Time Series Analysis of Apple Stock

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```
# Data
stockname = 'AAPL' # Apple Stock Data
startdate = '2015-01-01'
enddate = '2019-01-01'
```

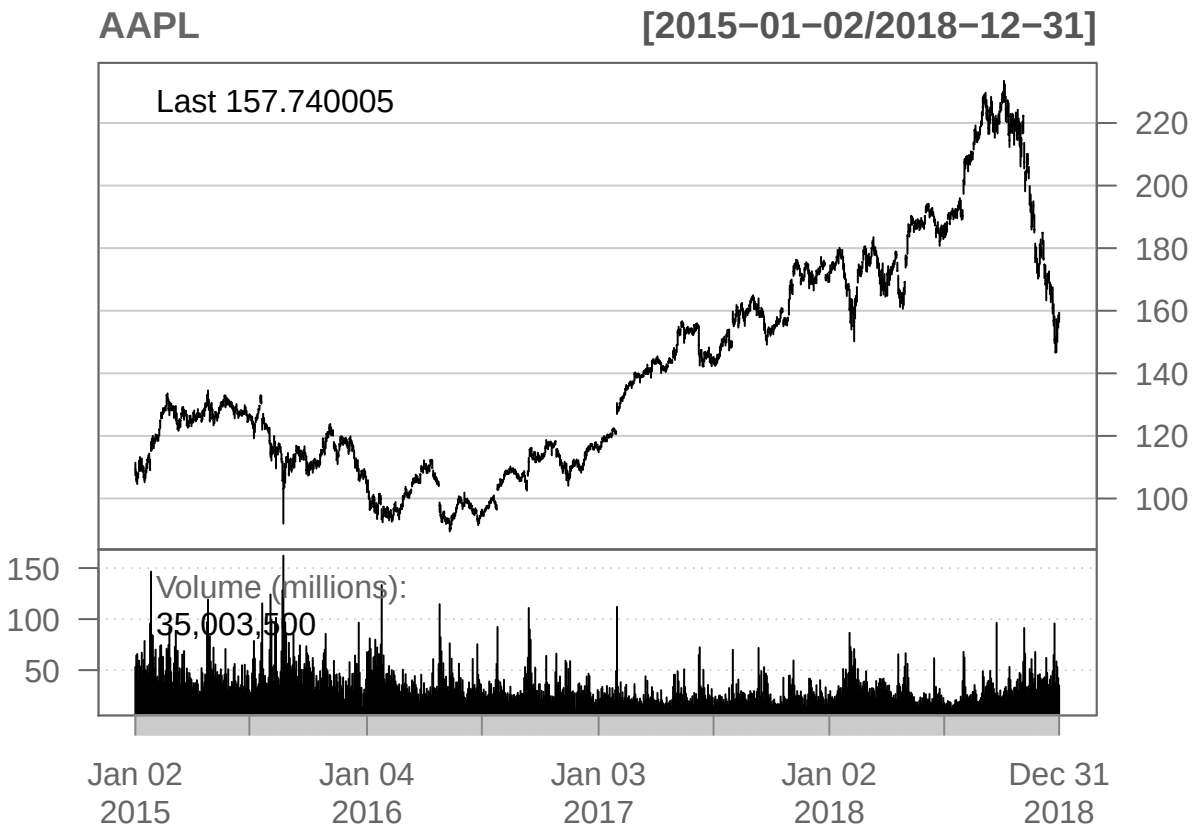
The data used for this project is financial stock prices data for Apple Inc. (ticker: AAPL) and has been taken from database of Yahoo Finance for a duration of four years (2015-2019).The data has been downloaded using the R code, directly in the form of a time series object. Since the data is updated regularly, it requires less processing. We have removed the NA values from the data.

The top few rows in the data can be seen in the image below:

```
options(width = 200)
# Visualizing Data
head(stockvar)
```

```
##            AAPL.Open AAPL.High AAPL.Low AAPL.Close AAPL.Volume AAPL.Adjusted
## 2015-01-02    111.39    111.44   107.35     109.33    53204600     100.75590
## 2015-01-05    108.29    108.65   105.41     106.25    64285500      97.91743
## 2015-01-06    106.54    107.43   104.63     106.26    65797100      97.92667
## 2015-01-07    107.20    108.20   106.70     107.75    40105900      99.29981
## 2015-01-08    109.23    112.15   108.70     111.89    59364500     103.11513
## 2015-01-09    112.67    113.25   110.21     112.01    53699500     103.22571
```

```
barChart(stockvar,theme='white.mono',bar.type='hlc', name=c(stockname)[1])
```



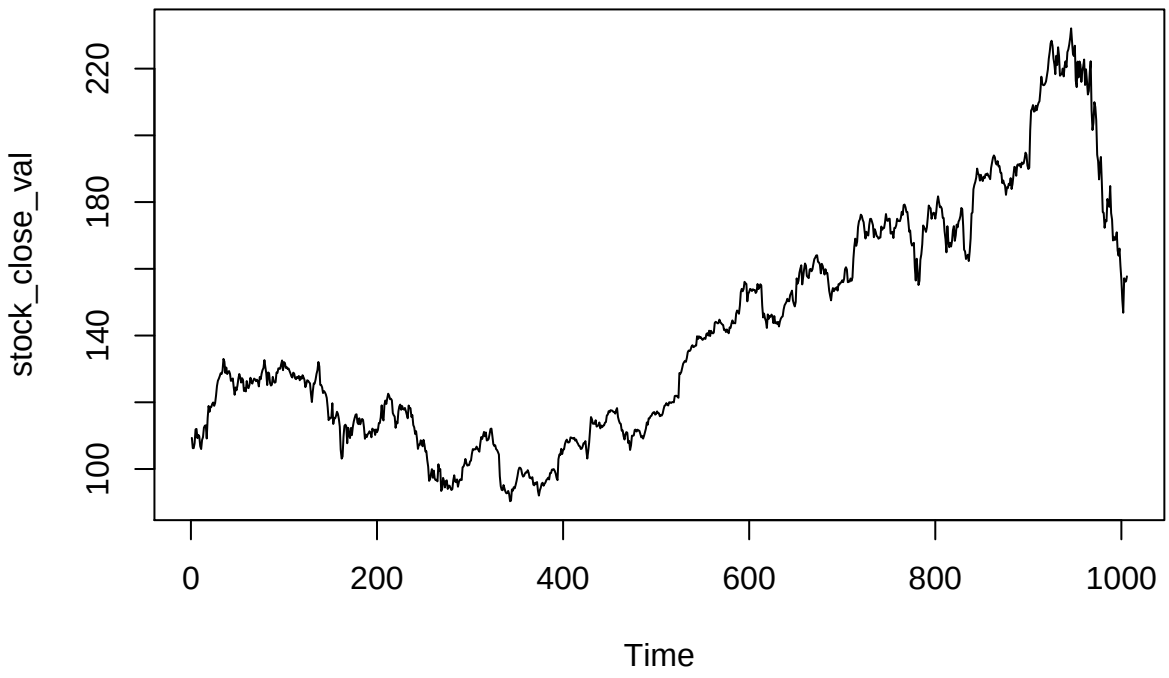
The plot shows the dollar value fluctuations of the Apple stock closing prices. In the bottom part we can see the volume of shares traded during this time. It clearly shows the fall of apple stock during the 2016 when the Apple stock prices crashed due to the disappointing earnings call causing the Apple's market value to plummet by upwards of $40 billion, significantly affecting several large shareholders like Swiss National Bank and various hedge funds that heavily invested in AAPL.

We extracted the stock closing values from the dataset and plotted the time series for observation.

```
# Extract Stock closing values
price = stockvar[,4]
head(price)
```

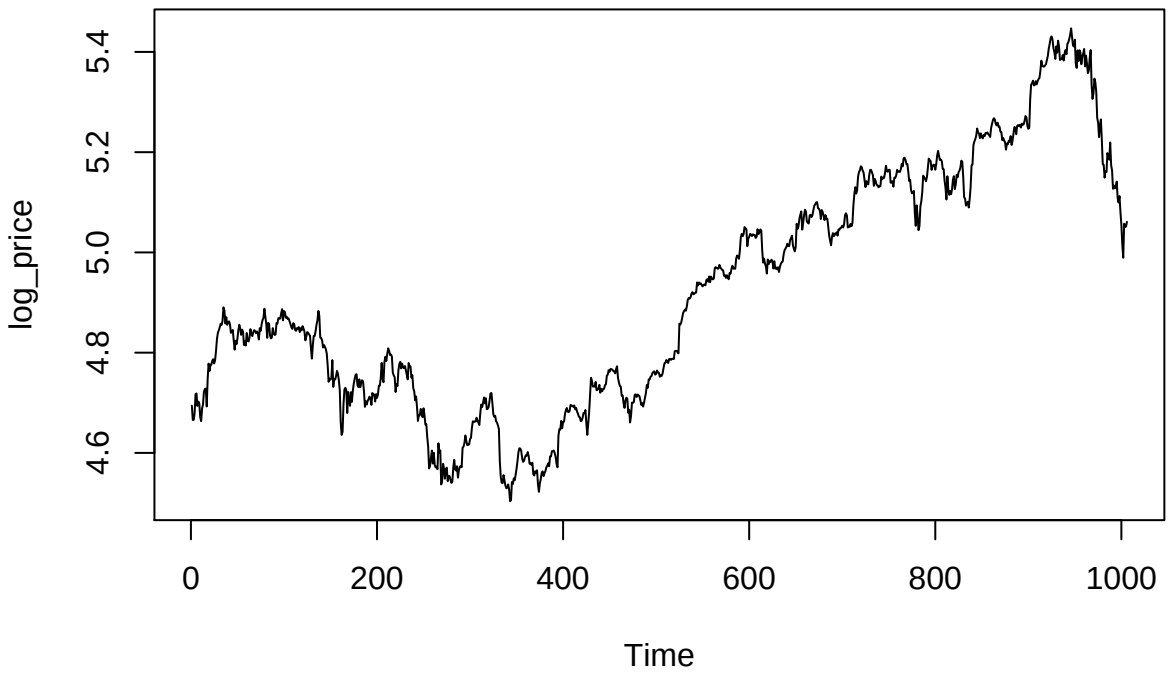
```
##            AAPL.Close
## 2015-01-02     109.33
## 2015-01-05     106.25
## 2015-01-06     106.26
## 2015-01-07     107.75
## 2015-01-08     111.89
## 2015-01-09     112.01
```

```
stock_close_val = as.data.frame(price)[,1] # converted to list type
plot.ts(stock_close_val)
```



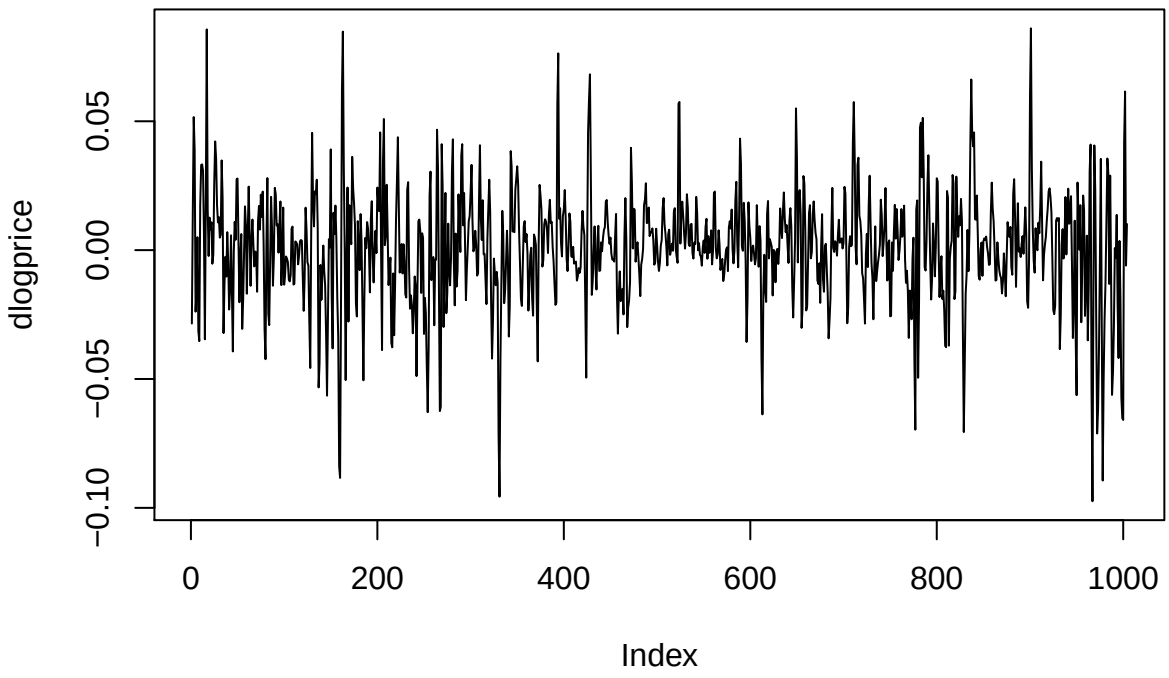
For forecasting and economic analysis many variables are used in logarithms (logs). In time series analysis, this transformation is often considered to stabilize the variance of a series. We took the logarithm of closing prices and stabilized the variance.

```
# Taking Log of Data
log_price = log(stock_close_val)
# Plot of TS (log_price)
plot.ts(log_price)
```



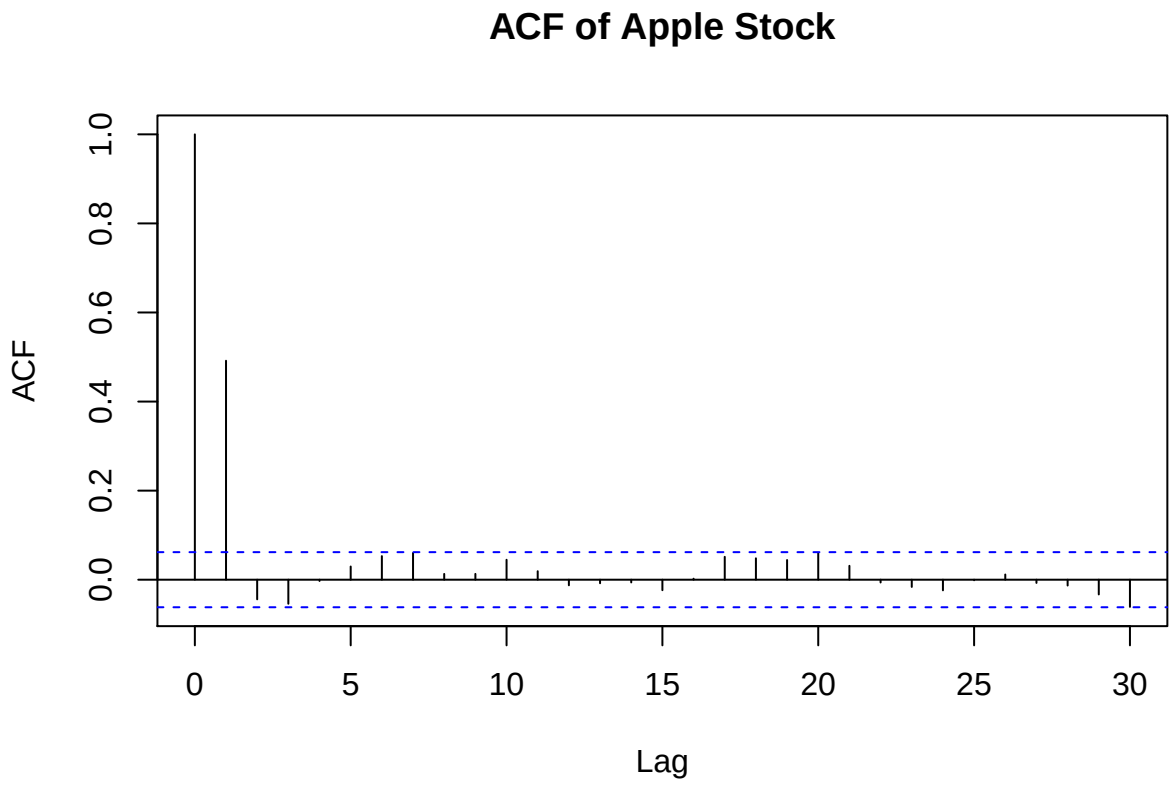
A stationary time series is one whose statistical properties such as mean, variance etc. are all constant over time. Most statistical forecasting methods are based on the assumption that the time series can be rendered stationary approximately through using some transformations, Since a stationarized series is relatively easy to predict. Here we applied differencing to convert the data into a stationary time series. The plot shows the data after differencing and we can see it appears stationary.

```
dlogprice = diff(log_price, lag = 2)
dlogprice = dlogprice[!is.na(dlogprice)]
plot(dlogprice, type='l')
```

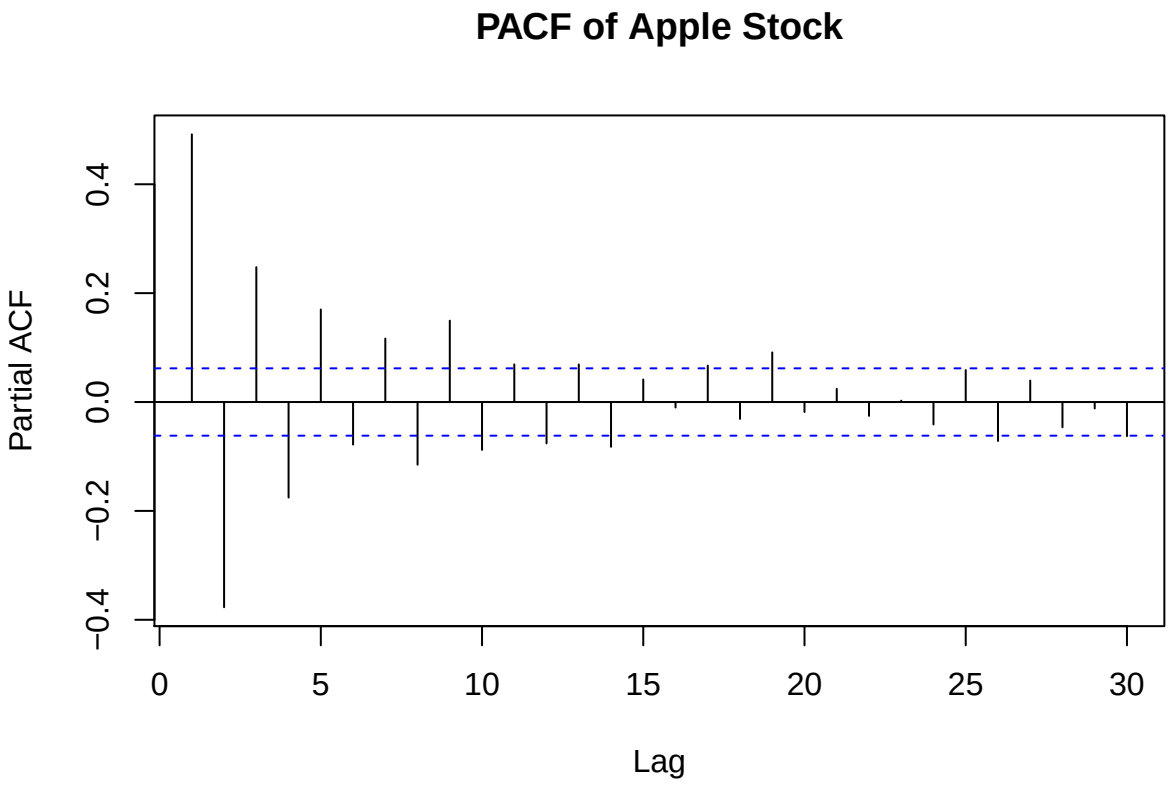


These plots show the ACF and PACF of the augmented data.

```
acf(dlogprice, main = "ACF of Apple Stock")
```




```
pacf(dlogprice, main = "PACF of Apple Stock")
```


PACF of Apple Stock
Partial ACF
0.4
0.2
0.0
−0.2
−0.4
0
5
10
15
20
25
30
Lag