Analysis of Stock Prices using Time Series Model

Shaswata Banik

Sem-VI

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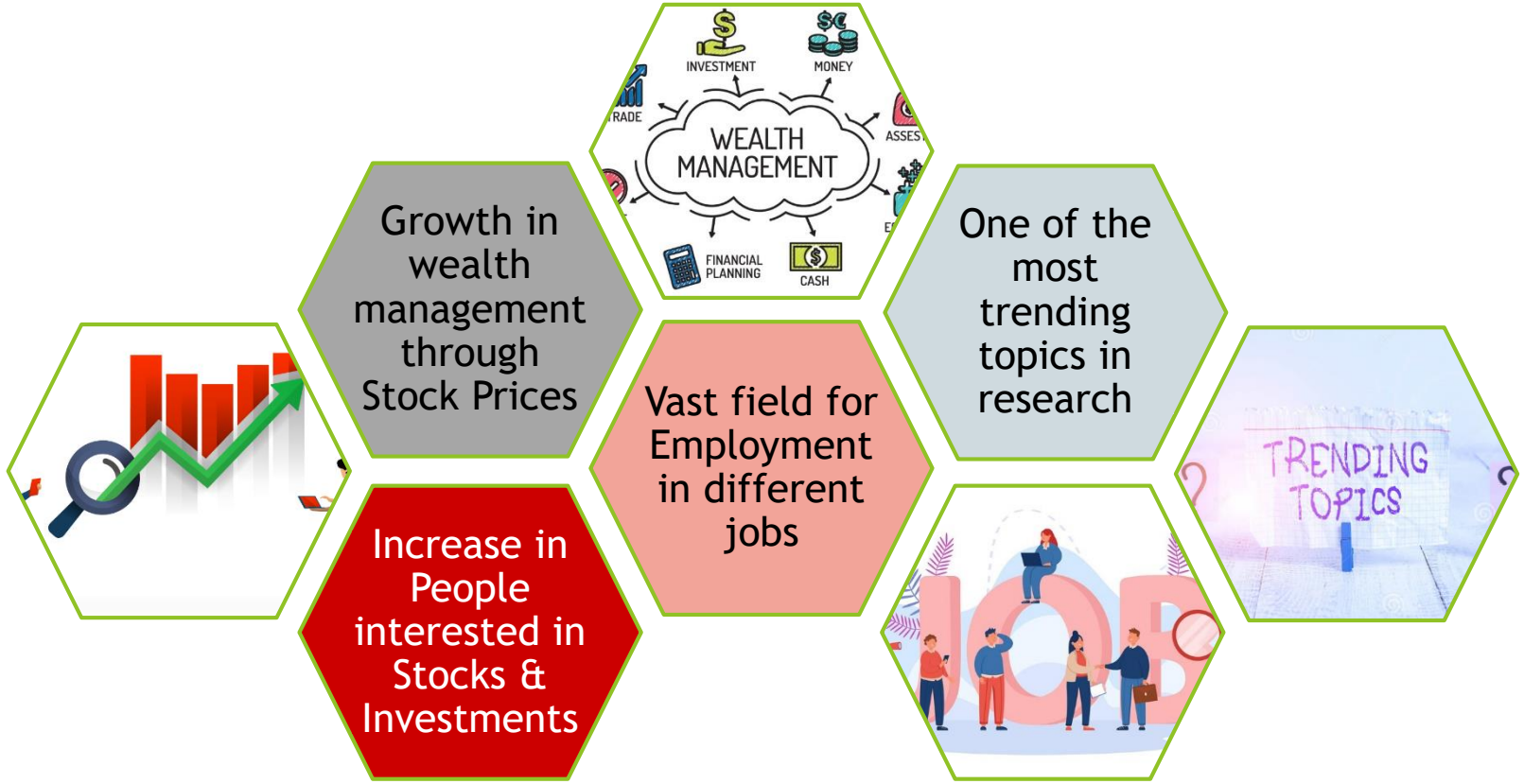
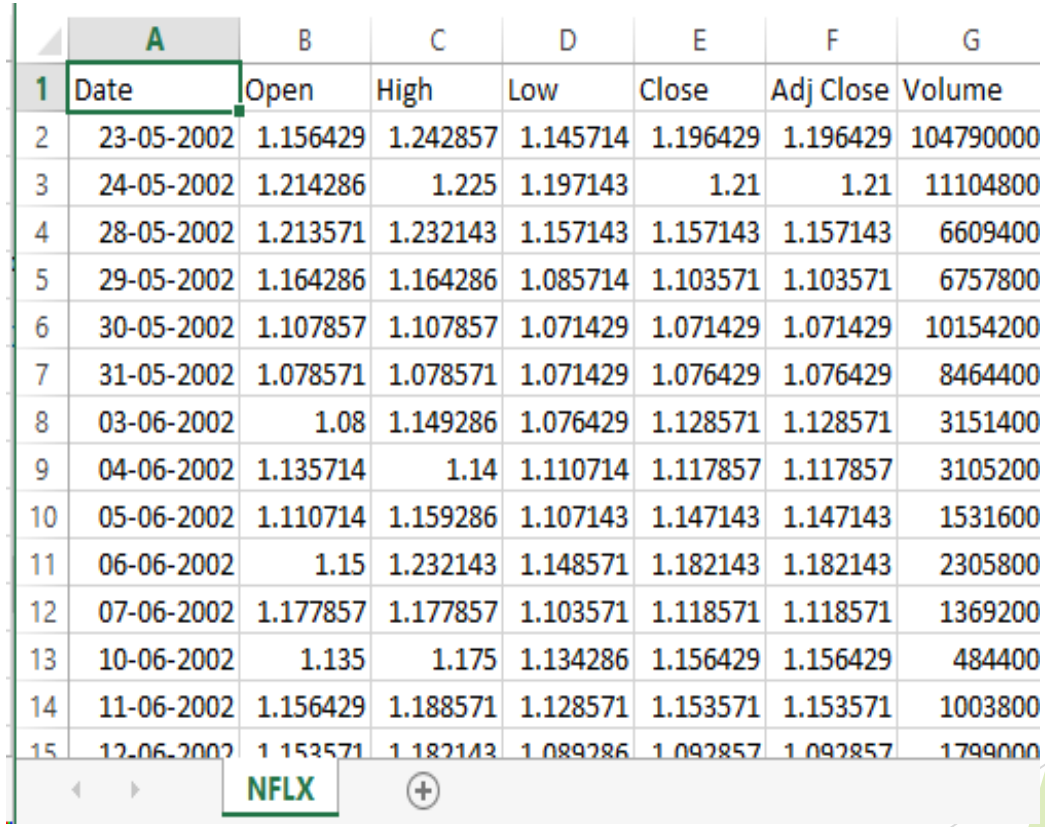
Introduction



Data Description

Daily data on stock prices on trading days (namely date, opening, high, low, closing, adjusted closing prices & volume) of –

- Amazon (Jan,1999 - Dec,2022)
- Microsoft (Jan,2000 – Nov,2023)
- Netflix (May,2002 – July,2020)



	A	B	C	D	E	F	G
1	Date	Open	High	Low	Close	Adj Close	Volume
2	23-05-2002	1.156429	1.242857	1.145714	1.196429	1.196429	104790000
3	24-05-2002	1.214286	1.225	1.197143	1.21	1.21	11104800
4	28-05-2002	1.213571	1.232143	1.157143	1.157143	1.157143	6609400
5	29-05-2002	1.164286	1.164286	1.085714	1.103571	1.103571	6757800
6	30-05-2002	1.107857	1.107857	1.071429	1.071429	1.071429	10154200
7	31-05-2002	1.078571	1.078571	1.071429	1.076429	1.076429	8464400
8	03-06-2002	1.08	1.149286	1.076429	1.128571	1.128571	3151400
9	04-06-2002	1.135714	1.14	1.110714	1.117857	1.117857	3105200
10	05-06-2002	1.110714	1.159286	1.107143	1.147143	1.147143	1531600
11	06-06-2002	1.15	1.232143	1.148571	1.182143	1.182143	2305800
12	07-06-2002	1.177857	1.177857	1.103571	1.118571	1.118571	1369200
13	10-06-2002	1.135	1.175	1.134286	1.156429	1.156429	484400
14	11-06-2002	1.156429	1.188571	1.128571	1.153571	1.153571	1003800
15	12-06-2002	1.153571	1.182143	1.089286	1.092857	1.092857	1799000

NFLX

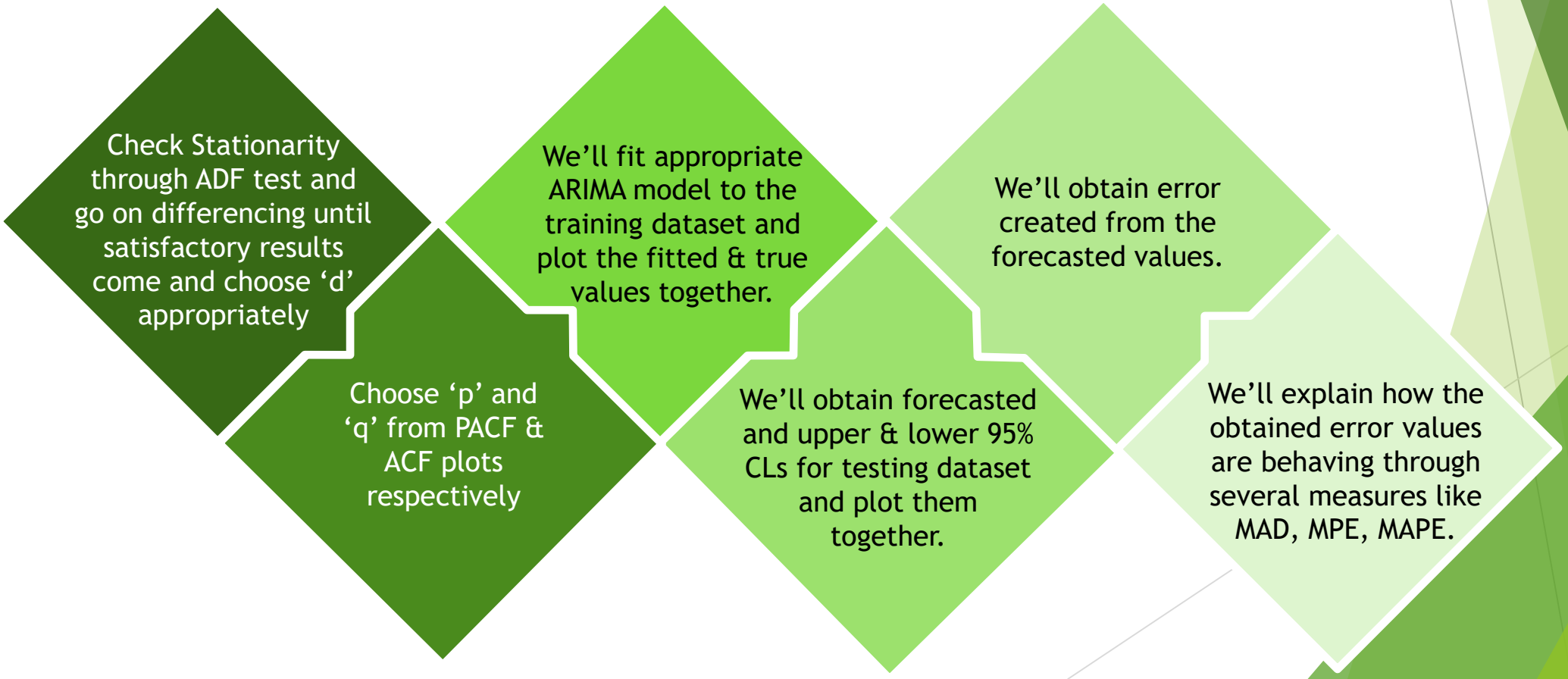
Sources:

- https://www.kaggle.com/datasets/prajwaldongre/microsoft-stock-price2000-2023
- https://www.kaggle.com/datasets/aayushmishra1512/netflix-stock-data
- https://www.kaggle.com/datasets/sriharshaeedala/amazon-stock-price-from-1999-to-2022

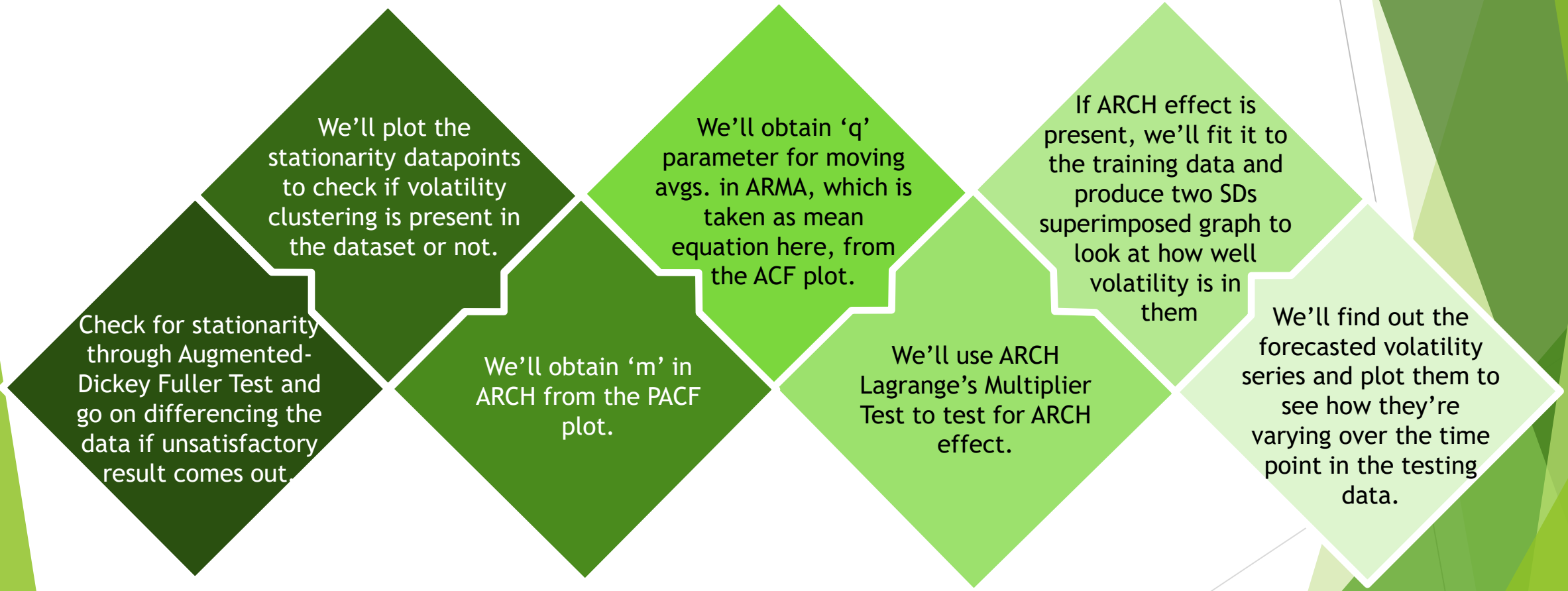
Methodology

We'll take log returns of the stock prices and divide them in 8:2 ratio for training & testing purposes

ARIMA(p,d,q) fitting



ARCH(m) fitting

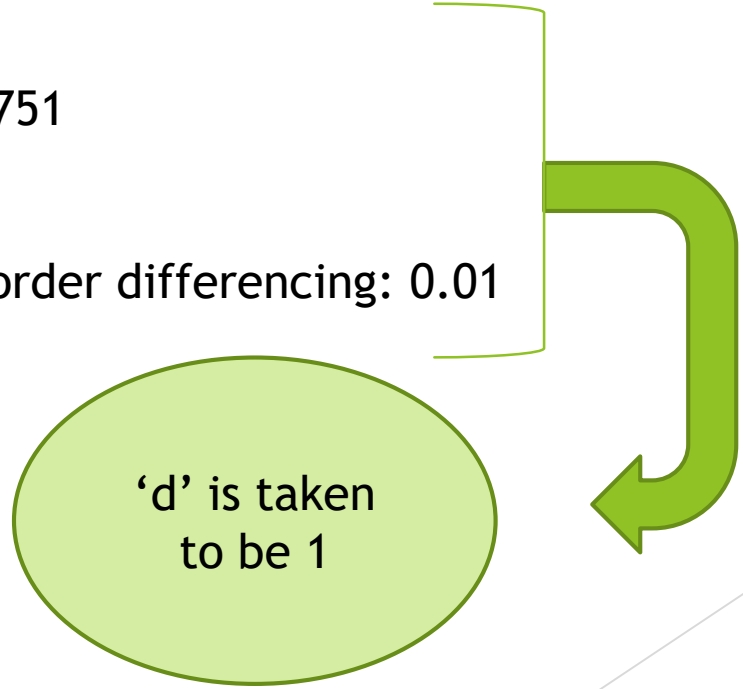


Results

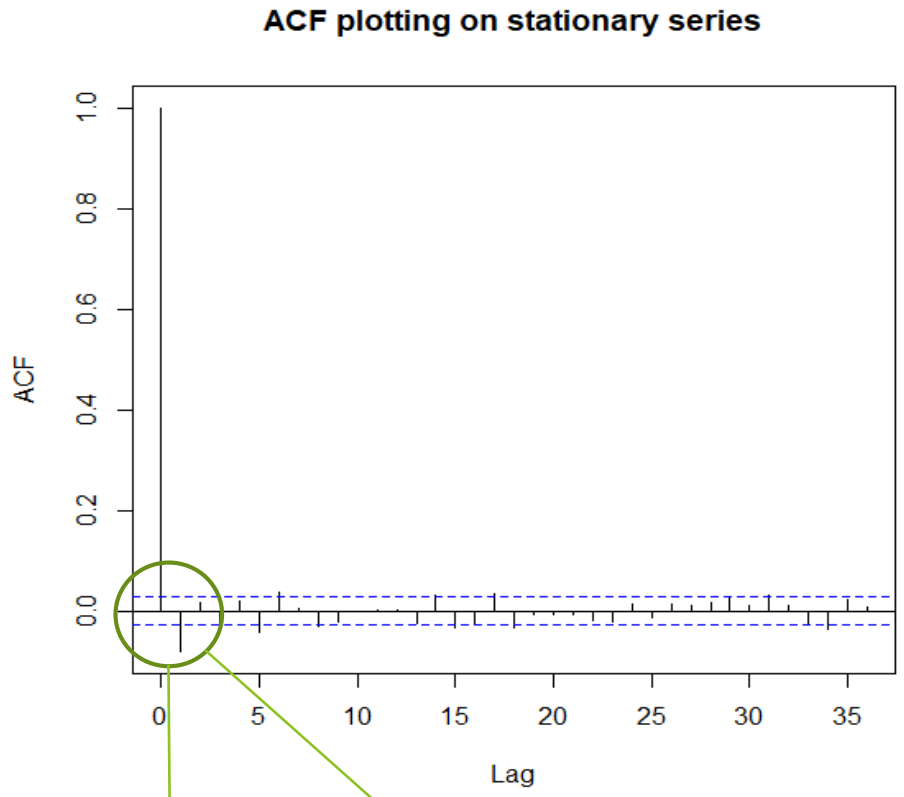
We'll look at the results obtained through analysis on log returns of opening prices of Amazon.

Stationarity Checking (through ADF test)

- p-value based on the true values: 0.2751
- p-value based on the values after 1st order differencing: 0.01



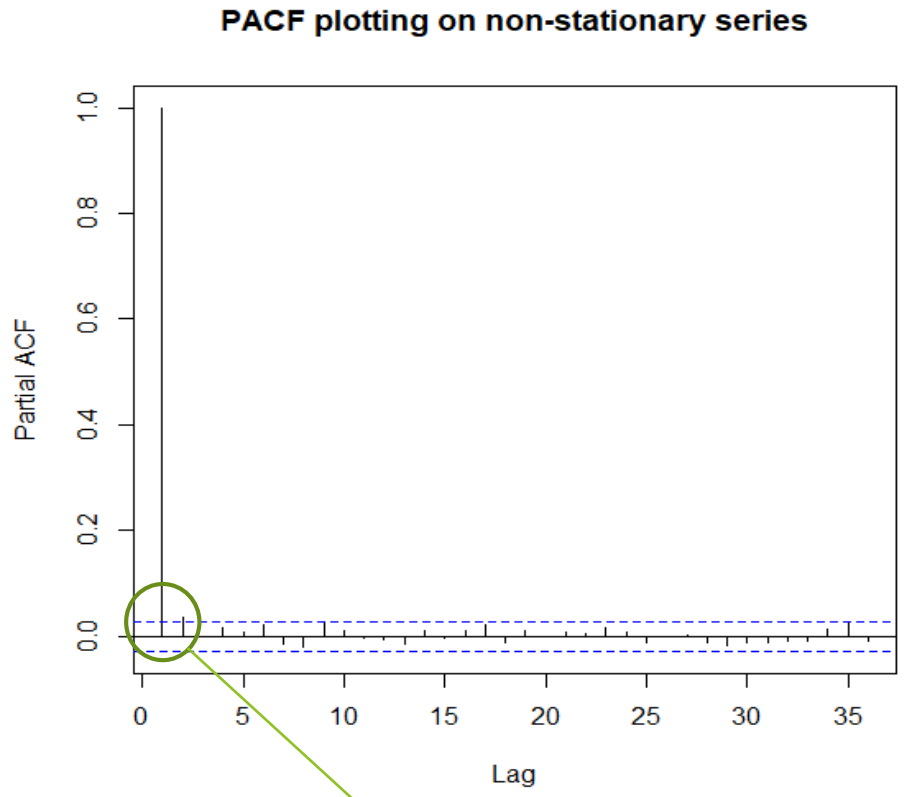
ACF Plot



‘q’ is taken as 1 in ARIMA

‘q’ is taken as 0 in ARMA

PACF Plot

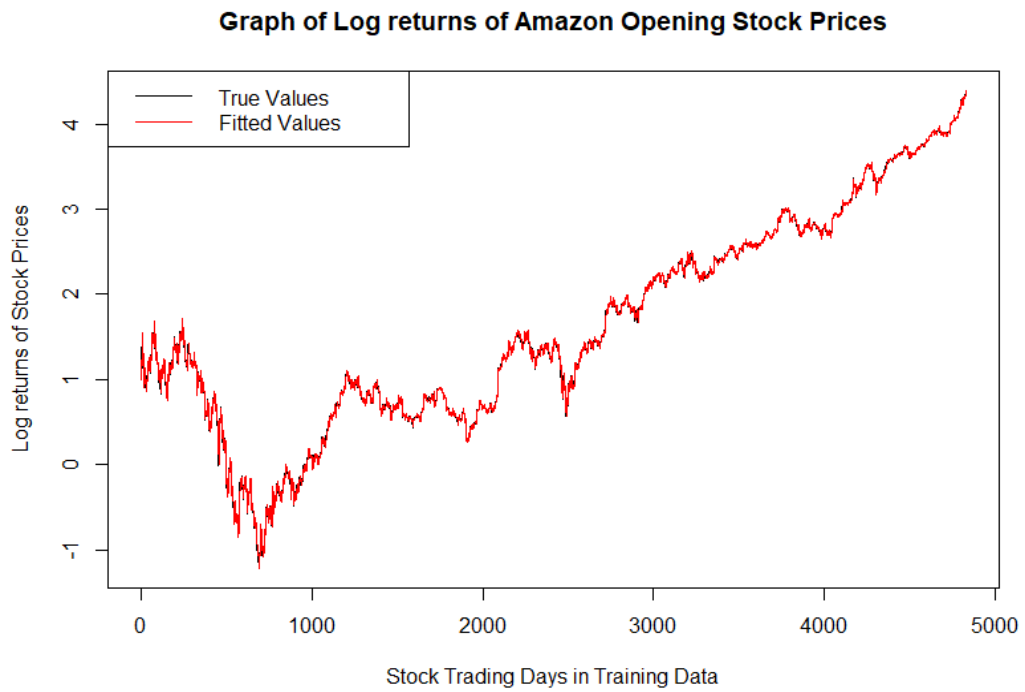


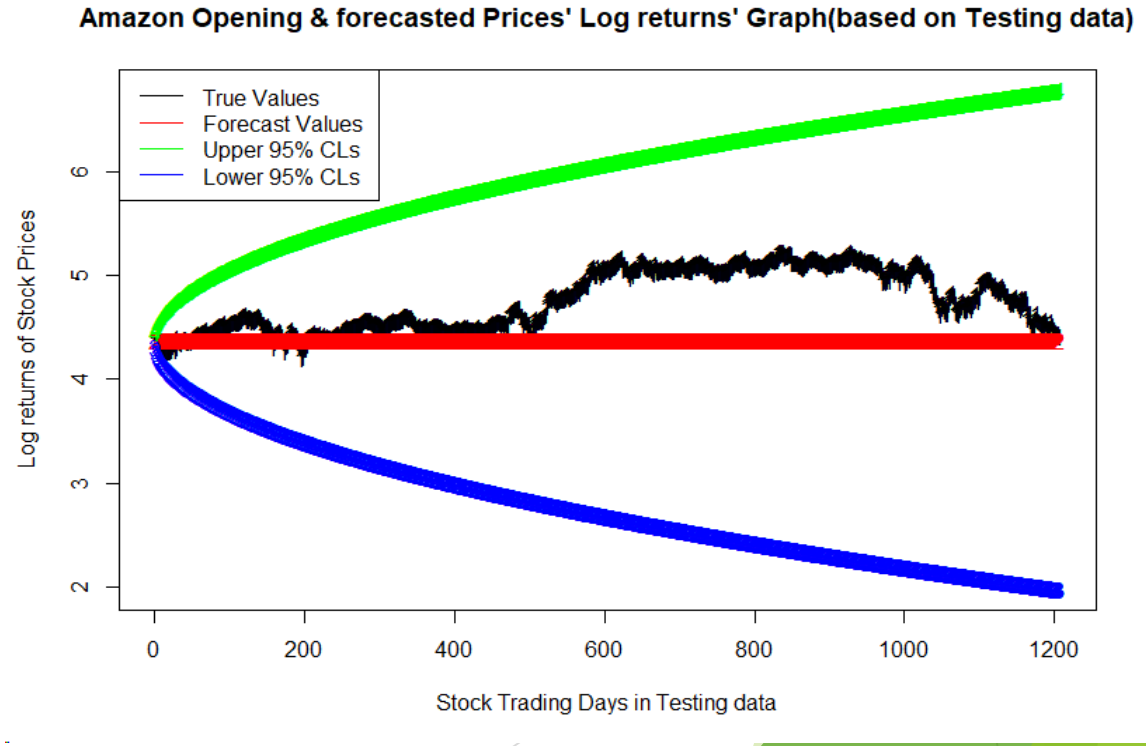
‘p’ is taken as 1 in ARIMA & ARCH

Fitting ARIMA(1,1,1) model

The fitted model is given by $(\hat{Y}_t - Y_{t-1}) = -0.6922(Y_{t-1}-Y_{t-2}) + e_t + 0.6304(e_{t-1})$ where Y_t is the Amazon's. opening stock prices' log returns at t.

Plotting forecasted & 95% CLs' values along with true testing data's values





Measures on error based on the forecasted values

MAD = 0.389801

The forecasted values is on an average deviated from the real testing values in the absolute magnitude of 0.389801 units.

MPE = 7.726643

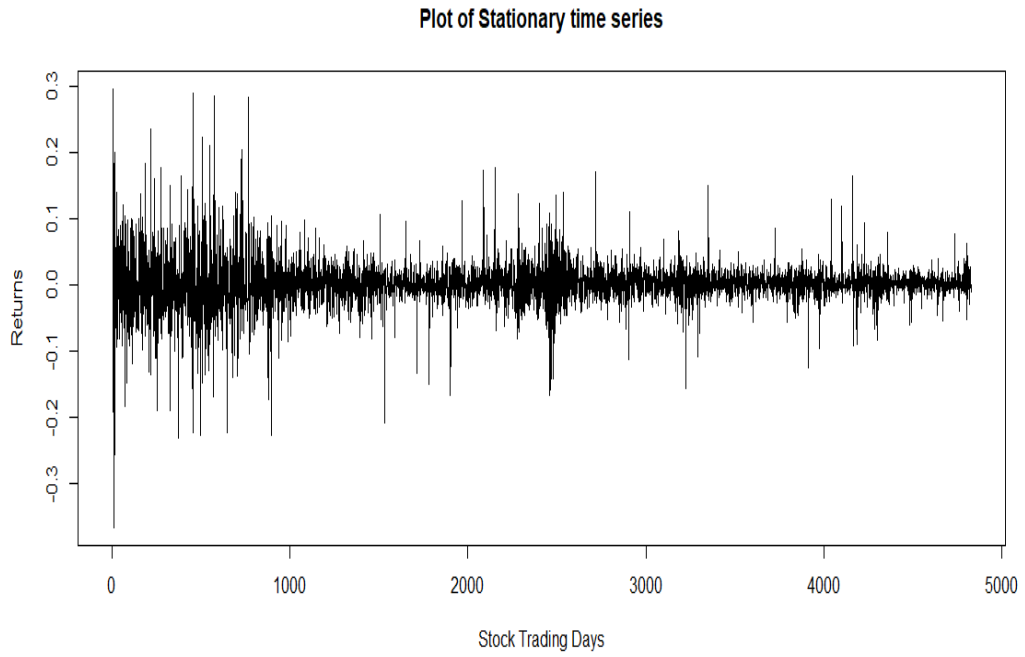
The average percentage deviation of the forecasted values from the real testing values is of 7.726643.

MAPE = 7.862295

The average percentage absolute deviation of the forecasted values from the real testing values is of 7.862295.

ARCH fitting

Checking for volatility clustering



Volatility Clustering is present

Fitting ARMA(1,0) as the mean equation

The model is given by, $r_t = \mu_t + a_t$ where,

μ_t is the mean equation at time point t & $\mu_t = 0.0006239 + 1.0000467r_{t-1}$

r_t is the log return of the stock prices at time point t

Fitting linear regression eqn. to sq. shock values

We'll fit sq. shock values on its prev. m(=1) lag values

The equation is given by, $a_t^2 = 0.001351 - 0.008867a_{t-1}^2$; t=2,…,4831

Performing ARCH LM test for ARCH effect

SSR_0 = 0.1213478

where $\bar{w} = 0.001351208$

&

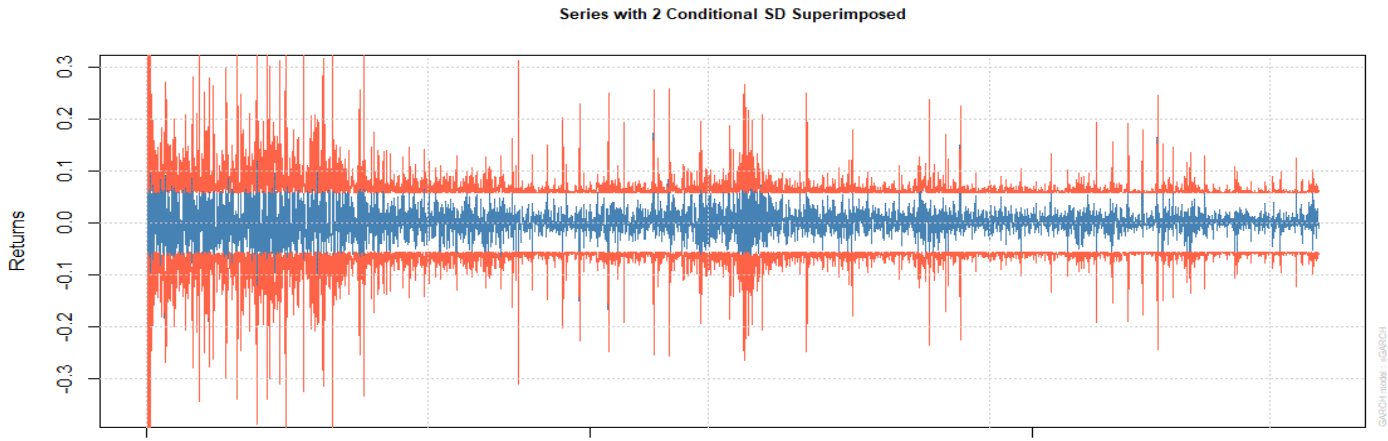
SSR_1 = 0.1208329

F_obs = 20.5731

F_obs > $\chi^2_{m;\alpha}$ = 3.841459 when α=0.05

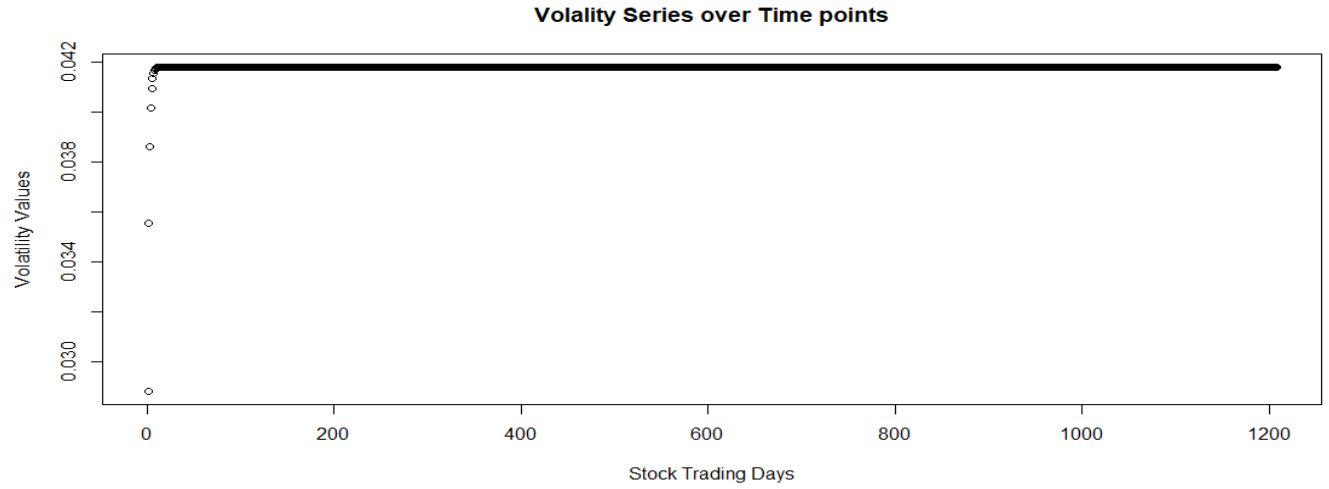
Null hyp. Is rejected at α l.o.s. So, ARCH effect is present

Plotting the series with two conditional SDs



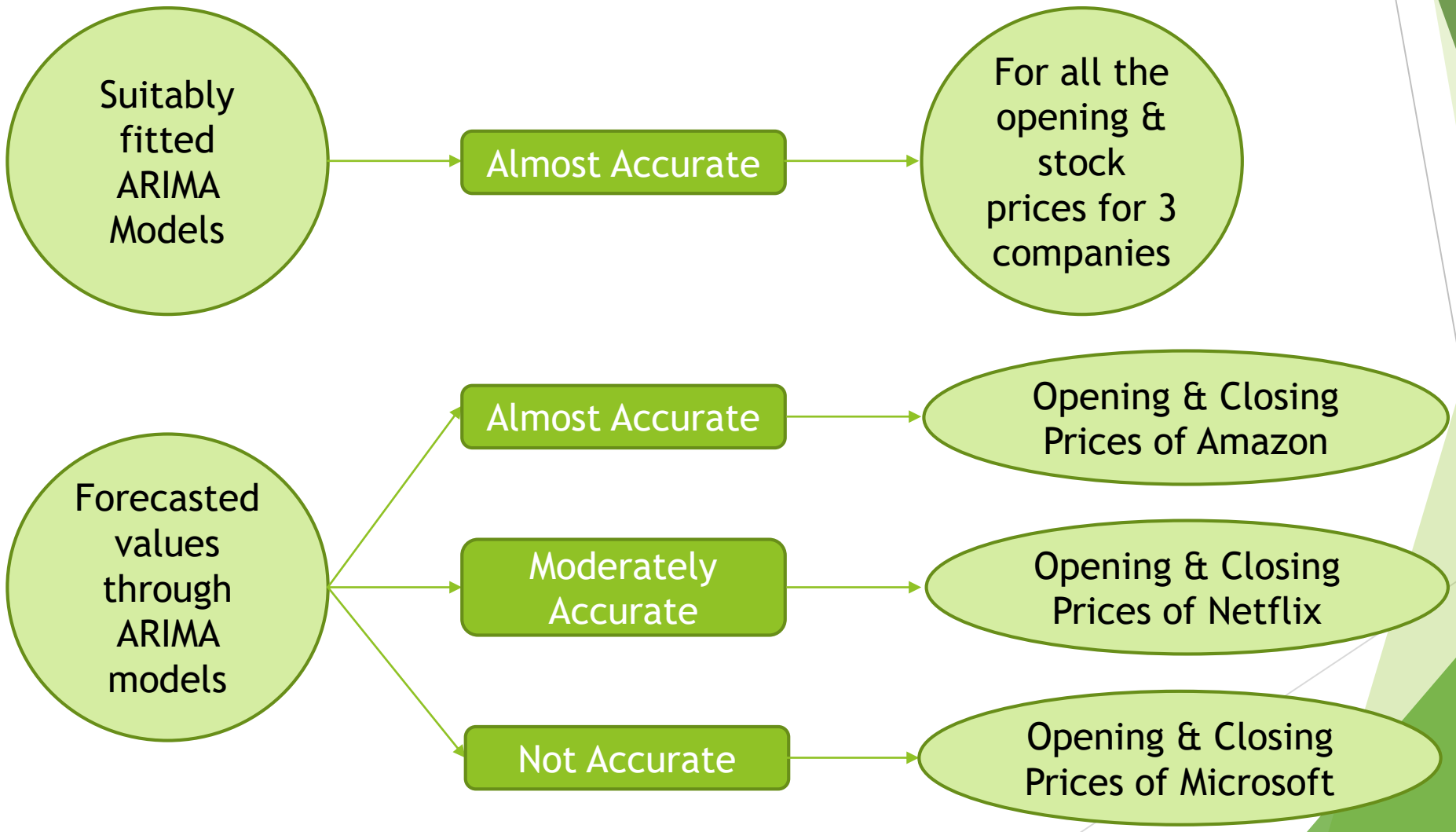
Most of volatility component is inside the interval formed by the SDs

Plotting forecasted volatility series over time points

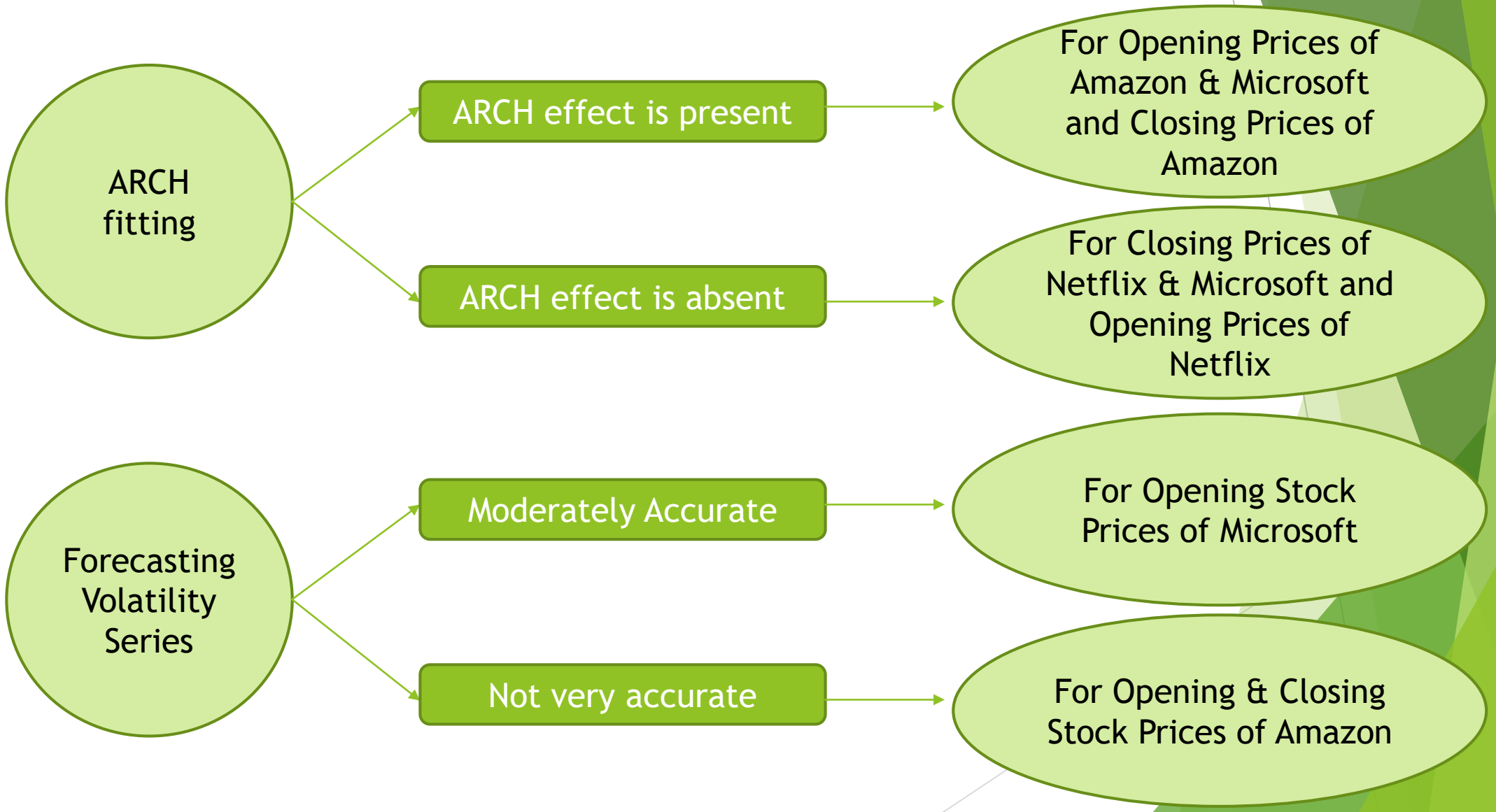


Volatility of stock prices increases for 13 days, then stay at same level.

Conclusions

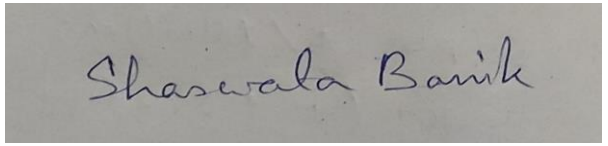


Conclusions Contd.



Acknowledgement

I, hereby, affirm that I have acknowledged any materials that I've used in my dissertation from outside sources. So, to the best of my knowledge, any parts of my dissertation paper doesn't use any unacknowledged materials.



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THANK YOU!!