0, 0, 12)12 - AIC:331.740255110838

ARIMA(1, 1, 1)x(2, 0, 1, 12)12 - AIC:333.46473592208514

ARIMA(1, 1, 1)x(2, 0, 2, 12)12 - AIC:324.7832626860535

ARIMA(1, 1, 1)x(2, 1, 0, 12)12 - AIC:262.4409992969335

ARIMA(1, 1, 1)x(2, 1, 1, 12)12 - AIC:256.71390487682834

ARIMA(1, 1, 1)x(2, 2, 0, 12)12 - AIC:206.26186908985358

ARIMA(1, 1, 1)x(2, 2, 1, 12)12 - AIC:206.79066847021136

ARIMA(1, 1, 2)x(0, 0, 0, 12)12 - AIC:459.6835652708871

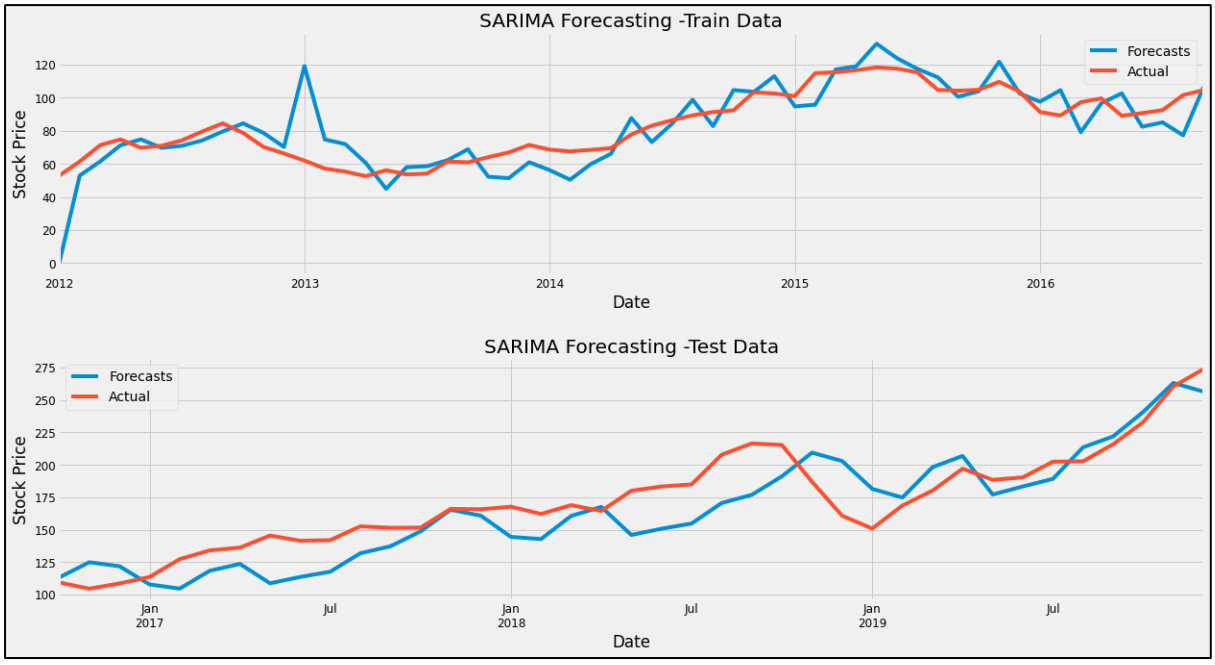
ARIMA(1, 1, 2)x(0, 0, 1, 12)12 - AIC:386.9565978957946

ARIMA(1, 1, 2)x(0, 0, 2, 12)12 - AIC:3937.920519627023

By Observing the Lowest AIC , we come to Seasonality Order of (2,2,0)12 and non-seasonal component is (1,1,1) as derived earlier by correlograms.

Seasonal Arima is used as we have seasonality component present. During Fall time period (July-Nov) the stock seems to rally on the news of product launch and product releases in that cycle of the year.

Forecasting Seasonal ARIMA



We check Overfitting and Underfitting by observing the In and Out samples fitting. Seems that our model has a balance fit.

```
Result Metrics for SARIMA-Train Data
R2 Score :  0.491
Mean Squared Error :  199.567
Mean Absolute Error :  9.797
Mean Absolute Percentage Error 13.39
Accuracy(100-MAPE) of Model is 87.0%
None
----
Result Metrics for SARIMA-Test Data
R2 Score :  0.704
Mean Squared Error :  441.121
Mean Absolute Error :  17.557
Mean Absolute Percentage Error 10.65
Accuracy(100-MAPE) of Model is 89.0%
None
```

Model Summary

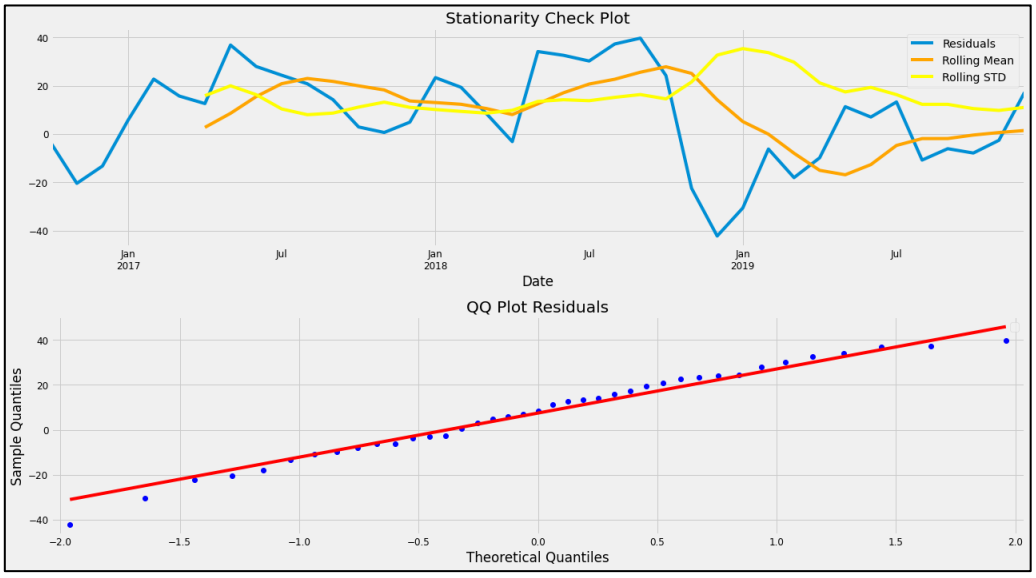
Statespace Model Results

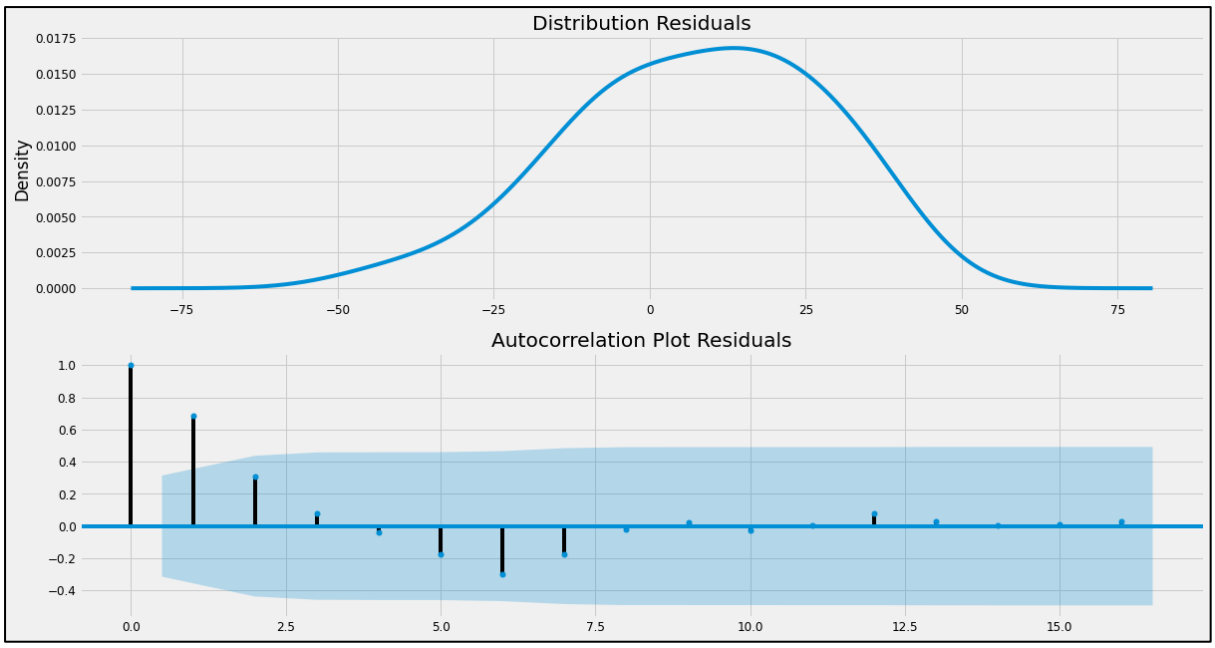
Dep. Variable:	Adj Close	No. Observations:	57
Model:	SARIMAX(1, 1, 1)x(2, 2, 0, 12)	Log Likelihood	-120.570
Date:	Fri, 21 Aug 2020	AIC	251.139
Time:	18:17:51	BIC	258.468
Sample:	01-31-2012 - 09-30-2016	HQIC	253.569
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	0.7677	0.439	1.748	0.081	-0.093	1.629
ma.L1	-0.5014	0.592	-0.848	0.397	-1.661	0.658
ar.S.L12	-0.5420	0.265	-2.045	0.041	-1.062	-0.023
ar.S.L24	-0.3440	0.399	-0.862	0.389	-1.126	0.438
sigma2	92.9283	34.127	2.723	0.006	26.041	159.815

Ljung-Box (Q):	nan	Jarque-Bera (JB):	1.24
Prob(Q):	nan	Prob(JB):	0.54
Heteroskedasticity (H):	2.30	Skew:	0.46
Prob(H) (two-sided):	0.18	Kurtosis:	2.73

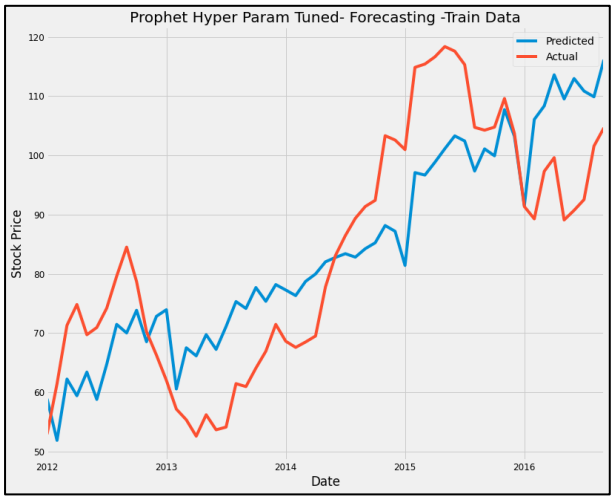
Residual Analysis

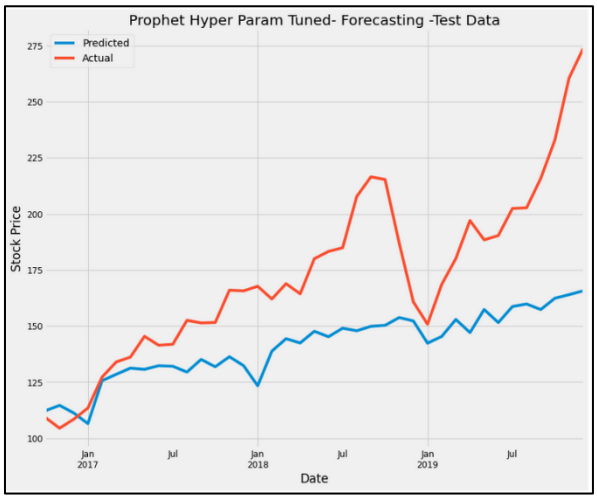




Residuals show us that model approximately follows Normal Distribution, and it also indicates randomness when we look at the ACF plot. This indicates that the model has random residuals and the model has captured the series in a good way. There is little bias in the model.

Prophet Model Facebook






```
Result Metrics for Hyper-Tuned Prophet Test Data
R2 Score :  -1.31
Mean Squared Error :  2187.789
Mean Absolute Error :  40.501
Mean Absolute Percentage Error 20.338
Accuracy(100-MAPE) of Model is 80.0%
```

The model is not able to capture the seasonality and sudden jump in time series in the Year 2017 onwards as effectively as the Seasonal ARIMA model.

Seasonal ARIMA Vs Facebook's Prophet

- Advantages of Prophet includes very easy to implement, fast, and less statistical/mathematical know-how model. In Seasonal ARIMA we had to follow lot of tests in order to generate predictions.
- Seasonal ARIMA is better at capturing the seasonality part.
- Overall Both models are robust.
- Prophet is easily overfitted.
- Seasonal ARIMA is superior to Prophet
- Prophet is good at capturing the trend.
- By creating Extra Regressors we can maybe improve the Results in future projects.
- Prophet is better at dealing with outliers.
- We have found Seasonal ARIMA is much better at prediction problem. More confidence when predicting with Seasonal-ARIMA since its backed by Mathematical and Statistical tests.
- Accuracy of SARIMA is 89% and 80% for Prophet (Both on Out of Sample Data)

Actionable Insight

Observing the Trend given by Both Models.

Apple IS A BUY.

Part-B-Fundamental Analysis

(Business Valuation – (Discounted Cash Flow)-Intrinsic Valuation Technique)

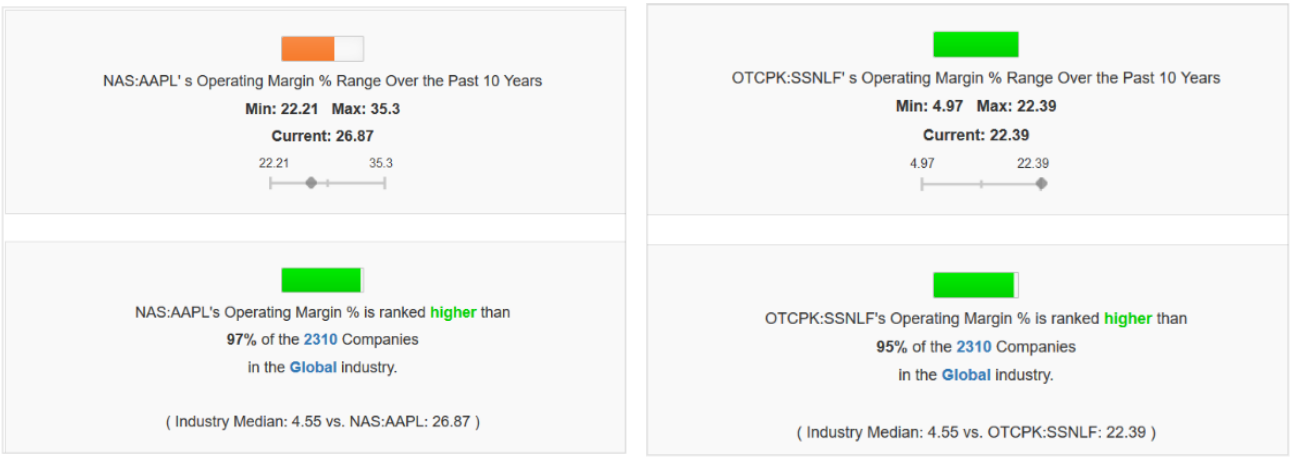
Kindly Note this Valuation has taken place at the time between Feb-April 2018-all insights and analysis are subject to that time.

Some Insights from Company Study: -

- The main cash cow for Apple is the iPhone. It roughly generates 60% of total revenues for Apple.
- This company is very fortunate that it was able to release products that changed some industries.
- The reason for Apple's success is because it offers you quality hardware with easy to use software and the lifetime of its products is very good when compared to competitors.
- The Apple ecosystem is a competitive advantage as they make it difficult for you to change to another ecosystem.

Operating Margins

Since Apple is a company which has been known for its premium products its operating margins are also premium. Let us compare the operating margins with Apple's biggest competitor in terms of smartphone which is Samsung.



Operating Margins -Apple & Samsung

Brand Value

The reason was Apple's high operating margin is because of impact on **Brand value**. Apple's brand value is one of its most valued competitive advantage.

But there a different side to this argument. When we talk about Samsung and Apple it's not only about the brand value difference.

This can be justified by saying that there's a different software experience and hardware.

To some extend brand value plays a big role. But the brand value is not the only reason.

Competitive Advantages

- Company has a history of releasing new technology, by focusing on less R&D they have less things to concentrate on and that's why there's a saying

"Apple makes the best, not the first". Doing something First is a big competitive advantage.

• Giving better customer service is also a part of it.

• Giving software update to older smartphones, for a time of 4 yrs on an average whereas Samsung and other Chinese manufacturers give only 2 yrs. of software updates. Including updates to security and new features whereas android updates are rolled out late as there is problem in software integration by manufacturers. Helps in more customer satisfaction levels thereby decreasing rate of switching to another platform such as android. <u>This also helps maintaining a active user base.</u>

Estimating Growth Rates :-

To estimate the growth rates for coming years we need to do a product breakdown to get an idea of Apple's business composition.

Data has been collected from SEC filings of 10-k Report.

Data taken from the SEC fillings of 10-K report 2017 of Apple

Sales Data

The following table shows net sales by operating segment and net sales and unit sales by product for 2017, 2016 and 2015 (dollars in millions and units in thousands):

	2017	Change	2016	Change	2015
Net Sales by Operating Segment:					
Americas	$ 96,600	12 %	$ 86,613	(8)%	$ 93,864
Europe	54,938	10 %	49,952	(1)%	50,337
Greater China	44,764	(8)%	48,492	(17)%	58,715
Japan	17,733	5 %	16,928	8 %	15,706
Rest of Asia Pacific	15,199	11 %	13,654	(10)%	15,093
Total net sales	$ 229,234	6 %	$ 215,639	(8)%	$ 233,715
Net Sales by Product:					
iPhone (1)	$ 141,319	3 %	$ 136,700	(12)%	$ 155,041
iPad (1)	19,222	(7)%	20,628	(11)%	23,227
Mac (1)	25,850	13 %	22,831	(10)%	25,471
Services (2)	29,980	23 %	24,348	22 %	19,909
Other Products (1)(3)	12,863	16 %	11,132	11 %	10,067
Total net sales	$ 229,234	6 %	$ 215,639	(8)%	$ 233,715
Unit Sales by Product:					
iPhone	216,756	2 %	211,884	(8)%	231,218
iPad	43,753	(4)%	45,590	(17)%	54,856
Mac	19,251	4 %	18,484	(10)%	20,587

(1) Includes deferrals and amortization of related software upgrade rights and non-software services.

(2) Includes revenue from Digital Content and Services, AppleCare, Apple Pay, licensing and other services. Services net sales in the fourth quarter of 2017 included a favorable one-time adjustment of $640 million due to a change in estimate based on the availability of additional supporting information.

(3) Includes sales of Apple TV, Apple Watch, Beats products, iPod touch and Apple-branded and third-party accessories.

Data taken from the SEC fillings of 10-K report 2015 of Apple

Sales Data

The following table shows net sales by operating segment and net sales and unit sales by product during 2015, 2014 and 2013 (dollars in millions and units in thousands):

	2015	Change	2014	Change	2013
Net Sales by Operating Segment:					
Americas	$ 93,864	17%	$ 80,095	4%	$ 77,093
Europe	50,337	14%	44,285	8%	40,980
Greater China	58,715	84%	31,853	18%	27,016
Japan	15,706	3%	15,314	11%	13,782
Rest of Asia Pacific	15,093	34%	11,248	(7)%	12,039
Total net sales	$ 233,715	28%	$ 182,795	7%	$ 170,910
Net Sales by Product:					
iPhone (1)	$ 155,041	52%	$ 101,991	12%	$ 91,279
iPad (1)	23,227	(23)%	30,283	(5)%	31,980
Mac (1)	25,471	6%	24,079	12%	21,483
Services (2)	19,909	10%	18,063	13%	16,051
Other Products (1)(3)	10,067	20%	8,379	(17)%	10,117
Total net sales	$ 233,715	28%	$ 182,795	7%	$ 170,910
Unit Sales by Product:					
iPhone	231,218	37%	169,219	13%	150,257
iPad	54,856	(19)%	67,977	(4)%	71,033
Mac	20,587	9%	18,906	16%	16,341

(1) Includes deferrals and amortization of related software upgrade rights and non-software services.

(2) Includes revenue from the iTunes Store ®, App Store, Mac App Store, iBooks Store™ and Apple Music™ (collectively "Internet Services"), AppleCare, Apple Pay ®, licensing and other services.

(3) Includes sales of Apple TV ®, Apple Watch, Beats products, iPod and Apple-branded and third-party accessories.

Thought Process -Growth Across Products: -

- Our valuation is based on Supply chain rumours and products in the pipeline.
- Using the SEC annual fillings by Apple Inc. we will calculate the growth rate of year 2018.
- First, we would estimate the number of iPhone's Apple will ship in 2018.

iPhone Growth

We estimate that since Apple's iPhone will cause super-cycle in 2018 we will consider that iPhone model of $700 with iPhone X like design will sell 100 million smartphones in its life cycle.

So, by the end of Q4 2018 it should sell 60% of its cycle.

So, we estimate 60 million more than it did in this year of 2017.

Assuming Apple sells the other iPhone's in the previous year ratio.

Therefore, we get 267 million iPhones for year of 2018.

iPad Growth

For iPad we expect an increase of 10% yoy according as Apple released a student friendly iPad at an attractive price on $349.

Mac Growth

For Mac as supply chain rumours point we expect sales increase by 15% as Apple will be releasing a student friendly Mac priced at around $850-$1050.

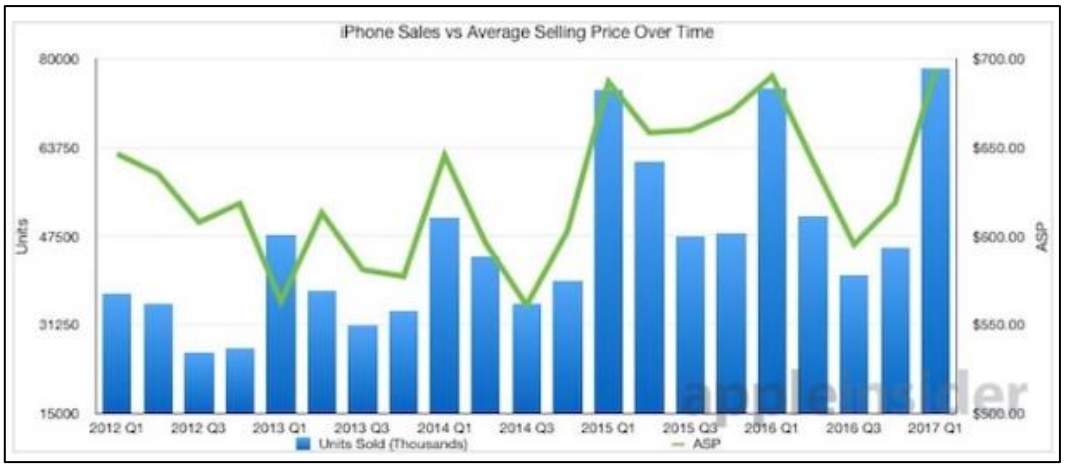
Services Growth

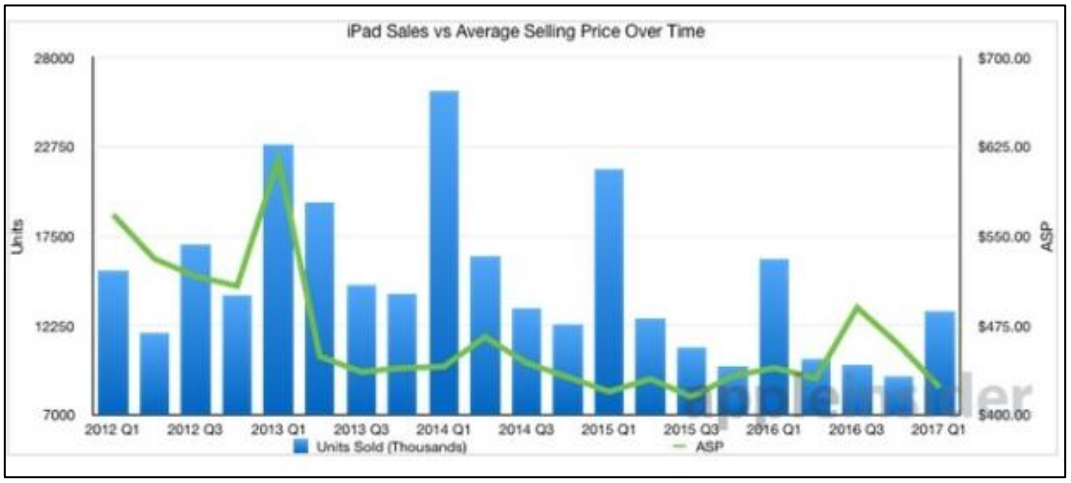
Services we expect to grow by 13% as observed historically.

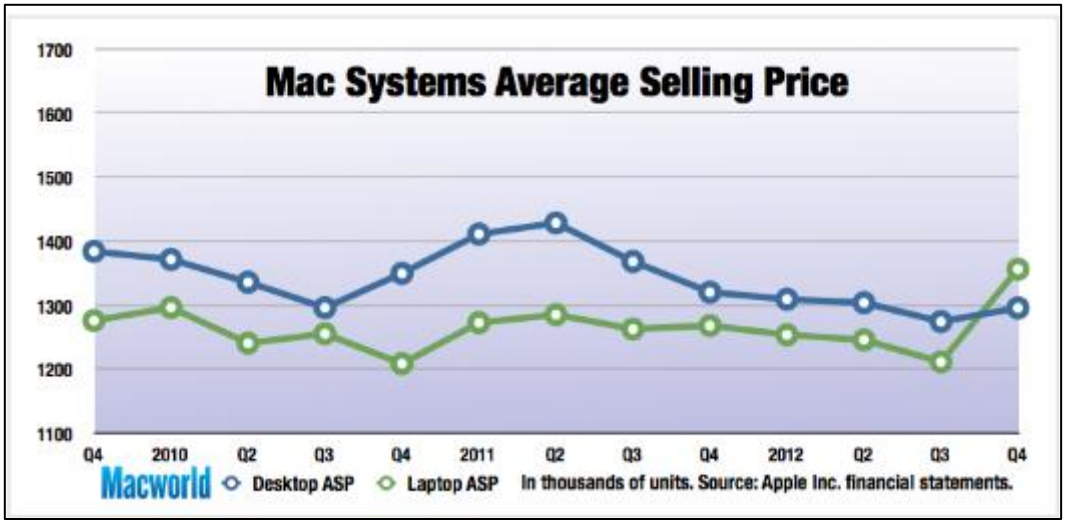
Product Category	Net Sales by product($) 2017(in Million)	Percentage
iPhone	$ 1,41,319.00	61.65%
iPad	$ 19,222.00	8.39%
Mac	$ 25,850.00	11.28%
Services	$ 29,980.00	13.08%
Other Products	$ 12,863.00	5.61%
Total	$ 2,29,234.00	100%

Product Category	Unit Sales by Product 2017(in thousands)
iPhone	216756
iPad	43753
Mac	19251
Services	-
Other Products	-

Historic Average Selling Price (ASP) of Products: -







iPad's becoming cheaper and also in March Apple launched a cheaper iPad at $350. This year iPad ASP will come down.

iPhone ASP will also come down as Apple will be releasing iPhone will cheaper price.

Apple will be launch cheaper MacBook this year. ASP should come down significantly.

Estimated the Unit Sales for 2018

Product Category	Unit Sales by Product 2017(in thousands)	Projected Unit sales 2018
iPhone	216756	267000
iPad	43753	48565
Mac	19251	28000
Services	-	
Other Products	-	

YOY increase of sales will increase the revenue by same amount.

Increase in YOY revenue in 2018
25.00%
11.00%
15.00%

The year-over-year of sales in units can be used to calculate the total revenue.

Product Category	Net Sales by product($) 2017(in Million)	Percentage	Increase in YOY revenue in 2018	Total Projected Revenue 2018
iPhone	$ 1,41,319.00	61.65%	25.00%	$ 1,76,648.75
iPad	$ 19,222.00	8.39%	11.00%	$ 21,336.42
Mac	$ 25,850.00	11.28%	15.00%	$ 29,727.50
Services	$ 29,980.00	13.08%		$ 39,000.00
Other Products	$ 12,863.00	5.61%		$ 18,000.00
Total	$ 2,29,234.00	100%		$ 2,84,712.67

By comparing 2017 revenue and 2018(E) revenue we get the growth for 2018.

By dividing the Revenue by the units sold we get the ASP for the product category respectively.

Estimated ASP: -

Average Selling Price	ASP(Estimated 2018)
iPhone	$ 661.61
iPad	$ 439.34
Mac	$ 1,061.70

This matches with our conclusion of ASP given above.

Growth Rate comes out to be 24% for 2018.

	Difference in revenue	Initial revenue
Growth Rate 2018	$ 55,478.67	$ 2,29,234.00

This year is very important to get the growth rate right as this is the year were super-cycle is bound to happen.

Apple releasing cheaper variant of Apple iPhone X with same facial recognition technology and make it available at around $700.

This time a similar specification phone will come for $999.

This would drive the pent-up demand and sell 100 million units in its lifetime.

Key Points from New Rumoured iPhone's

- Average selling Price to decrease there by increasing demand.

Before it was understood that iPhone X could have sold more but the price decreased the demand.

- Delayed Super cycle has caused Apple Inc. to miss the 1 Trillion Dollar market cap earlier than expected.
- There is going to be a huge buyback of shares in the coming Q2 2018.

Why the super-cycle is so important?

This is going to push Apple Stock past 215$ mark and give a big boost to Apple.

Has been delayed for 2 years, it is long time coming after iPhone 6.

Transition from iPhone 5s to iPhone 6 is considered a super cycle.

iPhone	Unit Sales(in thousands)	Revenue($)Million	Release date	Till next year	Stock Price
iPhone 5s period	169,219	101,991	2013	2014	$79
iPhone 6 period	231,218	155,041	2014	2015	$125-132
iPhone 6S period	211,884	136,700	2015	2016	$95
iPhone 7,7+ period	216,756	141,319	2016	2017	$117

If we see unit sales from 2014 to 2015 we can understand how powerful super-cycle has impact on the stock as well. We term it has super-cycle because Apple had significantly changed its design pattern of making smartphones. This had caused a super cycle.

The stock price went up from $79 to around $125's which is growth of 56%. And this is all because of Apple change in design of its smartphone.

Why iPhone 6 sold like super cycle

- It was trend that large screen smartphones were in demand.
- iPhone 6 bought a new redesign to Apple's product iPhone line-up

Apple then continued the same design pattern for iPhone 6s, iPhone 7 and iPhone 8. Which didn't board well for Apple as consumers didn't see a reason to buy a smartphone that looked similar in design to their 4-year-old iPhone 6.

For your reference a picture to show design similarities in iPhone's Apple released in years.

If you observe above it wouldn't look like Apple had done something different from their old iPhone 6 design. This was the 4th year after which Apple had finally took out a different design phone after 4 long years known as iPhone X.

But as we know a phone having price tag of $999 would be difficult even for Apple to sell in very high quantities.

It sold pretty well in Q4 of 2017, in fact it was the most selling smartphone model in the world with 29 million units sold in Q4.

It sold well but the super-cycle expected failed to happen due price tag of $999. Since their was radical change in design that caused the same hype as iPhone 6 died after January 2018.

The iPhone X had soon become so difficult to sell that Apple had cut the production for Q2 2018 by half of its originally planned 40 million targets according to supply chain.

iPhone X had also cannibalized the sales of iPhone 8 which was released at a significantly lower price tag of $700 alongside in Sept 2017; since it looked similar to the consumers 3-year-old iPhone's.

According to supply chain rumours Apple is going to release new cheaper iPhone's as above discussed which will cause super cycle.

Growth Rates for coming years

- In 2019 somewhere around 11.5%

  After the super-cycle the growth will be boosted and still effect growth rate for 2 years as momentum will be on Apple's side.

  It should come to around half of what the company grew in 2018.

- In 2020 around 10.06%

  Apple has become a well-diversified company.

We expect it to be of following industries and not only computer peripherals.

Apple industry classification: -

- Computer Peripherals
- Semiconductor (As it makes its own chips)
- Computer Services (Its services business is also having big impact)
- Software System (It makes its own software)

From Prof. Damodaran 's website we took average of the following industry growth rates after 2 years: -(www.stern.nyu.edu/~adamodar/pc/datasets/histgr.xls)

Industry Name	*Number of Firms*	*CAGR in Net Income- Last 5 years*	*CAGR in Revenues- Last 5 years*	Expected Growth in Revenues - Next 2 years
Computer Services	111	0.23%	15.31%	7.92%
Computers/Peripherals	58	22.65%	-2.67%	5.07%
Semiconductor	72	16.18%	8.72%	12.42%
Software (System & Application)	255	16.08%	12.71%	14.90%

If we take the average of growth rates we get around 10.06%.

This we consider as our growth rate for 2020.

- In 2021 around 7%.

The growth rate is based on assumption that Apple will suffer from its premium pricing somewhere down the line.

For calculating the growth rate of perpetuity after 2022, took the weighted average between the demographic growth rate and percentage of Apple's business in the demographics respectively.

Demographics	GDP Growth Rate	Sales 2016-17	Percentage impact by demographic	Growth effect by region on sale
Americas	1.6	96600	42.14	67.425
Europe	2.4	54938	23.97	57.518
Greater China	6.7	44764	19.53	130.835
Japan	1	17733	7.74	7.736
Rest of Asia	7	15199	6.63	46.412
		229234	100	

weighted avg	3.099261017

So, the perpetuity growth rate of Apple is around 3.10% after 2022.

Discounted Cash Flow Sheet

The valuation method we are using is intrinsic valuation in which value of company is based on its cash flows, growth potential and risk. We use the discounted cash flow approach to estimate intrinsic value, and the present value of the expected cashflows on the asset, discounted back at a rate that reflects the riskiness of these cashflows.

A	B	C	D	E	F	G	H
Apple Inc. (All units in Millions except no.of shares,rates,value per share)	2017	2018	2019	2020	2021	2022 TO PERPETUTIY	
EBIT	69,412						
Tax Rate(worldwide effective tax rate)	24.60%	24.60%	24.60%	24.60%	24.60%		
EBIT*(1-TaxRate)	52336.648	0	0	0	0		
Net Operating Working Capital	22117						
Net Plant and Machinary 2017	33783						
Total Operating Capital	55900	0	0	0	0		
Net plant and Machinary 2016	27,010						
Depreciation & Ammortization	10517						
Capex(Net plants&machinary (2017-2016))	6,773						
EBITDA=EBIT + Ammortization+ depreciation	79,929						
FCF=EBITDA -Net Operating Working Capital -CAPEX	51,039	63293.4639	70572.21225	77671.7768	83108.80118	85685.17401	
Net Operating Working Capital=Cash + A/C Recievables + Inventory -(A/C payable + Accrued Expenses)							
Growth Rates		24.01%	11.50%	10.06%	7.00%	3.10%	
Risk free rate	**2.19%**						
WACC	10.32%	10.32020%					
Risk Premium	5.89%						
Beta	1.38000						
Discount factor	110.32%						
After discount rates present value	51,039	57372.6105	57986.27693	57849.61601	56108.67398	801219.4303	10,81,576
Total Cash Flow Sum at end of 2022 at constant growth rate of 3.10%	In Million	Billion					
NPV	10,81,576	1081.575608					
Add value of non-operating assets							
Short term investments	53,892						
Intangible Assets	2,298						

			More accurate
Net Debt Level	97,272		
Value of equity	9,84,303.60776	984.3036078	9.84304E+11
No of shares outstanding	5,25,16,92,000	5.25	5,25,16,92,000
Value per share		187.4864015	187.4259968
Historical Price			
09/29/2017		171	
Conclusion			
Since Fair Value>Market Price			
Difference		16.42599676	
Percentage Undervalued		9.606%	
Apple is a BUY			

EBITDA= EBIT + (Ammortization & Depreciation)

Effective Tax Rate: -

This data is taken from company's fillings from 10-K as of 2017.

Provision for Income Taxes

Provision for income taxes and effective tax rates for 2017, 2016 and 2015 were as follows (dollars in millions):

	2017	2016	2015
Provision for income taxes	$ 15,738	$ 15,685	$ 19,121
Effective tax rate	24.6%	25.6%	26.4%

Total Operating Capital = Net Plant and Machinery 2017 + Net Operating Working Capital

= 33783 + 22117

= 55900;

Cash Flows in million $

FCF=EBITDA -Net Operating Working Capital -CAPEX= 51,039;

FCF (2018) =FCF (2017) *(1+Growth 2018) =63923;

FCF (2019) =FCF (2018) *(1+Growth 2019) =70572;

FCF (2020) =FCF (2019) *(1+Growth 2020) =77671;

FCF (2021) =FCF (2020) *(1+Growth 2021) =83108;

FCF (2022) =FCF (2021) *(1+Growth 2022) =85685;

Discount these all free cash flows to present value by discount factor of "k", where k is the weighted average cost of capital of Apple Inc.

Calculating W.A.CC

By capital asset pricing model, we get the relation between risk free rate, beta, risk premium and risk-free rate of company which can be treated as the weighted average cost of capital.

The risk-free rate of United States we calculated by taking last 4-year average.

United States 10-Year Bond Yield Historical Data

Time Frame: Monthly | Download Data | 08/01/2014 - 08/01/2015

Date	Price	Open	High	Low	Change %
Aug 15	2.214	2.200	2.293	1.905	1.23%
Jul 15	2.187	2.373	2.470	2.176	-6.90%
Jun 15	2.349	2.128	2.500	2.106	10.65%
May 15	2.123	2.049	2.366	2.046	4.32%
Apr 15	2.035	1.930	2.110	1.802	5.60%
Mar 15	1.927	2.005	2.259	1.852	-3.46%
Feb 15	1.996	1.653	2.164	1.649	21.78%
Jan 15	1.639	2.200	2.213	1.637	-24.47%
Dec 14	2.170	2.178	2.347	2.009	-0.14%
Nov 14	2.173	2.309	2.407	2.166	-6.94%
Oct 14	2.335	2.500	2.508	1.865	-6.41%
Sep 14	2.495	2.357	2.655	2.354	6.40%
Aug 14	2.345	2.562	2.591	2.303	-8.47%

Highest: 2.655 | Lowest: 1.637 | Difference: 1.018 | Average: 2.153 | Change %: -13.583

Time Frame: Monthly | Download Data | 08/01/2016 - 08/01/2017

Date	Price	Open	High	Low	Change %
Aug 17	2.120	2.303	2.321	2.086	-7.67%
Jul 17	2.296	2.314	2.398	2.225	-0.35%
Jun 17	2.304	2.213	2.309	2.103	4.44%
May 17	2.206	2.282	2.423	2.181	-3.63%
Apr 17	2.289	2.396	2.405	2.165	-4.19%
Mar 17	2.389	2.415	2.629	2.348	-0.33%
Feb 17	2.397	2.461	2.524	2.310	-2.80%
Jan 17	2.466	2.439	2.555	2.305	0.82%
Dec 16	2.446	2.397	2.641	2.340	2.34%
Nov 16	2.390	1.838	2.417	1.716	30.96%
Oct 16	1.825	1.600	1.879	1.593	14.21%
Sep 16	1.598	1.580	1.752	1.519	1.27%
Aug 16	1.578	1.463	1.635	1.463	8.83%

Highest: 2.641 | Lowest: 1.463 | Difference: 1.178 | Average: 2.177 | Change %: 46.207

Time Frame: Monthly | Download Data | 08/01/2015 - 08/01/2016

Date	Price	Open	High	Low	Change %
Aug 16	1.578	1.463	1.635	1.463	8.83%
Jul 16	1.450	1.471	1.628	1.321	-1.69%
Jun 16	1.475	1.844	1.856	1.406	-20.31%
May 16	1.851	1.830	1.890	1.700	0.87%
Apr 16	1.835	1.784	1.941	1.685	3.67%
Mar 16	1.770	1.737	2.002	1.702	1.84%
Feb 16	1.738	1.933	1.966	1.530	-9.62%
Jan 16	1.923	2.293	2.293	1.911	-15.25%
Dec 15	2.269	2.217	2.358	2.120	2.76%
Nov 15	2.208	2.137	2.377	2.130	2.89%
Oct 15	2.146	2.042	2.183	1.904	5.45%
Sep 15	2.035	2.214	2.303	2.035	-8.08%
Aug 15	2.214	2.200	2.293	1.905	1.23%

Highest: 2.377 | Lowest: 1.321 | Difference: 1.056 | Average: 1.884 | Change %: -27.846

Time Frame: Monthly | Download Data | 08/01/2017 - 08/01/2018

Date	Price	Open	High	Low	Change %
Apr 18	3.028	2.755	3.035	2.717	10.46%
Mar 18	2.741	2.866	2.936	2.739	-4.29%
Feb 18	2.864	2.724	2.957	2.648	5.60%
Jan 18	2.712	2.429	2.754	2.416	12.77%
Dec 17	2.405	2.411	2.504	2.314	-0.41%
Nov 17	2.415	2.379	2.437	2.304	1.60%
Oct 17	2.377	2.344	2.477	2.273	1.62%
Sep 17	2.339	2.127	2.359	2.016	10.33%
Aug 17	2.120	2.303	2.321	2.086	-7.67%

Highest: 3.035 | Lowest: 2.016 | Difference: 1.019 | Average: 2.556 | Change %: 31.868

We get the risk-free rate as 2.192 %

Calculating Apple Beta Value

1.) From Yahoo finance got the monthly adjusted price closing of the index NYSE DJ composite and the Apple Inc. accordingly.

2.) Calculated the monthly return percentage accordingly.

3.) Slope of return % company to return % of index gave the Beta for the following year.

		Beta on stable year 2014-15(supercycle)		1.38
Date	Apple Closing Price	Return %	Nyse Closing Price	Return %
01-08-2014	94.575012		10702.92969	
01-09-2014	101.380669	7.20	10845	1.327
01-10-2014	111.64077	10.12	10955.41016	1.018
01-11-2014	104.064095	-6.79	10839.24023	-1.060
01-12-2014	110.456161	6.14	10537.21973	-2.786
01-01-2015	121.109573	9.64	11062.79004	4.988
01-02-2015	117.773132	-2.75	10899.19043	-1.479
01-03-2015	118.45462	0.58	11049.74023	1.381
01-04-2015	123.310173	4.10	11056.29981	0.059
01-05-2015	119.215553	-3.32	10805.2002	-2.271
01-06-2015	115.290161	-3.29	10882.28027	0.713
01-07-2015	107.325356	-6.91	10176.5	-6.486
01-08-2015				

Calculating the Risk Premium of Apple: -

From Apple's 10-K SEC fillings at end of 2017

	2017	Change	2016	Change	2015
Net Sales by Operating Segment:					
Americas	$ 96,600	12 %	$ 86,613	(8)%	$ 93,864
Europe	54,938	10 %	49,952	(1)%	50,337
Greater China	44,764	(8)%	48,492	(17)%	58,715
Japan	17,733	5 %	16,928	8 %	15,706
Rest of Asia Pacific	15,199	11 %	13,654	(10)%	15,093
Total net sales	$ 229,234	6 %	$ 215,639	(8)%	$ 233,715

Demographics	Sales 2016-17	Percentage impact by demographic	Rounding UP	Equity Risk premium (ERP))	Weighted Avg(Weight * ERP)
Americas	96600	42.14	43%	5.08	2.1844
Europe	54938	23.97	24%	7	1.68
Greater China	44764	19.53	19%	5.89	1.1191
Japan	17733	7.74	8%	5.89	0.4712
Rest of Asia	15199	6.63	6%	7.27	0.4362
	229234	100			5.8909
		Risk Premium Apple=5.89%			

We take the weighted average of ERP by regions and that of Apple's presence in the regions its weight in different demographics.

By Capital Asset Pricing Model

W.A.C.C = Risk_free_rate + (Beta*Risk Premium)

= 2.192 + (1.38 * 5.89)

= 10.32%

We discount each FCF by the factor of (1 + W.A.C.C) ^N where N is no. of years to discount to from zero.

We bring the cash flows to present value.

Value of firm = FCF(2017) + {FCF(2018)/(1+K)} {FCF(2019)/(1+K)^2} + {FCF(2020)/(1+K)^3} + {FCF(2021)/(1+K)^4} + {FCF(2022)/(1+K)^4/(K-G)}

= 51,039 + 57372.6105 + 57986.27693 + 57849.61601 + 56108.67398 + 801219.4303

= 10,81,576 $ (in million)

=1081 $ (in billion)

Net Value of debt=long term debt = 97 272 $ million

=97 $ billion

Net value of equity= Value of firm – value of debt

= 984.30 $ Billion

We divide the net value of equity by no. of outstanding shares , we get the Value per share.

The following table shows the computation of basic and diluted earnings per share for 2017, 2016 and 2015 (net income in millions and shares in thousands):

	2017	2016	2015
Numerator:			
Net income	$ 48,351	$ 45,687	$ 53,394
Denominator:			
Weighted-average shares outstanding	5,217,242	5,470,820	5,753,421
Effect of dilutive securities	34,450	29,461	39,648
Weighted-average diluted shares	5,251,692	5,500,281	5,793,069
Basic earnings per share	$ 9.27	$ 8.35	$ 9.28
Diluted earnings per share	$ 9.21	$ 8.31	$ 9.22

Potentially dilutive securities whose effect would have been antidilutive are excluded from the computation of diluted earnings per share.

We take 5.251 million shares.

Value per share = Value of equity / Wt. avg diluted shares

Estimated value=187 $.

Market value of Apple (we took last 6-month daily Adj closing price average) =171$

Since, Estimated Value > Market Value

APPL is undervalued by 9.6%.

Our valuation was completed before April 30th 2018

Conclusion

On 1st May 2018 Apple Inc. declared its earnings of Q2 2018.

Analysts were bear about the stock. As iPhone X wasn't selling that well.

Everyone though the stock be in the red after the earnings.

According to my valuation I had quoted optimism about Apple.

And so, it happened that Apple beats Wall Street expectation and we were right.

The stock picked up and reached 178 on the day after earnings call.

We were also expected a huge buyback as Apple's plan is to get net neutral of its 267 $ billion overseas cash.

Apple announced 100 billion of buyback which we had right on our prediction.

Apple is going to perform well in long term and investors shouldn't worry of any downs as end of the day I don't think we can live without an iPhone.

End Notes

I would like to express my gratitude to Dr. Natesa Prasad, who has guided me as the Project Supervisor.

Some Links: -

This was a brief report to summarize my project.

You can also visit the detailed files as given below: -

1.) Detailed Full Report

https://drive.google.com/file/d/14RQdLYkBWvWVceD0L3907620Jf-c9tdN/view?usp=sharing

2.) Valuation Excel Sheet

https://drive.google.com/file/d/1EPU_JsF5EnPc9fhBniFpKeXH9J9GkFDt/view?usp=sharing

3.) Entire Project Files

https://docs.google.com/document/d/1zNf9gxoUwTUocQpKLseXJqHEit162CRx1bI5srsSMTE/edit?usp=sharing

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Part-C-Comparisons Between Fundamental Analysis & Time Series Analysis

Time series analysis is based on forecasting the future trends based on previous patterns.

The problem is divided by observing the trend, seasonality effects and by determining the order of the series using statistical methods we fit a line which then forecasts values into the future.

In many cases, as far as univariate analysis is concerned we ignore external factors like competitive advantages, business study, economic factors and focus on the series of historic prices itself.

In multivariate analysis we are able to counter this and we can account for some economic factors. But there are limitations to what we can quantify and what we cannot.

We cannot completely ignore the balance sheet essentials and say that this is the right way to forecast.

During our problem of stock price prediction, we had focused on the series and then we applied Seasonal ARIMA. We didn't focus much on external factors/variables.

In fundamental analysis, we ignore most charts and trends and focus more on the financial reports like balance sheets. We look into competitive advantages, economic factors, growth story of the company, etc. At the end we value the company and see whether it is overvalued or undervalued according to our prediction.

Neural networks and new machine learning techniques have given forecasting models unimaginable accuracy. But the challenge is no model is perfect.

Fundamental analysis in its own way is unique and powerful and is a more traditional way for valuing companies.

Apart from difference methodologies, time series forecasting is much quicker at deployment than valuing a company. Valuation can take much longer time in comparison.

The best way to make forecasting decisions I believe is by deploying both types of methods.

By using both of the techniques to give us more intuition towards the problem and make sure that we invest in the right place.

Using many techniques in harmony can create a more complete picture and give better forecasting powers.