AN EMPIRICAL STUDY OF STOCK VOLATILITY & ASSET PRICING IN INDIAN STOCK MARKETS DURING 2009-2014

A THESIS SUBMITTED TO
TILAK MAHARASHTRA VIDYAPEETH
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UNDER THE BOARD OF MANAGEMENT STUDIES

BY
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UNDER THE GUIDANCE OF
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SEPTEMBER 2015

DECLARATION

I hereby declare that the thesis entitled " An Empirical Study of Stock Volatility & Asset Pricing in Indian Stock Markets during 2009-2014" completed and written by me has not previously been formed as the basis for the award of any degree or other similar title upon me of this or any other Vidyapeeth or examining body.

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Date : 15th September, 2015

CERTIFICATE

This is to certify that the thesis entitled "**An Empirical Study of Stock Volatility & Asset Pricing in Indian Stock Markets during 2009-2014"** which is being submitted herewith for the award of Vidyavachaspati (Ph.D.) in **Management** of **Tilak Maharashtra Vidyapeeth, Pune** is the result of original research work completed by Shri. **Krishnaswamy H. Iyer** under my supervision and guidance. To the best of my knowledge and belief the work incorporated in this thesis has not formed the basis for the award of any degree or similar title of this or any other University or examining body upon him.

Place: Mumbai
Date: 15th September, 2015

Dr. Arvind S. Luhar
Research Guide

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CHAPTER 1
INTRODUCTION

1.1"The Convergence": An Integrative Approach

Finance & Mathematics have always shared a very good rapport for at least over a century. Application of Mathematics in Finance originated in 1900, when a French Doctoral student Louis Bachelier, whilst defending his thesis on modeling stock returns as Random Walk, found that stock prices move akin to Geometric Brownian motion as observed in states of nature, and proposed the returns on stock to be statistically independent, considered an important pre-requisite for scaling Volatility.

Modern Finance, as a subject distinct and divorced from Economics emerged with the enunciation of Modern Portfolio Theory by Harry Markowitz in1952, employing the Mean-Variance Criterion derived from preferences of Individual Investors assuming Log normal distribution of Asset Price Returns, subsequently leading to the development of Capital Asset Pricing Model (C.A.P.M.) in 1964 by William Sharpe, a single period equilibrium model being one of the fundamental pillars of Finance.

Stochastic Calculus was extensively used by Researchers in depicting the randomness element in stock price movement, thereby constantly altering its Intrinsic Worth, and the relationship between Asset Price and Investor's expected return captured by the now famous Gordon's Constant Growth Model, a manifestation of the Discounted Cash Flow technique yet another pillar of Finance.

Perhaps this randomness which sneaks into the Asset pricing Models via the Volatility of Asset prices, continuously adjusts to the unexpected portion of news which arrives at random, baffling even the stock prices as to which way to move, due to the uncertainty involved in tracing the asset price paths. The deterministic component of news being fairly predictable called the drift and the second component which is stochastic, being uncertain imparting random walk to the overall price movements, penalizes the overall returns on the investor’s expectations on the stock or Index. Does Volatility then cause erosion of Investors wealth,

because in the short run due to the various sudden and unanticipated price movements, it will vitiate our long term forecasting ability to a great extent, and in the long run we are all dead as per Keynes theory.

Capital Markets in general serves to offer to investors the economic pricing function of this random walk, smoother flow of capital from household savings to borrowers of such capital, besides providing latest information on asset prices for investors to take decisions and chances of their getting a fair price increasing significantly. The current market price on a stock therefore fully reflects all pertinent information of a company stock performance and as the random walk theory implies that if the markets are efficient it will indeed be a herculean task for an investor to consistently beat the market in earning superior returns.

A Survey undertaken by Forbes for the eighteen year period ending 1990, revealed a gross error of 40 percentage points made by security analysts in forecasting Corporate Earnings computed on a quarterly basis which signifies that news and tweets bearing a significant after effect in predicting stock price, returns being shrouded in substantial uncertainty even if it is reasonable enough to predict which way the news either good or bad will force the stock price to move.

Eugene Fame, Professor of Finance in Chicago University and one of the American trio shared the Noble Prize conferred upon them on 14th October 2013, is credited with the coinage of the term "Efficient Markets".Eugene.F.Fama, Robert .J.Shiller, and Lars Peter Hansen shared the 2013 Noble Prize in “Economic Sciences” for their research on how the market prices of assets such as stocks move. They laid the foundation for the current understanding of asset prices, concluded that asset prices relies in part on fluctuations in risk and risk attitudes and in part on behavioral biases and market frictions. They also concurred that there is no way to predict prices of stocks and bonds over days or weeks, but it is indeed possible to foresee these prices over a long run of three to five years, making it a challenging conundrum in the realm of Rational Decision Theory Continuum for Investors, Traders, Analysts and Economists.

Investor Sentiments has been one of the key determinants of Market movements encompasses in its fold the role played by a new and rapidly emerging field called "Behavioral Finance" whose proponents believe that Investors are often prone to possess cognitive biases which includes besides Overconfidence, Anchoring, Representativeness, Gambler's Fallacy, Loss Aversion & Regret Aversion, and mental accounting frames, and these heuristic driven biases are chief factors responsible for Market prices to deviate from its Intrinsic Worth besides the Investors resorting to participative arbitrage which signifies that the markets are indeed far from being efficient a counterview to the traditional or fundamental finance supporters.

"Arthasya Purusha Dasah" (Man is money's slave). Warren Buffet, the venerable sage of Omaha, isn't glued to the terminal all day, thereby shielding him from all those daily doses of volatility. **"Wealth is the slave of the wise man, Master of the fool."** As Willa Cather says– **"No man can build his security upon the nobleness of another person."**

The dictionary defines Stochastic as denoting the process of selecting from among a group of theoretically possible alternatives those elements or factors whose combination will most closely approximate a desired result. In Finance Security Returns are usually considered stochastic. Our study involves NSE, India (S &P CNX NIFTY), as our population consisting of fifty high market capitalization, free float methodology adopted in computing the index consisting of twelve sectors/Industry representative of the Indian Economy, and we have used optimal risk metrics in constructing a portfolio for an investor consisting of only twenty stocks from this fifty Nifty list. The Leverage aspect along with Investor's liquidity preferences also needs careful consideration, in arriving at an optimal portfolio mix.

Technical analysts or chartists, generally try to decipher identifiable forms in the clouds or in constellation of stars, our brains are creative enough to find patterns in a sequence of stock prices. These technical charts have a behavioral element that we do not fully comprehend. In the book –Making up the mind: **Chris. Frith**, a leading Neuro-scientist presented evidence of how our brain creates our mental world, wrote in 2010, about an investor's 14 emotional stages, beginning with

Optimism, proceeds through Excitement, Thrill, Euphoria, Anxiety, Denial, Fear, Desperation, Panic, Capitulation, Despondency, Depression, Hope, Relief, right back to Optimism.

Nassim Nicholas Taleb—(well known for his Black Swan concept):former Wall street trader turned, philosophical essayist in his book "Antifragile" writes: A dark swan is a metaphor used for events that completely surprise observers by their impact and are poorly rationalized even after the fact with benefit of hindsight. Financial Economists & Engineers firmly believe that psychological study and other social sciences can throw significant light on un- predictive and erratic nature of human behavior and thereby challenge the prevailing paradigm of financial markets being efficient, and also explain stock market anomalies, market bubbles and crashes.

For Hindus, the world is created, when **Narayana** awakens. Narayana is the God reclining on the serpent with multiple hoods. When he is in dreamless slumber, the world does not exist. When he wakes up, the world comes into being. Narayana is thus a visual, representation of human consciousness, the awakening which heralds, the creation of our World. In Spain, Fibonacci found it useful to solve equations without taking the aid of abacus. Fibonacci summation series formed by 3, 5,8,13,21,34,55 ---- and its associated golden ratio of 1.618 (55/34 etc.) called Phi (Ø)& (not pi) is a mathematical limit which measures the maximum rate of change of the slope of exponential growth curves which are mainly derived from a Fibonacci Series and these growth curves are quite often the underlying long run conditional mean for the geometrical price versus time chart patterns in individual stocks or indices.

William Delbert Gann (1877 – 1955): "Tunnel Thru the Air" said that the mathematical basis of stock markets is part and parcel of Nature's Law. Perhaps Sir Gann drew his inspiration from his visits to Indian Temples & Egyptian pyramid where he observed the consistent use of geometrical shapes (squaring the circle and circling the square) in temples and its construction.

“Gann Square of Nine” contains Astrological secrets and its adaptability to predict stock & commodity prices. Gann a gifted Mathematician, expert tape reader, Astrologer and a seer said” Understand Law of Vibration, understand “Law of Nature”. He said price is square by time, or when price & time come together it will be possible to forecast important trend changes with greater accuracy.

When analyzing cycles, we need to think inside the box (Gann Box) and air in sacred geometry is represented by an Octahedron (8 triangles), and also Gann Square of Nine Support & Resistance levels does indeed coincide with Fibonacci pivot point levels. Gann further stated that there is a cosmic connection and vibration connects between heaven and earth.

The art of scientific speculation for intraday traders could be implemented by all of us, to win at least 70% trades consistently, irrespective of period. Stock prices can be forecasted quite accurately with exhaustive study of individual astrological zodiac sign in a horoscope which can equip a common investor with building and managing a well-balanced diversified optimal portfolio at the end of the day.

To Summarize

An Eclectic (Convergence) Approach should be adopted in Predicting Stock Prices, and study of the Financial Econometric Time series, should cover major facets of Fundamental Finance in arriving at the intrinsic share worth. Technical Analysis for using the past to forecast the future, employing W. D. Gann's references to 'Bible', in which Sir states, that everything is contained in the Bible, urging people to seriously delve into the holy Bible time and again, it may appear to be an unveiled secret, and everyone can develop this skill set, in Gann's words, and comprehending his teachings, in real world settings in replicating a very high success rate in trading, by an exhaustive perennial study & blend of Astrological charts of individual Investors and Gann's unveiled secrets. Academic Approach in making it accessible and practically relevant to all, as there is always a gap between what is being academically taught and what the industry practitioners expect. Psychological Approach, in reducing the Irrationality of Humans in Investment Decision Making.

1.2 RESEARCH OBJECTIVES

To predict the type of investor based on their demographics factors and risk perceptions and attitudes and

A. To Test & Ascertain "Normal (Gaussian) distribution Properties Compliance in the Empirical Data Distribution considered in this study. we will be using Natural log- arithmetic returns [Ln of Stock Price Ratio of today's stock price to Yesterday's stock price] , of the Empirical Financial 'Econometric Time series data spanning five years (**1247 sample daily observations** on price/volume data, for the fiscal year ending 2014.
B. To examine whether these Logarithmic returns are Independent and Identically Distributed (I .I. D)?
C. Why does Risk matter if it does not hurt the Investor? Given that an Investment made money, what difference does it make how the money was earned? Does Volatility decrease wealth of an investor?
D. What are the empirical properties of Indian stock market returns?

    - What characterizes Indian Stock Market Returns?
    - How volatile are stock returns in this market?
    - Are Returns predictable?
    - How does Volatility change over time?
    - What type of Stocks has highest returns?
    - What properties should Stock prices have in Efficient Markets?

E. Gann Analysis and its practical implications for the Indian Stock Markets?

F. To build an Optimal Portfolio for an Investor, considering twenty sample equity stocks, carefully ferreted from the proxy population (NSE, India).

G. Can the past time series be used to arrive at long term (Conditional Mean) & Long run (Conditional Volatility) forecasts for Out-of-The Sample period (1st April 2014 to 31st March 2015), and how reliable will be the forecasts?

H. To apply Traditional (Fundamental) models, to Empirical data, and builds Risk-Return- Utility Triad for the Investor on The Investment vehicle optimally so chosen.

I. To determine whether Idiosyncratic Volatility is “Priced" in the Indian Stock Markets?

1.3 BACKGROUND OF RESEARCH

Mathematical Finance was born on March 29, 1900, when a French doctoral student, Louis. Bachelier successfully defended his thesis employing what is now known as Stochastic Analysis. He proposed a theory for valuation of Financial Options and his formulations resembles closely to Noble Prize winning solution to Option Pricing problems enunciated by Fischer Black, Myron Scholes & Robert Merton in the now famous Black-Scholes Model (1973) considered the first decisive advance in finance since 1900.

Harry Markowitz [1952, 1956, 1959],developed a theory of portfolio selection based on optimization of a quadratic function subject to linear constraints. He proposed – Efficient Frontier of Risky Assets". His work led to development of a single period equilibrium model the **Sharpe-Lintner** Capital Asset Pricing Model **(C.A.P.M**)—(See Sharpe (1964), Lintner (1965 a, 1965b) (Nobel Laureates in the nineties**). R.C .Merton** (1973), extended the C.A.P.M.), to a continuous time model using Lognormal diffusion processes, to represent stock price series, and showed that the original conclusions continued to hold virtually without change. In this continuous time model, it became possible to observe the dynamic interaction between Investor’s behavior and the

behavior of the stocks. In fact, **Rosenberg &Olson** (1976) showed that this interaction led to internal inconsistencies in continuous time CAPM.

Markowitz Portfolio Theory

Markowitz (1959) justifies Mean-Variance analysis by relating it to the theory of rational decision making over time & under Uncertainty, as developed by **Von Neumann & Morgenstern** (1944), **Savage** (1954) and **Bellman** (1957).His quadratic approximations to Expected Utility theory, stipulates, the supposition that an investor wishing to maximize the Expected value of a log arithmetic Utility function: U = LN (1+ R), where R is return on Investor's Portfolio. Perhaps this is Investor's goal due to reasons **Daniel. Bernoulli** (1954),gave in favor of this function when he first proposed Maximizing Expected Utility rather than Maximizing Expected Income, or perhaps, due to its connection with growth rate G (I.E. Geometric Mean Return),of the portfolio namely, LN (1+G) = E [LN (1 + R)],where E is the Expected value operator.

Random Walk, Efficient Market Hypothesis (E.M.H)

(Also Refer Appendix For Mathematical Derivations Used, Which Forms Background of This Research).

Security Prices and Random Walks

When the news relevant to a particular stock is good, people adjust their estimates of future returns upwards, or they reduce the discount rate they attach to these returns. Either way, the stock price goes up. Conversely, when the news is bad, the stock price goes down. Many people misunderstand what the random walk idea means. It does not say that stock prices move randomly, rather it says that the unexpected portion of the news arrives randomly, and that stock prices adjust to the news, whatever it is. A famous analogy compares security prices to the path of a drunk staggering from lamppost to lamppost.

The drunk has a beginning point and a target destination. The path of the drunk shows a trend from one post to the next. Along the way however the path is erratic. The drunk wanders right and left, perhaps occasionally out into the street or into the wall of a building. An observer cannot accurately predict the precise route. The same is true of a security price and its consequent return. Over the long run, security returns are consistent with what we expect given their level of risk.

Efficient Market Hypothesis (EMH) relates to Informational Efficiency and the Fair Price function, but not to operational efficiency. The essence of the EMH is that so many people watch the marketplace that it is highly unlikely that any individual can consistently make windfall profits by picking stocks better than the next person EMH has three forms. The **weak form** says that past prices, or charts, are of no value in predicting future stock price performance. The **semi-strong form** says that security prices already fully reflect all relevant publicly available information. The **strong form** of the EMH extends the semi-strong form to include private, inside information as well. We know that insiders can make illegal profits, so this form of the EMH does not hold up.

Anomalies are occurrences in the market that Finance theory cannot explain? Stocks with low Price-Earnings (P/E) Ratios, tend to show unusually higher returns; January is a good month for the stock market, and small firms tend to do better than large firms in January (**January Effect**).Monday is a bad day for the stock market while Wednesdays and Fridays have historically been good. Technical analysis is diametrically opposed to the efficient market hypothesis (EMH), yet it has many advocates, including well educated finance professors and analysts. Why for that matter Sir. Gann is a novel example. Chaos theory has the potential to explain partially some of these issues.

1.4 RESEARCH QUESTIONS & RESEARCH CONTRIBUTIONS.

Q) Why are 'ASSET PATHS' unpredictable in the short run?

This is a fundamental question, the answer to which underlies, the entire Asset Price Modeling in Finance. Asset prices are unpredictable in short run, because stochastic (random) differential equation that describes the asset price path evolution over time is non-differentiable. Asset prices are driven by a deterministic (non-stochastic) term which is the drift and a stochastic random term. The randomness enters the asset price equation through the volatility of the asset price (or asset returns).If an equation is differentiable—in mathematical terms, then it cannot be stochastic. All stochastic (random) equations are non- differentiable, because of the presence of randomness which prevents the system from having a bounded measure. In stochastic equations the rate of change of a function with respect to time does not converge. Hence, randomness ensures the non-existence of mathematical derivatives.

Q) Why do we have log returns in continuous- time Finance?

Let us consider a closed time interval say [0, T], where 0 denotes price of an asset today and T any time period in future from now. Ignoring for the time being dividend payments, simple arithmetic return on a stock is expressed as:

$\boldsymbol{R_t = \frac{P_{t-}P_{t-1}}{P_{t-1}}}$, where P_{t-1} is yesterday's price of an asset and P_t today's price. Now let us slice this closed time interval into say discrete time periods say 12 months in a year. Now we can obtain the total returns yielded by an asset as a summation of these discrete returns as follows:

$$\boldsymbol{R_t} = \sum \boldsymbol{R_t} = \sum \frac{\boldsymbol{P_{t-}P_{t-1}}}{\boldsymbol{P_{t-1}}} .$$

We are always interested in Continuous time in Finance, and let us see what happens if we divide this closed time interval considered into smaller and smaller

sub periods say days, hours, minutes, seconds, nanoseconds etc., using Limits and Continuity concepts we get the mathematical definition of Infinitesimal small time periods(Δ_t)

$$R_t = \underbrace{\lim}_{\Delta_t \to 0} \sum R_t = \underbrace{\lim}_{\Delta_t \to 0} \sum \{\frac{\Delta P_t}{P_t}\}$$

In the limiting case as Δ_t tends to zero, then ΔP_t changes to dP & summation sign changes to the integral sign (Using Integral Calculus), thus we have:

$$\boldsymbol{R_t} = \int_0^t dP/P = \text{Ln } P_t - \text{Ln } P_0 = \text{Ln } [P_t/P_0]$$

Thus we log the asset prices which forms basis of analysis undertaken in this study.

1.5 Data Description

a) Primary Data:- Researcher employed a 56 questions "Questionnaire" eliciting 425 respondents responses, which were analyzed, and a multinomial Logistic Regression equation fitted, to predict the type of Investor (Aggressive, Moderate, Defensive),on the basis of their demographic factors. Refer CD, for the Questionnaire and responses received from these four hundred and twenty five respondents, mandatorily answering all 56 questions.

b) Secondary Data: Sample Twenty Least Volatile, Equity Stocks are ferreted based on Empirical Time Series Data Analysis, from the NSE Fifty Index our population, and all 50 stocks data were downloaded from official website- **www.nseindia.com**, where yearly data, on daily frequency basis were downloaded. The select sample twenty stocks from our proxy population NIFTY, were exhaustively analyzed for working out relevant descriptive, and graphical plots and ascertaining the statistical significance of the type and nature of empirical data distribution, operational dynamics on log normal returns, ascertaining

consistently, the "**Non- Normality in Normality**" on behavior of stock prices both in short term and long run spans.

c) Regressing the returns of these select individual assets (equity stocks), on the proxy Market Index (NSE -NIFTY). The Characteristic Security Line can be derived, then applying **Sharpe's Single Index Model (Market Model),** to this empirical data and finding relevant statistical estimates and significantly testing their significance. Regression Stability (**Chow Test**) to ascertain the stability of the **Beta** statistic. Beta of an Asset must be estimated, and estimate is clouded with substantial uncertainty.

How uncertain is this Uncertainty? As time passes, the Beta of a self-contained stock/Portfolio often declines? Outliers/Influencers Identification and it's weeding out, restoring normality to our empirical data series, (Refer Reliance Industries Ltd Stock example in 'Regression Analysis' Section in greater details) and whether as a consequence smoothing out all volatility concerns, provides any relief? As it is enough for us to determine the first two Moments of a Normal Distribution namely Returns and Volatility, for describing the empirical time series data as Normal.

d) Assuming a Risk-free (Risk-less) rate: R_f = 7% for our study, not actually determined, could be a limitation of this study. In the Primary Data analysis, we have given scores to respondents based on their responses, to classify investor's on their risk aversion behavior, which then stipulates that an Investor ought to get at least this 7%, the risk free rate, hence the motivation for an investor to invest in equity stock markets to achieve profitable returns, certainly more than 7%.is imperative.

Applying C.A.P.M. **(Capital Asset Pricing Model)** to our Empirical data, to compute expected returns from stock investing. by applying the Price-Return Dividend Discount Model, a Manifestation of Discounted Cash Flow technique, and related SML (Security Market Line), a graphical plot of CAPM, which connects the risk-free rate and the Market or the average

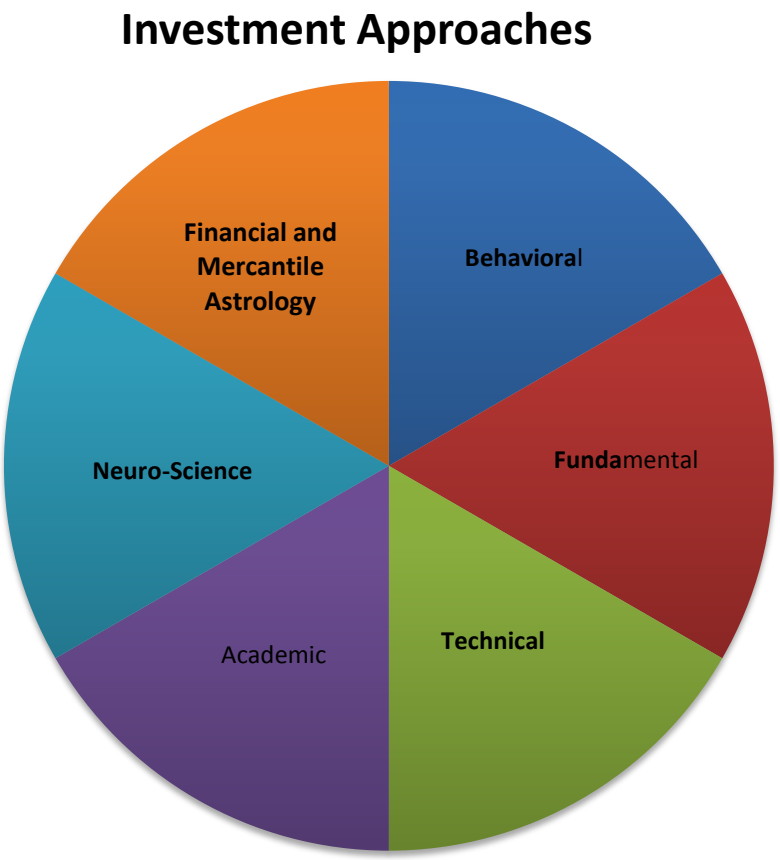
asset portfolio, and also Interspersing the data analysis section with Idiosyncratic Volatility issues related to these Risky Returns.

e) Gann Analysis used to forecast buy/sell/targets/resistance/support of price levels, using Gann Calculator and his teachings.

f) Sharpe's Portfolio Optimization Model employed to our empirical data series, to answer the question whether "Idiosyncratic Volatility is priced in the Indian stock markets?"

g) Achieving **"The Convergence"** approach to Stock Market Investing, using empirical **in-the-sample time series data**, and trying to forecast for an **out-of-sample forecast, of 252 trading days** (A year ahead beginning 1st April 2014 and ending 31st March 2015), how accurate this forecast would be? Only **time** will tell.

CHART 1.1 THE CONVERGENCE-AN INTEGRATIVE APPROACH



Chapter 2

Review of Literature

Literature review was undertaken on the Randomness of Asset Prices, Efficient Markets, Financial Volatility, Extreme value Historical Volatility Estimators, Idiosyncratic Volatility & Forecasting Volatility in Stock Market returns, besides using traditional Financial Models to data set found in standard Financial Management Textbooks.

2.1 Tracing the Randomness in Asset Price Paths and Efficient Markets.

French Mathematician Louis Bachelier in 1900 performed rigorous analysis on stock market returns and established that stock returns are statistically independent, which implies forgetfulness or memory-less property in stock market returns, and thereby making it difficult to predict tomorrow's return based on today's stock prices. He was of the view that stock prices exhibit simple arithmetic Brownian motion as observed in liquids and gases and states of nature.

John Burr Williams in 1938 proposed that stock prices are indeed based on their economic fundamentals, in his work on “Intrinsic Value" of a stock.

John Maynard Keynes opined that stock price behaviour being speculative in nature proposed the “Beauty Contest Analogy", wherein stock analysts generally recommend not the stocks they consider best but what the other analysts consider best. He also said that in the long run these speculations will finally achieve Convergence in tune with the Intrinsic Value, but in the long run he said we are all dead.

Advent of Computing prowess in the 1950's made it feasible for researchers to undertake rigorous empirical analysis on enormous data sets.

Maurice Kendall, a British Statistician in 1953, documented the property of statistical independence in weekly returns of British Stock Markets.

Harry Roberts in 1959 found evidence of statistical independence on Dow Jones Industrial Index.

Eugene Fama in 1965 furnished evidence of stock returns being statistically Independent, in support of the Random Walk Model in stock prices and stated that the techniques as employed by technical analysts and chartists had no predictive power on stock prices in future based on historical prices.

Paul Samuelson in 1965 & Benoit Mandelbrot in 1966 stated that the randomness in stock prices can be expected from a well-functioning market. This development bore its roots in the development of the Rational Expectation Theory of Macroeconomics, and that investors are rational and competitive in the "Fair Game" of Investment decision making.

Eugene Fama in 1970 published a paper “Efficient Capital Markets"- A review of theory and empirical work and contributed to future research by defining three forms or levels of Market Efficiency namely the Weak form, semi-strong form and the strong form of efficient markets. In the weak form of market hypothesis he proposed that future returns cannot be predicted based on past returns, whereas in a semi-strong market efficiency form, the stock prices reflect all publicly available information based on the Company's economic Fundamentals which included public domain market data in the weak form as well as financial company reports, economic forecasts, company news, information and tweets. In the Strong form of the efficient market hypothesis considered the highest level of Market Efficiency stock prices fully reflect all public and private information which could involve insider trading.

Fama stated that weak form precludes only Technical Analysis from being profitable; while the semi-strong form precludes usage of both the Technical & Fundamental Analysis for profit booking and that the strong form implies that

even those insiders having privileged information cannot expect to earn superior returns.

Sanford Grossman & Joseph Stiglitz in 1980 proposed that Market Frictions also play a key role which includes costs involved in performing security analysis and trading which may impair market efficiency; hence it would be better to define market efficiency in terms of generalized and continuous terms with swift adaptability of prices akin to greater informational efficiency.

While 1970's empirical research strongly supported the semi-strong level of market efficiency, but some anomalies like" Small Firm Effect", "January Effect", "Monday Effect" and the like were observed in the stock behavior in the late 1970's and early part of 1980's. These price anomalies could be attributable to asset pricing models to be mis-specified or it may be due to market frictions as observed by today's financial economist.

Robert Shiller in 1981 argued that stock returns being highly volatile vis-a-vis payment of aggregate dividends, which was in support of Keynesian view that stock prices are more often than not driven by speculation rather than by economic fundamentals.

Werner Debondt & Richard Thaler in 1985 showed evidence of “Mean Reversion" phenomena in stock returns and stated that individual stocks displayed apparent overreaction over a longer horizon of three to five years, which meant that stocks which performed well in the long horizon of 3 to 5 years were inclined on reverting to their means over the subsequent 3 to 5 years resulting in negative returns and vice-versa.

Lawrence Summers in 1986 found evidence of the stock prices in displaying short and long swings away from their intrinsic values and hence it is difficult to decipher short horizon returns.

Behavioral Finance evolved in the late 1980's to counter these so called inefficiencies which dispensed with the traditional assumptions of Investor's

Utility Maximization maxim and Rational expectations theory by proposing that it is the heuristic biases or cognitive illusions which shroud human behavioral patterns in Stock Market investing coupled with arbitrage limits depicting inefficient markets, responsible for observing deviation of stock prices from its Intrinsic fundamentals.

Fama & Kenneth French in 1988 corroborated the evidence of “Mean Reversion" patterns in aggregate returns and found that stocks earn larger returns during more stressed and difficult Economic conditions. Efficient Market theory also argued that a few individual's cognitive blunders would not majorly impact or influence stock markets as stocks which may be either undervalued or overpriced are bound to invite rationalistic traders who would be keen on buying undervalued ones and selling overvalued stocks.

Andrei Shleifer & Robert Vishny and etal observed that these market inefficiencies would anyhow exist for an ephemeral time frame and traders who are quick in exploiting such arbitrage opportunities will chance upon such price gaps and as a result the normal equilibrium will be restored on the price front due to such arbitrage acts. Internet bubble of late 1990's and stock market crash of 1987, was attributable to corrections in stock price which will take effect only after this mispricing issue of the assets becomes large and noise traders would be at a loss for confidence to trade and due to inaction of these noise traders the rational traders may have to bear the brunt of the incremental risk on account of noise traders not participating in such trading.

Burton Malkiel in 2003 analyzed the Internet bubble and said that at higher prices of internet & technology stocks, there is euphoria in the market leading to attracting more capital from investors through Initial Public offer (IPO) subscriptions thereby indicating that resource allocation playing a key role in stock market investments.

Efficient Market Theory and its proponents could be considered appropriate at least on two major fronts

1) As regards Short frequency data (Days/Weeks/Months) or in short run stock prices are quick enough to assimilate new information which serves as a reasonable approximation to the variability in the stock's Intrinsic Worth.

2) There seems to be variability in stock prices across different markets and countries. Rather than seeking an apt explanation to capital market efficiency, researchers and academicians ought to focus on conditions that tend to explain and enhance informational efficiency of capital markets.

2.2 Financial Volatility in Financial Econometric Time series

Barndorff-Nielsen & Shephard in 2003 and Andersen & etal in 2003, stated that Financial volatility is a latent factor and hence cannot be directly observable, making it more difficult to predict stock prices.

Nisson in 1991 employed Japanese Candle Sticks charting techniques using the intraday Stock price information on the Open, High, Low and Closing stock prices of individual stocks and market indices.

There are mainly two types of volatility, namely idiosyncratic volatility (Residual Variance/Unique Risk/ Company Specific risk) on account of microeconomic factors which can be termed as Diversifiable or Unsystematic Risk and the other one being Market risk or systematic risk or non-diversifiable risk.

2.2.1 Idiosyncratic Volatility

In 2003,2006 & 2007, Malkiel & Xu observed strong positive correlation between value weighted idiosyncratic volatility and portfolio returns for the stocks listed in Standard & Poor's 500 index during a study of a 45 year period

ending 1996.They further observed that the increased influx of Institutional Investors was the cause for increased volatility in stock market as increased capital inflows led to increased expectations of growth in earnings by the firm employing these funds to boost retained earnings based on enhanced projected growth in future earnings, which propels the idiosyncratic volatility to increase further. Beta which measures the sensitivity of asset returns in relation to market index movements was considered a pertinent measure of market risk and higher the beta higher the stock returns and higher the stock returns higher will be the idiosyncratic volatility.

Goyal & Santaclara in 2003 reported on their study of stocks enlisted in the Canadian Stock Markets during the period July 1962 to December 1999, and found that idiosyncratic volatility and portfolio returns were positively correlated.

Fu in 2009 reported for US stock markets for the period 1963 to 2006, that by employing GARCH (General Autoregressive conditional heteroscedasticity) model he found that idiosyncratic volatility was positively correlated with stock portfolio's returns.

Bali, Cakici, Yan & Zhang in two distinct studies undertaken in 2005 & 2008, for differing periods between 1958 to 2004, found that there is no correlation between idiosyncratic volatility and portfolio returns by employing CAPM (Capital Asset Pricing Model).

Ang, Hodrick, Xing & Zhang published reports during 2006 to 2009 on their study on US Stock Markets during the period 1963 to2003 exhibited negative correlation between Idiosyncratic Volatility and expected return on the stock portfolio, by employing Fama French three factor model.

2.2.2 Harry Markowitz, (1952 -1954) father of **Modern Portfolio Theory** enunciated the “Efficient Frontier of Risky Assets" by employing the Mean-Variance Criterion to stock data. William Sharpe was sharp enough to point out that since the diversifiable risk can anyway be diversified away what one

needs to focus on is the Market risk or the Non-diversifiable risk. He concluded that it's the market which offers returns to investors and beta is what one needs to focus on for investment purposes.

2.3 Price Range Historical Volatility Estimators.

Besides the traditional or classical historical volatility estimators which are computed using inter day closing prices of stocks, many studies were undertaken by researchers by carefully exploiting all available intraday price information as to opening price, high price, low price and the closing daily stock prices with a view to garner evidences on the stock volatility conundrum.

Alizadeh, Brandt and Diebold in 2002, employed the Maximum Likelihood principle for stochastic volatility models and they were of the opinion that lognormal returns on the stock approximates Normal or Gaussian distribution.

Parkinson in 1980, Garman and Klass in 1980, Rogers & Satchell in 1991 and Yang Zhang in the year 2000 computed efficient risk metrics to measure historical volatility, of which Yang Zhang volatility estimators turning out to be more efficient among these four computations as mentioned above, which turned out to be not only an unbiased estimate of historical volatility but also was independent of the drift term.

Shu & Zhang in 2006 reported that these price range estimators performed well when an asset price is said to adhere to a continuous Geometric Brownian Motion or the so called Random Walk Theory.

2.4 Forecasting Stock Market Volatility in returns.

Akgiray and etal in 1989, employed the Exponential Weighted Moving Average (EWMA), to forecast volatility on New York Stock exchange stocks. This model albeit being useful in forecasting a financial econometric time series they concurred that GARCH (General Autoregressive Conditional

Heteroscedasticity) Model exhibited best performance in this volatility forecasting exercise.

Tse in 1991 employed EWMA, ARCH & GARCH Models for a three year period ending 1989 for studying stock return volatility in the Japanese Stock Exchange and they were of the opinion that EWMA performed the best when it came to forecasting Volatility.

Nelson in 1992 employed the ARCH (Autoregressive Conditional Heteroscedasticity) Model and found that despite the model being severely mis-specified this model performs the best for forecasting volatility employing high frequency data such as the daily stock price information, but was poor in its forecasting ability for out-of-sample forecast for both in the medium term and long run conditional volatility.

Tse & Tung in 1992 studied the stocks listed in the Singapore Stock Exchange by considering monthly data set frequency, and were also of the opinion that EWMA Model best suited for the Singapore Markets.

Brailsford & Faff in 1996 found the GJR Model to be the best for forecasting Australian Stock Markets.

Franses & Vindijk in 1996 suggested QGARCH (Quadratic General Autoregressive Heteroscedasticity) to possess best forecasting ability on stock returns.

Wash & Tsou in 1998 studied the Australian Index for a two year period ending 31st December 1995 and concurred that EWMA Model is the best suited for forecasting volatility.

Chong, Ahmad & Abdullah in 1999 observed that EGARCH Model was best suited in forecasting one year ahead volatility in stock returns for it was the skewness or asymmetry which was a common embedded feature in stock return.

Blair & etal in 2001 employed the volatility index (VIX), model for studying the intraday returns on S&P Index for 11and half years which they considered it to be the best unbiased estimate for forecasting volatility in stock returns.

Awartani & Corradi in 2005 observed that GARCH Models had better predictive power which incorporated the asymmetries or skewness as was evident in stock returns volatility.

Wilhemsson in 2006 investigated forecasting ability of GARCH (1, 1) Model in S&P 500 Index Futures using nine different innovations/shocks.

Evans &McMillan in 2007 compared nine different models on stock market returns for 33 economies and concurred that GARCH Model outperformed others when it came to forecasting volatility in stock returns.

Chuang, Lu & Lee in 2007 found that GARCH Model with t distribution as an innovation worked well in Forex markets.

Galdi & Pereira in 2007 made a comparative study of EWMA, GARCH, VaR, and Stochastic Volatility models and concurred that VaR (Value at Risk) Model was the best suited in forecasting volatility in stock returns.

Patev, Kanaryan& Lourdi in 2009 studied the Bulgarian Stock Markets and concluded that both EWMA with an Innovation of GED (General Error Distribution) function and EWMA with t distribution worked the best in forecasting volatility of stock returns in the Bulgarian Stock Exchange.

2.5 Gann Analysis: William Delbert Gann used Astrology as an unveiled secret in predicting accurately stock prices for intraday traders.

2.6 Portfolio Optimization Model

Sharpe's portfolio optimization model, both in case of short sales not allowed and short sales allowed, Fama's Model of decomposition of excess returns and other pertinent models on asset pricing and its volatility can be found in standard financial management textbooks.

Chapter 3

Research Methodology

3.1 Primary data: - At the end of this thesis is appended the Questionnaire designed consisting of 56 questions including the investor demographic variables, and a CD containing the actual responses of 425 sample respondents was collected separately. An Opportune Multinomial Logistic Regression Model was employed in testing the statistical significance of categorical variables considered with the use of questionnaire in finding the Investor behavior and psychographics to stock market Investment behavioral patterns. SPSS 21 was employed in this study, by codification of responses and then employing this tool for detailed analysis and testing of Hypothesis.

3.2 Num XL(freely downloadable trial version),an add-in feature of MS Excel was exhaustively employed on **Secondary Data**, enabling testing of hypothesis sets, and forecasting long run volatility convergence metrics on the empirical data downloaded from NSE website[1]

3.2.1 Data collection: Secondary Data

Period of Study: **(1/4/2009-31/3/2014)**

	MONTH	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	
4	APRIL	17	20	18	20	20	
5	MAY	20	21	22	22	23	
6	JUNE	22	22	22	21	20	
7	JULY	23	22	21	22	23	
8	AUGUST	21	22	21	21	20	
9	SEPTEMBER	20	21	21	20	20	
10	OCTOBER	20	21	19	21	21	
11	NOVEMBER	20	21	20	20	20	
12	DECEMBER	21	22	21	20	21	
1	JANUARY	19	20	22	23	23	
2	FEBRUARY	20	20	20	20	19	
3	MARCH	21	22	22	19	21	
	Total Trading days	244	254	249	249	251	1247

[1]SOURCE:-www.nseindia.org.

STANDARD & POOR'S CNX NIFTY (FIFTY) STOCK INDEX (S&P CNX NIFTY) INDIA		
50 STOCKS OF NSE INDEX		
SNO	INDUSTRY	COMPANIES
1	AUTOMOBILE	1.1 BAJAJ AUTO LTD.
		1.2 HERO MOTOCORP LTD.
		1.3 MAHINDRA & MAHINDRA LTD.
		1.4 MARUTI SUZUKI INDIA LTD.
		1.5 TATA MOTORS LTD.
2	CEMENT & CEMENT PRODUCTS	2.1 ACC LTD
		2.2 AMBUJA CEMENTS LTD.
		2.3 GRASIM INDUSTRIES LTD.
		2.4 ULTRATECH CEMENT LTD.
3	CONSTRUCTION	3.1 DLF LTD
		3.2 LARSEN & TOUBRO LTD.
4	CONSUMER GOODS	4.1 ASIAN PAINTS LTD.
		4.2 HINDUSTAN UNILEVER LTD.
		4.3 ITC LTD.
5	ENERGY	5.1 BHARAT PETROLEUM CORPORATION LTD.
		5.2 CAIRN INDIA LTD.
		5.3 GAIL (INDIA) LTD.
		5.4 NTPC LTD.
		5.5 OIL & NATURAL GAS CORPORATION LTD.
		5.6 POWERGRID CORPORATION OF INDIA LTD.
		5.7 RELIANCE INDUSTRIES LTD.
		5.8 TATA POWER COMPANY LTD.
6	FINANCIAL SERVICES	6.1 AXIS BANK LTD.
		6.2 BANK OF BARODA
		6.3 HDFC BANK LTD.
		6.4 HOUSING DEVELOPMENT FINANCE CORPORATION LTD.
		6.5 ICICI BANK LTD.
		6.6 IDFC LTD.
		6.7 INDUSIND BANK LTD.
		6.8 KOTAK MAHINDRA BANK LTD.
		6.9 PUNJAB NATIONAL BANK
		6.10 STATE BANK OF INDIA
7	INDUSTRIAL MANUFACTURING	7.1 BHARAT HEAVY ELECTRICALS LTD.
8	INFORMATION TECHNOLOGY	8.1 HCL TECHNOLOGIES LTD.
		8.2 INFOSYS LTD.
		8.3 TATA CONSULTANCY SERVICES LTD.
		8.4 TECH MAHINDRA LTD.
		8.5 WIPRO LTD.
9	MEDIA & ENTERTAINMENT	9.1 ZEE ENTERTAINMENT ENTERPRISES LTD.
10	METALS	**10.1 COAL INDIA LTD ****
		10.2 HINDALCO INDUSTRIES LTD.
		10.3 JINDAL STEEL & POWER LTD.
		10.4 NMDC LTD.
		10.5 SESA STERLITE LTD.
		10.6 TATA STEEL LTD.
11	PHARMACEUTICALS	11.1 CIPLA LTD
		11.2 DR.REDDY'S LABORATORIES LTD.
		11.3 LUPIN LTD.
		11.4 SUN PHARMACEUTICALS INDUSTRIES LTD.
12	TELECOM	12.1 BHARTI AIRTEL LTD.
		**** INDICATES DATA FOR FOUR YEARS 1/4/2009-31/3/2014**

3.3 Computational Methodology and Volatility Formulations.

This section is arranged section wise as follows:-

3.3.1:- **Stock Returns**: Were computed using natural log arithmetic ratio of today's closing price of stock/Index Value to yesterday's closing price. Prices cannot be negative but returns can be and also log of a negative value is not defined. We need to exercise caution in this aspect as although we undertake statistical analysis on stock returns using the lognormal returns on the stock but when it comes to portfolio construction of sample 20 stocks carefully chosen from the NSE (Nifty Fifty) Population with respect to having relatively lower risk and the proportion of capital to be invested in these sample twenty stocks there arises the issue of weights being applied, hence it is customary to use normal returns whilst constructing portfolio of these select twenty equity stocks from the population.

High frequency data (daily closing prices of stock and market index), and if there happens to be little variation in stock returns using normality assumptions and stock return computed using natural logarithmic ratio of closing prices, which generally results in high frequency data computing (also refer the plots in data sampling section where python software was employed wherein graphical plots hardly shows any significant difference when price is plotted v/s time or log of closing prices v/s time. Hence we will employ the log returns for our portfolio construction and management exercise in this study to maintain uniformity in our analysis.

As regards risk free rate of return we have assumed 7% (calculations not done),which could be obtainable from the money market data set on a one year Treasury bill issued by Indian Government. This could be construed as a limitation in this study needless to say that the same can be computed albeit some variability and choice of the data set are used from requisite website of Reserve Bank of India.

3.3.2:- Stock Volatility: Volatility is a measure of risk which is traditionally computed using Standard Deviation of returns from their Mean Return

3.3.3:- Historical Volatility Computations

10day,20day,30day,60day,90day,120day,150day,180day historical volatility on Annualized basis. These historical annualized volatilities are computed in MS Excel using standard formulations.

3.3.4:- Extreme value volatility estimators:-

a) Classical /Traditional Historical volatility metrics: - Computed on Annual basis and reported on Annualized basis taking into account only the closing stock prices.

b) Parkinson's Estimator

c) Garman-Klass Estimator

d) Rogers- Satchell Estimator

e) Yang- Zhang Volatility Estimator.

3.4 Data Analysis Tables and Plots Methodology

A) Exploratory data analysis done using

a) Histograms

b) Q-Q Plots.(Quantile- Quantile Box Plots)

c) Empirical Distribution Function.

d) Kernel Density Function.

B) PYTHON SOFTWARE Used for plotting

a) **Japanese Candle Stick Plots**.

b) **Data Sampling Plots**

1) Closing Stock Price V/S Time.
2) Natural Log of Closing Stock Price V/S Time.
3) Historical Volatility Estimator plots of different durations V/S Time.

4) Natural Log Returns V/S Time.

C) **Correlogram Analysis Plots**.

D) **Model for Volatility Forecast table and plots**.

E) **Smoothing Plots.**

F) Descriptive Statistics Tables and other relevant Statistics Computational Tables.

Operating software employed: - MS Excel and Num XL

Although Exhaustive Analysis of NSE Index and all Fifty Stocks were undertaken in this study, of which the top twenty stocks based on the criteria of minimal risk is considered for constructing an optimal portfolio for the investor, and carefully selecting the sample twenty equity stocks from NSE population considering output from exploratory data analysis and model building stage analysis.

- **Gann Square Of Nine Technique**:- Use of Gann Calculator employed, in determining various Intraday trade prices as a forecast, using Gann Sir's teachings. There are several Training programs being conducted on Gann Analysis in India especially for use in intraday trading but can also be used for long run as well.

- **Sharpe's Optimization Model and Fama's decomposition of excess return** was also undertaken which will shed light on answering the question of whether Idiosyncratic Volatility is priced in the Indian Stock Markets.

3.5 Computation Methodology for Price Range Estimators

A) Traditional /Classical (Close-to-Close) Volatility Estimators:-

1) CLASSICAL/ TRADITIONAL:-

STEP:-1 Find ln (C/C-1), where C is today's closing price and C-1, is yesterday's closing prices.

STEP:-2 Find the mean of Step 1. Using Excel Formula = Average (Log Returns Ratio) as found in step 1 above.

STEP:- 3 Find the Standard Deviation of Log returns ratio of these closing prices as obtained in step 1,by using the excel function = STDEV (Log Returns Ratio) as found in step 1 above.

STEP:-4 Annualized historical volatility = Standard deviation of log returns as obtained in step 3 above is multiplied by square root of the number of trading days in a year which is taken throughout this study to be 252 days, 1 year = 252 Trading Days).

2) Classical/Traditional (Sum Of Squares) Method:-

Step 1:- Take $\{\ln (C/C-1)\}^2$ .That is the square of the first step of above.

Step 2:- Take the summation of this step 1 intermediate results.

Step 3:- Trading days as per number of days in a year were ranging from 244 to 254 days depending on the year of study undertaken.

Step 4:- Find Variance which is step 2 results divided by step three.

Step 5:- Find the standard deviation which is the square root of the variance as obtained in step 4 above.

Step 6:- Annualized Historical Volatility = Step 5 result multiplied by square root of 252 trading days in a year.

B) Price-Range Volatility Estimators:-

1) Parkinson (1980):-

STEP 1:- Find ln (H/ L),where H stands for the trading days High price and L stands for that trading days Low price.

STEP 2:- Find the Square of the value obtained of the estimator of step 1.

STEP 3:- Compute 4 ln2 = (4* 0.69314718)= 2.772588722 , a constant used in this model.

STEP 4:- Result of step 2 is divided by Step 3 result, alternately, multiply step 2 results by the reciprocal of 4ln2 which is 0.36067376.

STEP 5:- Take the summation of step 4 values.

STEP 6:- Trading days as is applicable for the year (2009 to 2014) varying between 244 to 254 days as is applicable for that individual year.

STEP 7:- Variance is then computed as step 5 divide by step 6.

STEP 8:- Find standard deviation which is the square root of the value obtained as in step 7.

STEP 9:- Annualized Historical Volatility is obtained by multiplying the value obtained in step 8 by the square root of 252 trading days in a year.

2) Garman & Klass:-

STEP 1:- Find ln (C/O), where C stands for day's closing price and O stands for that day's opening price of stock or index.

STEP 2:- Square the quantity of the estimate as obtained in step 1 above.

STEP 3:- First term of this GK estimator is obtained as:-
$0.5 * \{ \ln (H/L)\}^2$.

STEP 4:- Second term of this GK estimator is obtained as:-
$(2LN2 -1) * \{ \ln (C/O))^2$.

STEP 5:- Find the difference of step 3 and step 4 above as:-
first term minus second term.

STEP 6:- Take the summation of step 5.

STEP 7:- Identify appropriate trading days in the year.(RANGE 244 TO 254 DAYS).

STEP 8:- Find Variance = step 6 divided by step 7.

STEP 9:- Find Standard Deviation which is the square root of variance value as obtained in step 8 above.

STEP 10:- Annualized historical volatility = std deviation as obtained in step 9 is multiplied by square root of 252 trading days.

3) Rogers & Satchell's Estimator:-

STEP :-1 Take natural log of :- ln(O/C-1),Where O stands for today's opening price and C-1 stands for yesterday's closing price.

STEP:-2 Take the summation of step 1 above.

STEP:- 3 Take the average of step 1 above.

STEP:-4 Take the deviation of individual observations as in step 1 above from the average obtained in step 3 above.

STEP:-5 Find ln (H/O), where H is day's highest price and O is that day's opening price.

STEP:-6 Take ln(C/O),where C is the day's closing price of stock or index and O is the opening price of the stock or index.

STEP:-7 Take ln (L/O), where L is the day's lowest price and O is that day's opening price.

STEP:-8 Take the difference between step 5 and step 6.STEP 5-STEP6.

STEP:- 9 Multiply step 5 by step 8:- STEP 5 * STEP 8.

STEP:-10 Take the difference of step 7 and step 6:- STEP 7 – STEP 6.

STEP:-11 Take the product of step 7 and step 10:- STEP 7*STEP10.

STEP:-12 Add steps 9 and 11.STEP 9+STEP11.

STEP:-13 Add up step 12,or take the sum of step 12 values.

STEP:-14 Identify trading days in a year which ranges from 244 to 254 days in one year for the five year period 2009-2014 considered for our study.

STEP :-15 Thus we obtain ROGERS-SATCHELL'S Variance figure as:- step 13 divided by step 14.

STEP :-16 We workout the standard deviation by taking the square root of the estimate as obtained in step 15 above.

STEP:-17 Finally calculate the annualized historical volatility by multiplying the std deviation as obtained in step 16 above by the square root of the trading days which is customarily taken as 252 days throughout this study.

4) Yang-Zhang Estimator

STEP:-1 Find ln(O/C-1),where O stands for day's opening price and C-1 represents the previous day's closing price. Also referred to as "JUMP".

STEP:-2 Find the difference between step 1 values and average of step 1 values: step1 minus average of step1.

STEP:-3 Take the sum of step 2.

STEP:-4 Identify the number of trading days in a year ranging from 244 to 254 days depends upon the value in each of these five years under study. Here we use n-1 trading days in a year, if there are 244 observations in the sample then we need to take 243 as a figure.

STEP:-5 This is how we get the first term of This Yang-Zhang estimator.

STEP:-6 Find "k" and hence "1-k", where k = 0.34/ 1.34 + (n+1)/n-1.

STEP:-7 Second term of this Yang-Zhang estimator is obtained as follows:-

Step 3 * (k/n-1)

STEP:-8 Third term is obtained as:-

(1-k)* Rogers Satchell Variance.

STEP:-9 Take The Total of First Term, Second Term , And Third Term.:- STEP 5 + STEP7 + STEP 8.

STEP:-10 We get the Yang-Zhang variance estimate in step 9 after adding these three terms.

STEP:-11 Standard deviation is obtained as the square root of variance obtained as in step 10.

STEP:-12 Finally we get the annualized Yang Zhang historical volatility estimate by multiplying the standard deviation as obtained in step 11 with the square root of 252 trading days as is customary.

3.6 Time Series Models for Forecasting Volatility

3.6.1 Random Walk Model:

A Random walk is defined as a process where the current value of a variable is composed of past value plus an error term defined as a White Noise (A Normally distributed variable with mean zero and variance of unity). A random walk model with drift acts like a trend which displays both a deterministic trend and a stochastic trend and we employ the Ordinary Least Squares Technique to estimate the parameters.

Forecasting Volatility serves three main purposes: a) Risk Management b) Asset Allocation & c) Speculating future volatility. The simplest approach is to use historical standard deviation in forecasting volatility as we have discussed earlier.

3.6.2 ARCH Models (Auto Regressive Conditional Heteroscedasticity Model)

Auto regressive models are autoregressive in squared returns of an asset, which implies that next period's volatility is conditional on this period's volatility. If the variances of residuals in a standard linear regression model are not constant we call it as Heteroscedasticity, Engle in 1982 first developed a simple ARCH (1) model, which consists of two equations one for conditional mean and another for conditional variance, which needs simultaneous estimation as we are aware that variance is a function of the mean.

3.6.3 GARCH Model (General Autoregressive Conditional Heteroscedasticity) Model

Bollerslev & Taylor in 1986 developed the GARCH (p, q) model.Garch Analysis helps us model and foresee conditional variance or volatility rather than the variable's conditional Mean which is a function of past errors and variances.

Following questions needs to be addressed and resolved using GARCH Model employed for our study.

1) Does the Log Returns time series on stocks/index for selected span of five years exhibit White Noise? We use the LJUNG-BOX Test for this purpose which enables us to test no serial or auto correlation in log returns of the asset.
2) Are these Log Returns Normally distributed?
3) Does the Daily Log Returns on the Asset exhibit an ARCH Effect? Implying whether the squared daily log returns on stocks exhibit white noise?

In time series modeling exercise we have exhaustively employed Num XL an add in feature of MS Excel, which supports numerous Time series models. We have restricted our study by using (1,1) order for all models selected for the order p and q, which are most popular and widely used in modeling financial econometric time series. For Noise/ Residual/ Stochastic Disturbances/ Innovations we have employed three main distributions such as the Normal (Gaussian distribution), Student's t test and General Error Distribution functions.

Next we compute Goodness of fit using LLF (Log Likelihood Function) and AIC (Akaike Information criterion) in tandem with Residuals (Standardized) Analysis which are tested at 5% level of significance for hypothesis testing purposes.

We need to find the optimal model using model calibration and solver to estimate parameters of these ten different time series models employed in this study to ascertain the best model which fits the empirical data distribution of stocks and NSE Index, for forecasting volatility.

3.6.4 EGARCH (Exponential General Auto regressive Conditional Heteroscedasticity) Models:

Nelson (1991) proposed the EGARCH Model which incorporates the leverage effects which takes into account asymmetries in the model formulations.

Estimation of in sample Volatility and Out of sample volatility for next step or year is then undertaken for all stocks and NSE Index.

Chapter 4

Hypothesis Formulations

PART A: - Primary Data

Null hypothesis

1) Investor's Investment objectives and their demographic factors are significantly correlated.

2) There is a strong positive correlation between type of Investor and Investor demographics.

3) Young Investors have higher degree of risk tolerance.

4) Behavioral factors do not influence portfolio decisions.

PART B: - Secondary Data

Set 1 Based On Descriptive Statistics Covering;

Daily log normal returns empirical distribution analyzed :- four moments (central tendency, dispersion, symmetry, kurtosis) - normality test et al.

1. Mean daily returns are zero. H_0:- $\mu = 0$ v/s H_1 :- $\mu \neq 0$.
2. Density (Mass) distribution is Symmetric. H_0:- Skew = 0 v/ s HI:- SKEW $\neq 0$
3. Density distribution has no fat tails. H0:- Excess-Kurtosis = 0, v/s HI:-Excess Kurtosis $\neq 0$.
4. H_0: Half of the data observations fall between the quartiles Q1 & Q3.
5. H_0: Median of the distribution = Mean

Set 2 Based On Random Walk Process Paths For Asset Prices In Daily Log Normal Returns.

- Random walk (Unit Root Existence) (ADF) (Augmented Dickey Fuller) test and time series data are interdependent.
  - H0: There is presence of unit root existence (Random walk) in all formulations.(ADF)

- H0: The log returns time series exhibit strong interdependency (ACF & PACF)

Set 3 Serial/Auto Correlation And Homoscedasticity (Equal Variance) Assumptions Tested On The Empirical Data Time Series.

- H_0: Log returns time series exhibit white noise (no serial/auto) correlation. (LJUNG-BOX).
- H_0:-Log returns time series exhibits an ARCH EFFECT.(ARCH EFFECT)

SET 4 Residual Diagnostic (Standardized) Test Analysis

- Population Mean (H_0:- $\mu = 0$)
- Population Standard Deviation (H_0:- $\sigma = 1$)
- Population Skew (H_0:- $S = 0$)
- Population Excess Kurtosis (H_0:- $K = 0$)
- White noise or serial (auto) correlation test (H_0:- $\rho_1 = \rho_2 = \ldots\ldots\ldots\ldots = \rho_k = 0$)
- Normality test:- H_0:- $\varepsilon_t \sim \emptyset(0,1)$
- White Noise & Arch Effect:- Residuals are Identical & Independently distributed.H_0:-$\varepsilon_t \sim i.i.d.$
- H_0:- The negative returns deviate more from normality than positive returns.

SET 5: Goodness of Fit of the Empirical Time Series Data

- H_O: – Random walk model is best suited for modeling log return time series.(LLC/AIC)

SET 6: Price Range Volatility Estimators.

- H0:-Extreme value intraday volatility estimators are more efficient than traditional/classical close to close volatility estimators.

- H0:- High frequency data impacts significantly the forecasting ability of the model.

SET 7: Linear Regression Based

- ❖ OLS Regression Estimators
- ❖ ANOVA
- ❖ Residual Diagnostics
- ❖ Chow (regression stability) test
- ❖ Role of influencers/outliers on paradigm shift of empirical distribution towards normality a contrast to the normal rule for this time series study.

Before we consider the Regression Model, we must answer the following question.

- ❖ "Is the Regression Model Statistically Significant or a statistical data anomaly"?

- ❖ A.N.O.V.A. Test (F test statistic is computed along with its corresponding p value, which enables us to test the overall significance of the Regression Model. We regress the Daily log- Arithmetic returns on a certain stock (Y) v/s the NSE Stock Market Daily log arithmetic returns.(X).If the p value is less than 5% our chosen level of significance , to test the statistical significance of the Null Hypothesis,(False) mentioned under significance column in our reports), we reject the null hypothesis.

- ❖ H_0:- $\beta_k = 0$ (Slope coefficient of the linear regression line is insignificant) v/s H_1:- $\exists\ \beta_k \neq 0$ (Slope coefficient is statistically significant)

- ❖ If the Alternative Hypothesis is accepted (H_1- True or H_O: False), we may infer that the linear regression model is statistically valid and it does explain some of the variation in the values of the dependent variable (Y).

- To test the Individual significance of the O.L.S .Regression estimators (Ordinary Least squares Principle method), we employ the student's t test to test individually the statistical significance of the estimators, again using the same concept as explained under ANOVA, using the p values computed of the t test statistic.

- Residual Diagnostics (Analysis Tableau):- Once having confirmed that the regression model does explain some variation in the values of the response variable (dependent variable/Endogenous variable), we then proceed to examine the residuals to make sure that the underlying assumptions of the model are complied with.

- H_O:- $\mu = 0$ v/s H_1:- $\mu \neq 0$ Average.

- H_O:- $\sigma = 1$ v/s H_1:- $\sigma \neq 1$ Standard Deviation (Volatility) .

- H_O:- Skew =0 v/s H_1:- Skew $\neq$ 0 (Skewness)

- H_0:- Kurtosis =0 v/s Kurtosis $\neq$ 0 (Kurtosis)

- H_O:- Residuals are Independent and identically distributed random variables v/s H_1:- Residuals are Not Normally distributed. (Normality).

- Regression Stability Test (Chow Test):- In this we partition the data into two parts and run the regression independently, for each set, and the output displays the chow statistics with its corresponding p value. In our case we had 1246 daily returns observations hence we partitioned the data set into two halves, each half containing 623 y and x variables pair set each. We ran the usual regression and if the p value is less than 5% we reject the Null hypothesis that is H_O: - Regression beta is stable in the two parts v/s H_1:- Beta is unstable.

- OUTLIERS/INFLUENCERS:- Refer CD Where we have attempted a case on how to identify whether a given data set is an outlier or not, and whether it has influencing properties of navigating the regression line better, once we drop that outlier/influencing observation. This is a tedious process which we experimented only on Reliance Industries stocks, as we need to compute the Cook's Distance (D), for each observation and compare with the threshold value (Approximately 20% of the number of sample observations), and we drop those points one by one, if the cook's distance exceeds the threshold limits(Highest value observation first, omit that observation, sample size changes, so also the threshold, again repeat the same step, we had to go through 90 plus iterations to weed out all influencing observations/outliers, which to quite an extent improved the regression model. Refer the r^2 measure before and after omitting those outliers. Also refer working in Regression Sheet in MS Excel.

CHAPTER 5

Data Analysis

Part I Primary Data Analysis

This study is an attempt to understand and unravel how Investor's make decisions, in deploying their Investible Surplus in the Indian Stock Market. The Demographic factors (Exogenous Variables) considered in this study encompasses: - Gender, Age, Qualification, Occupation & Annual Income in Indian Currency. This study attempts to predict type of investor, being classified as Aggressive, Moderate, and Defensive, which is based on Investor Demographic factors. This study has employed Multinomial Logistic Regression Model, in predicting the type of investor as the variables considered are categorical in nature.

A Detailed questionnaire containing 56 questions were framed, to elicit responses from retail investors primarily, in finding out how investors make investment decisions? A Risk tolerance questionnaire and the investor demographics which in this study includes:- Age, Gender, Qualification, Occupation, Income., and interspersed between them were 42 questions, which were administered to 425 respondents, who gave their feedback on these questions on Google. Using the Dow Jones and company survey report, which employed scores to be assigned to the risk tolerance questions hitherto mentioned, we classified type of investor as Conservative, Moderate and Aggressive, for these 425 respondents.

Data Analysis was done using SPSS 21 Software, to study the investor sentiments on stock market investing behaviour patterns. Predominantly Chi square statistic was used pertinent to the questionnaire framed.

3) Descriptive statistics extensively done on the data collected.

4) An attempt was made to formulate a model on type of investor, considering relevant variables as deemed by the researcher.

Descriptive statistics: - Pie charts and bar charts.

Chart 5.1 Type of Investor - Summary

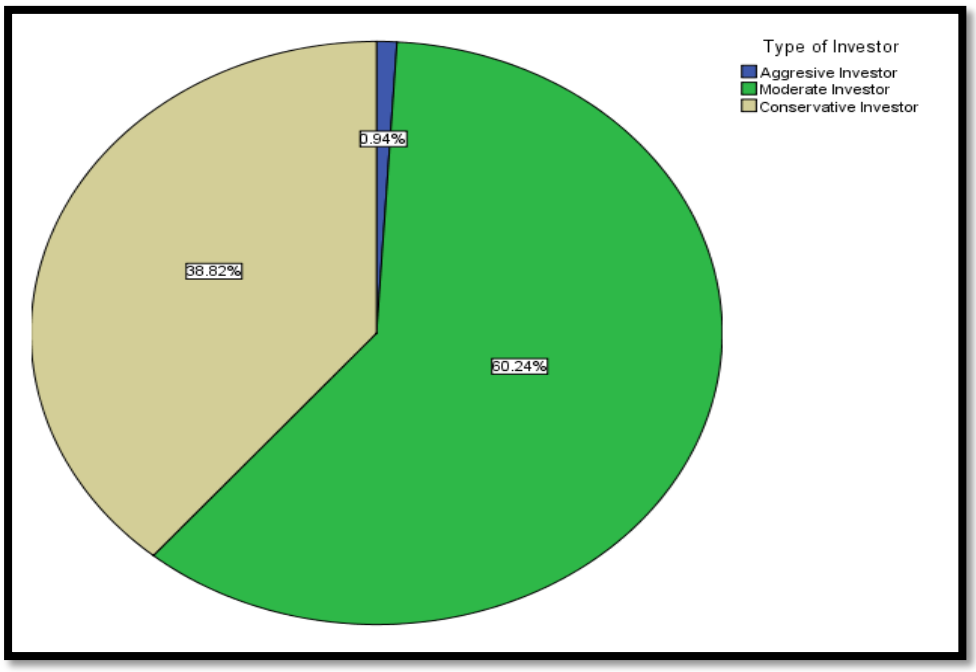


Chart 5.2 Investor's Age

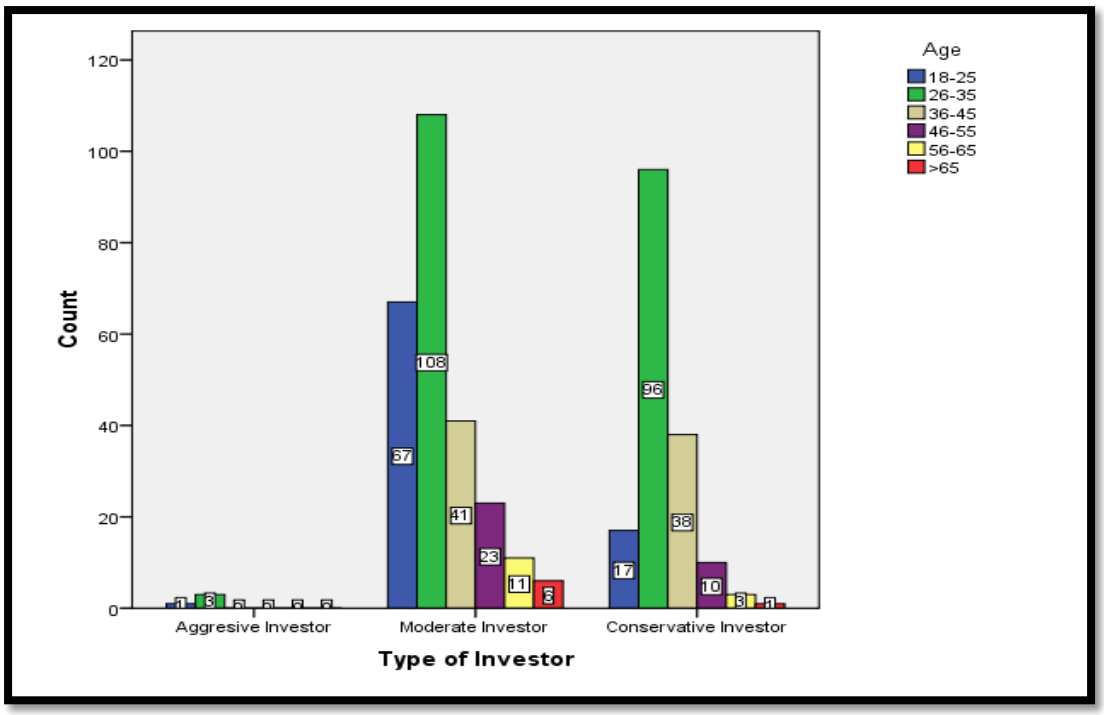


Chart 5.3 Investor's Gender

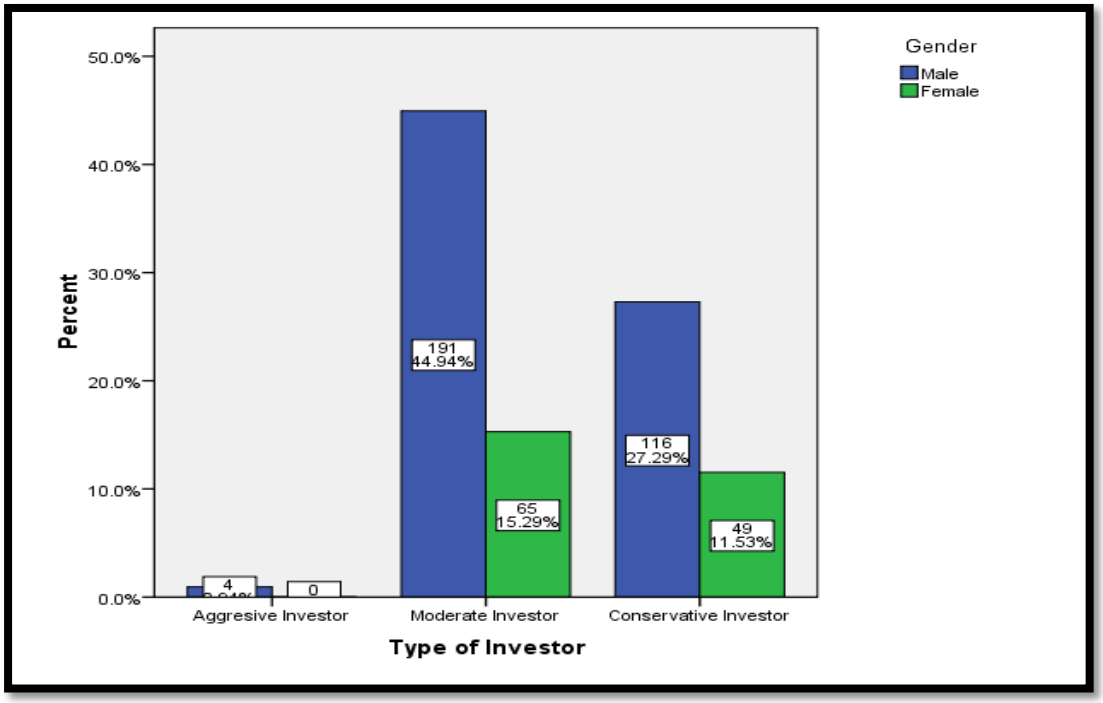


Chart 5.4 Investor's Qualification

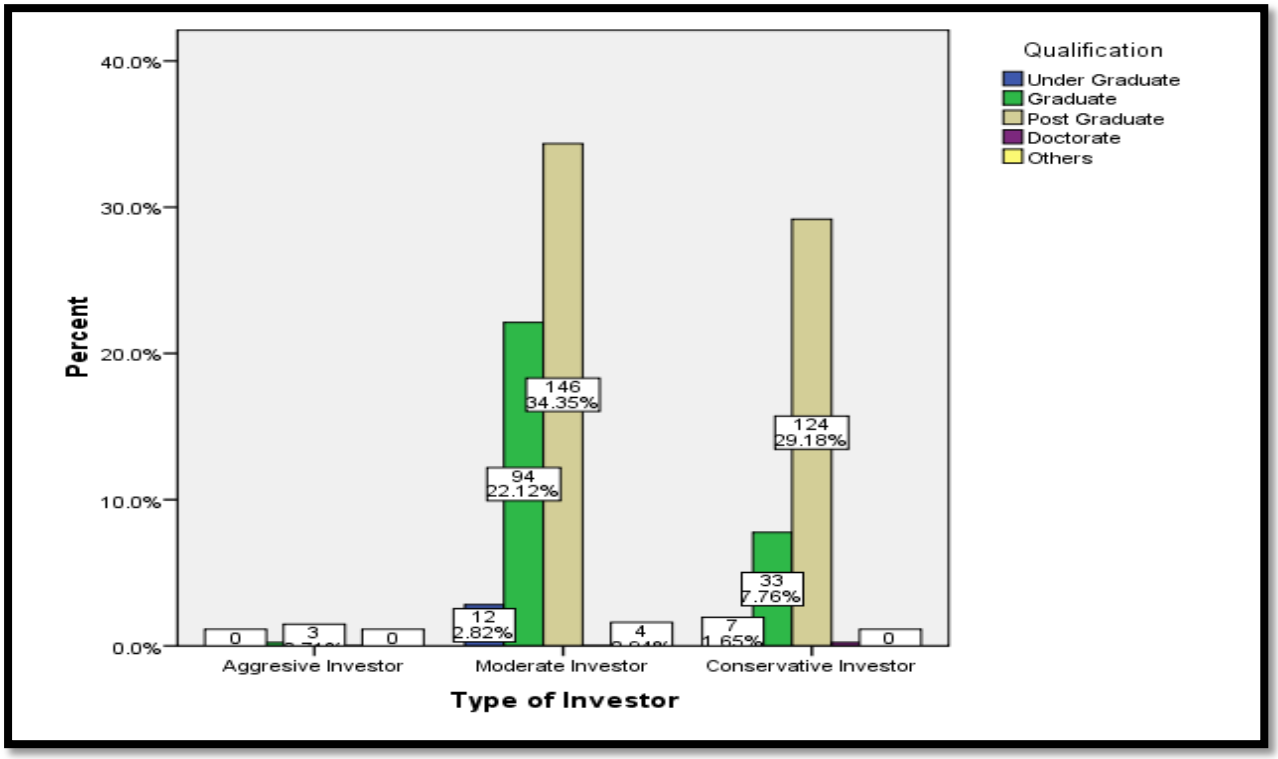


Chart 5.5 Investor's Occupation

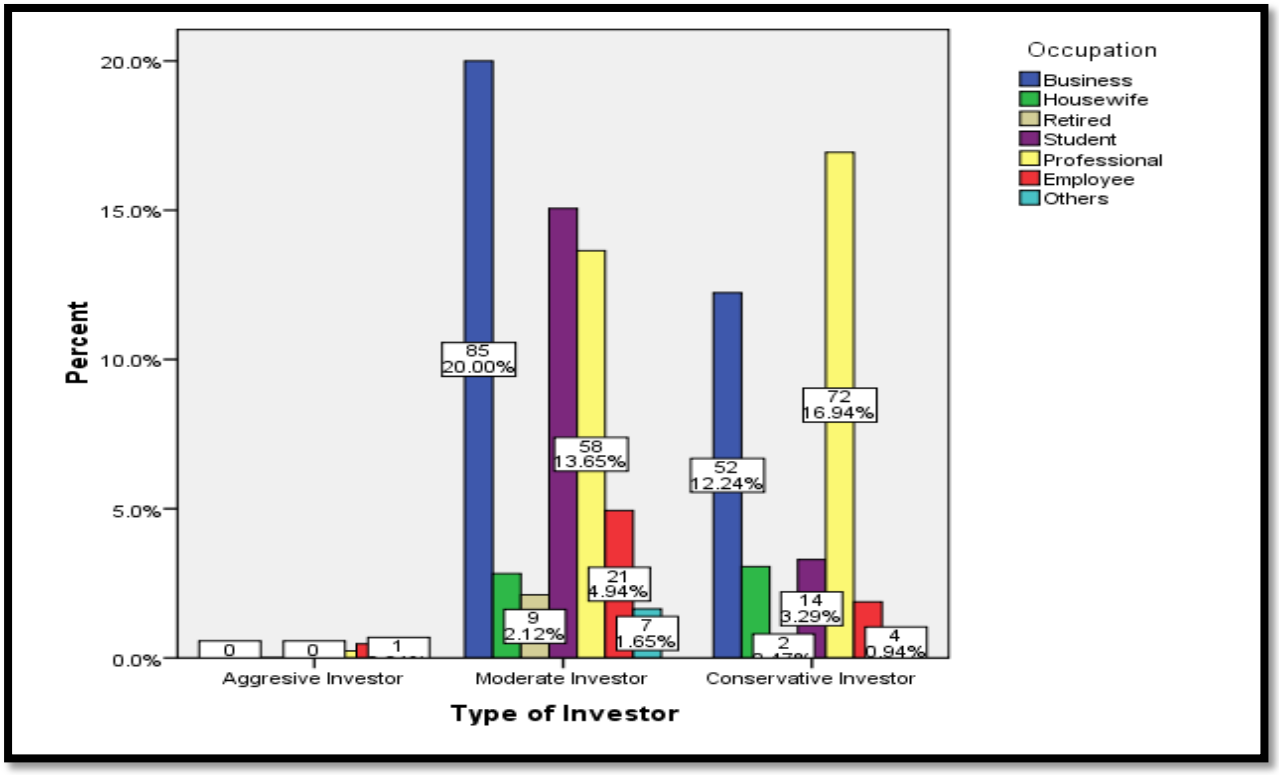
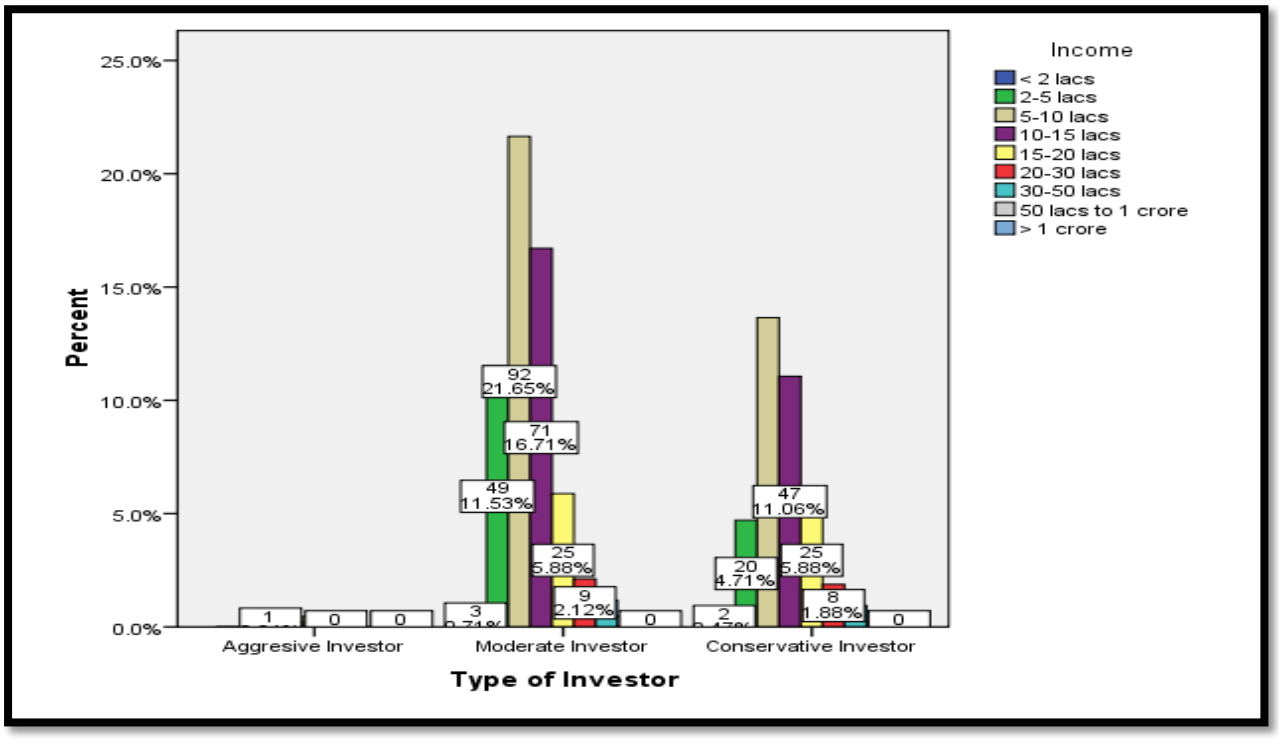


Chart 5.6 Investor's Income



Model fitting

Multinomial Logistic Regression method has been applied for classifying investors as Aggressive, conservative and moderate. Logistic regression is helpful for prediction of presence or absence of a characteristic or outcome based on values of a set of Predictor variables (here demographic variables are considered as Exogenous Variables in this study).

This model enables us to form a Multivariate Regression between an Endogenous Variable and multiple independent variables and is designed to estimate the parameters of the model especially in cases where the Dependent Variable is of Dichotomous nature and the Independent or exogenous variables are either continuous or categorical.

The beta coefficients can be estimated and interpreted using Logistic Regression Model by the addition of an appropriate link function to the standard linear regression model, which also enables computation of Odds Ratios for each of the Independent Variables being considered in this study. Also the variables considered can be either discrete or continuous and may not necessarily follow Gaussian distribution, which is an important assumption in the employability of standard linear regression models, being a major advantage.

BETA's are regression coefficients that are estimated through an iterative Maximum Likelihood method. The estimated results of Multivariate Logistic Regression Model are summarized in tables below, using SPSS-21 Software.

Table 5.1 Logistic Regression

Case Processing Summary			
		N	Marginal Percentage
Type of Investor	Aggressive Investor	4	.9%
	Moderate Investor	256	60.2%
	Conservative Investor	165	38.8%
Valid		425	100.0%
Missing		0	
Total		425	
Subpopulation		104[a]	
a. The dependent variable has only one value observed in 63 (60.6%) subpopulations.			

A Likelihood ratio test shows whether the model fits the data better than a null model. Chi-squared test statistic is the difference between the 2 log-likelihood of null and final models. Since significance level of test is < 0.05(see table below)

In Linear Regression, R square (Coefficient of Determination), test statistic measures proportion of variation in the response variable that is explained by model.R^2 cannot be exactly calculated for Multinomial Logistic Regression Model, hence approximations are done and thus called pseudo R^2

Large pseudo R^2 statistics indicate more of the variation explained by the model. Here these are observed to be highly insignificant.

Table 5.2 Pseudo R-Square

Pseudo R-Square	
Cox and Snell	.039
Nagelkerke	.051
McFadden	.027

Test of Significance Of Parameters

Null hypothesis (H_O):- All parameters of that effect are zero.

Likelihood ratio tests check whether each effect contributes to the model.-2 LOG-LIKELIHOOD is calculated for the reduced model that is one without effect. If the significance of test is small say (less than 10 % or 0.10), then we can say that the effect contributes to the model.

Table 5.3 Likelihood Ratio Tests

Likelihood Ratio Tests				
	Model Fitting Criteria	**Likelihood Ratio Tests**		
Effect	**-2 Log Likelihood of Reduced Model**	**Chi-Square**	**df**	**Sig.**
Intercept	**269.178**	**13.710**	**2**	**.001**
Age	**257.916**	**2.449**	**2**	**.294**

Gender	**258.845**	**3.377**	**2**	**.185**
Qualification	**261.427**	**5.959**	**2**	**.051**
Income	**261.044**	**5.576**	**2**	**.062**
Occupation	**81.903**	**11.113**	**2**	**.004**
The Chi-Square test statistic is the difference in -2log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The Null Hypothesis being all parameters of that effect are zero.				

Parameter Estimates

Parameter estimates, their standard error, significance tests, and confidence intervals are provided for all model parameters. The WALD statistic is the square of the ratio of parameter estimate to its standard deviation. If the significance of this statistic is small (say less than 10% or 0.10), then the parameters is useful to the model. Parameters with significant negative coefficients decrease the likelihood of that response. Parameters with positive coefficients increase the likelihood of that response category. The estimated correlation between each pair of parameters is displayed. Missing values in the matrix mean that one or both of the parameters is redundant. The estimated covariance between each pair of parameters is displayed. Zero values in matrix means that one or both of the parameters are redundant. This cross tabulation of observed response categories with predicted response. Categories help you to assess the predictive performance of our model. For each case, the predicted response category is chosen by selecting the category with highest model predicted probability. Cells along the diagonal represent number of correct predictions.

Table 5.4 Parameter Estimates

Parameter Estimates									
Type of Investor		B	Std. Error	Wald	df	Sig.	Exp.(B)	95% Confidence Interval for Exp.(B)	
								Lower Bound	Upper Bound
Aggressive Investor	Intercept	14.308	3.091	21.431	1	.000			
	Age	-1.038	.775	1.795	1	.180	.354	.078	1.617
	Gender	-18.046	.000		1		1.455E-8	1.455E-8	1.455E-8
	Qualification	.099	.778	.016	1	.899	1.104	.240	5.071
	Income	.539	.438	1.516	1	.218	1.714	.727	4.045
	Occupation	1.383	.543	6.481	1	.011	3.988	1.375	11.568
Moderate Investor	Intercept	2.318	.643	12.986	1	.000			
	Age	.024	.098	.059	1	.808	1.024	.845	1.240
	Gender	-.238	.226	1.111	1	.292	.788	.506	1.227
	Qualification	-.400	.170	5.561	1	.018	.670	.480	.935
	Income	-.158	.085	3.472	1	.062	.854	.723	1.008
	Occupation	-0.039	.052	.563	1	.453	.961	.868	1.065
a. The reference category is: Conservative Investor.									

Interpretation of Logistic Regression:

The interpretation has been made on the basis of Exp. (B) values.

Comparison of Aggressive Investor with reference to Conservative Investor

With increase in age it is more probable that investor is conservative compare to aggressive.

Males are more aggressive Investor compared to females.

Both with increase in Income, Occupation (i.e. a professional, service compared to business) & qualification Investor is more aggressive compare to being conservative.

Comparison of Moderate Investor with reference to Conservative Investor

With increase in age it is more probable that investor is moderate compared to being conservative.

Males are more moderate Investors compared to females.

Both with increase in Income, occupation (i.e. a professional, service compared to business) & qualification Investor is more conservative compare to being moderate.

Conclusions

Model validation requires checking model against independent data to ensure its prediction capability. Also further studies need to be conducted, like incorporating genetic algorithm, set approach and et al to increase the prediction ratio, which needs to be undertaken, and is not part of this study. Further researcher felt that if sample size is large at least 1000 respondents, the demographic variables will assume significance in predicting the type of investor.

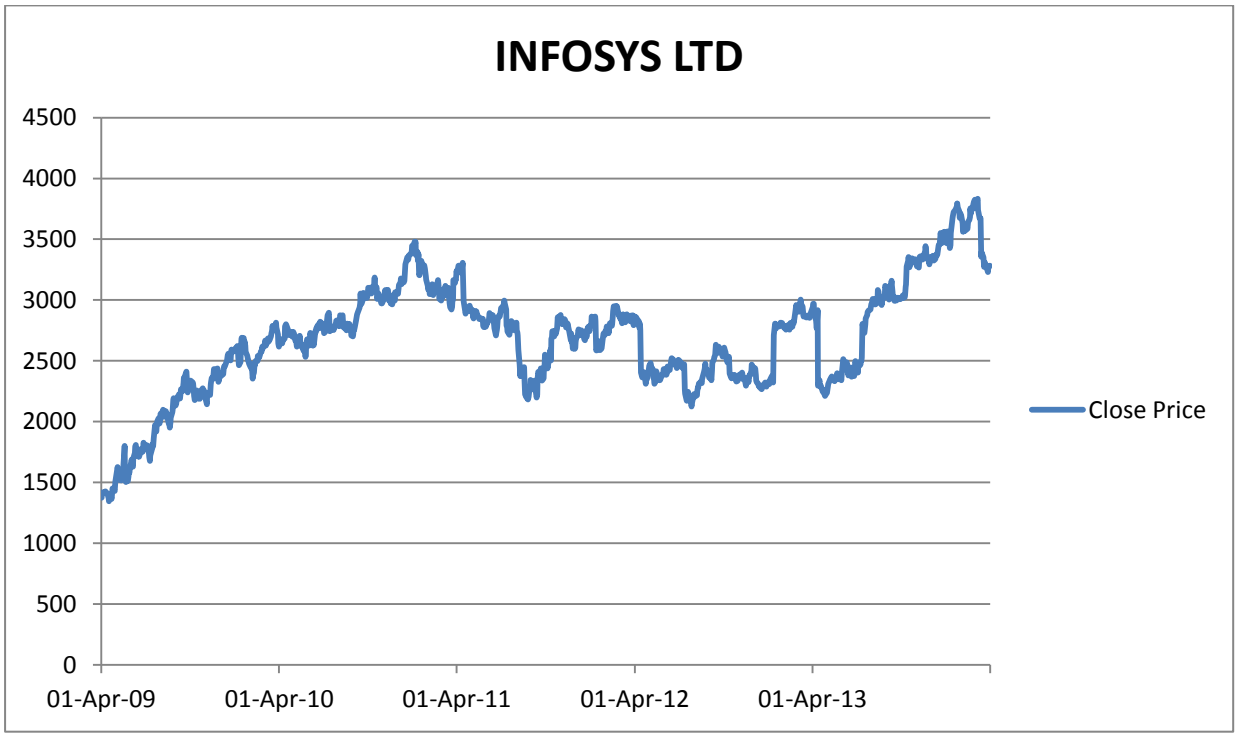
Part II Secondary Data Analysis

Below is the Stepwise procedure adopted in analysing Empirical data.

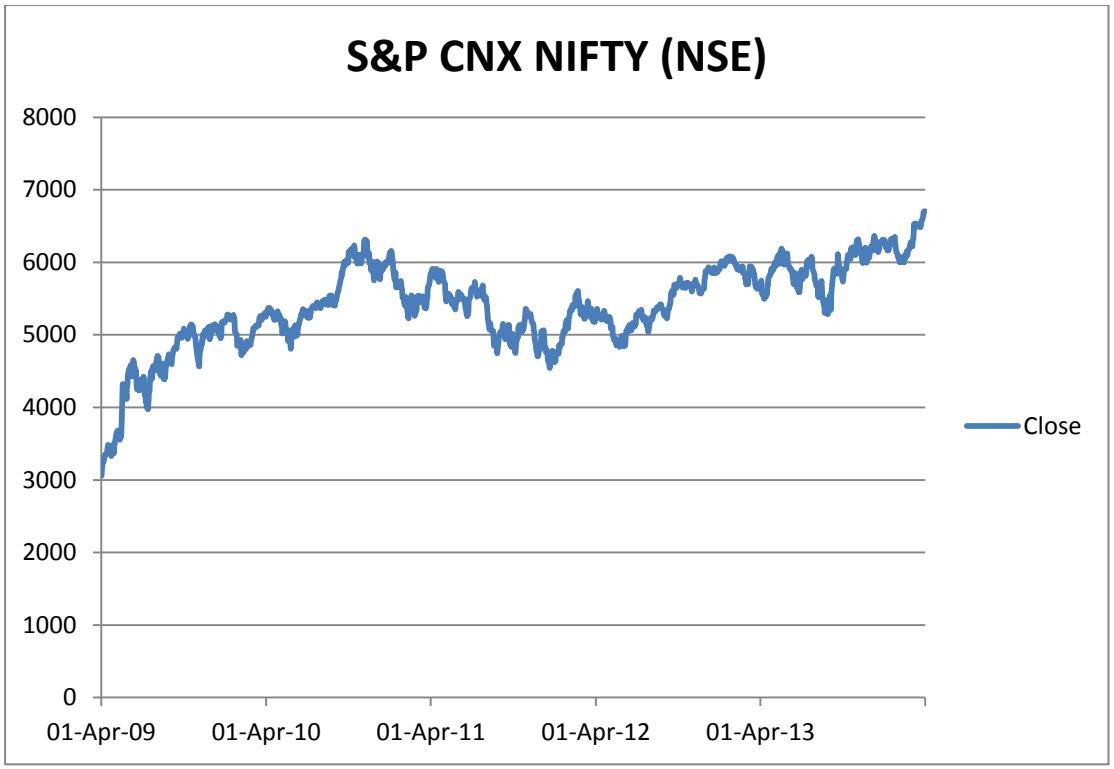
I Data Preparation

Sample Data:- Daily closing prices of all 50 stocks listed in NSE Stock exchange, including the NSE Market index, for the period 2009-2014 freely downloadable from the official NSE Website was undertaken. The sample data was tracked at the end of each work day (Trading day, not calendar day), and sample data were observed to be equally spaced as can be seen from in graph below. (Infosys Ltd and NSE Plots).

Graph 5.1



Graph 5.2



II Data Sampling:-

Before proceeding with Data analysis it is considered customary to check for the following characteristics of the empirical data considered for this study.

1) **Homogeneity:-** Before we try to propose a model for a Time series data, we need to verify that the underlying process did not undergo any structural change, at least during the span of study. Structural changes are events that permanently alter the statistical properties of the stochastic process. A structural change can be triggered by new policies, new laws, or any macroeconomic development during study span of sample data. To examine the Homogeneity (or lack thereof), we visually inspect the data plot along with WMA (Weighted Moving Average), using a window size of 20 days equally weighted moving average along with the original data plot of closing stock prices.

   Examining the sample data plot and Weighted Moving Average (WMA), we find that there is no evidence of a sudden permanent change in the underlying process mean, implying thereby homogeneity in the empirical data set or in other words we can say that the Underlying process is stable.

2) **Stationarity:-** For stationarity, we are mainly concerned with stability of variance and covariance throughout the sample. The stationarity assumption is a key for time series theories, hence we need to inspect it. Paradoxically, we begin by testing for the non-stationary condition; primarily:-1) The presence of unit root (Random walk) &/or 2) The presence of deterministic trend? If we cannot find them we may conclude that the data is stationary. We observe from the plots that the data plots do not exhibit any trend and series seems stationary.

3) **Outliers: -** An outlier is an observation that is numerically distant from rest of the data. An outlier is one that appears to deviate markedly from other members. The mere presence of an outlier in our data may change the mean level in the uncontaminated time series and it might suggest that the underlying process distribution has fat tails (Leptokurtosis) (Excess Kurtosis). A quick way to detect outliers is by using a robust measure such as the IQR (Inter- Quartile Range) (Q3-Q1), where Q3 is the third quartile and Q1 is the first quartile.

   We calculate the lower limit and upper limit as follows:-

   LL= Q1 – 1.5*IQR & UL = Q3 + 1.5*IQR , and try to identify whether any observation, is lying outside this band, qualifies to be labeled as an outlier.

4) **Concentration Of Values:**

   a) Time series models does not assume any bounds or limits , hence using these models to a constrained data set may pose problems which may yield a poor fitting to the data set.

   b) Having a floor or ceiling limit in the data set may affect symmetry (or lack of skew) of values around the mean. This phenomenon will be difficult to capture using the time series models.

   c) A data set whose values spans several orders of magnitude can prove to be problematic for modelling and forecasting.

   d) A relationship between observed values and local variance may develop and hence we need to stabilize the variance before modelling the Financial Econometric Time Series.

PART III Data Transformation

We have in our study employed the BOX-COX Transformation to our data set, by using zero lambda in this transformation, by taking the log ratio of the closing price of today over yesterday (zero power), to stabilize the data set for analysis. We have also attached the following visual and graphical plots encompassing the following, using Num XL add-in software to MS Excel. They are 1) Histograms (Scott's Choice is employed having 15 bins uniformly throughout our analysis) 2) Q-Q PLOTS (Quantile –Quantile plots) which clearly brings out the third and fourth moment of the data set i.e. (Skewness & Kurtosis). 3) Empirical distribution function and 4) Kernel density function for the 50 stocks and the NSE Index considered as population for our study.

PART IV. Descriptive Statistics:-

Japanese candle sticks plots (Python software used)

Refer table 1, 2, 3

Refer exploratory data graphs.

Refer table 4, 5, 6

Refer Data sampling plots.

All the tables contain analysis hypothesis testing and acceptance or rejection of the Null Hypothesis, and we have analysed all the fifty assets listed in the population of our study, S&P CNX Nifty Fifty stocks and NSE as the proxy Market Index considered as the barometer of the Indian Economy.

As regards Exploratory Data analysis, Data sampling plots, Candle stick plots, ACF & PACF correlogram plots, out of sample forecasts we have restricted it to our sample size of 20 equity stocks from this population based on various factors like least variability, clear exploratory data sampling plots, trouble free computation for finding best optimal model for volatility forecasting, and leaving out extreme fluctuating stocks from our select sample twenty stocks. The final lists of the twenty select stocks are as under.

Table 5.5 LIST OF SELECT SAMPLE 20 EQUITY STOCKS FROM N S E POPULATION

Sr. No.	Name of Index / stocks
1.	S&P CNX NIFTY INDEX
2.	HERO MOTO CORP LTD
3.	MARUTI SUZUKI LTD.
4.	ACC LTD
5.	AMBUJA CEMENTS LTD
6.	GRASIM INDUSTRIES LTD
7.	ULTRATECH CEMENT LTD
8.	DLF LTD
9.	HINDUSTAN UNILEVER LTD
10.	CAIRN INDIA LTD.
11.	GAIL (INDIA) LTD.
12.	NTPC LTD
13.	POWERGRID CORPORATION OF INDIA LTD.
14.	AXIS BANK LTD.
15.	BANK OF BARODA
16.	STATE BANK OF INDIA LTD
17.	INFOSYS LTD
18.	TECH MAHINDRA LTD.
19.	CIPLA LTD.
20.	DR. REDDY'S LABORATORIES LTD
21.	BHARTI AIRTEL LTD.

Tables 1 to 10 includes analysis of all 50 securities listed in the NSE Nifty Fifty population are included in this report, but as regards Japanese Candlesticks Plots, Data sampling plots, Exploratory data analysis, Optimal model befitting empirical data and Portfolio Construction section we have included in this report only select twenty sample equity stocks and NSE Market index, in same chronological order as in Table 5.5 above for all plots and data analysis.

Plot 5.1.1 (S&P CNX NIFTY (NSE INDIA) CNX NIFTY Japanese Candlestick Plots



Plot 5.1.2 Hero Moto Corp Japanese Candlestick Plots



Plot 5.1.3 Maruti Suzuki Japanese Candlestick Plots



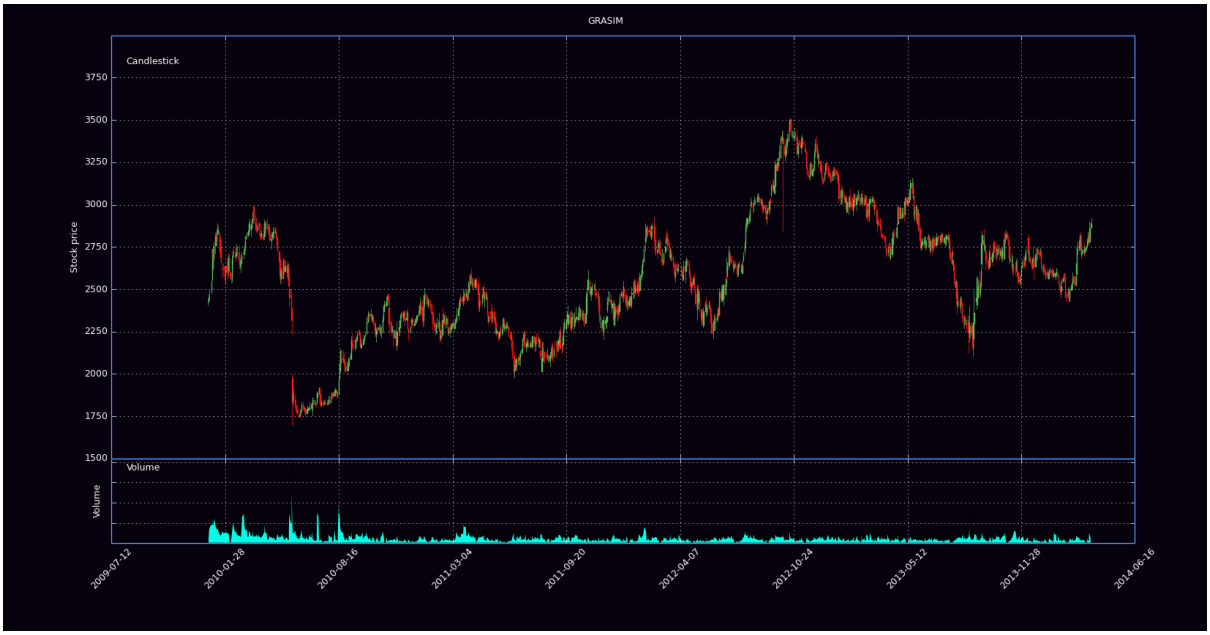
Plot 5.1.4 (Cement & Cement Products) ACC Japanese Candlestick Plots



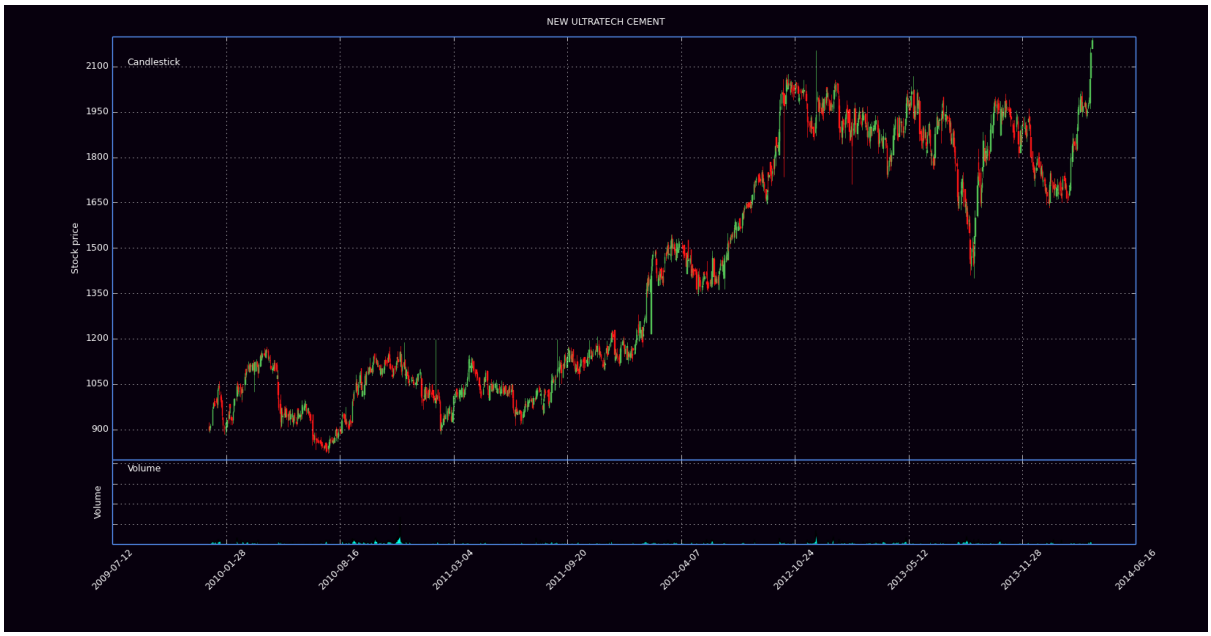
Plot 5.1.5 Ambuja Cement Japanese Candlestick Plots



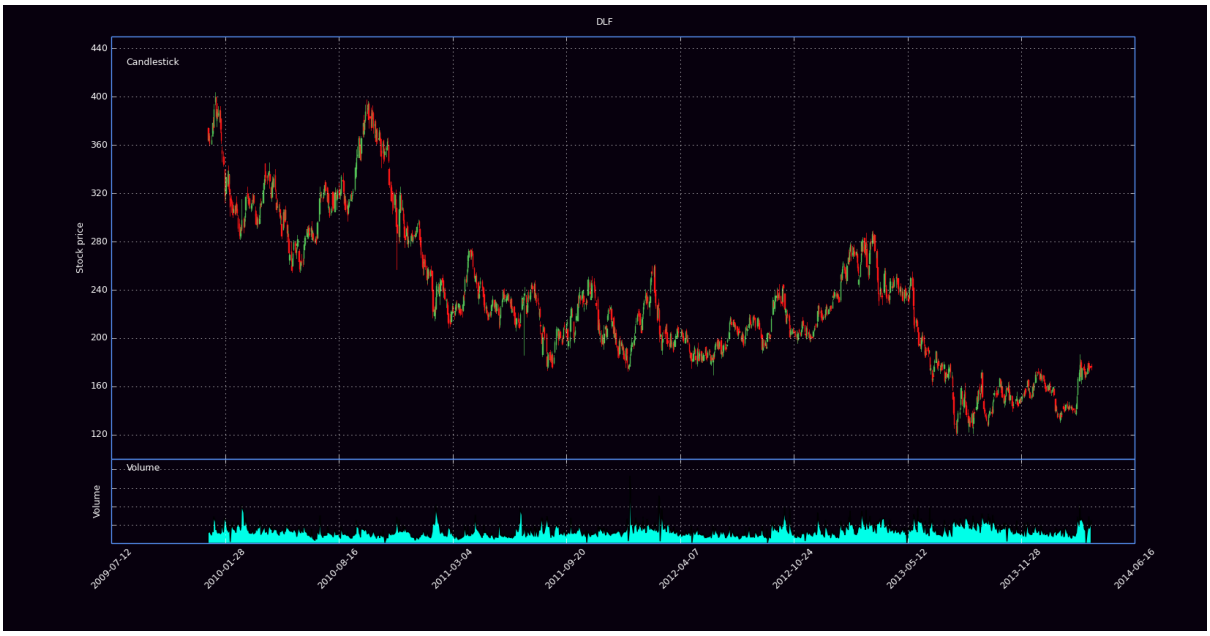
Plot 5.1.6 Grasim Industries Japanese Candlestick Plots



Plot 5.1.7 Ultratech Cement Japanese Candlestick Plots



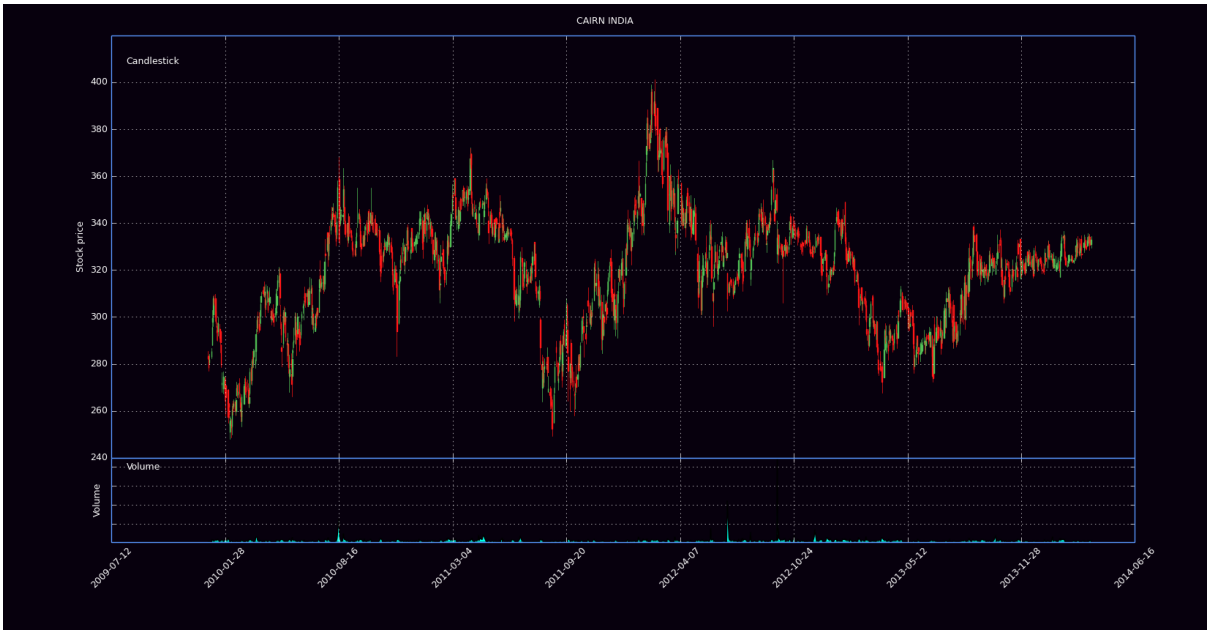
Plot 5.1.8 (Construction) DLF LTD Japanese Candlestick Plots



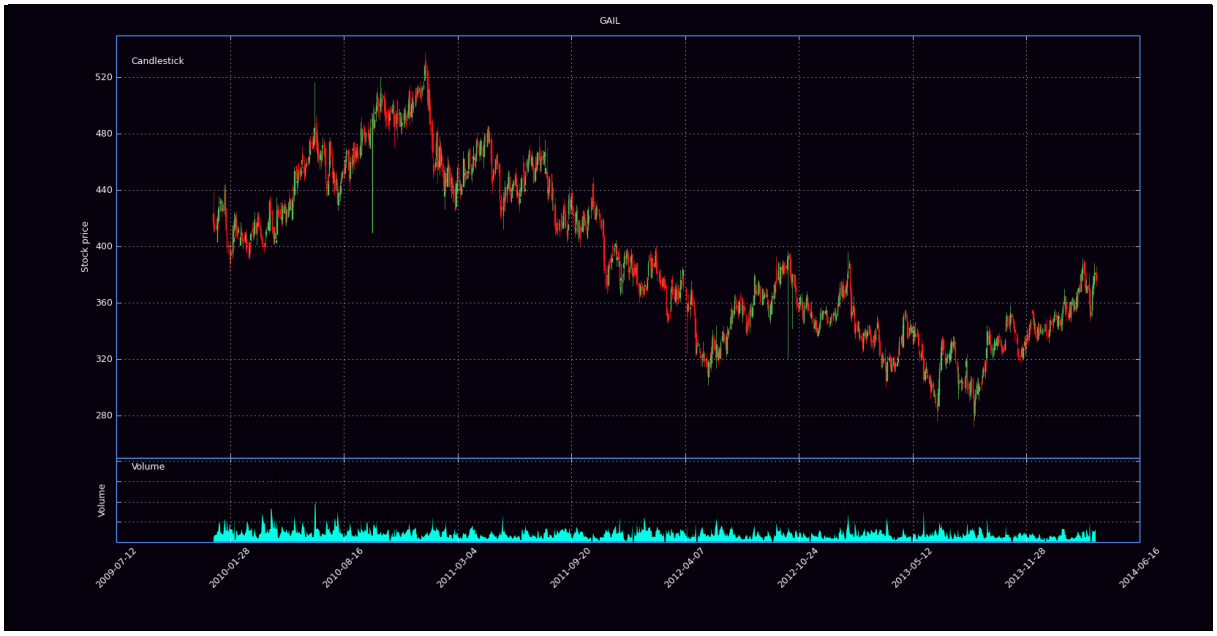
Plot 5.1.9 Hindustan Unilever Ltd Japanese Candlestick Plots



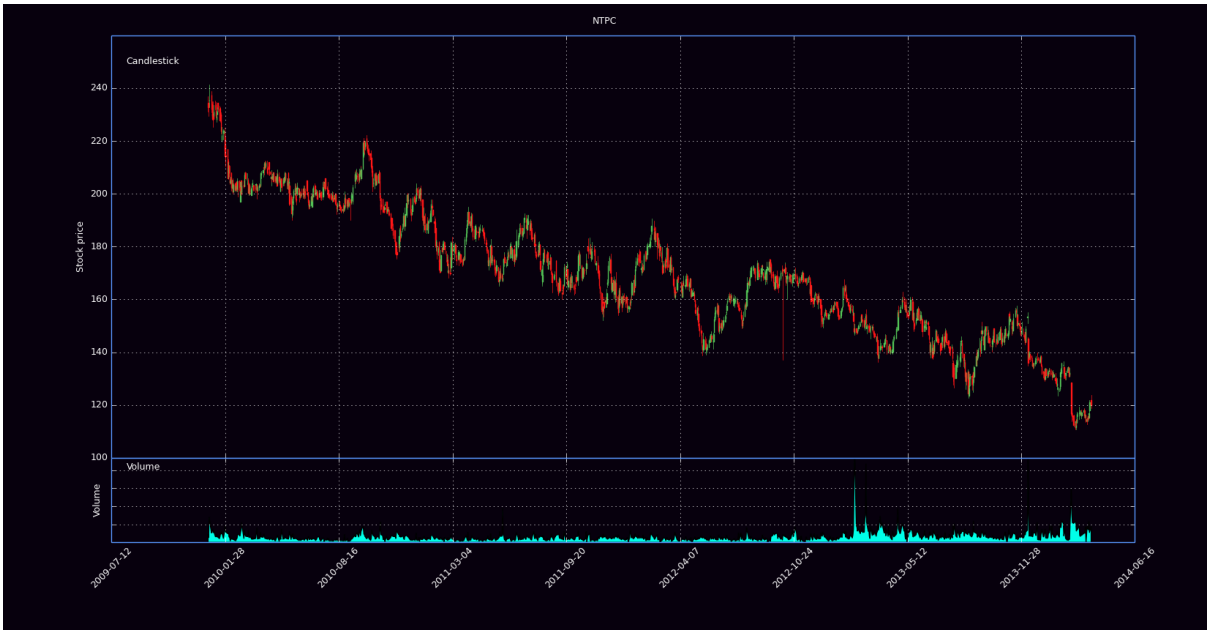
Plot 5.1.10 Cairn India Ltd Japanese Candlestick Plots



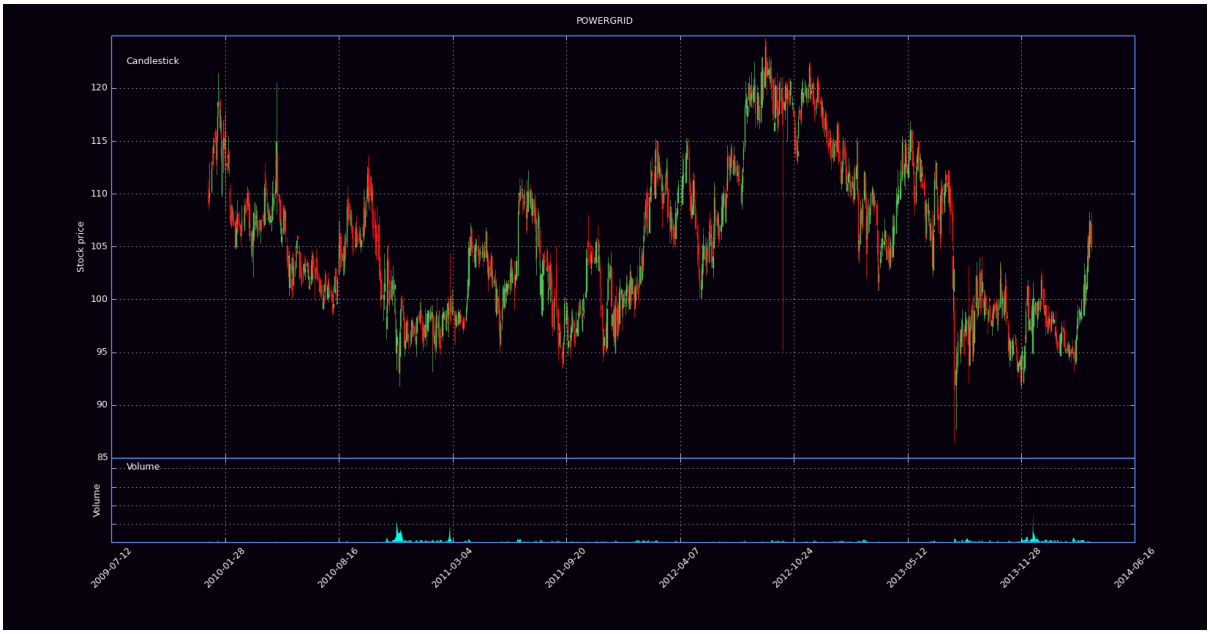
Plot 5.1.11 GAIL (INDIA) Ltd Japanese Candlestick Plots



Plot 5.1.12 NTPC Ltd Japanese Candlestick Plots



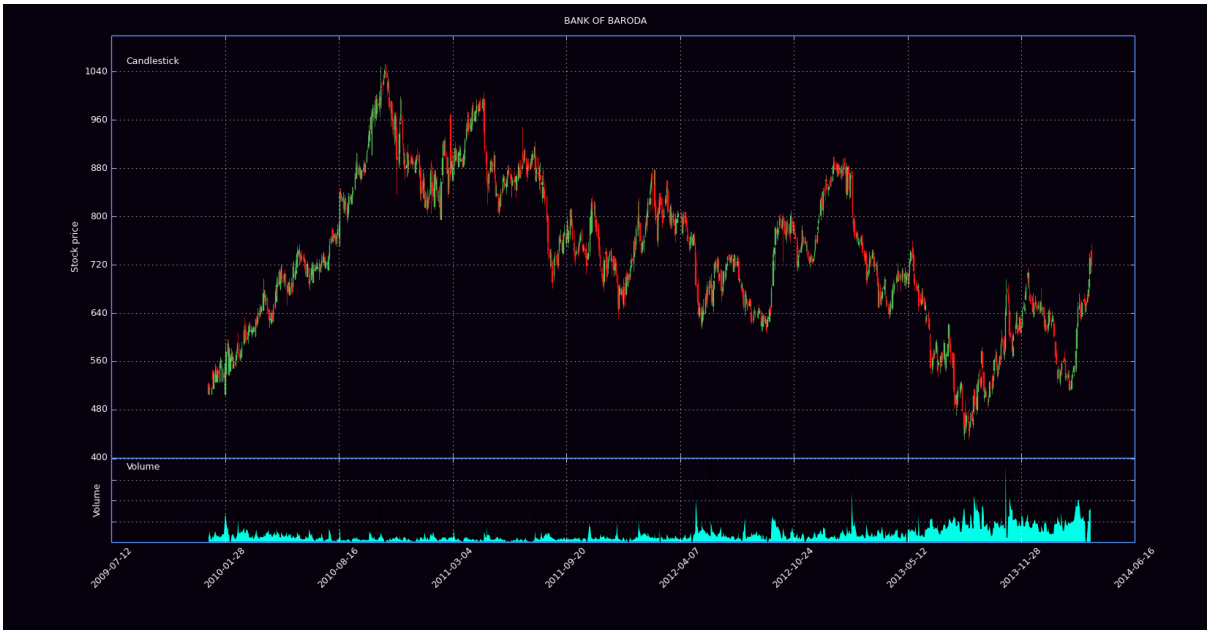
Plot 5.1.13 Powergrid Corporation of India Ltd Japanese Candlestick Plots



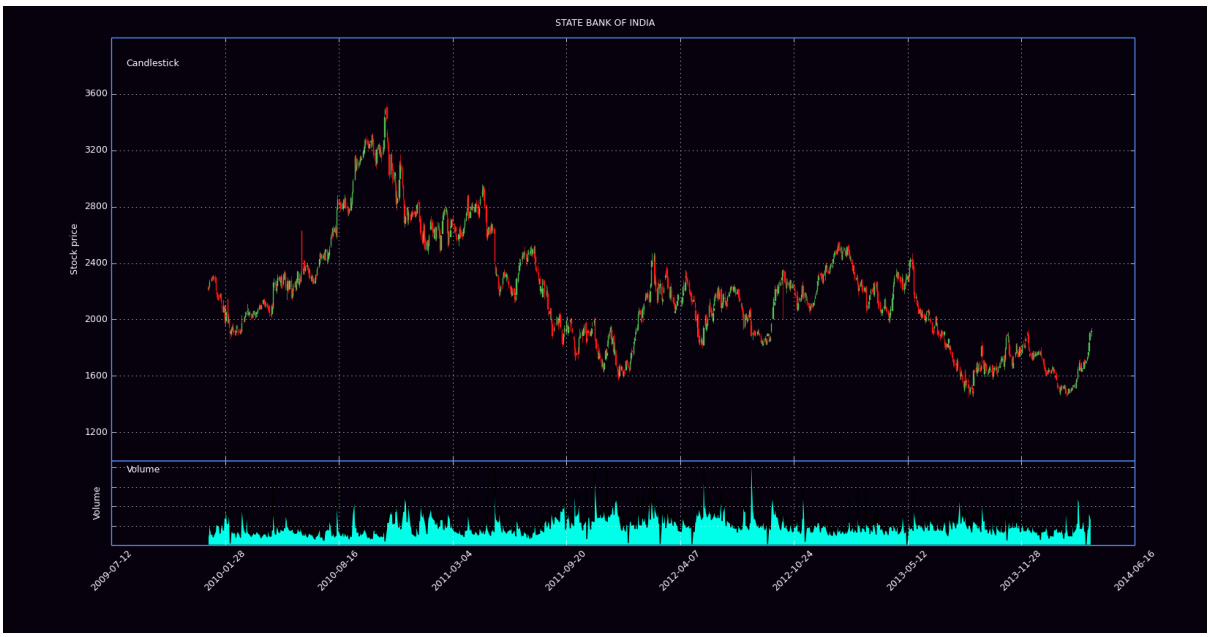
Plot 5.1.14 (Financial Services) Axis Bank Ltd Japanese Candlestick Plots



Plot 5.1.15 Bank of Baroda Ltd Japanese Candlestick Plots



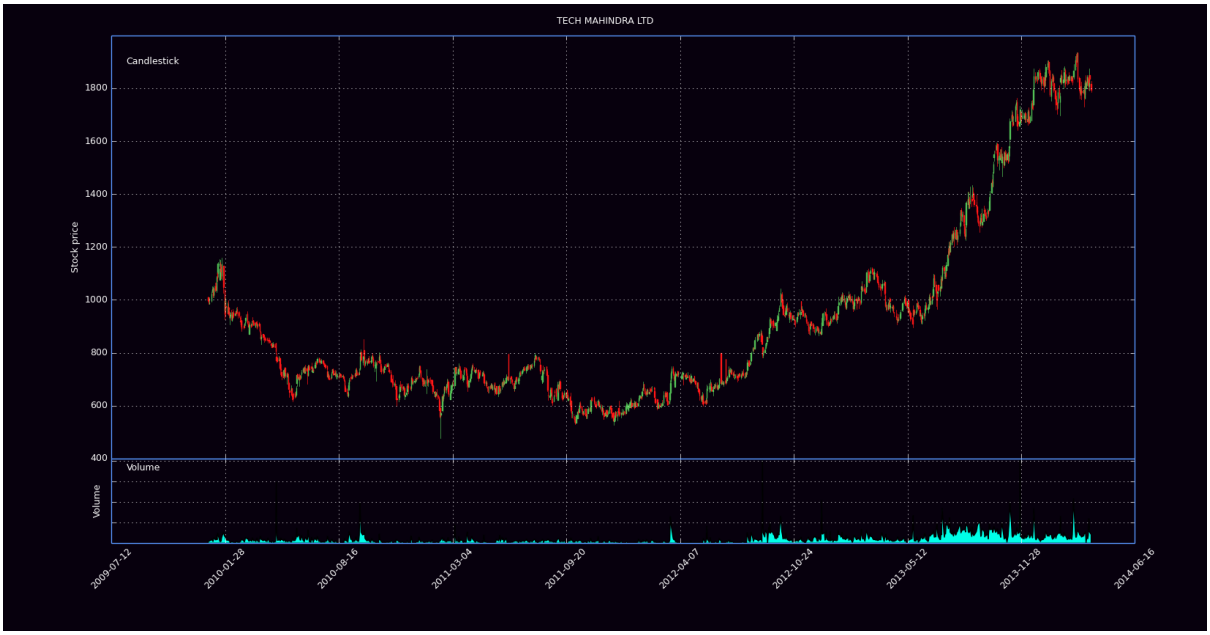
Plot 5.1.16 State Bank of India Ltd Japanese Candlestick Plots



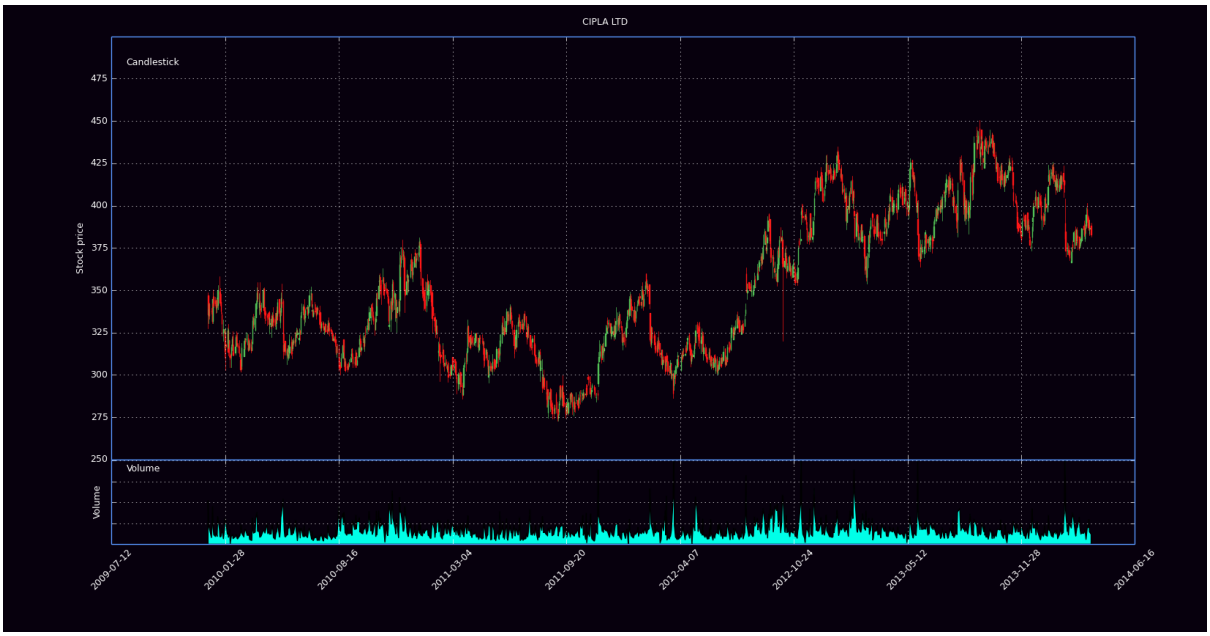
Plot 5.1.17 INFOSYS Ltd Japanese Candlestick Plots



Plot 5.1.18 Tech Mahindra Ltd Japanese Candlestick Plots



Plot 5.1.19 (Pharmaceuticals) CIPLA Ltd Japanese Candlestick Plots



Plot 5.1.20 DR. Reddy's Laboratories Ltd Japanese Candlestick Plots



Plot 5.1.21 (Telecom) Bharti Airtel Ltd Japanese Candlestick Plots



Table 5.6 Computation of Returns and Volatility –Descriptive Statistics: Table 1

Table 1 Computation of Returns and Volatility (Log Returns) (1 Year Trading Days)						
	DAILY MEAN (μ)		ANNUALISED RETURNS		HISTORICAL VOLATILITY	
INDUSTRY/SECTOR	μ	ADJUSTED (μ)	μ	ADJUSTED (μ)	DAILY	ANNUALISED
	%	DRIFT	%	DRIFT	STD DEV	σ %
S&P CNX NIFTY (NSE)						
S&P CNX NIFTY (NSE)	0.06	0.07	15.12	17.64	1.3	20.64
AUTOMOBILES						
1) BAJAJ AUTO LTD	0.1	0.14	25.2	35.28	2.73	43.34
2) HERO MOTOCORP LTD	0.06	0.08	15.12	20.16	2.01	31.91
3) MAHINDRA & MAHINDRA LTD.	0.07	0.11	17.64	27.72	2.9	46.04
4) MARUTI SUZUKI LTD.	0.07	0.09	17.64	22.68	1.99	31.59
5) TATA MOTORS LTD.	0.06	0.21	15.12	52.92	5.45	86.52
CEMENT & CEMENT PRODUCTS						
6) ACC LTD	0.07	0.09	17.64	22.68	1.83	29.05
7) AMBUJA CEMENTS LTD	0.08	0.1	20.16	25.2	2.13	33.81
8) GRASIM INDUSTRIES LTD	0.05	0.07	12.6	17.64	1.82	28.89
9) ULTRATECH CEMENT CO LTD	0.11	0.13	27.72	32.76	1.8	28.57
CONSTRUCTION						
10) DLF LTD	0	0.05	0	12.6	3.09	49.05
11) LARSEN & TOUBRO LTD	0.05	0.08	12.6	20.16	2.44	38.73
CONSUMER GOODS						
12) ASIAN PAINTS LTD	-0.03	0.2	-7.56	50.4	6.73	106.84
13) HINDUSTAN UNILEVER LTD	0.08	0.09	20.16	22.68	1.64	26.03
14) ITC LTD	0.05	0.08	12.6	20.16	2.59	41.11
ENERGY						
15) BHARAT PETROLEUM CORP.LTD	0.02	0.06	5.04	15.12	2.95	46.83
16) CAIRN INDIA LTD	0.05	0.07	12.6	17.64	1.95	30.96
17) GAIL (INDIA) LTD.	0.03	0.05	7.56	12.6	1.75	27.78
18) NTPC LTD	-0.03	-0.02	-7.56	-5.04	1.64	26.03
19) ONGC LTD	-0.07	0.03	-17.64	7.56	4.51	71.59
20) POWERGRID LTD	0.01	0.02	2.52	5.04	1.56	24.76
21) RELIANCE INDUSTRIES LTD	-0.04	0	-10.08	0	2.79	44.29
22) TATA POWER COMPANY LTD	-0.18	0.06	-45.36	15.12	6.88	109.22
FINANCIAL SERVICES						
23) AXIS BANK LTD	0.1	0.13	25.2	32.76	2.45	38.89
24) BANK OF BARODA	0.09	0.12	22.68	30.24	2.25	35.72
25) HDFC BANK LTD	-0.02	0.1	-5.04	25.2	4.85	76.99
26) HOUSING DEVPMT FIN CORPN.	-0.04	0.08	-10.08	20.16	4.9	77.79
27) ICICI BANK LTD	0.1	0.13	25.2	32.76	2.38	37.78
28) IDFC LTD	0.06	0.1	15.12	25.2	2.75	43.65
29) INDUSIND BANK LTD	0.22	0.26	55.44	65.52	2.65	42.07
30) KOTAK MAHINDRA BANK	0.08	0.12	20.16	30.24	2.92	46.35
31) PUNJAB NATIONAL BANK	0.05	0.07	12.6	17.64	2.16	34.29
32) STATE BANK OF INDIA	0.05	0.07	12.6	17.64	2.17	34.45
INDUSTRIAL MANUFACTURING						
33) BHARAT HEAVY ELECTRICALS LTD	-0.16	-0.03	-40.32	-7.56	5.18	82.23

INFORMATION TECHNOLOGY						
34) HINDUSTAN COMPUTERS LTD	0.21	0.24	**52.92**	**60.48**	2.28	**36.19**
35) INFOSYS LTD	0.07	0.09	**17.64**	**22.68**	1.92	**30.48**
36) TATA CONSULTANCY SERVICES LTD	0.11	0.15	**27.72**	**37.8**	2.75	**43.65**
37) TECH MAHINDRA LTD	0.15	0.18	**37.8**	**45.36**	2.48	**39.37**
38) WIPRO LTD	0.06	0.09	**15.12**	**22.68**	2.38	**37.78**
MEDIA & ENTERTAINMENT						
39) ZEE ENTERTAINMENT ENTERPRISES	0.08	0.13	**20.16**	**32.76**	3.03	**48.1**
METALS						
40) COAL INDIA * (FOUR YEARS)	-0.02	0	**-5.04**	**0**	1.85	**29.37**
41) HINDALCO INDUSTRIES LTD	0.08	0.12	**20.16**	**30.24**	2.77	**43.97**
42) JINDAL POWER & STEEL	-0.11	0.05	**-27.72**	**12.6**	5.6	**88.9**
43) NMDC LTD	-0.01	0.02	**-2.52**	**5.04**	2.53	**40.16**
44) SESA STERLITE LTD	0.05	0.09	**12.6**	**22.68**	2.81	**44.61**
45) TATA STEEL LTD	0.05	0.08	**12.6**	**20.16**	2.6	**41.27**
PHARMACEUTICALS						
46) CIPLA LTD	0.04	0.05	**10.08**	**12.6**	1.65	**26.19**
47) DR. REDDY'S LABORATORIES LTD	0.13	0.14	**32.76**	**35.28**	1.59	**25.24**
48) LUPIN INDIA LTD	0.03	0.15	**7.56**	**37.8**	4.89	**77.63**
49) SUN PHARMACEUTICALS LTD.	-0.05	0.09	**-12.6**	**22.68**	5.29	**83.98**
TELECOM						
50) BHARTI AIRTEL LTD.	-0.05	-0.01	**-12.6**	**-2.52**	2.98	**47.31**

Table 5.7 Descriptive Statistics: Table 2

Table 2:- Descriptive Statistics (LEVEL OF SIGNIFICANCE FOR HYPOTHESIS TESTING: α= 5%) (R STANDS FOR REJECT H0, AND A STANDS FOR ACCEPT HO)

Company	AVERAGE				STD DEV	SKEW				EXCESS-KURTOSIS				MEDIAN	MIN	MAX	Q 1	Q 3	IQR	OUTLIERS/INFLUENCERS	
	Mean	P-Value	SIG?	HO		SKEW	P-Value	SIG?	HO	EXCESS-KURT	P-Value	SIG?	HO							LL Q1-1.5IQR	UL Q3+1.5IQR
S&P CNX NIFTY (NSE)	0.06%	4.34%	TRUE	R	1.30%	1.56	0%	TRUE	R	20.38	0%	TRUE	R	0.07%	-6.02%	16.33%	-0.64%	0.72%	1.36%	-2.67%	2.75%
AUTOMOBILES																					
1) BAJAJ AUTO LTD	0.10%	10.87%	FALSE	A	2.73%	-13.81	0.00%	TRUE	R	359.54	0.00%	TRUE	R	0.06%	-70.53%	11.51%	-0.94%	1.24%	2.18%	-4.21%	4.50%
2) HERO MOTOCORP LTD	0.06%	13.49%	FALSE	A	2.01%	1.04	0.00%	TRUE	R	11.76	0.00%	TRUE	R	0.01%	-10.42%	19.66%	-1.00%	1.01%	2.01%	-4.01%	4.03%
3) MAHINDRA & MAHINDRA LTD.	0.07%	18.71%	FALSE	A	2.90%	-9.50	0.00%	TRUE	R	230.89	0.00%	TRUE	R	0.05%	-66.91%	21.40%	-1.17%	1.30%	2.47%	-4.88%	5.00%
4) MARUTI SUZUKI LTD.	0.07%	9.78%	FALSE	A	1.99%	0.07	16.98%	FALSE	A	3.49	0.00%	TRUE	R	-0.01%	-13.10%	10.08%	-1.03%	1.17%	2.20%	-4.33%	4.47%
5) TATA MOTORS LTD.	0.06%	33.97%	FALSE	A	5.45%	-22.45	0.00%	TRUE	R	682.78	0.00%	TRUE	R	0.09%	-165.37%	17.25%	-1.32%	1.72%	3.04%	-5.88%	6.27%
CEMENT & CEMENT PRODUCTS																					
6) ACC LTD	0.07%	8.90%	FALSE	A	1.83%	0.33	0.00%	TRUE	R	3.63	0.00%	TRUE	R	0.01%	-9.18%	12.69%	-0.98%	1.07%	2.05%	-4.05%	4.15%
7) AMBUJA CEMENTS LTD	0.08%	8.47%	FALSE	A	2.13%	0.39	0.00%	TRUE	R	2.94	0.00%	TRUE	R	0.00%	-11.17%	13.86%	-1.15%	1.20%	2.35%	-4.67%	4.73%
8) GRASIM INDUSTRIES LTD	0.05%	16.65%	FALSE	A	1.82%	-1.04	0%	TRUE	R	25.46	0%	TRUE	R	0.02%	-23.20%	15.44%	-0.91%	0.94%	1.85%	-3.68%	3.72%
9) ULTRATECH CEMENT CO LTD	0.11%	1.35%	TRUE	R	1.80%	0.35	0%	TRUE	R	3.87	0%	TRUE	R	0.05%	-6.94%	13.66%	-0.90%	1.03%	1.93%	-3.79%	3.93%
CONSTRUCTION																					
10) DLF LTD	0.00%	49.87%	FALSE	A	3.09%	0.37	0%	TRUE	R	3.56	0%	TRUE	R	0.00%	-12.34%	22.34%	-1.81%	1.79%	3.60%	-7.21%	7.19%
11) LARSEN & TOUBRO LTD	0.05%	23.01%	FALSE	A	2.44%	-2.47	0%	TRUE	R	53.03	0%	TRUE	R	0.02%	-38.20%	21.94%	-1.10%	1.21%	2.32%	-4.58%	4.69%
CONSUMER GOODS																					
12) ASIAN PAINTS LTD	-0.03%	43.96%	FALSE	A	6.73%	-32.29	0%	TRUE	R	1106.32	0%	TRUE	R	0.08%	-230.47%	9.22%	-0.72%	1.03%	1.76%	-3.36%	3.67%
13) HINDUSTAN UNILEVER LTD	0.08%	5.25%	FALSE	A	1.64%	1.05	0%	TRUE	R	9.20	0%	TRUE	R	0.02%	-7.99%	16.03%	-0.84%	0.99%	1.83%	-3.58%	3.73%
14) ITC LTD	0.05%	23.89%	FALSE	A	2.59%	-16.25	0%	TRUE	R	445.22	0%	TRUE	R	0.10%	-70.60%	10.55%	-0.81%	1.00%	1.81%	-3.53%	3.72%
ENERGY																					
15) BHARAT PETROLEUM CORP.LTD	0.02%	41.17%	FALSE	A	2.95%	-10.98	0.00%	TRUE	R	270.10	0.00%	TRUE	R	-0.04%	-70.90%	14.08%	-1.18%	1.23%	2.41%	-4.80%	4.86%
16) CAIRN INDIA LTD	0.05%	18.88%	FALSE	A	1.95%	0.32	0.00%	TRUE	R	3.17	0.00%	TRUE	R	0.00%	-9.85%	11.69%	-1.01%	1.11%	2.12%	-4.18%	4.29%
17) GAIL (INDIA) LTD.	0.03%	25.30%	FALSE	A	1.75%	0.38	0.00%	TRUE	R	2.57	0.00%	TRUE	R	0.00%	-6.77%	12.39%	-1.01%	1.05%	2.06%	-4.10%	4.14%
18) NTPC LTD	-0.03%	24.54%	FALSE	A	1.64%	-0.41	0.00%	TRUE	R	6.58	0.00%	TRUE	R	-0.05%	-12.49%	9.67%	-0.93%	0.83%	1.76%	-3.58%	3.47%
19) ONGC LTD	-0.07%	28.07%	FALSE	A	4.51%	-26.20	0.00%	TRUE	R	839.86	0.00%	TRUE	R	-0.03%	-144.34%	15.26%	-1.10%	1.02%	2.12%	-4.28%	4.20%
20) POWERGRID LTD	0.01%	40.45%	FALSE	A	1.56%	0.13	2.90%	TRUE	R	10.92	0.00%	TRUE	R	0.00%	-11.86%	14.80%	-0.83%	0.84%	1.67%	-3.34%	3.35%
21) RELIANCE INDUSTRIES LTD	-0.04%	29.55%	FALSE	A	2.79%	-13.74	0.00%	TRUE	R	363.69	0.00%	TRUE	R	-0.05%	-72.42%	19.37%	-1.16%	1.09%	2.25%	-4.54%	4.46%
22) TATA POWER COMPANY LTD	-0.18%	17.92%	FALSE	A	6.88%	-30.90	0.00%	TRUE	R	1043.37	0.00%	TRUE	R	0.00%	-232.47%	13.95%	-1.06%	1.10%	2.16%	-4.30%	4.35%
FINANCIAL SERVICES																					
23) AXIS BANK LTD	0.10%	7.38%	FALSE	A	2.45%	0.41	0.00%	TRUE	R	3.13	0.00%	TRUE	R	0.00%	-9.90%	16.56%	-1.27%	1.50%	2.77%	-5.43%	5.66%
24) BANK OF BARODA	0.09%	7.74%	FALSE	A	2.25%	0.33	0.00%	TRUE	R	3.56	0.00%	TRUE	R	0.10%	-8.93%	15.10%	-1.16%	1.32%	2.48%	-4.89%	5.04%
25) HDFC BANK LTD	-0.02%	43.29%	FALSE	A	4.85%	-29.15	0.00%	TRUE	R	966.70	0.00%	TRUE	R	0.05%	-160.55%	15.10%	-0.85%	1.01%	1.86%	-3.65%	3.81%
26) HOUSING DEVPMT FIN CORPN.	-0.04%	37.90%	FALSE	A	4.90%	-26.80	0.00%	TRUE	R	865.93	0.00%	TRUE	R	-0.02%	-157.77%	20.27%	-0.99%	1.13%	2.12%	-4.18%	4.31%
27) ICICI BANK LTD	0.10%	6.56%	FALSE	A	2.38%	0.75	0.00%	TRUE	R	5.40	0.00%	TRUE	R	0.06%	-10.50%	20.73%	-1.31%	1.36%	2.66%	-5.30%	5.35%
28) IDFC LTD	0.06%	21.94%	FALSE	A	2.75%	0.41	0.00%	TRUE	R	5.47	0.00%	TRUE	R	0.00%	-18.05%	22.15%	-1.67%	1.59%	3.26%	-6.57%	6.49%
29) INDUSIND BANK LTD	0.22%	0.19%	TRUE	R	2.65%	0.37	0.00%	TRUE	R	2.63	0.00%	TRUE	R	0.13%	-12.49%	15.96%	-1.32%	1.66%	2.98%	-5.80%	6.13%
30) KOTAK MAHINDRA BANK	0.08%	17.66%	FALSE	A	2.92%	-8.25	0.00%	TRUE	R	189.11	0.00%	TRUE	R	0.10%	-64.26%	17.51%	-1.16%	1.34%	2.50%	-4.90%	5.09%
31) PUNJAB NATIONAL BANK	0.05%	21.37%	FALSE	A	2.16%	0.05	24.68%	FALSE	A	2.78	0.00%	TRUE	R	0.02%	-10.31%	13.49%	-1.10%	1.24%	2.34%	-4.61%	4.75%
32) STATE BANK OF INDIA	0.05%	22.62%	FALSE	A	2.17%	0.53	0.00%	TRUE	R	5.11	0.00%	TRUE	R	0.09%	-9.02%	18.25%	-1.22%	1.27%	2.48%	-4.94%	5.00%

INDUSTRIAL MANUFACTURING																				
33) BHARAT HEAVY ELECTRICALS LTD	-0.16%	13.55%	FALSE	A	5.18%	-25.16	0.00%	TRUE	R	791.82	0.00%	TRUE	R	-0.03%	-163.42%	16.60%	-1.24%	1.22%	2.47%	-4.95%	4.93%
INFORMATION TECHNOLOGY																				
34) HINDUSTAN COMPUTERS LTD	0.21%	0.06%	TRUE	R	2.28%	0.57	0.00%	TRUE	R	5.47	0.00%	TRUE	R	0.11%	-9.96%	17.22%	-0.95%	1.33%	2.27%	-4.35%	4.74%
35) INFOSYS LTD	0.07%	9.95%	FALSE	A	1.92%	-1.64	0.00%	TRUE	R	30.03	0.00%	TRUE	R	0.09%	-23.90%	15.52%	-0.74%	0.96%	1.71%	-3.30%	3.52%
36) TATA CONSULTANCY SERVICES LTD	0.11%	7.95%	FALSE	A	2.75%	-12.67	0.00%	TRUE	R	328.66	0.00%	TRUE	R	0.07%	-69.28%	14.41%	-0.90%	1.15%	2.04%	-3.96%	4.21%
37) TECH MAHINDRA LTD	0.15%	1.56%	TRUE	R	2.48%	1.28	0.00%	TRUE	R	9.68	0.00%	TRUE	R	0.08%	-10.51%	22.80%	-1.11%	1.18%	2.28%	-4.53%	4.60%
38) WIPRO LTD	1.18%	18.06%	FALSE	A	2.38%	-7.59	0.00%	TRUE	R	161.07	0.00%	TRUE	R	0.12%	-50.18%	10.74%	-0.97%	1.11%	2.08%	-4.09%	4.23%
MEDIA & ENTERTAINMENT																				
39) ZEE ENTERTAINMENT ENTERPRISES	0.08%	19.05%	FALSE	A	3.03%	-9.46	0.00%	TRUE	R	219.09	0.00%	TRUE	R	0.00%	-69.28%	10.81%	-1.22%	1.30%	2.52%	-5.00%	5.09%
METALS																				
40) COAL INDIA * (FOUR YEARS)	-0.02%	37.55%	FALSE	A	1.85%	-0.08	16.83%	FALSE	A	3.82	0.00%	TRUE	R	-0.01%	-10.68%	11.31%	-1.02%	1.02%	2.03%	-4.07%	4.07%
41) HINDALCO INDUSTRIES LTD	0.08%	15.63%	FALSE	A	2.77%	0.28	0.00%	TRUE	R	1.42	0.00%	TRUE	R	0.00%	-11.14%	13.39%	-1.61%	1.63%	3.25%	-6.49%	6.51%
42) JINDAL POWER & STEEL	-0.11%	24.27%	FALSE	A	5.60%	-25.27	0.00%	TRUE	R	798.73	0.00%	TRUE	R	0.03%	-176.87%	19.26%	-1.42%	1.45%	2.87%	-5.72%	5.75%
43) NMDC LTD	-0.01%	44.91%	FALSE	A	2.53%	1.25	0.00%	TRUE	R	8.41	0.00%	TRUE	R	-0.09%	-10.03%	18.25%	-1.24%	1.12%	2.36%	-4.78%	4.67%
44) SESA STERLITE LTD	0.05%	26.20%	FALSE	A	2.81%	0.47	0.00%	TRUE	R	3.30	0.00%	TRUE	R	-0.05%	-13.41%	15.16%	-1.60%	1.49%	3.09%	-6.24%	6.13%
45) TATA STEEL LTD	0.05%	24.62%	FALSE	A	2.60%	0.30	0.00%	TRUE	R	2.46	0.00%	TRUE	R	0.00%	-10.79%	15.70%	-1.46%	1.52%	2.99%	-5.94%	6.00%
PHARMACEUTICALS																				
46) CIPLA LTD	0.04%	16.80%	FALSE	A	1.65%	-0.04	27.89%	FALSE	A	3.23	0.00%	TRUE	R	-0.04%	-10.39%	8.70%	-0.88%	0.92%	1.80%	-3.59%	3.62%
47) DR. REDDY'S LABORATORIES LTD	0.13%	0.15%	TRUE	R	1.59%	0.29	0.00%	TRUE	R	2.50	0.00%	TRUE	R	0.08%	-6.69%	10.15%	-0.76%	1.03%	1.78%	-3.43%	3.70%
48) LUPIN INDIA LTD	0.03%	42.17%	FALSE	A	4.89%	-28.69	0.00%	TRUE	R	945.12	0.00%	TRUE	R	0.10%	-161.08%	10.03%	-0.94%	1.15%	2.09%	-4.07%	4.28%
49) SUN PHARMACEUTICALS LTD.	-0.05%	37.04%	FALSE	A	5.29%	-24.38	0.00%	TRUE	R	713.45	0.00%	TRUE	R	0.10%	-161.09%	19.95%	-0.78%	1.08%	1.86%	-3.57%	3.87%
TELECOM																				
50) BHARTI AIRTEL LTD.	-0.05%	26.51%	FALSE	A	2.98%	-8.89	0.00%	TRUE	R	209.16	0.00%	TRUE	R	-0.06%	-67.15%	22.65%	-1.29%	1.30%	2.58%	-5.16%	5.17%

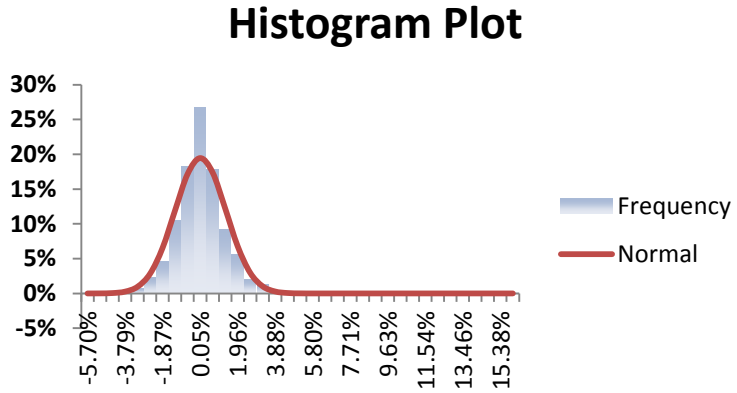
Table 5.8:- Normality Test: Table 3

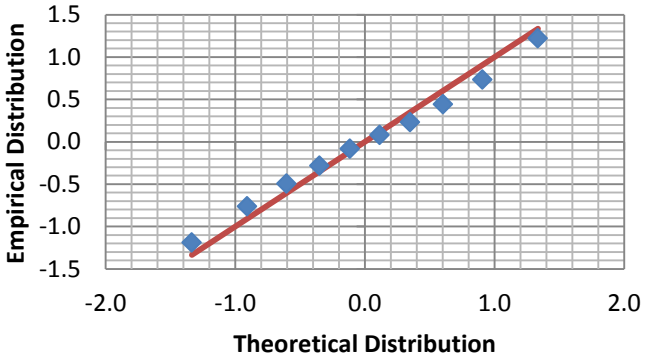
Table 3:- Normality Test						5.00%
	Jarque-Bera(JB)		Shapiro-Wilk		Doornick Chi-Square	
Company	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?
S&P CNX NIFTY (NSE)						
S&P CNX NIFTY (NSE)	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
AUTOMOBILES						
1) BAJAJ AUTO LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
2) HERO MOTOCORP LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
3) MAHINDRA & MAHINDRA LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
4) MARUTI SUZUKI LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
5) TATA MOTORS LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
CEMENT & CEMENT PRODUCTS						
6) ACC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
7) AMBUJA CEMENTS LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
8) GRASIM INDUSTRIES LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
9) ULTRATECH CEMENT CO LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
CONSTRUCTION						
10) DLF LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
11) LARSEN & TOUBRO LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
CONSUMER GOODS						
12) ASIAN PAINTS LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
13) HINDUSTAN UNILEVER LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
14) ITC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
ENERGY						
15) BHARAT PETROLEUM CORP.LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
16) CAIRN INDIA LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
17) GAIL (INDIA) LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
18) NTPC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
19) ONGC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
20) POWERGRID LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
21) RELIANCE INDUSTRIES LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
22) TATA POWER COMPANY LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
FINANCIAL SERVICES						
23) AXIS BANK LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
24) BANK OF BARODA	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
25) HDFC BANK LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
26) HOUSING DEVPMT FIN CORPN.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
27) ICICI BANK LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE

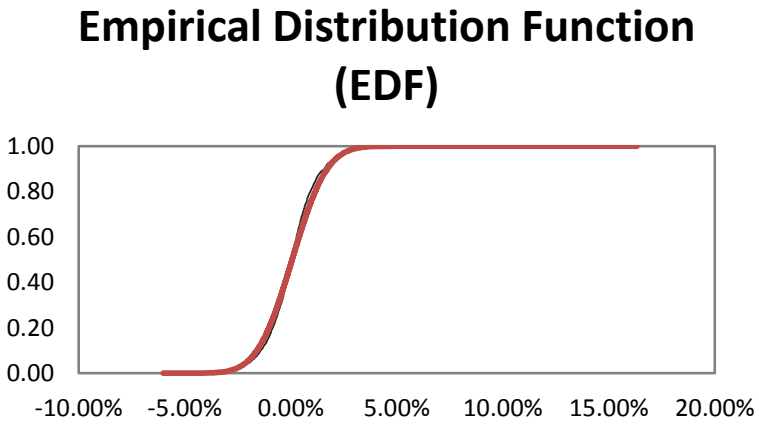
28) IDFC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
29) INDUSIND BANK LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
30) KOTAK MAHINDRA BANK	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
31) PUNJAB NATIONAL BANK	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
32) STATE BANK OF INDIA	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
INDUSTRIAL MANUFACTURING						
33) BHARAT HEAVY ELECTRICALS LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
INFORMATION TECHNOLOGY						
34) HINDUSTAN COMPUTERS LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
35) INFOSYS LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
36) TATA CONSULTANCY SERVICES LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
37) TECH MAHINDRA LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
38) WIPRO LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
MEDIA & ENTERTAINMENT						
39) ZEE ENTERTAINMENT ENTERPRISES	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
METALS						
40) COAL INDIA * (FOUR YEARS)	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
41) HINDALCO INDUSTRIES LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
42) JINDAL POWER & STEEL	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
43) NMDC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
44) SESA STERLITE LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
45) TATA STEEL LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
PHARMACEUTICALS						
46) CIPLA LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
47) DR. REDDY'S LABORATORIES LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
48) LUPIN INDIA LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
49) SUN PHARMACEUTICALS LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
TELECOM						
50) BHARTI AIRTEL LTD.	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE

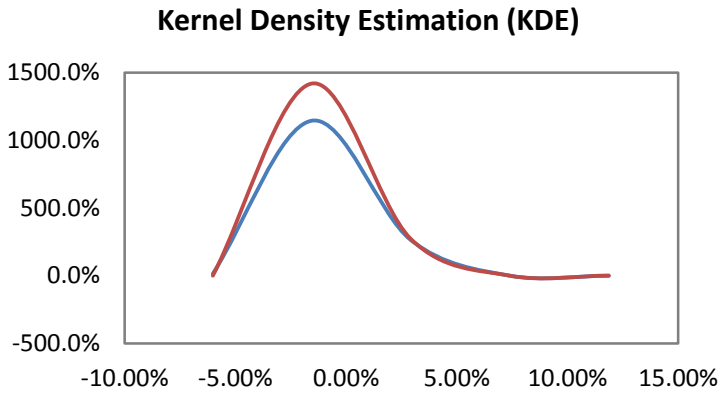
Exploratory Data Analysis Plots

5.2.1 (S&P CNX NIFTY NSE) CNX NIFTY Plots

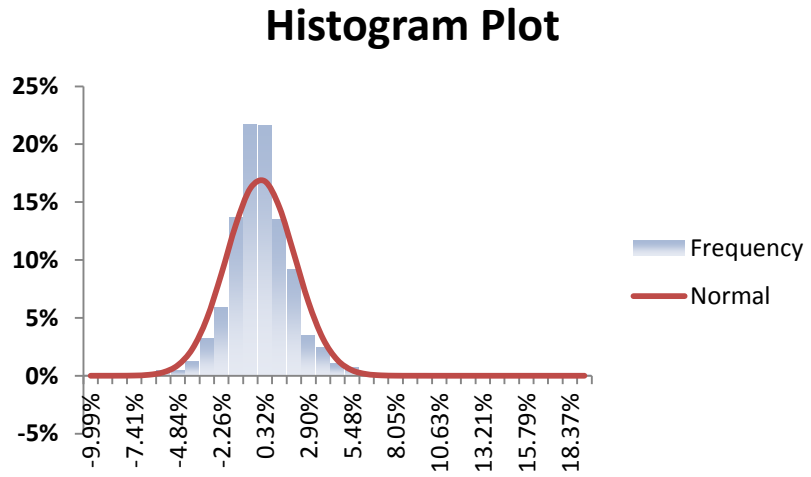


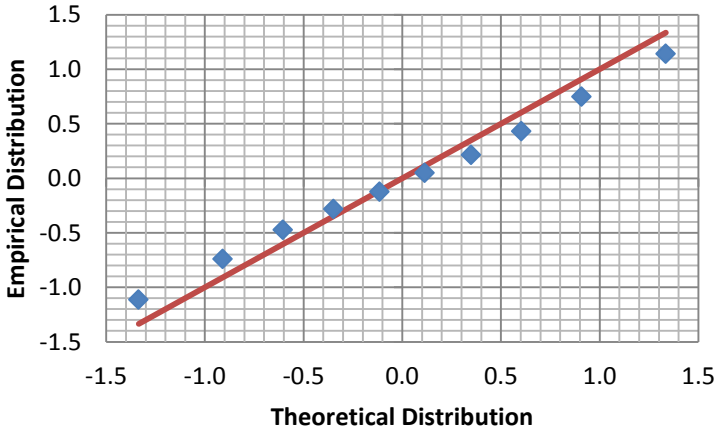


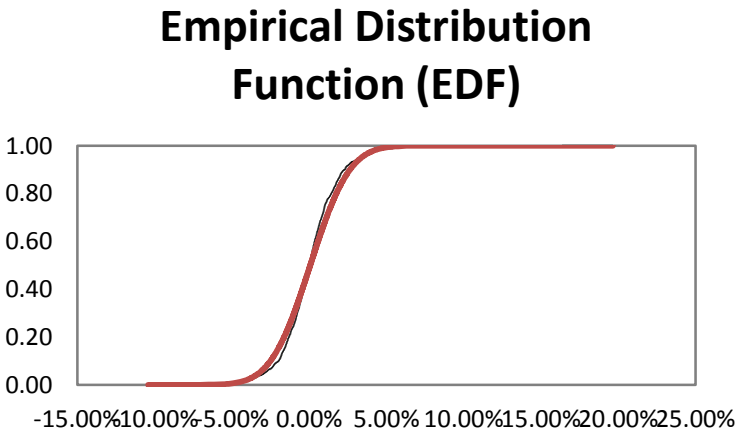


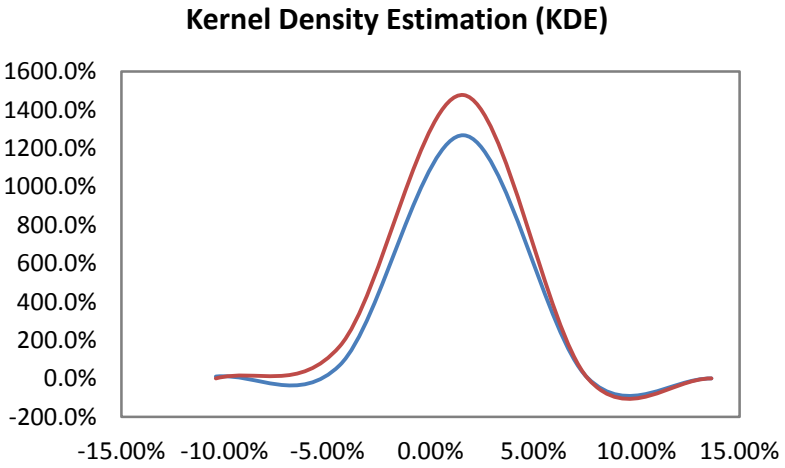


5.2.2 Hero Moto Corp Plots

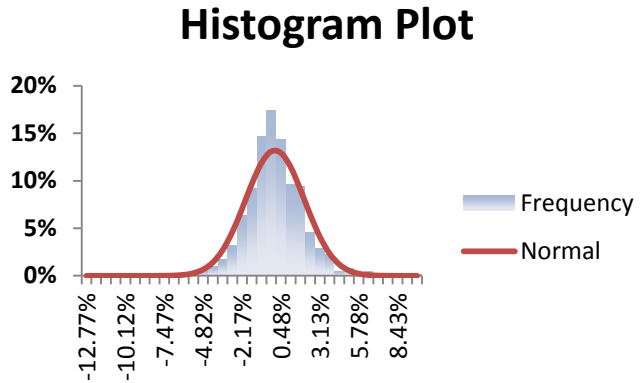


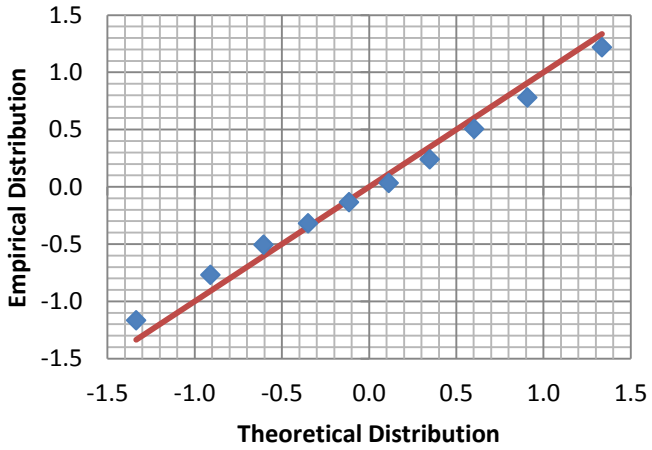


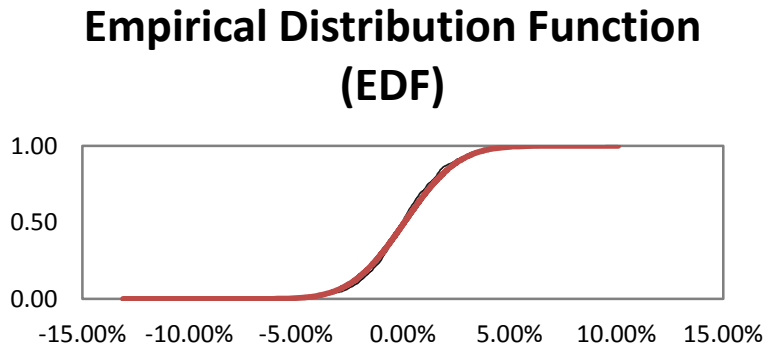


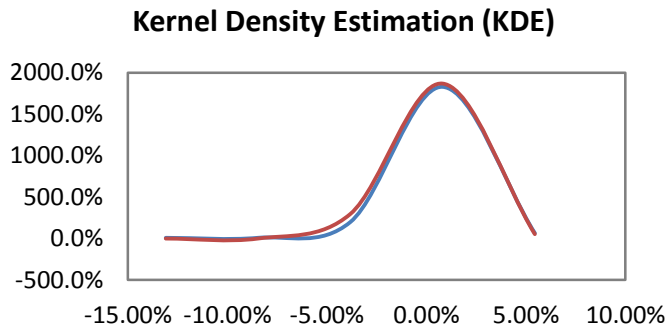


5.2.3 Maruti Suzuki Plots

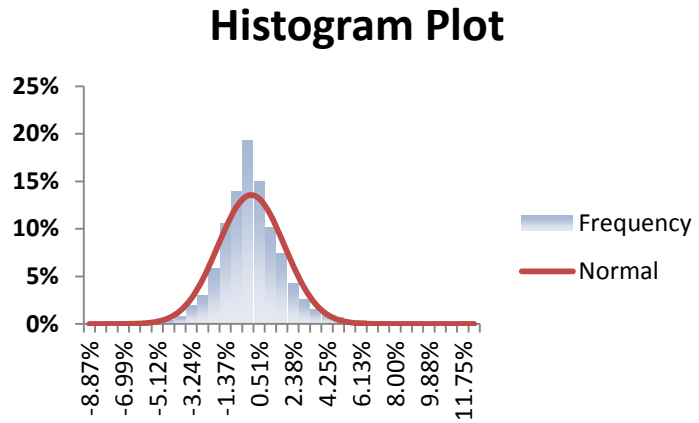


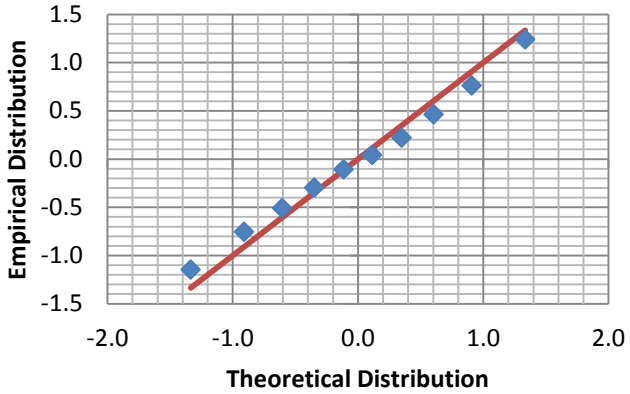


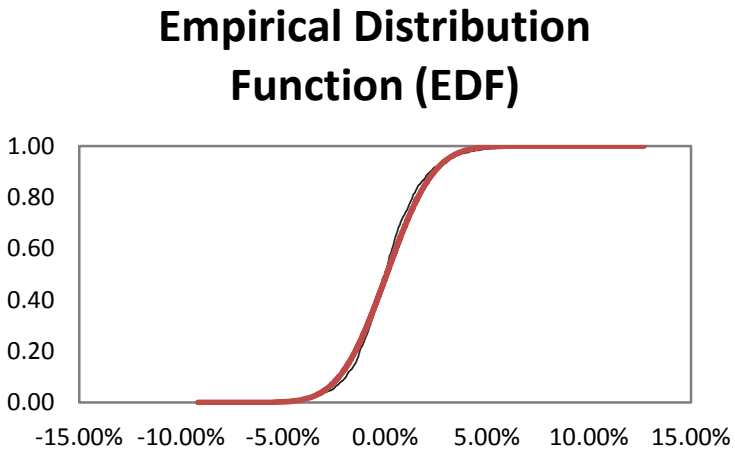


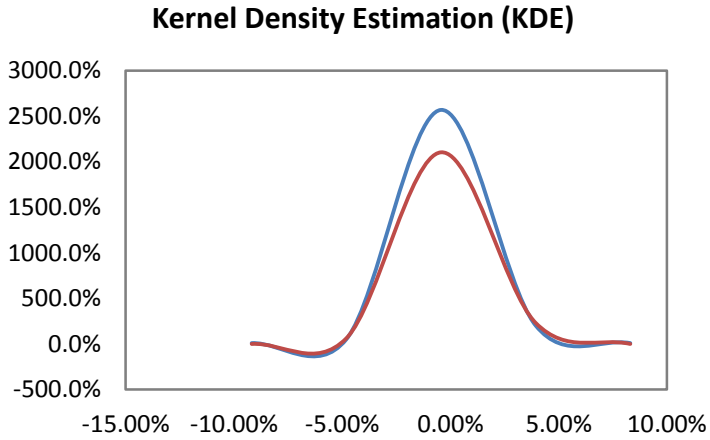


5.2.4 ACC Plots

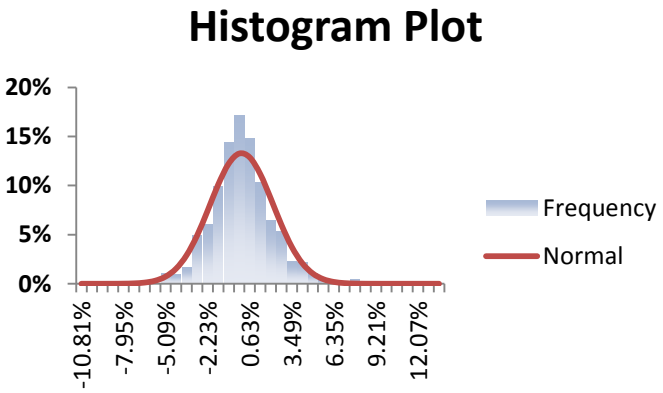


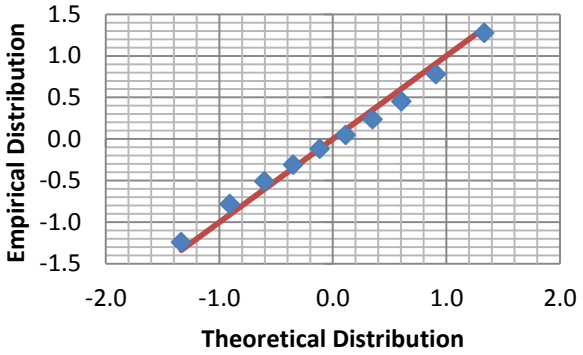


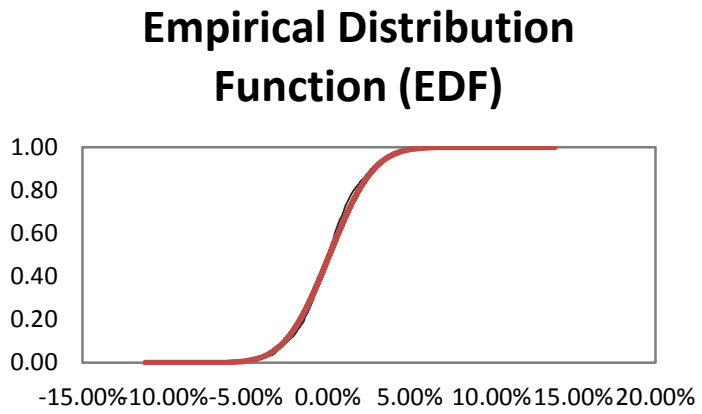


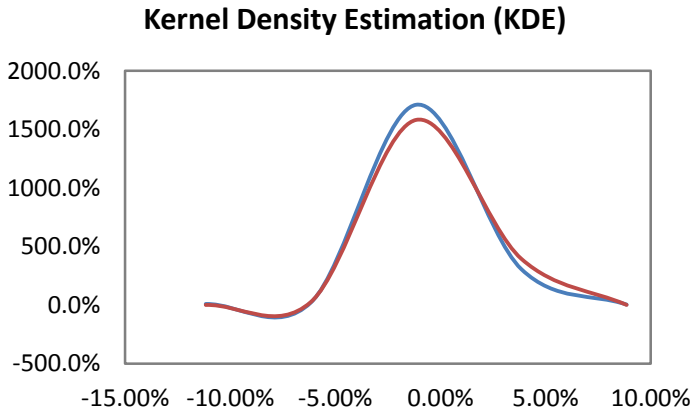


5.2.5 Ambuja Cement Plots

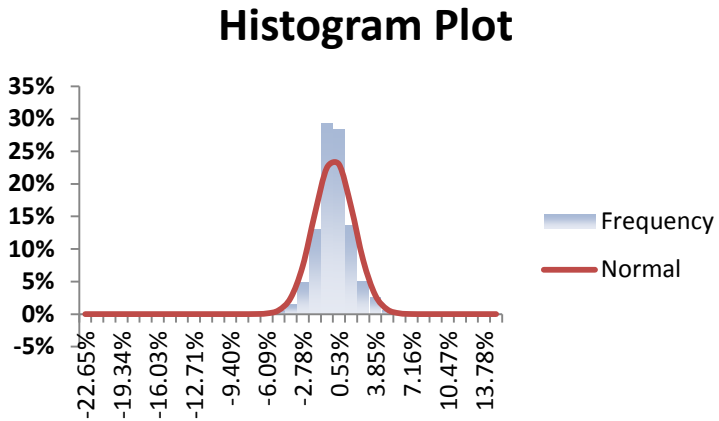


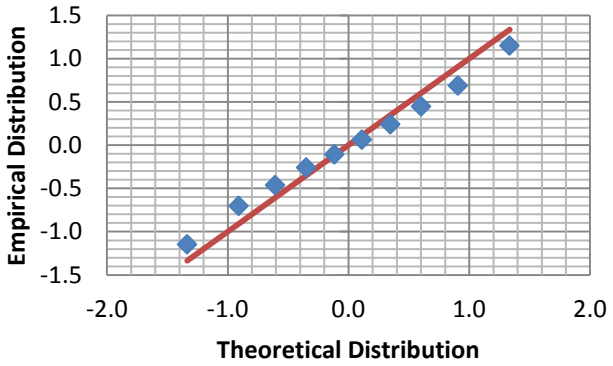


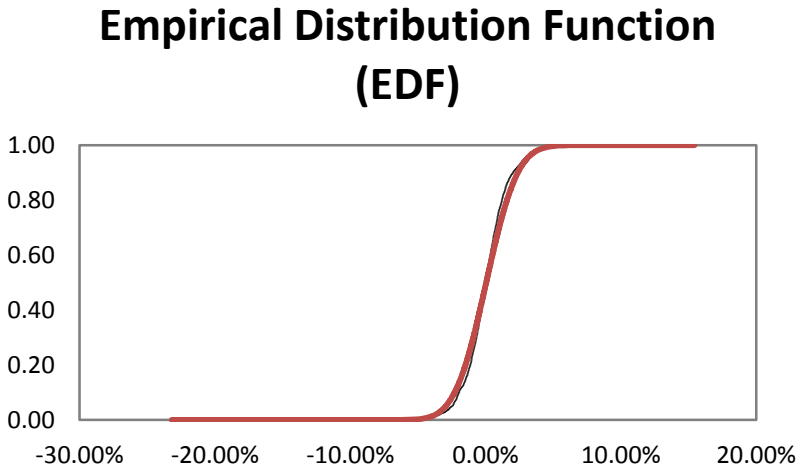


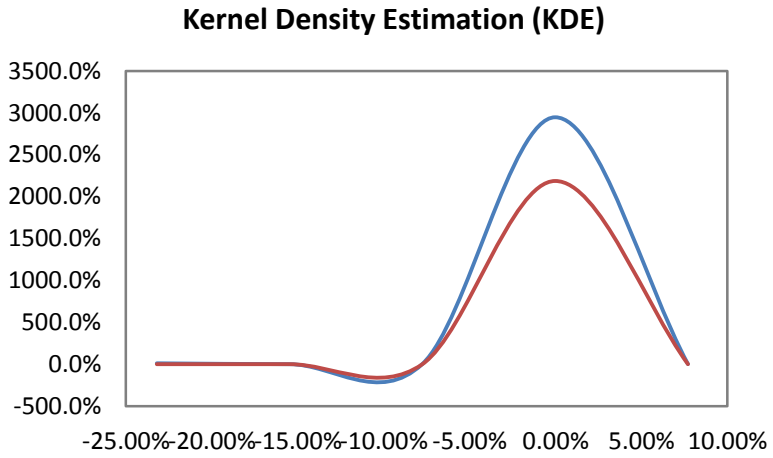


5.2.6 Grasim Industries Plots

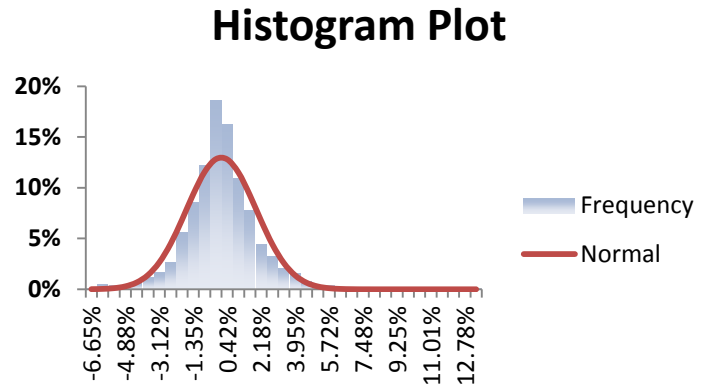


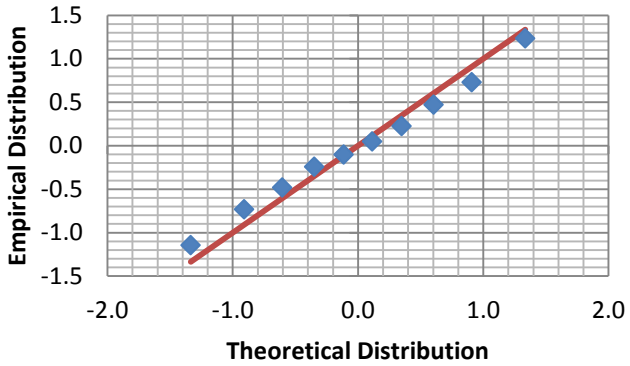


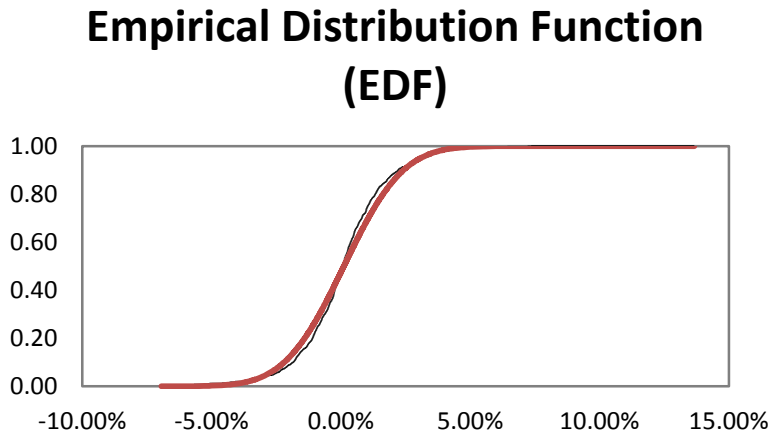


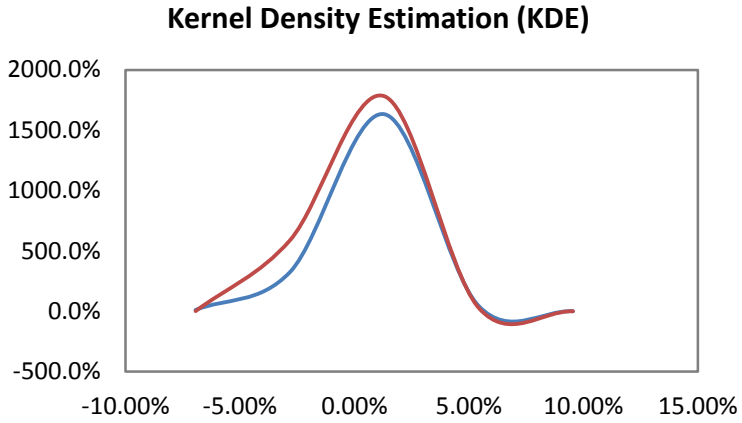


5.2.7 Ultratech Cement Plots

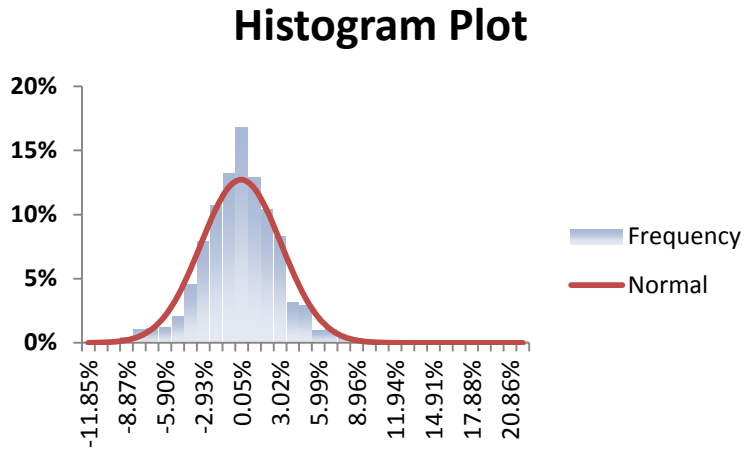


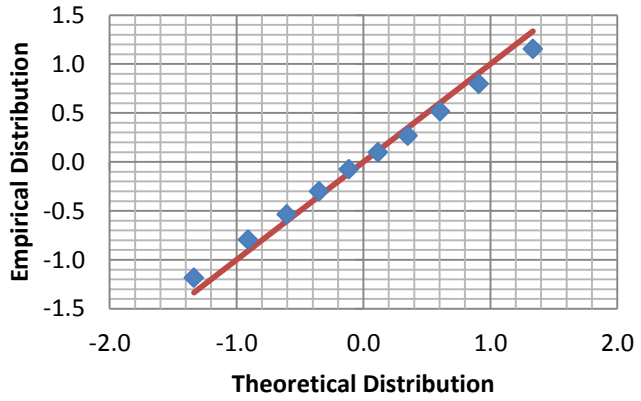


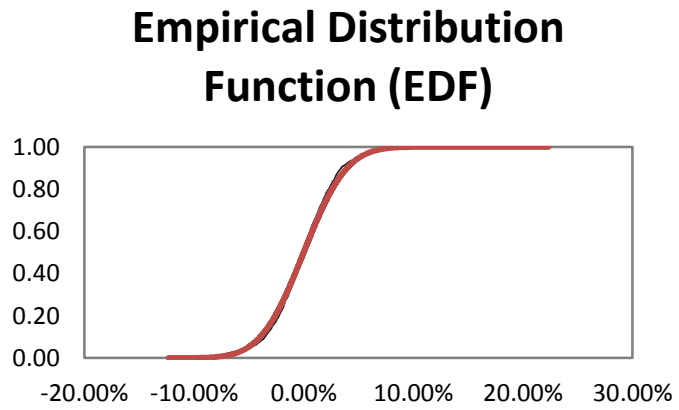


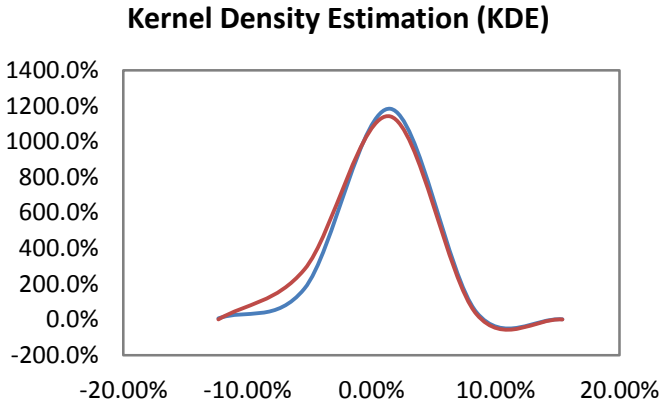


5.2.8 DLF Ltd Plots

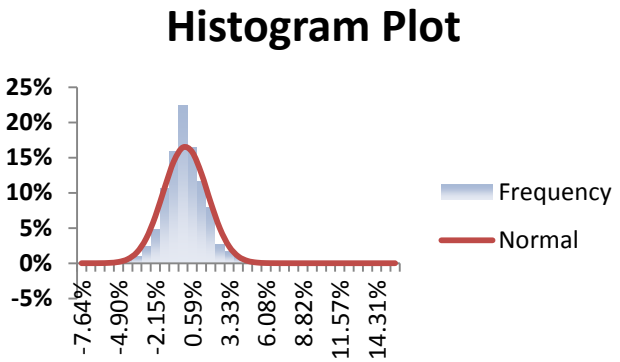


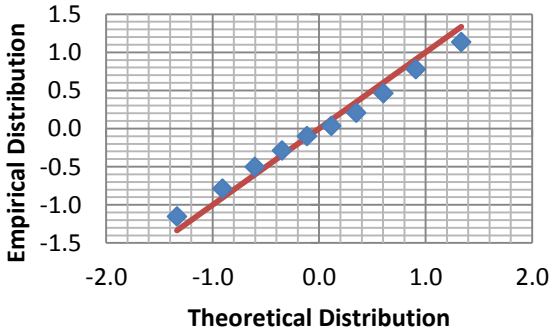


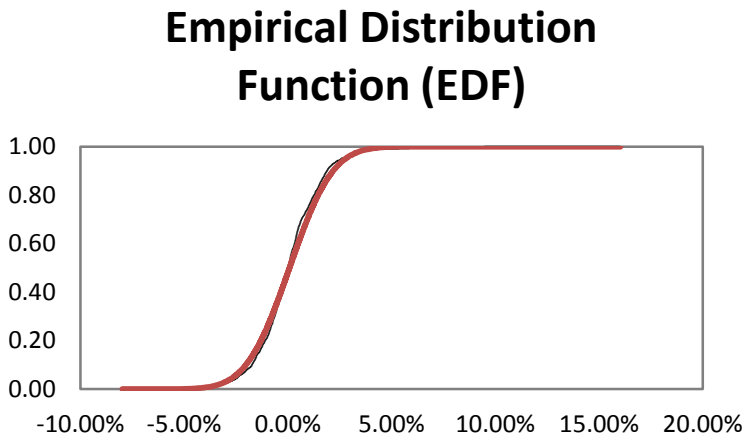


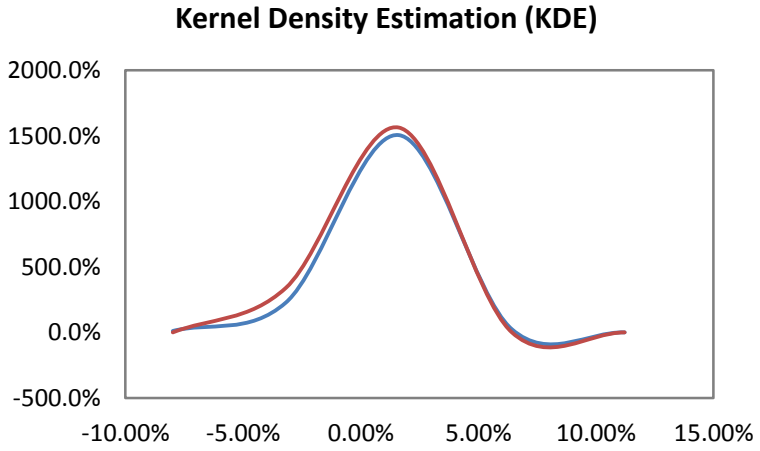


5.2.9 Hindustan Lever Plots

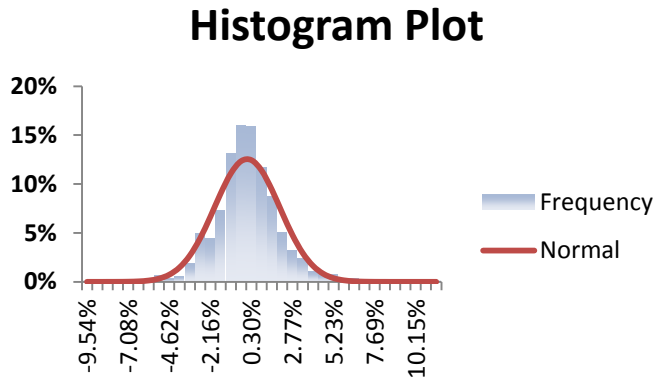


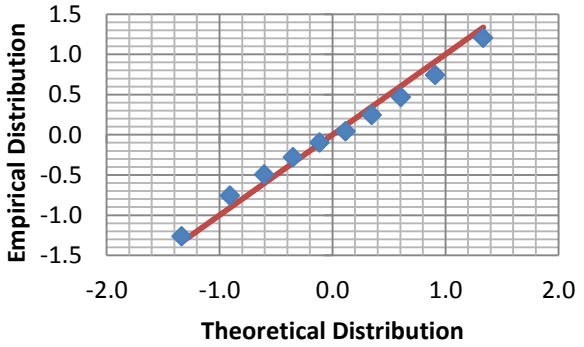


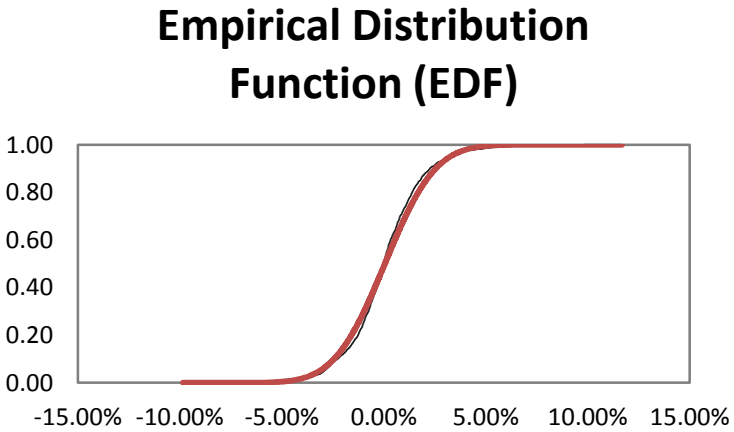


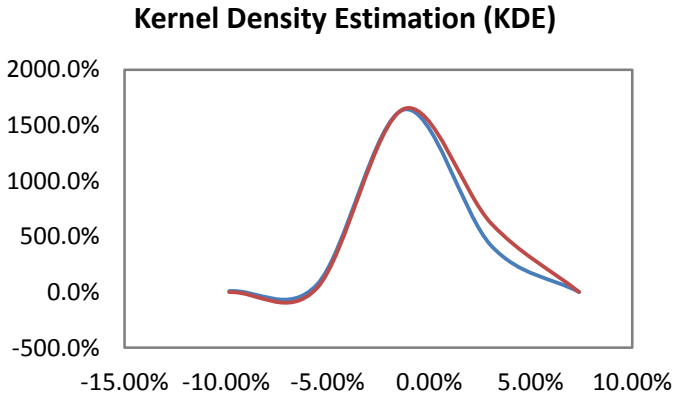


5.2.10 Cairn India Ltd Plots

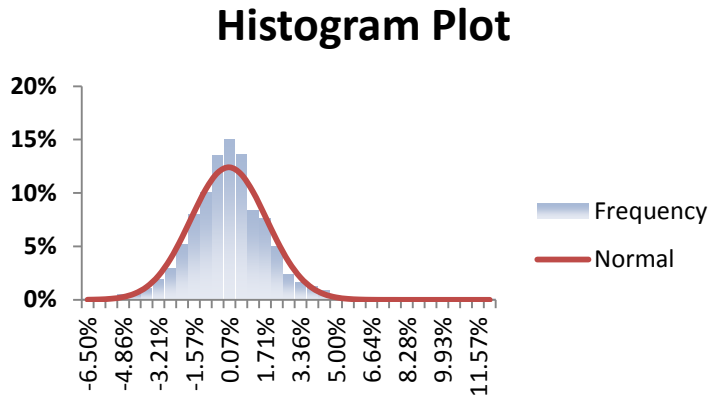


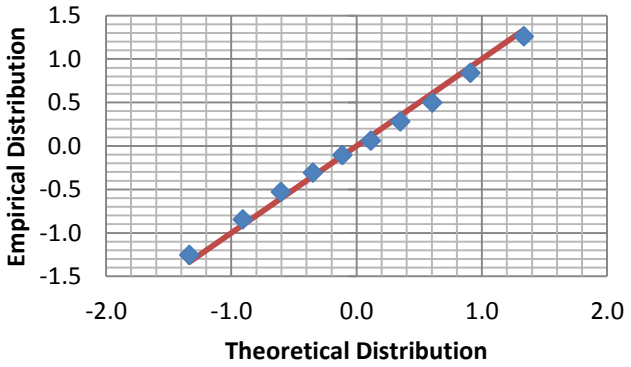


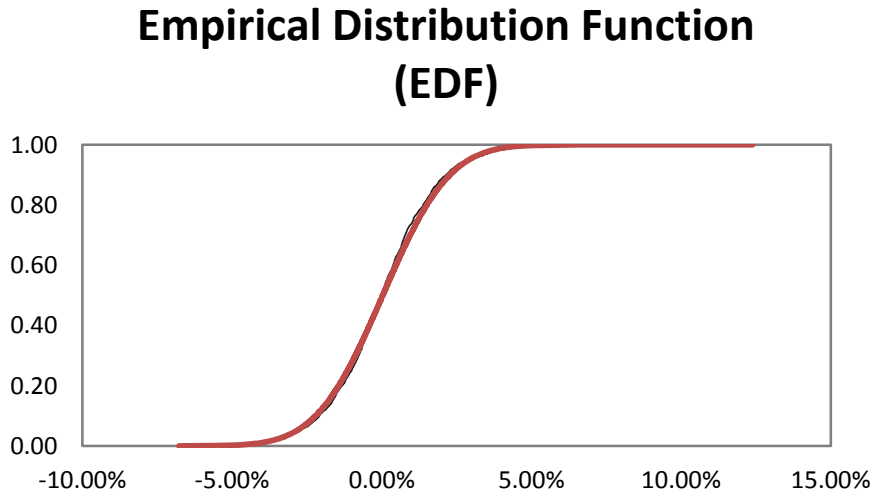


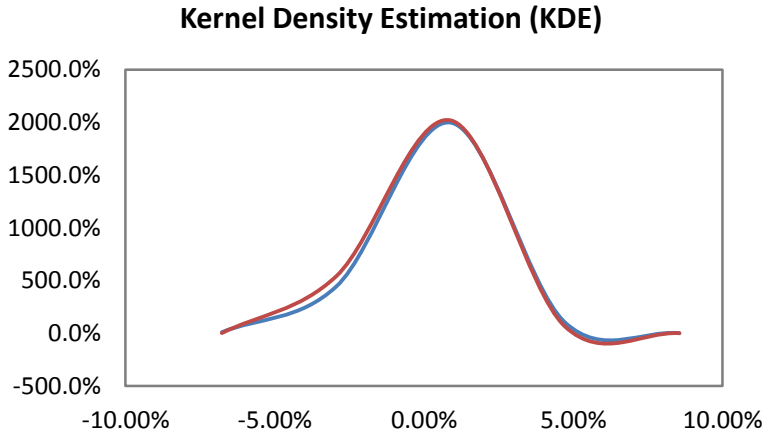


5.2.11 GAIL (India) Ltd Plots

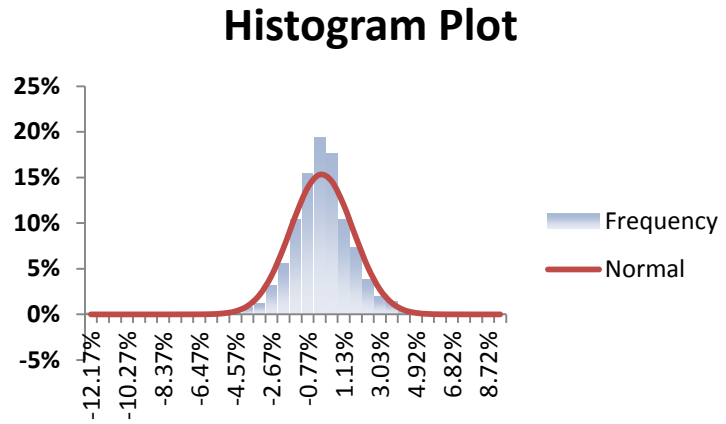


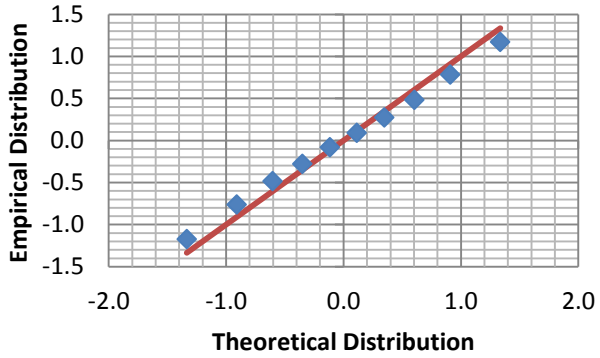


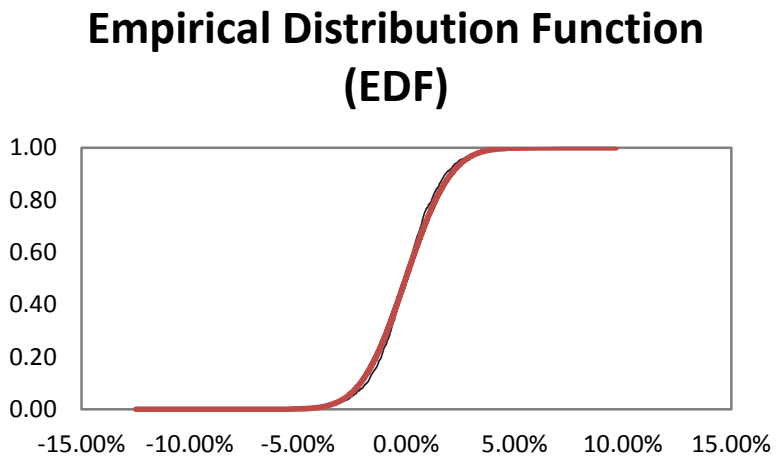


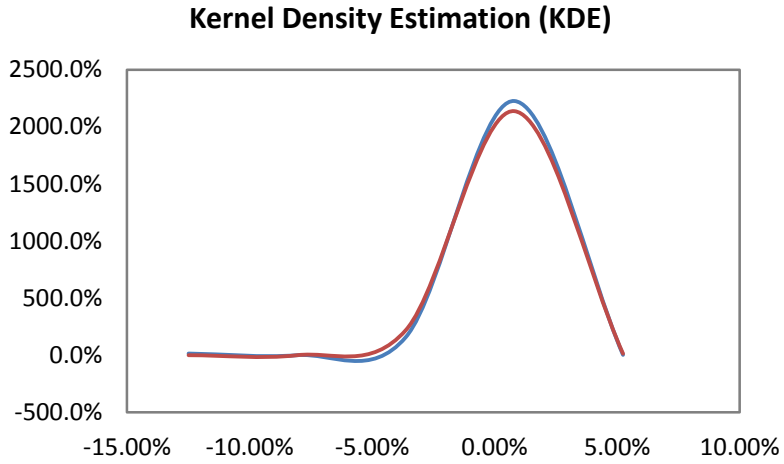


5.2.12 NTPC Ltd Plots

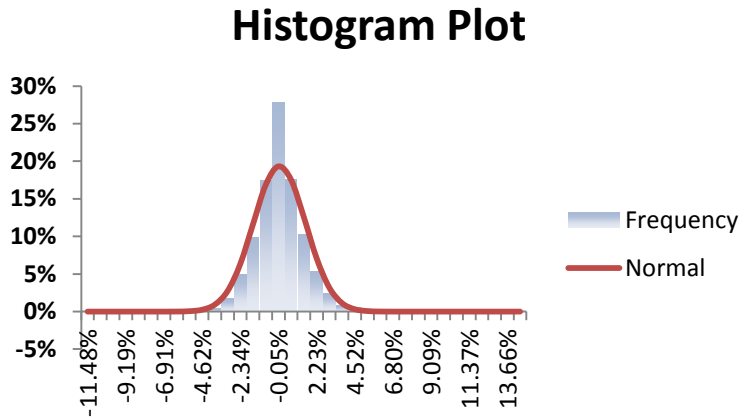


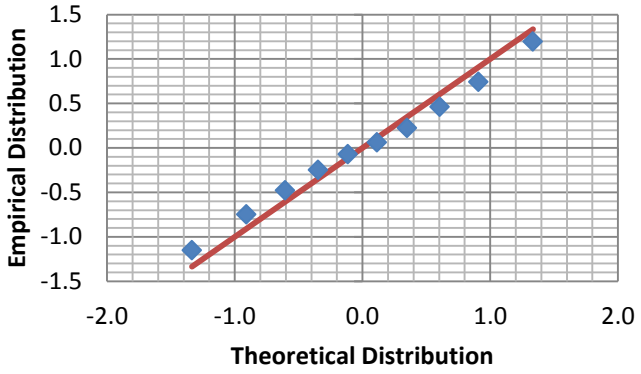


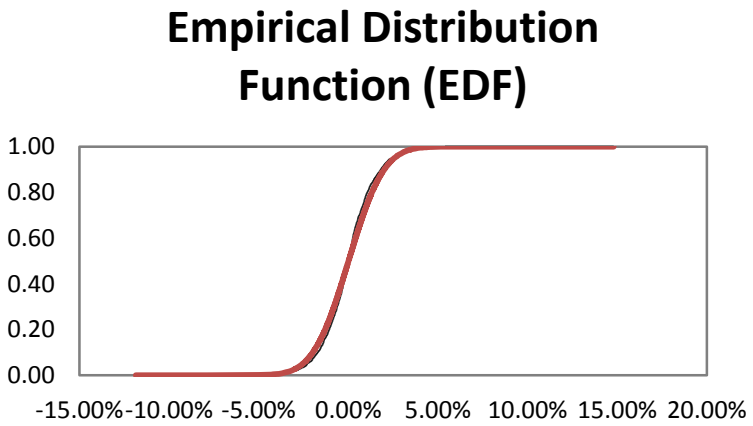


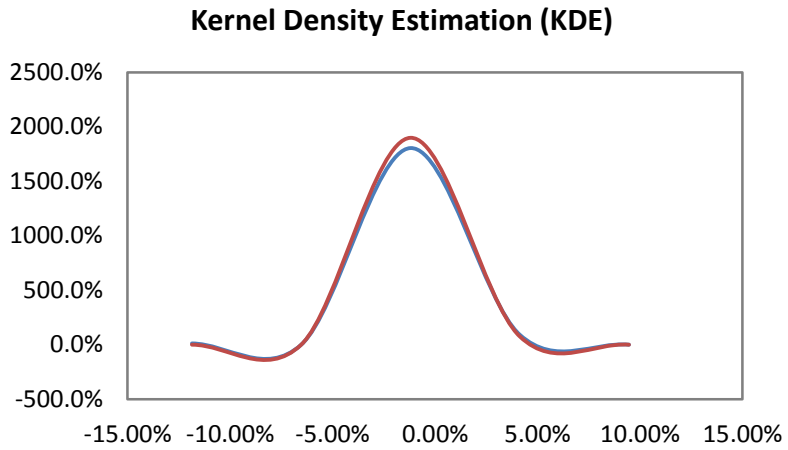


5.2.13 Powergrid Corporation of India Ltd Plots

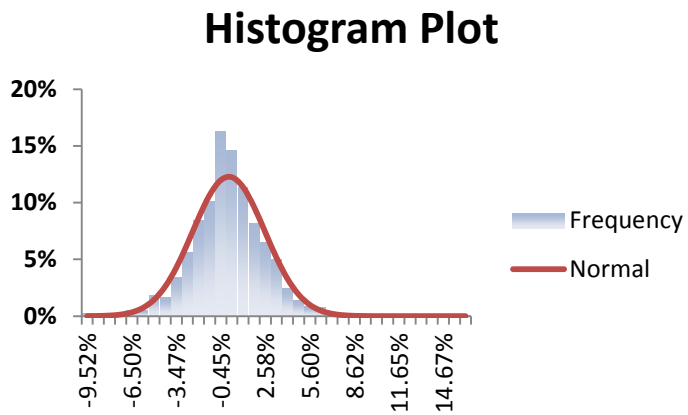


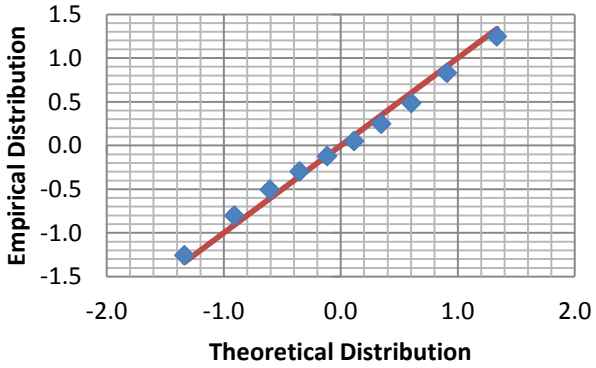


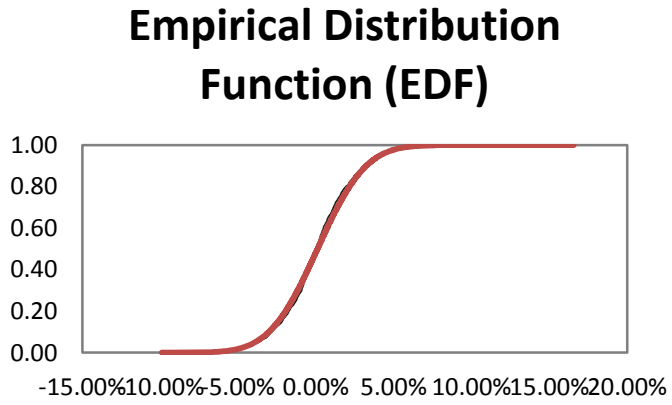


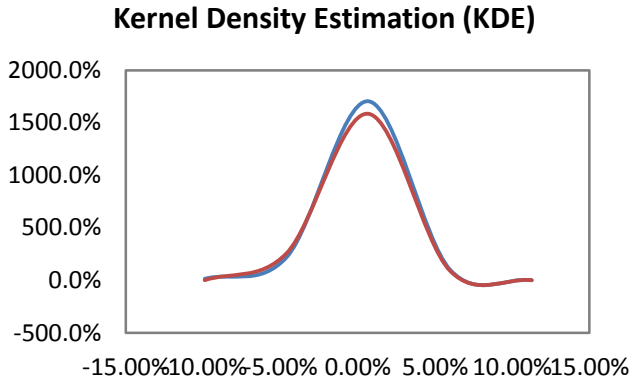


5.2.14 Axis Bank Ltd Plots

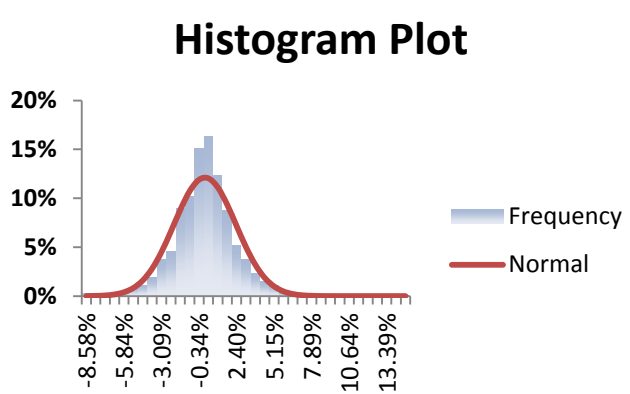


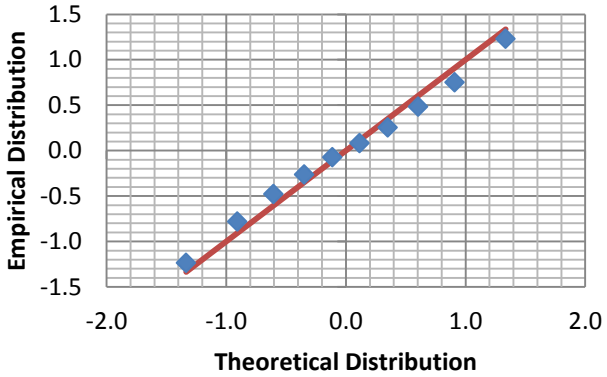


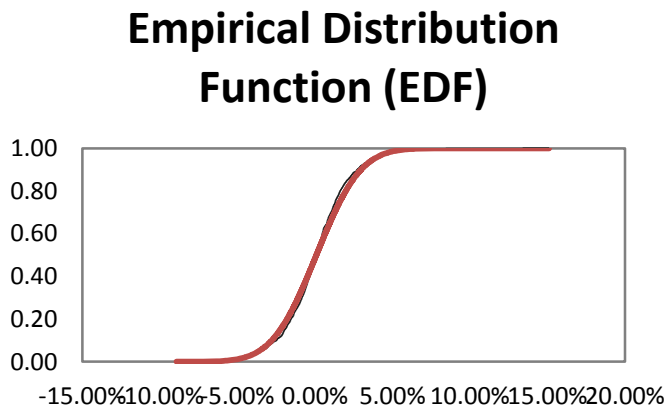


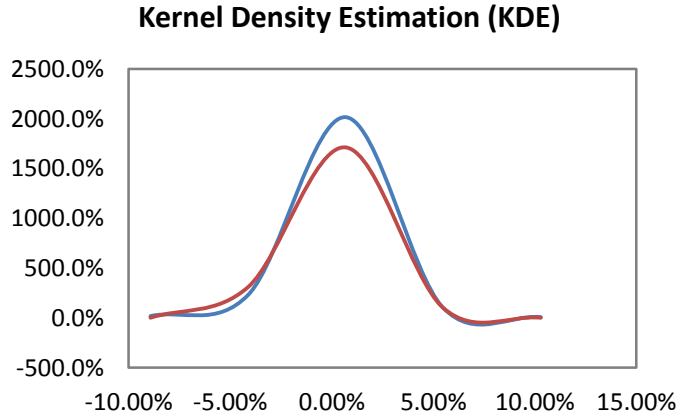


5.2.15 Bank of Baroda Plots

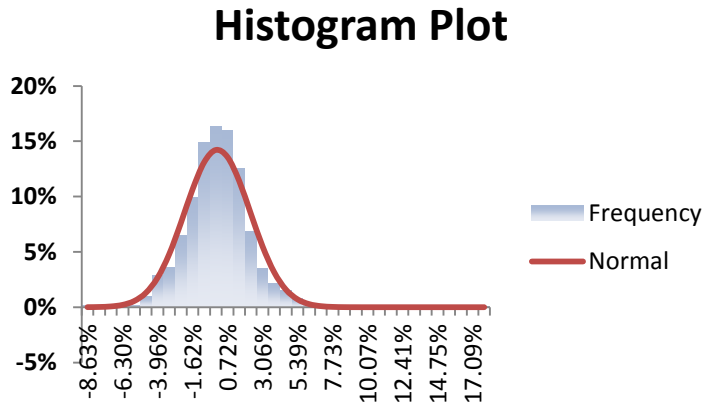


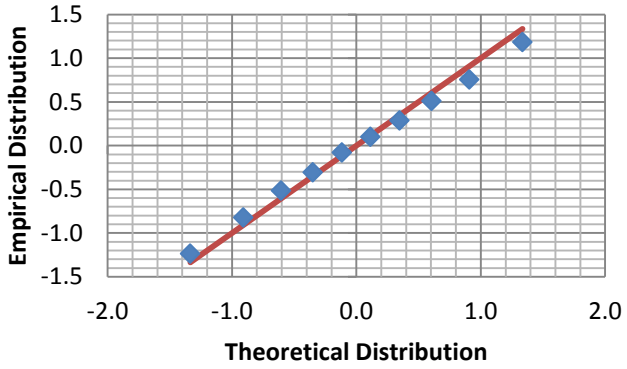


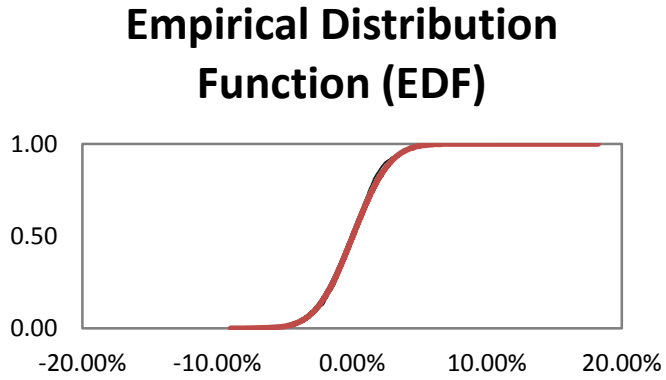


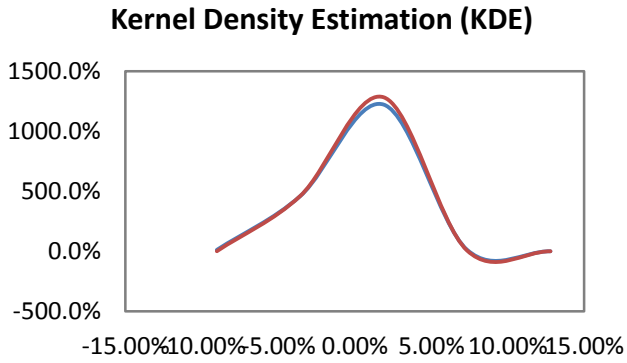


5.2.16 State Bank of India Plots

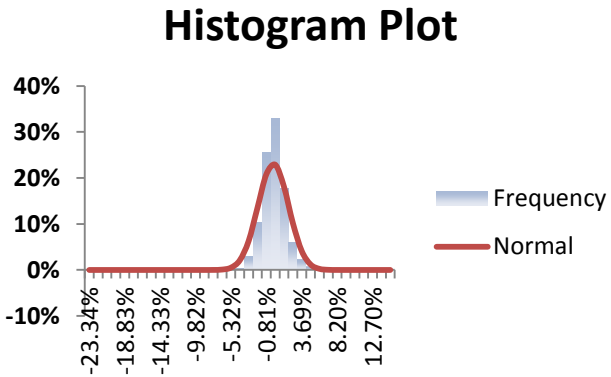


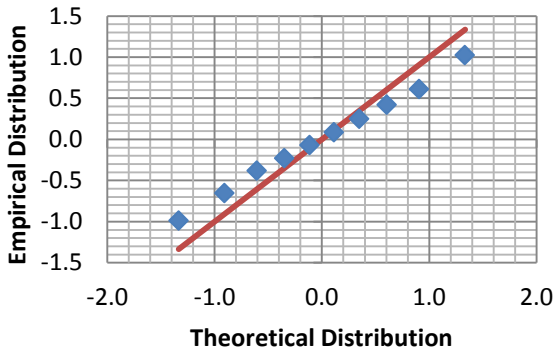


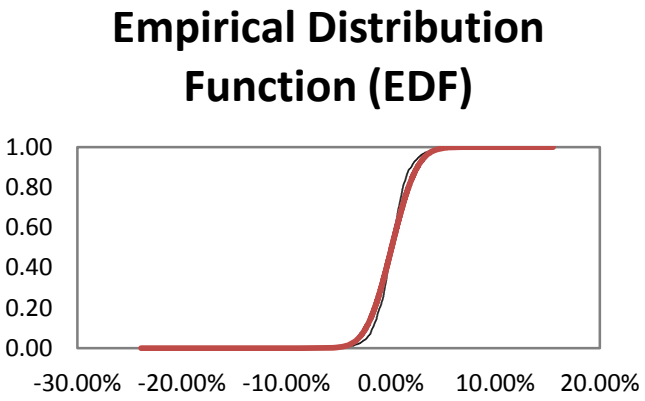


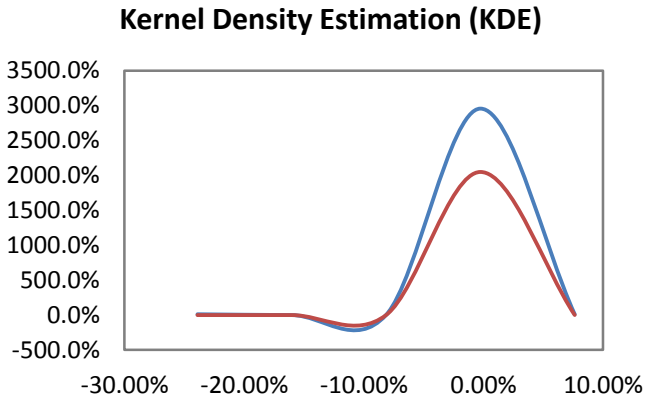


5.2.17 INFOSYS Ltd Plots

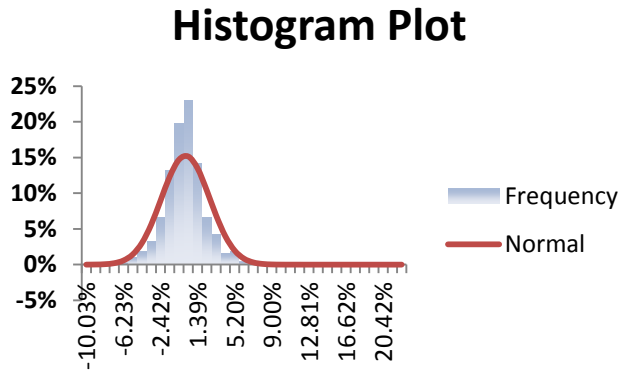


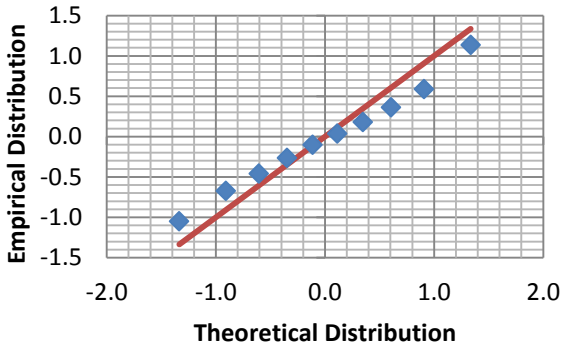


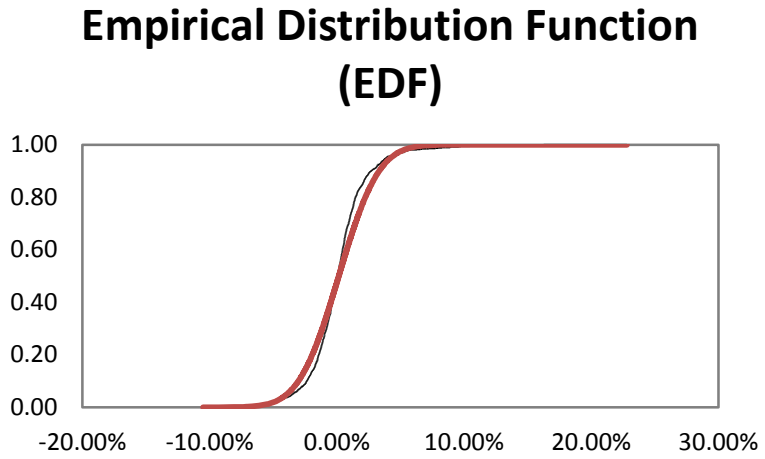


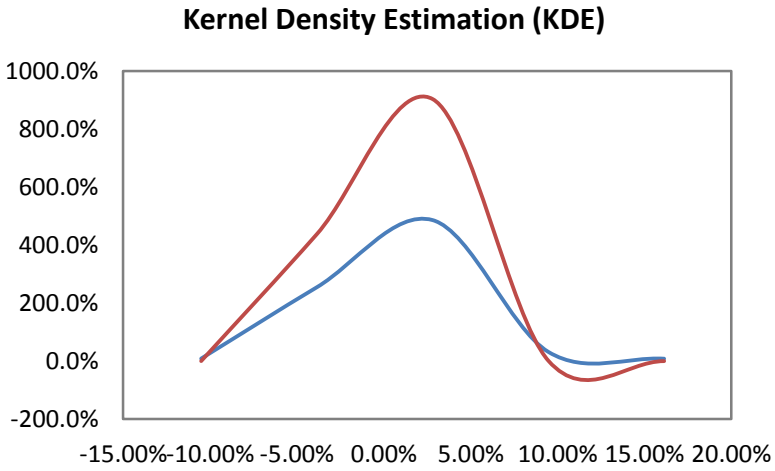


5.2.18 Tech Mahindra Ltd Plots

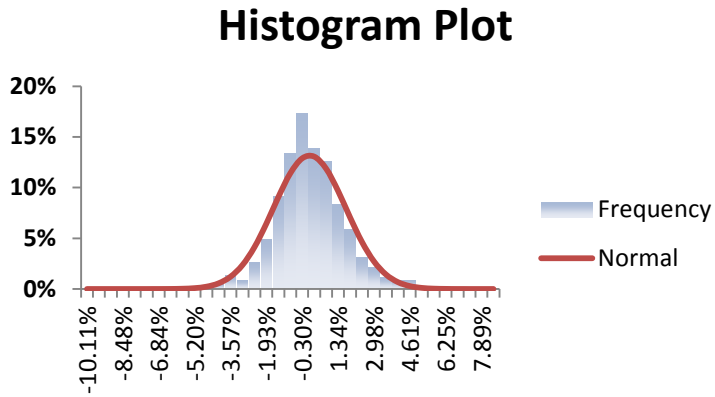


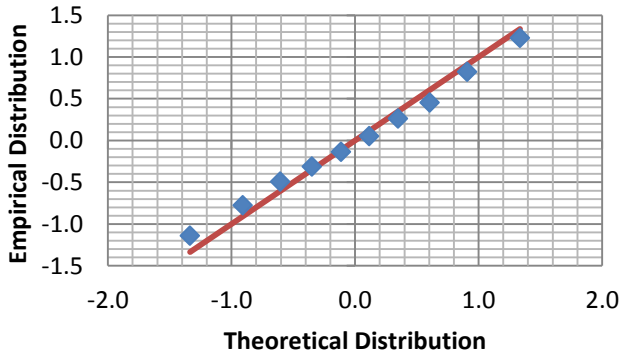


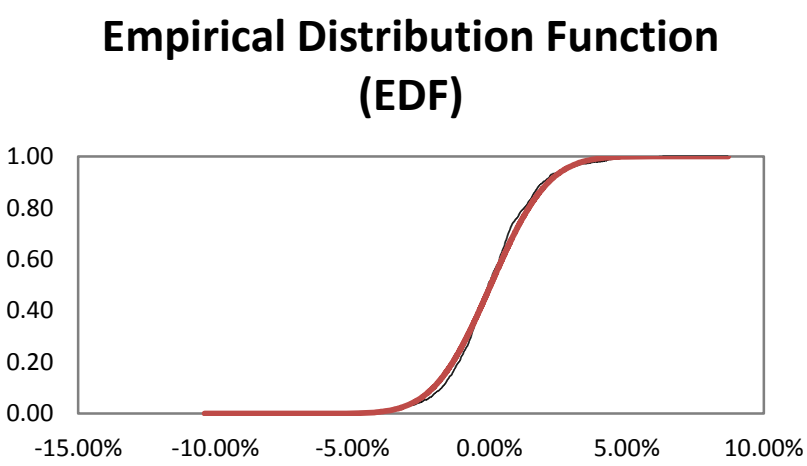


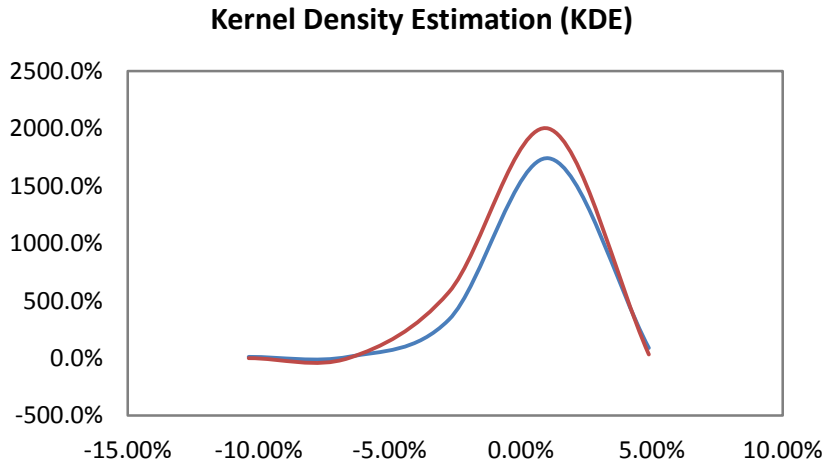


5.2.19 CIPLA Ltd Plots

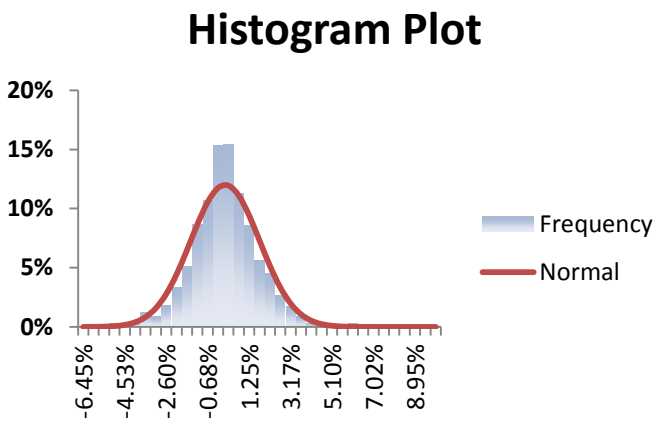


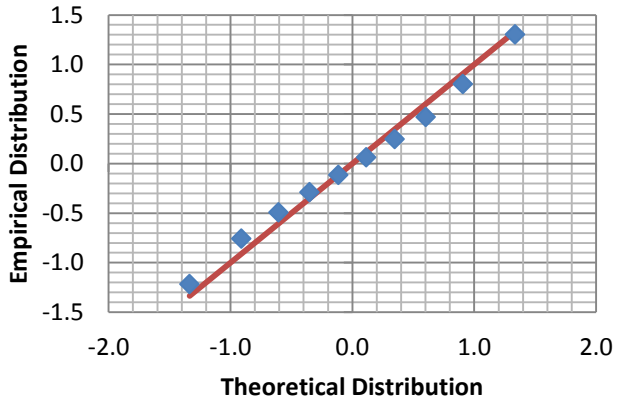


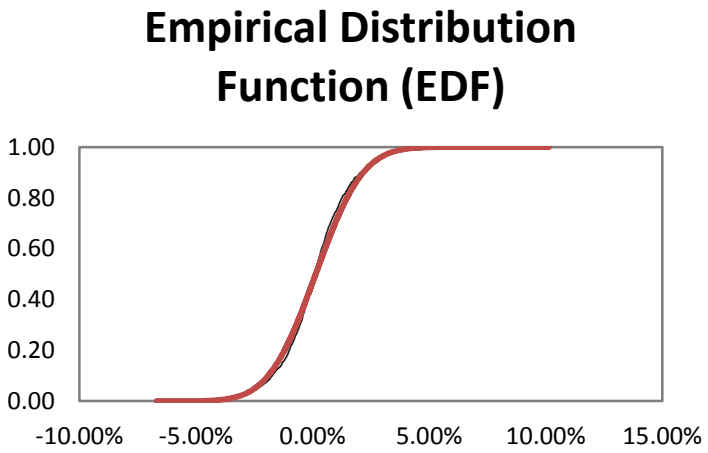


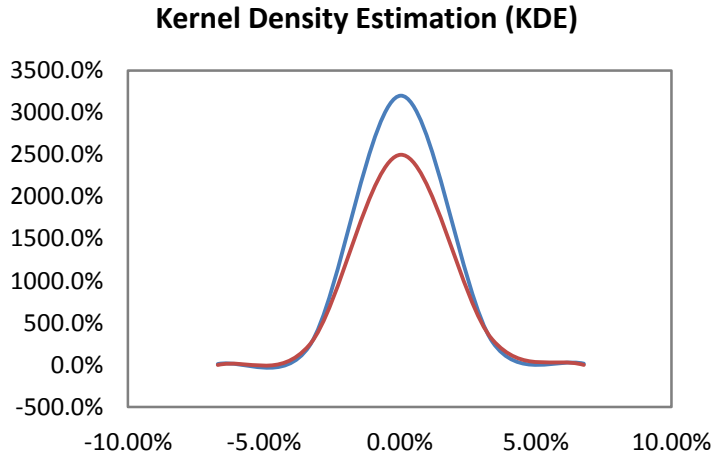


5.2.20 Dr. Reddy's laboratories Ltd Plots

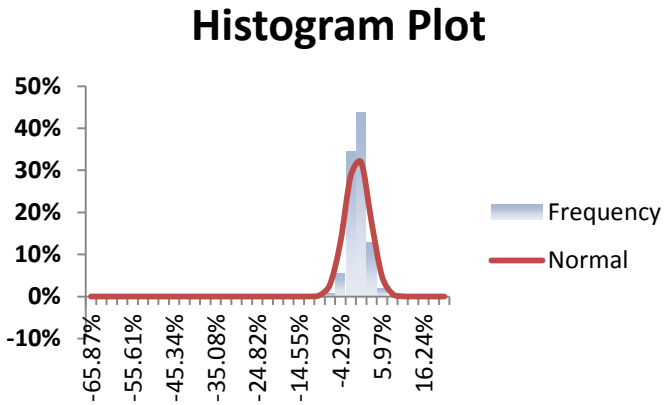


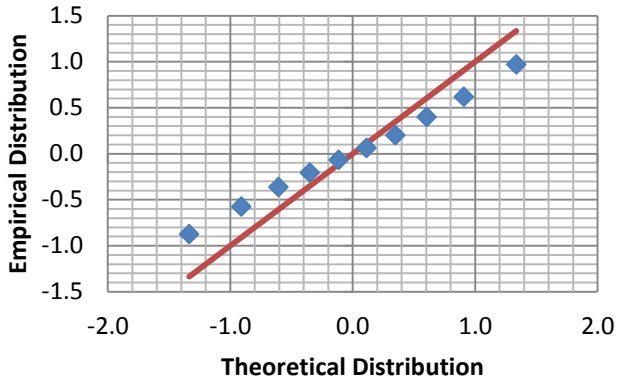


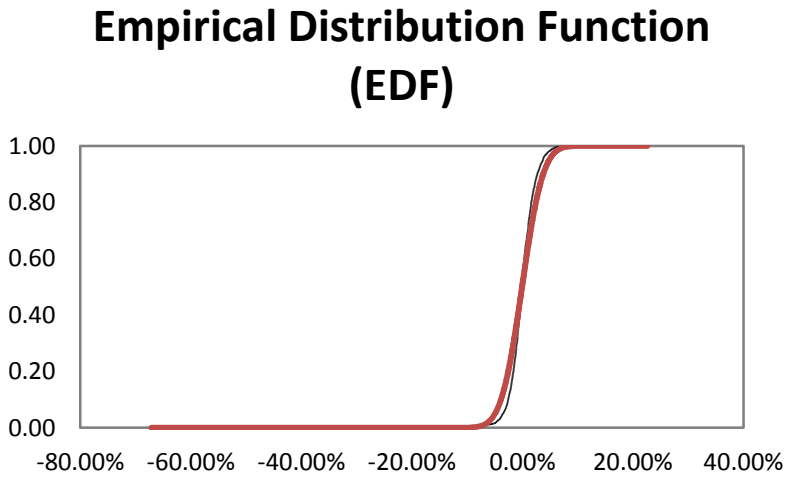




5.2.21 Bharti Airtel Ltd Plots







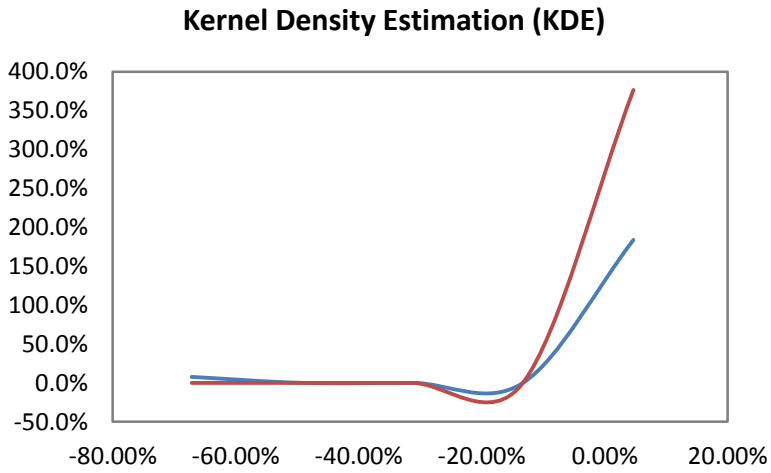


Table 5.9 White Noise Test: Table 4

Table 4:- White Noise Test (Ljung-Box Test)																5.00%
Company	LAGS															
	1		2		3		4		5		6		7		8	
	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?	P-Value	Pass?
S&P CNX NIFTY (NSE)																
S&P CNX NIFTY (NSE)	8.20%	TRUE	18.60%	TRUE	15.80%	TRUE	19.70%	TRUE	19.90%	TRUE	11.40%	TRUE	5.20%	TRUE	8%	TRUE
AUTOMOBILES																
1) BAJAJ AUTO LTD	2.8%	FALSE	8.6%	TRUE	7.2%	TRUE	8.40%	TRUE	14.30%	TRUE	17.60%	TRUE	24.30%	TRUE	31.10%	TRUE
2) HERO MOTOCORP LTD	49.10%	TRUE	19.20%	TRUE	0.10%	FALSE	0.20%	FALSE	0.20%	FALSE	0.20%	FALSE	0.10%	FALSE	0.10%	FALSE
3) MAHINDRA & MAHINDRA LTD.	88.70%	TRUE	98.90%	TRUE	83.60%	TRUE	92.40%	TRUE	96.30%	TRUE	97.30%	TRUE	91%	TRUE	58.90%	TRUE
4) MARUTI SUZUKI LTD.	15%	TRUE	30.80%	TRUE	6.50%	TRUE	7.00%	TRUE	9.80%	TRUE	3.60%	FALSE	0.90%	FALSE	1.50%	FALSE
5) TATA MOTORS LTD.	8.90%	TRUE	18.40%	TRUE	16.70%	TRUE	8.70%	TRUE	15.00%	TRUE	18.60%	TRUE	26%	TRUE	33.60%	TRUE
CEMENT & CEMENT PRODUCTS																
6) ACC LTD	7.90%	TRUE	16.70%	TRUE	17.80%	TRUE	27.80%	TRUE	26.10%	TRUE	10.20%	TRUE	2.10%	FALSE	3.20%	FALSE
7) AMBUJA CEMENTS LTD	3.40%	FALSE	4.40%	FALSE	9.60%	TRUE	13.80%	TRUE	21.00%	TRUE	19.80%	TRUE	21.20%	TRUE	29.20%	TRUE
8) GRASIM INDUSTRIES LTD	2.20%	FALSE	1.40%	FALSE	2.90%	FALSE	5.80%	TRUE	7.00%	TRUE	11.50%	TRUE	1.50%	FALSE	2.50%	FALSE
9) ULTRATECH CEMENT CO LTD	21.40%	TRUE	38.10%	TRUE	56.40%	TRUE	4.00%	FALSE	7.00%	TRUE	11.60%	TRUE	7.70%	TRUE	4.70%	FALSE
CONSTRUCTION																
10) DLF LTD	0.30%	FALSE	1.10%	FALSE	2.90%	FALSE	4.40%	FALSE	3.50%	FALSE	3.20%	FALSE	5.40%	TRUE	8.50%	TRUE
11) LARSEN & TOUBRO LTD	1.10%	FALSE	2.10%	FALSE	4.80%	FALSE	7.40%	TRUE	12.40%	TRUE	19.30%	TRUE	1.40%	FALSE	2.40%	FALSE
CONSUMER GOODS																
12) ASIAN PAINTS LTD	87.40%	TRUE	97%	TRUE	98.40%	TRUE	97.70%	TRUE	74.10%	TRUE	75.10%	TRUE	83.90%	TRUE	86.10%	TRUE
13) HINDUSTAN UNILEVER LTD	84.70%	TRUE	62.10%	TRUE	63.90%	TRUE	57.90%	TRUE	49.00%	TRUE	48.80%	TRUE	53.70%	TRUE	63.50%	TRUE
14) ITC LTD	17%	TRUE	29.30%	TRUE	10.40%	TRUE	15.80%	TRUE	24.30%	TRUE	28%	TRUE	35.40%	TRUE	21.60%	TRUE
ENERGY																
15) BHARAT PETROLEUM CORP.LTD	68.40%	TRUE	90.80%	TRUE	93%	TRUE	94.10%	TRUE	95.70%	TRUE	97.90%	TRUE	99.20%	TRUE	99.40%	TRUE
16) CAIRN INDIA LTD	30.30%	TRUE	0.20%	FALSE	0.50%	FALSE	0.6$%	FALSE	0.10%	FALSE	0.20%	FALSE	0.10%	FALSE	0.10%	FALSE
17) GAIL (INDIA) LTD.	6.70%	TRUE	18.50%	TRUE	7%	TRUE	4.00%	FALSE	5.10%	TRUE	4.40%	FALSE	5.40%	TRUE	8.50%	TRUE
18) NTPC LTD	26.60%	TRUE	50.20%	TRUE	47.1	TRUE	60.70%	TRUE	51.30%	TRUE	30.60%	TRUE	39.50%	TRUE	49.80%	TRUE
19) ONGC LTD	66.90%	TRUE	91.30%	TRUE	87%	TRUE	91.20%	TRUE	96.10%	TRUE	95.10%	TRUE	97.80%	TRUE	98.20%	TRUE
20) POWERGRID LTD	0.50%	FALSE	1.70%	FALSE	0.40%	FALSE	0.90%	FALSE	1.70%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
21) RELIANCE INDUSTRIES LTD	80%	TRUE	69.80%	TRUE	4.30%	FALSE	6.50%	TRUE	11.50%	TRUE	18.10%	TRUE	17.20%	TRUE	15.30%	TRUE
22) TATA POWER COMPANY LTD	38.80%	TRUE	67.90%	TRUE	83.40%	TRUE	92.50%	TRUE	95.60%	TRUE	97.80%	TRUE	99%	TRUE	99.60%	TRUE
FINANCIAL SERVICES																
23) AXIS BANK LTD	2.10%	FALSE	1.70%	FALSE	4.20%	FALSE	3.50%	FALSE	6.40%	TRUE	10.60%	TRUE	11.10%	TRUE	15.20%	TRUE
24) BANK OF BARODA	3.10%	FALSE	9.40%	TRUE	18.90%	TRUE	31.10%	TRUE	35.70%	TRUE	46.90%	TRUE	50.40%	TRUE	60.20%	TRUE
25) HDFC BANK LTD	89.20%	TRUE	96.10%	TRUE	98.80%	TRUE	98.30%	TRUE	99.50%	TRUE	99.70%	TRUE	99.90%	TRUE	100%	TRUE
26) HOUSING DEVPMT FIN CORPN.	34.40%	TRUE	57.40%	TRUE	77.10%	TRUE	85.50%	TRUE	92.30%	TRUE	95.80%	TRUE	98.20%	TRUE	98%	TRUE
27) ICICI BANK LTD	0.70%	FALSE	0.60%	FALSE	0.30%	FALSE	0.30%	FALSE	0.30%	FALSE	0.20%	FALSE	0.40%	FALSE	0.70%	FALSE
28) IDFC LTD	13.10%	TRUE	10%	TRUE	14.70%	TRUE	17.70%	TRUE	27.70%	TRUE	33.90%	TRUE	15.80%	TRUE	20.90%	TRUE
29) INDUSIND BANK LTD	88.10%	TRUE	16%	TRUE	13.60%	TRUE	23.40%	TRUE	26.90%	TRUE	5.40%	TRUE	4.10%	FALSE	3.20%	FALSE
30) KOTAK MAHINDRA BANK	43.20%	TRUE	51.70%	TRUE	70.10%	TRUE	79.10%	TRUE	85.50%	TRUE	85.80%	TRUE	91.90%	TRUE	94.10%	TRUE
31) PUNJAB NATIONAL BANK	0.10%	FALSE	0.30%	FALSE	0.60%	FALSE	1.50%	FALSE	2.60%	FALSE	4.10%	FALSE	1.90%	FALSE	2.80%	FALSE
32) STATE BANK OF INDIA	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
INDUSTRIAL MANUFACTURING																
33) BHARAT HEAVY ELECTRICALS LTD	31.60%	TRUE	60.30%	TRUE	55.60%	TRUE	44.90%	TRUE	55.00%	TRUE	58.10%	TRUE	57.70%	TRUE	66.90%	TRUE
INFORMATION TECHNOLOGY																
34) HINDUSTAN COMPUTERS LTD	31.50%	TRUE	0.40%	FALSE	0.30%	FALSE	0.20%	FALSE	0.30%	FALSE	0.60%	FALSE	0.40%	FALSE	0.50%	FALSE
35) INFOSYS LTD	95.40%	TRUE	5%	FALSE	5%	FALSE	0.40%	FALSE	0.80%	FALSE	1.10%	FALSE	2.10%	FALSE	3.60%	FALSE
36) TATA CONSULTANCY SERVICES LTD	84.40%	TRUE	95%	TRUE	97.50%	TRUE	82.90%	TRUE	59.20%	TRUE	10.60%	TRUE	11%	TRUE	11.90%	TRUE
37) TECH MAHINDRA LTD	4.70%	FALSE	2.70%	FALSE	1.80%	FALSE	0.80%	FALSE	0.30%	FALSE	0.00%	FALSE	0.00%	FALSE	0.10%	FALSE
38) WIPRO LTD	12.90%	TRUE	19.90%	TRUE	35.70%	TRUE	44.60%	TRUE	30.00%	TRUE	40.50%	TRUE	51.50%	TRUE	60.30%	TRUE
MEDIA & ENTERTAINMENT																
39) ZEE ENTERTAINMENT ENTERPRISES	89.60%	TRUE	84.40%	TRUE	70.50%	TRUE	26.10%	TRUE	36.90%	TRUE	43.30%	TRUE	48.10%	TRUE	43.20%	TRUE
METALS																
40) COAL INDIA * (FOUR YEARS)	93.40%	TRUE	98.30%	TRUE	6.80%	TRUE	10.60%	TRUE	13.30%	TRUE	20.50%	TRUE	24.80%	TRUE		
41) HINDALCO INDUSTRIES LTD	95%	TRUE	82.60%	TRUE	76%	TRUE	85.10%	TRUE	91.30%	TRUE	70.10%	TRUE	23.50%	TRUE	31.60%	TRUE
42) JINDAL POWER & STEEL	62.80%	TRUE	83.90%	TRUE	90.40%	TRUE	94.10%	TRUE	88.90%	TRUE	86.40%	TRUE	90.40%	TRUE	94.70%	TRUE
43) NMDC LTD	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE	0.00%	FALSE
44) SESA STERLITE LTD	43.40%	TRUE	41.60%	TRUE	48.90%	TRUE	63.60%	TRUE	69.10%	TRUE	5%	TRUE	4.80%	FALSE	7.10%	TRUE
45) TATA STEEL LTD	12.30%	TRUE	1.00%	FALSE	2.50%	FALSE	0.70%	FALSE	1.10%	FALSE	1.90%	FALSE	1.70%	FALSE	0.10%	FALSE
PHARMACEUTICALS																
46) CIPLA LTD	2.10%	FALSE	6.70%	TRUE	3.90%	FALSE	5.90%	TRUE	8.20%	TRUE	3.80%	FALSE	6.10%	TRUE	2.50%	FALSE
47) DR. REDDY'S LABORATORIES LTD	66.60%	TRUE	28.10%	TRUE	45.50%	TRUE	59.80%	TRUE	35.40%	TRUE	29.70%	TRUE	29.50%	TRUE	38.90%	TRUE
48) LUPIN INDIA LTD	48.60%	TRUE	71.70%	TRUE	75.10%	TRUE	81.90%	TRUE	81.70%	TRUE	89.70%	TRUE	94.50%	TRUE	97.10%	TRUE
49) SUN PHARMACEUTICALS LTD.	99.70%	TRUE	89.30%	TRUE	92.70%	TRUE	90.50%	TRUE	95.40%	TRUE	93.40%	TRUE	96.80%	TRUE	98.50%	TRUE
TELECOM																
50) BHARTI AIRTEL LTD.	53.20%	TRUE	12.40%	TRUE	20.40%	TRUE	30.50%	TRUE	32.20%	TRUE	44%	TRUE	44%	TRUE	53.70%	TRUE

Table 5.10 Arch Effect Test: Table 5

Table 5:- Arch Effect Test																5.00%
Company	LAGS															
	1		2		3		4		5		6		7		8	
	P-Value	Present?	P-Value	Present?	P-Value	Present?	P-Value	Present?	P-Value	Present?	P-Value	Present?	P-Value	Present?	P-Value	Present?
S&P CNX NIFTY (NSE)																
S&P CNX NIFTY (NSE)	57.0%	FALSE	76.6%	FALSE	87.2%	FALSE	52.8%	FALSE	64.6%	FALSE	36.0%	FALSE	9.1%	FALSE	13.6%	FALSE
AUTOMOBILES																
1) BAJAJ AUTO LTD	96.1%	FALSE	99.5%	FALSE	100.0%	FALSE	100.0%	FALSE	100.0%	FALSE	100.0%	FALSE	100.0%	FALSE	100.0%	FALSE
2) HERO MOTOCORP LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
3) MAHINDRA & MAHINDRA LTD.	88.74%	TRUE	98.9%	TRUE	83.63%	TRUE	92.44%	TRUE	96.3%	TRUE	97.3%	TRUE	91.0%	TRUE	58.9%	TRUE
4) MARUTI SUZUKI LTD.	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.10%	TRUE	0.20%	TRUE	0.30%	TRUE
5) TATA MOTORS LTD.	99.80%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
CEMENT & CEMENT PRODUCTS																
6) ACC LTD	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE	0.0%	TRUE
7) AMBUJA CEMENTS LTD	6.74%	FALSE	0.06%	TRUE	0.14%	TRUE	0.33%	TRUE	0.65%	TRUE	0.12%	TRUE	0.2%	TRUE	0.17%	TRUE
8) GRASIM INDUSTRIES LTD	8.17%	FALSE	20.34%	FALSE	31.13%	FALSE	44.02%	FALSE	55.96%	FALSE	68.45%	FALSE	61.57%	FALSE	69.89%	FALSE
9) ULTRATECH CEMENT CO LTD	1.19%	TRUE	2.34%	TRUE	0.32%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
CONSTRUCTION																
10) DLF LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
11) LARSEN & TOUBRO LTD	42.41%	FALSE	72.08%	FALSE	76.50%	FALSE	88.62%	FALSE	94.95%	FALSE	97.76%	FALSE	89.09%	FALSE	93.77%	FALSE
CONSUMER GOODS																
12) ASIAN PAINTS LTD	97.52%	FALSE	99.91%	FALSE	100%	FALSE	100.00%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
13) HINDUSTAN UNILEVER LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
14) ITC LTD	97.06%	FALSE	99.77%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
ENERGY																
15) BHARAT PETROLEUM CORP.LTD	94.28%	FALSE	99.74%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
16) CAIRN INDIA LTD	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
17) GAIL (INDIA) LTD.	63.16%	FALSE	42.17%	FALSE	62.36%	FALSE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
18) NTPC LTD	25.87%	FALSE	27.78%	FALSE	32.67%	FALSE	45.66%	FALSE	56.03%	FALSE	58.64%	FALSE	69.56%	FALSE	78.79%	FALSE
19) ONGC LTD	97.89%	FALSE	99.89%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
20) POWERGRID LTD	32.97%	FALSE	30.11%	FALSE	38.92%	FALSE	21.10%	FALSE	32.16%	FALSE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
21) RELIANCE INDUSTRIES LTD	97.43%	FALSE	99.84%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
22) TATA POWER COMPANY LTD	98.37%	FALSE	99.93%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
FINANCIAL SERVICES																
23) AXIS BANK LTD	0.30%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
24) BANK OF BARODA	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
25) HDFC BANK LTD	97.44%	FALSE	99.90%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
26) HOUSING DEVPMT FIN CORPN.	98.69%	FALSE	99.92%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
27) ICICI BANK LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
28) IDFC LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
29) INDUSIND BANK LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
30) KOTAK MAHINDRA BANK	81.6%	FALSE	97.23%	FALSE	99.65%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
31) PUNJAB NATIONAL BANK	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
32) STATE BANK OF INDIA	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
INDUSTRIAL MANUFACTURING																
33) BHARAT HEAVY ELECTRICALS LTD	97.16%	FALSE	99.90%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE	100%	FALSE
INFORMATION TECHNOLOGY																
34) HINDUSTAN COMPUTERS LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
35) INFOSYS LTD	0.73%	TRUE	2.7%	TRUE	6.50%	FALSE	12.43%	FALSE	20.22%	FALSE	28.61%	FALSE	38.32%	FALSE	47.97%	FALSE
36) TATA CONSULTANCY SERVICES LTD	96.44%	FALSE	100%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
37) TECH MAHINDRA LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
38) WIPRO LTD	86.61%	FALSE	98.48%	FALSE	99.86%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
MEDIA & ENTERTAINMENT																
39) ZEE ENTERTAINMENT ENTERPRISES	99.03%	FALSE	99.75%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
METALS																
40) COAL INDIA * (FOUR YEARS)	29.83%	FALSE	19.62%	FALSE	30.74%	FALSE	10.26%	FALSE	17.01%	FALSE	19.79%	FALSE	10.48%	FALSE		
41) HINDALCO INDUSTRIES LTD	0%	TRUE	0%	TRUE	0%	TRUE	0%	TRUE	0%	TRUE	0%	TRUE	0%	TRUE	0%	TRUE
42) JINDAL POWER & STEEL	98.04%	FALSE	99.91%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
43) NMDC LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
44) SESA STERLITE LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
45) TATA STEEL LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
PHARMACEUTICALS																
46) CIPLA LTD	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
47) DR. REDDY'S LABORATORIES LTD	0.60%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE	0.00%	TRUE
48) LUPIN INDIA LTD	97.81%	FALSE	99.92%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
49) SUN PHARMACEUTICALS LTD.	96.91%	FALSE	99.85%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE
TELECOM																
50) BHARTI AIRTEL LTD.	96.80%	FALSE	99.90%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE	100.00%	FALSE

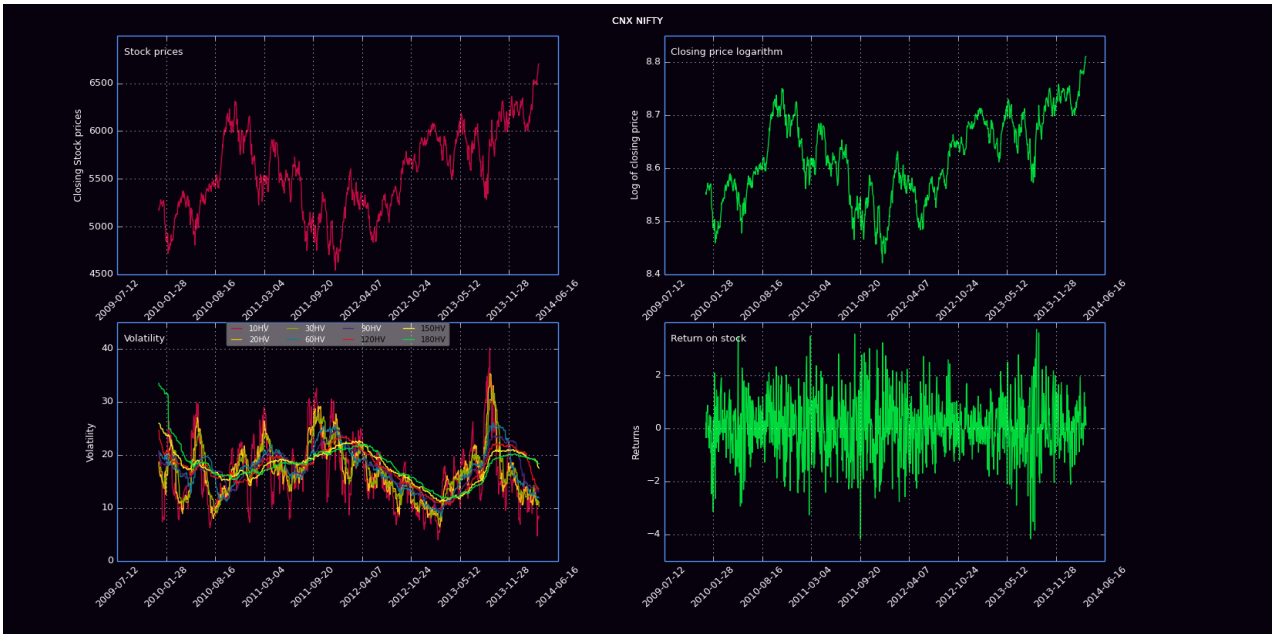
Table 5.11 Summary Sheet (White Noise, Normality, Arch Effect) Test: Table 6

Table 6:- Summary Sheet (White-Noise,Normality,Arch Effect)						5.00%
	White-noise		Normal Distributed?		ARCH Effect?	
Company	P-Value	SIG?	P-Value	SIG?	P-Value	SIG?
S&P CNX NIFTY (NSE)						
S&P CNX NIFTY (NSE)	8.03%	TRUE	0.00%	FALSE	13.59%	FALSE
AUTOMOBILES						
1) BAJAJ AUTO LTD	31.06%	TRUE	0.00%	FALSE	100.00%	FALSE
2) HERO MOTOCORP LTD	0.10%	FALSE	0.00%	FALSE	0.00%	TRUE
3) MAHINDRA & MAHINDRA LTD.	58.90%	TRUE	0.00%	FALSE	100.00%	FALSE
4) MARUTI SUZUKI LTD.	1.53%	FALSE	0.00%	FALSE	0.33%	TRUE
5) TATA MOTORS LTD.	33.58%	TRUE	0.00%	FALSE	100.00%	FALSE
CEMENT & CEMENT PRODUCTS						
6) ACC LTD	3.16%	FALSE	0.00%	FALSE	0.00%	TRUE
7) AMBUJA CEMENTS LTD	29.24%	TRUE	0.00%	FALSE	0.18%	TRUE
8) GRASIM INDUSTRIES LTD	2.54%	FALSE	0.00%	FALSE	69.89%	FALSE
9) ULTRATECH CEMENT CO LTD	4.67%	FALSE	0.00%	FALSE	0.00%	TRUE
CONSTRUCTION						
10) DLF LTD	8.53%	TRUE	0.00%	FALSE	0.00%	TRUE
11) LARSEN & TOUBRO LTD	2.36%	FALSE	0.00%	FALSE	93.77%	FALSE
CONSUMER GOODS						
12) ASIAN PAINTS LTD	86.13%	TRUE	0.00%	FALSE	100.00%	FALSE
13) HINDUSTAN UNILEVER LTD	63.50%	TRUE	0.00%	FALSE	0.00%	TRUE
14) ITC LTD	21.59%	TRUE	0.00%	FALSE	100.00%	FALSE
ENERGY						
15) BHARAT PETROLEUM CORP.LTD	99.42%	TRUE	0.00%	FALSE	100.00%	FALSE
16) CAIRN INDIA LTD	0.08%	FALSE	0.00%	FALSE	0.00%	TRUE
17) GAIL (INDIA) LTD.	8.47%	TRUE	0.00%	FALSE	0.04%	TRUE
18) NTPC LTD	49.84%	TRUE	0.00%	FALSE	78.79%	FALSE
19) ONGC LTD	98.17%	TRUE	0.00%	FALSE	100.00%	FALSE
20) POWERGRID LTD	0.01%	FALSE	0.00%	FALSE	0.00%	TRUE
21) RELIANCE INDUSTRIES LTD	15.34%	TRUE	0.00%	FALSE	100.00%	FALSE
22) TATA POWER COMPANY LTD	99.61%	TRUE	0.00%	FALSE	100.00%	FALSE
FINANCIAL SERVICES						

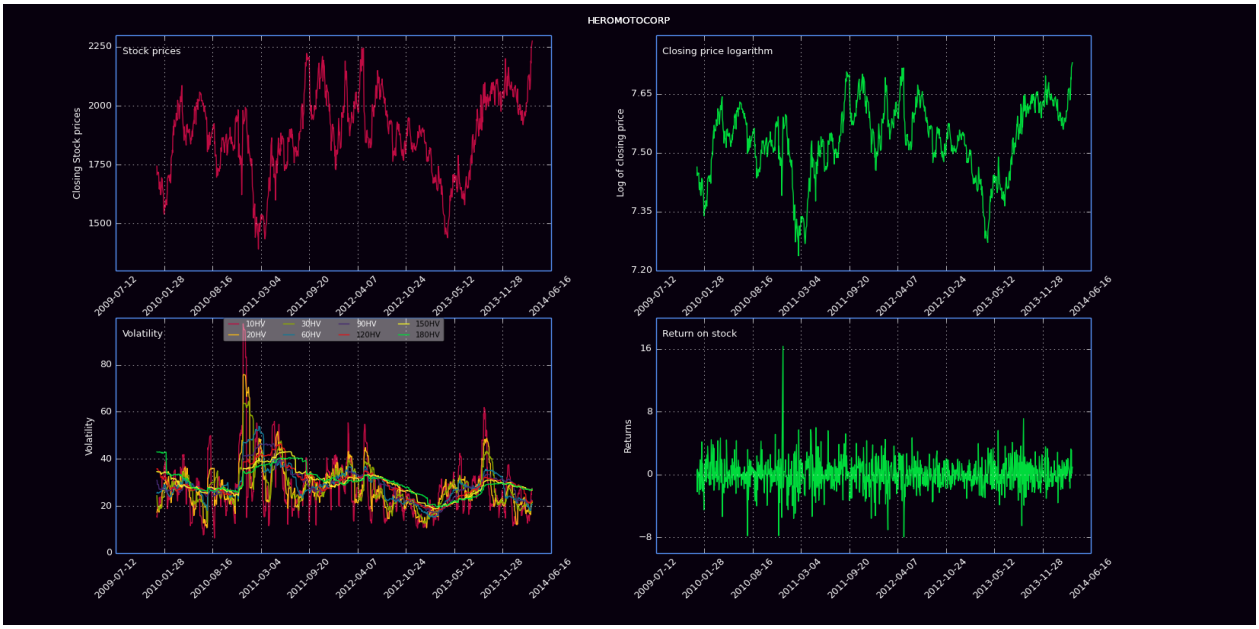
23) AXIS BANK LTD	15.15%	TRUE	0.00%	FALSE	0.00%	TRUE
24) BANK OF BARODA	60.19%	TRUE	0.00%	FALSE	0.00%	TRUE
25) HDFC BANK LTD	99.98%	TRUE	0.00%	FALSE	100.00%	FALSE
26) HOUSING DEVPMT FIN CORPN.	98.04%	TRUE	0.00%	FALSE	100.00%	FALSE
27) ICICI BANK LTD	0.72%	FALSE	0.00%	FALSE	0.00%	TRUE
28) IDFC LTD	20.89%	TRUE	0.00%	FALSE	0.00%	TRUE
29) INDUSIND BANK LTD	3.19%	FALSE	0.00%	FALSE	0.00%	TRUE
30) KOTAK MAHINDRA BANK	94.08%	TRUE	0.00%	FALSE	100.00%	FALSE
31) PUNJAB NATIONAL BANK	2.76%	FALSE	0.00%	FALSE	0.00%	TRUE
32) STATE BANK OF INDIA	0.00%	FALSE	0.00%	FALSE	0.00%	TRUE
INDUSTRIAL MANUFACTURING						
33) BHARAT HEAVY ELECTRICALS LTD	66.69%	TRUE	**0.00%**	FALSE	**100.00%**	FALSE
INFORMATION TECHNOLOGY						
34) HINDUSTAN COMPUTERS LTD	0.54%	FALSE	0.00%	FALSE	0.00%	TRUE
35) INFOSYS LTD	3.56%	FALSE	0.00%	FALSE	47.97%	FALSE
36) TATA CONSULTANCY SERVICES LTD	11.93%	TRUE	0.00%	FALSE	100.00%	FALSE
37) TECH MAHINDRA LTD	0.05%	FALSE	0.00%	FALSE	0.00%	TRUE
38) WIPRO LTD	60.26%	TRUE	0.00%	FALSE	100.00%	FALSE
MEDIA & ENTERTAINMENT						
39) ZEE ENTERTAINMENT ENTERPRISES	43.16%	TRUE	**0.00%**	FALSE	**100.00%**	FALSE
METALS						
40) COAL INDIA * (FOUR YEARS)	24.84%	TRUE	0.00%	FALSE	10.48%	FALSE
41) HINDALCO INDUSTRIES LTD	31.62%	TRUE	0.00%	FALSE	0.00%	TRUE
42) JINDAL POWER & STEEL	94.67%	TRUE	0.00%	FALSE	100.00%	FALSE
43) NMDC LTD	0.09%	FALSE	0.00%	FALSE	0.00%	TRUE
44) SESA STERLITE LTD	7.12%	TRUE	0.00%	FALSE	0.00%	TRUE
45) TATA STEEL LTD	0.13%	FALSE	0.00%	FALSE	0.00%	TRUE
PHARMACEUTICALS						
46) CIPLA LTD	2.52%	FALSE	0.00%	FALSE	0.00%	TRUE
47) DR. REDDY'S LABORATORIES LTD	38.86%	TRUE	0.00%	FALSE	0.00%	TRUE
48) LUPIN INDIA LTD	97.14%	TRUE	0.00%	FALSE	100.00%	FALSE
49) SUN PHARMACEUTICALS LTD.	98.53%	TRUE	0.00%	FALSE	100.00%	FALSE
TELECOM						
50) BHARTI AIRTEL LTD.	53.67%	TRUE	0.00%	FALSE	100.00%	FALSE

DATA SAMPLING PLOTS

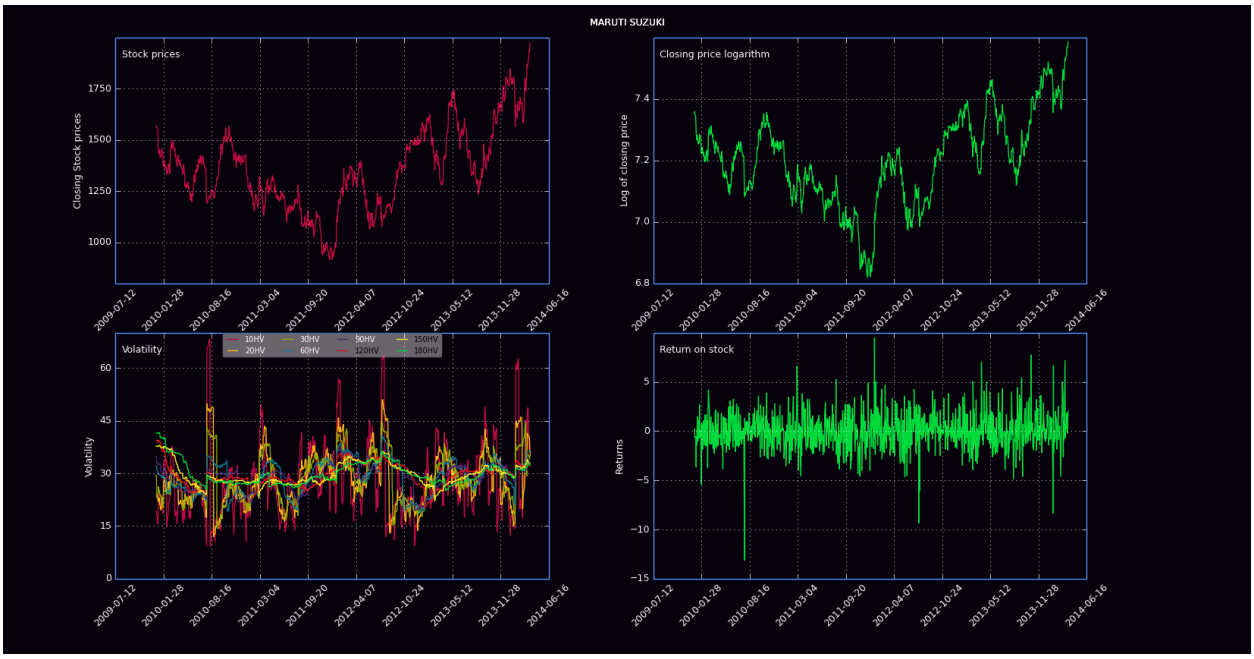
5.3.1 S&P CNX NIFTY (NSE) CNX NIFTY Data Sampling Plots



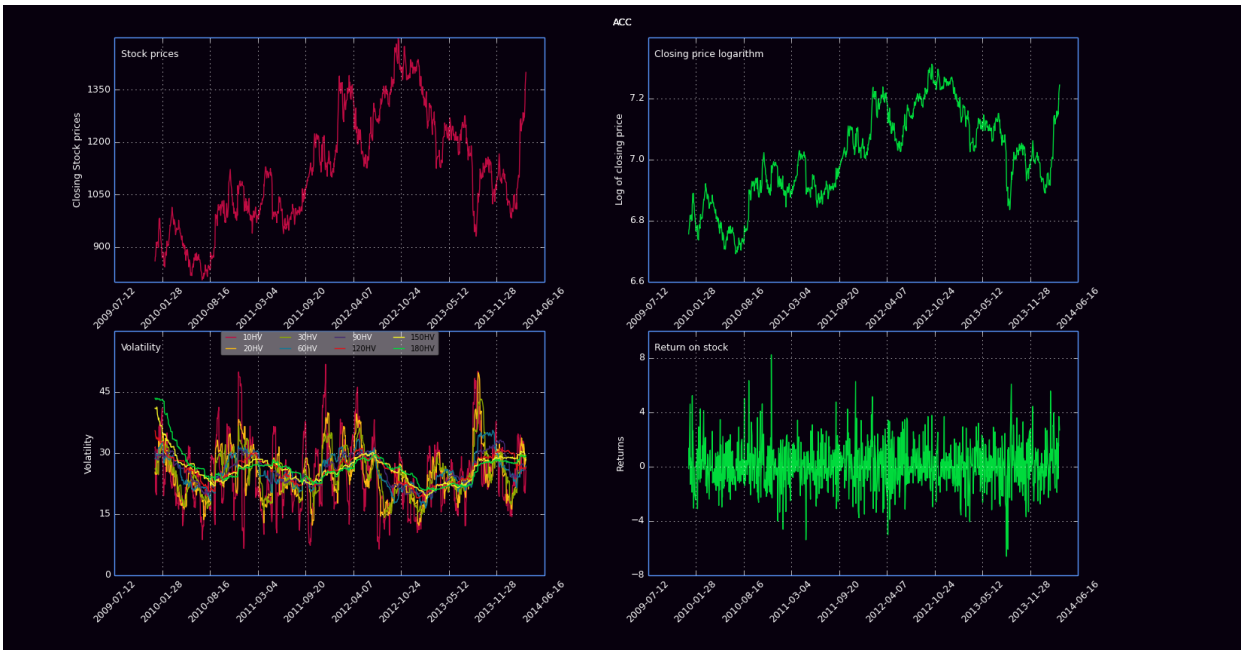
5.3.2 Hero Moto Corp Data Sampling Plots



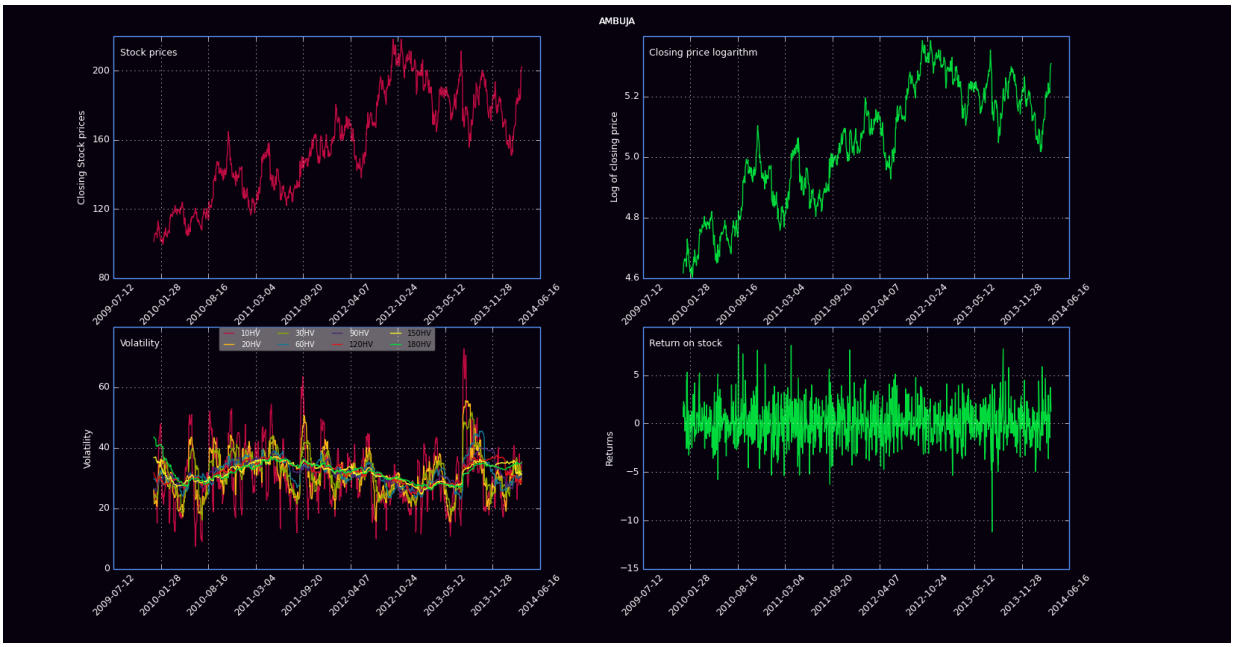
5.3.3 Maruti Suzuki Ltd Data Sampling Plots



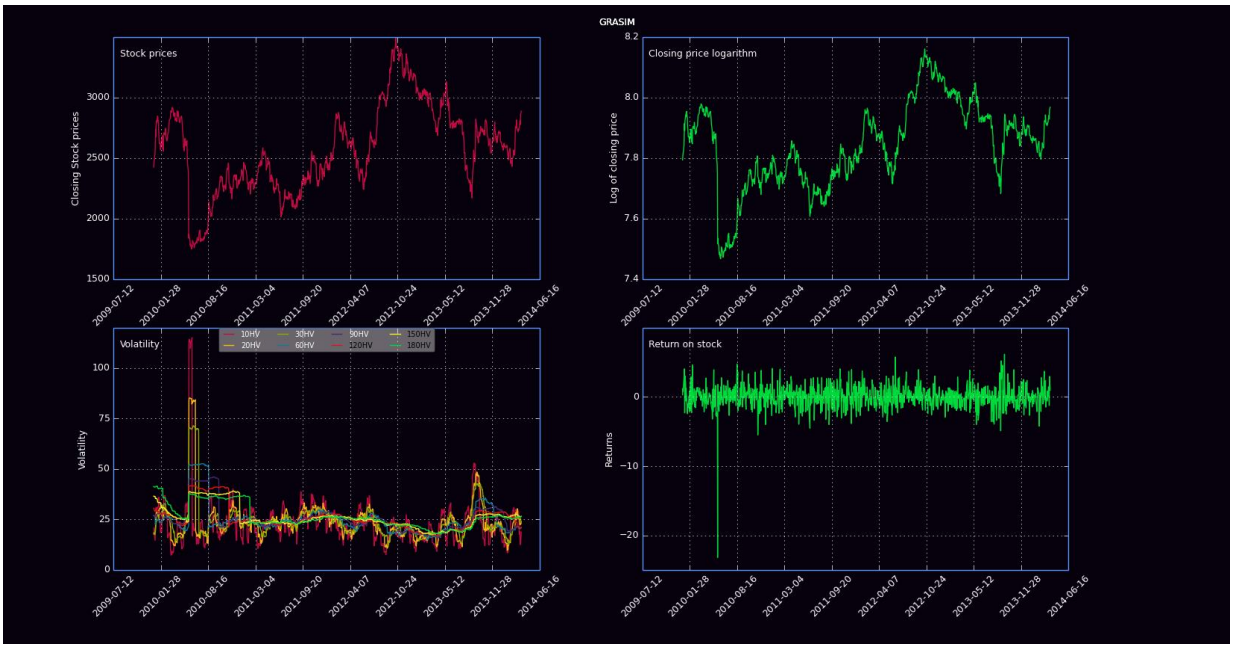
5.3.4 ACC Ltd Data Sampling Plots



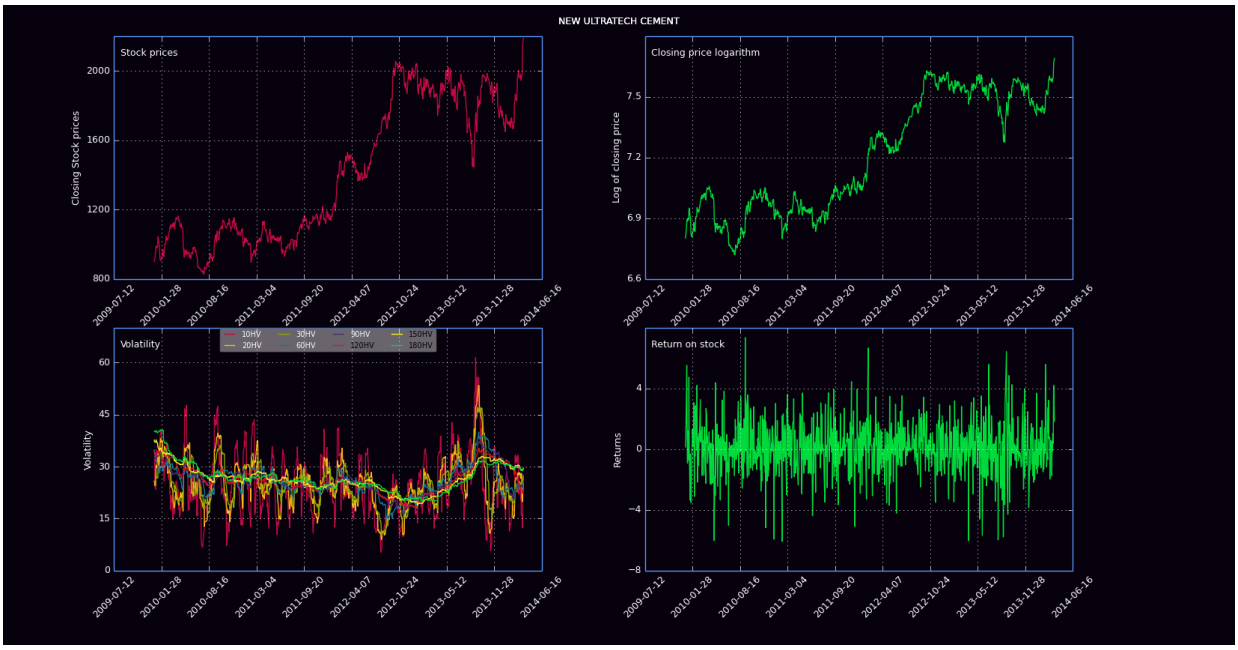
5.3.5 Ambuja Cement Ltd Data Sampling Plots



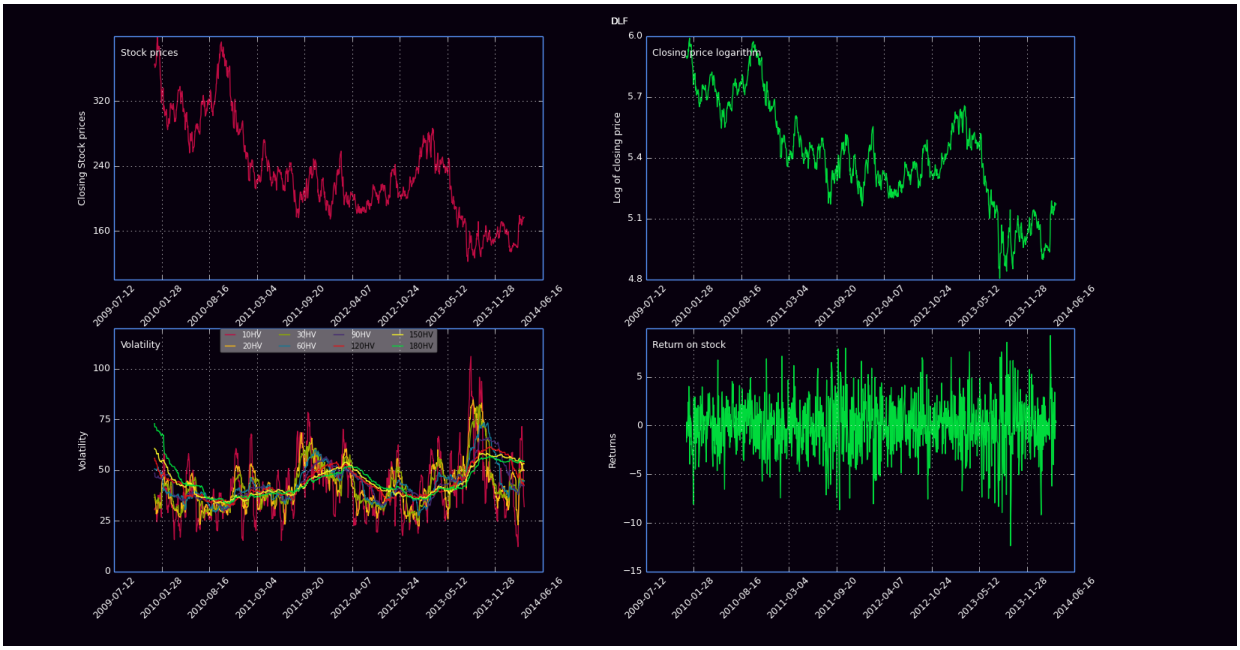
5.3.6 Grasim Industries Data Sampling Plots



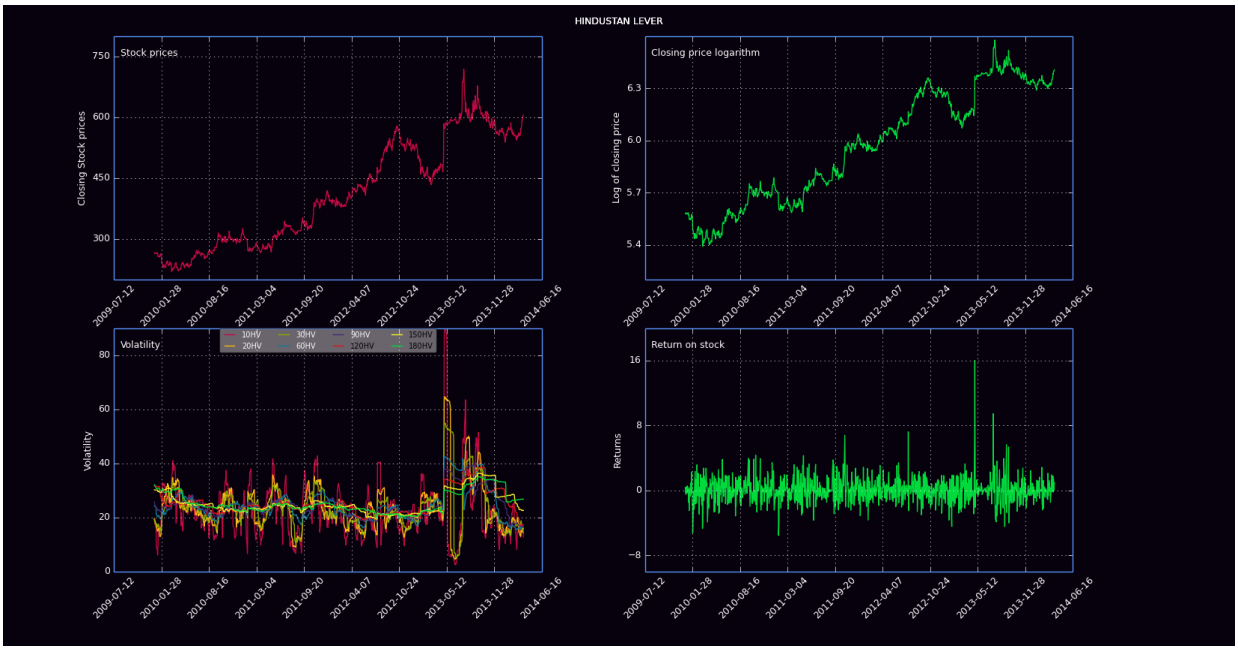
5.3.7 Ultratech Cement Data Sampling Plots



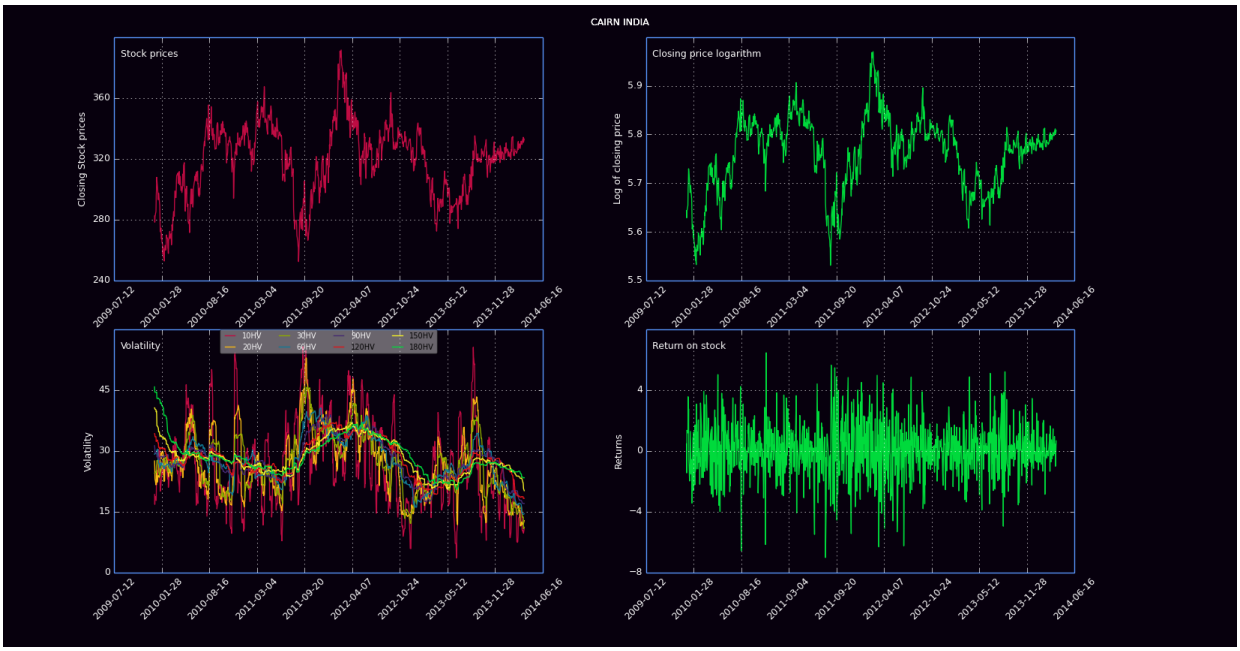
5.3.8 DLF Ltd Data Sampling Plots



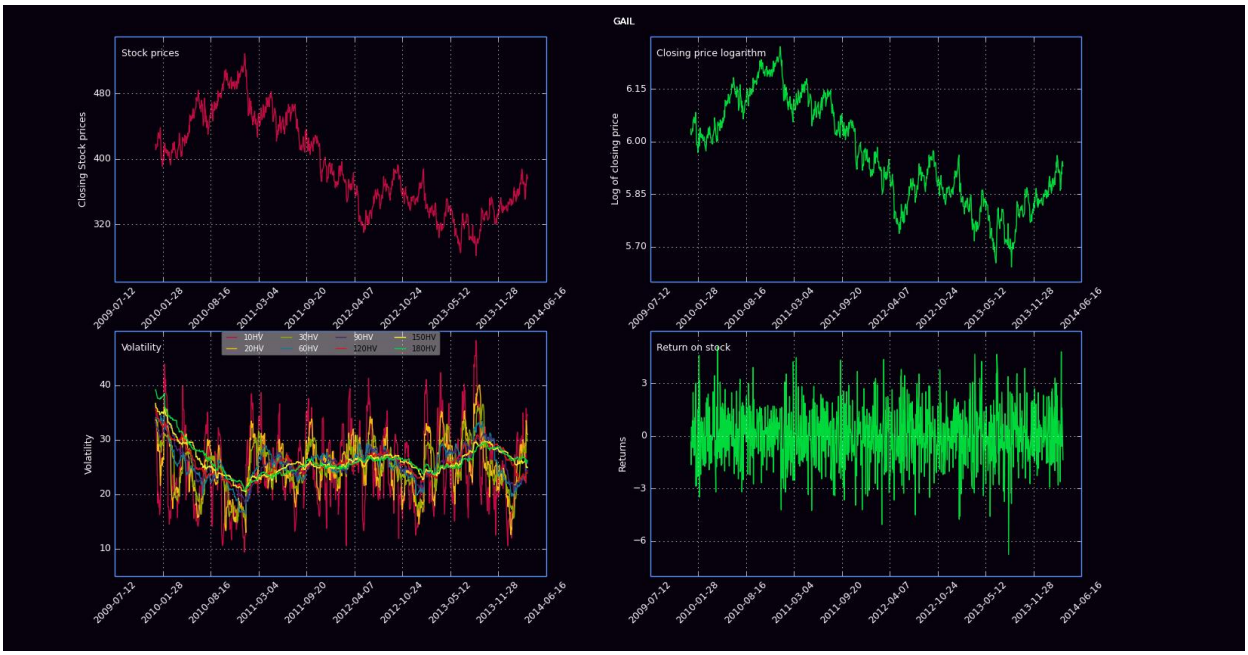
5.3.9 Hindustan Lever Data Sampling Plots



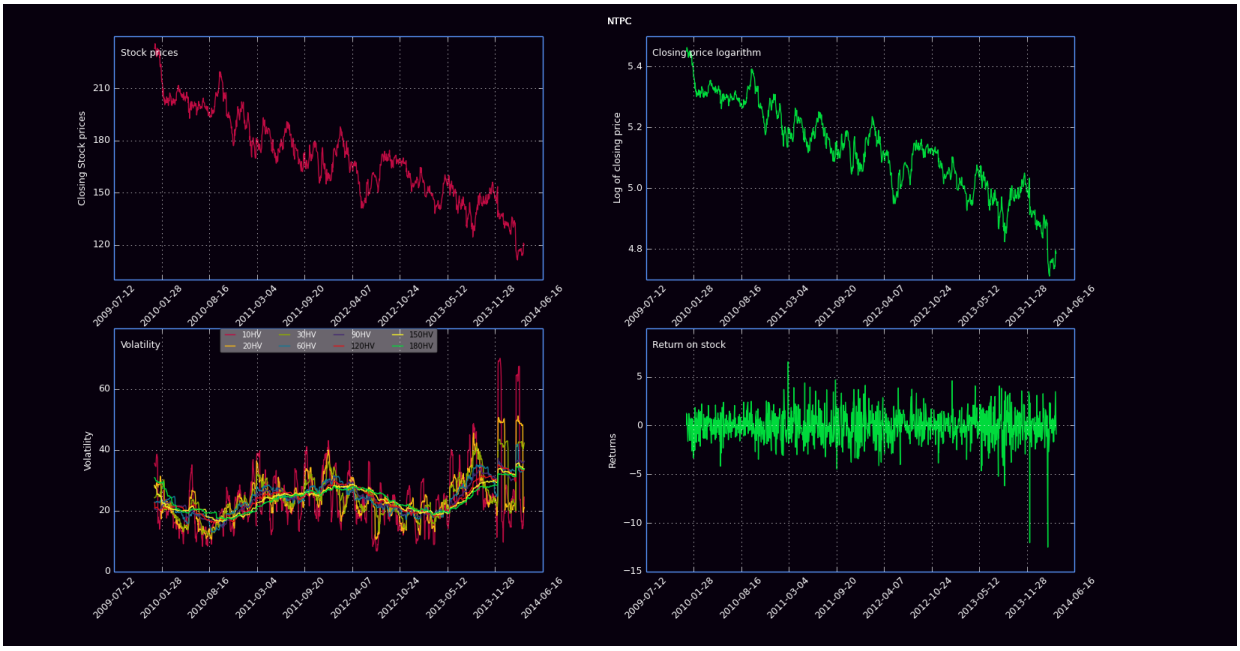
5.3.10 Cairn India Ltd Data Sampling Plots



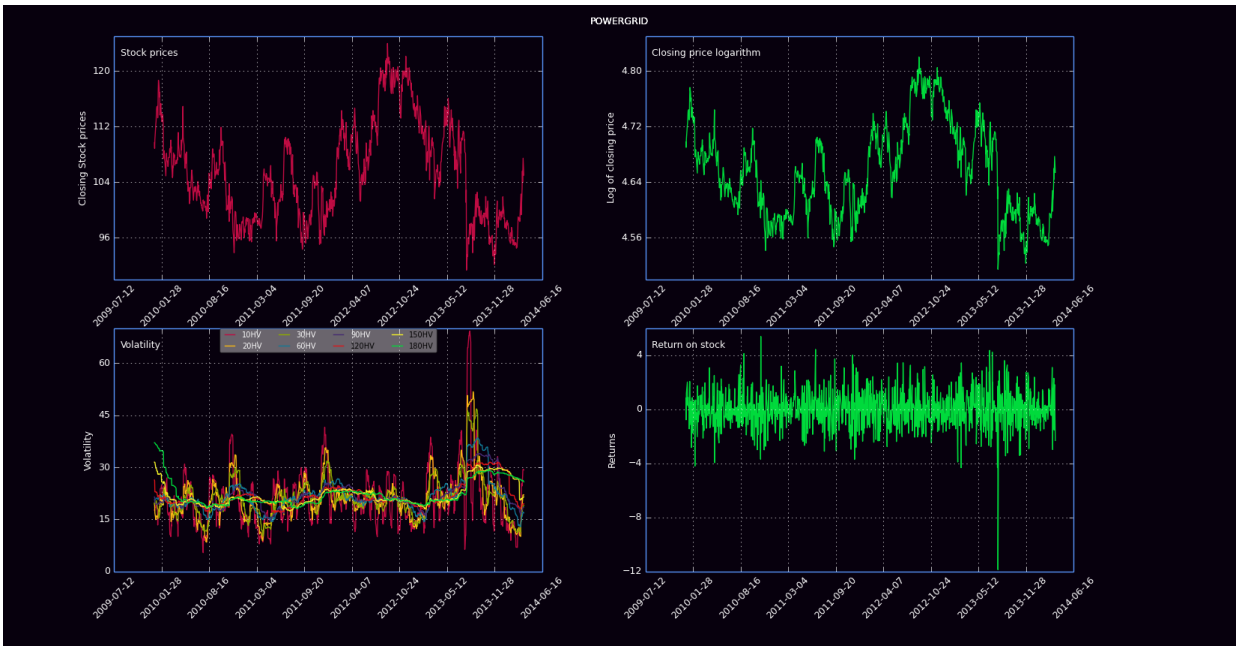
5.3.11 GAIL (INDIA) Ltd Data Sampling Plots



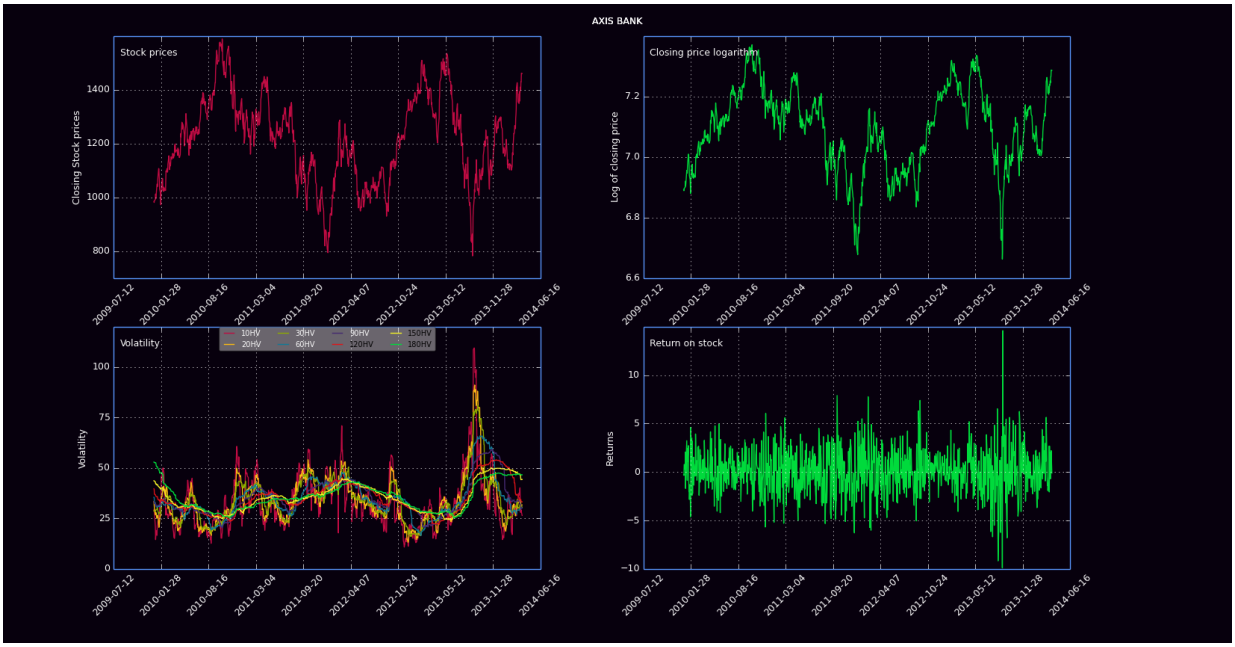
5.3.12 NTPC Ltd Data Sampling Plots



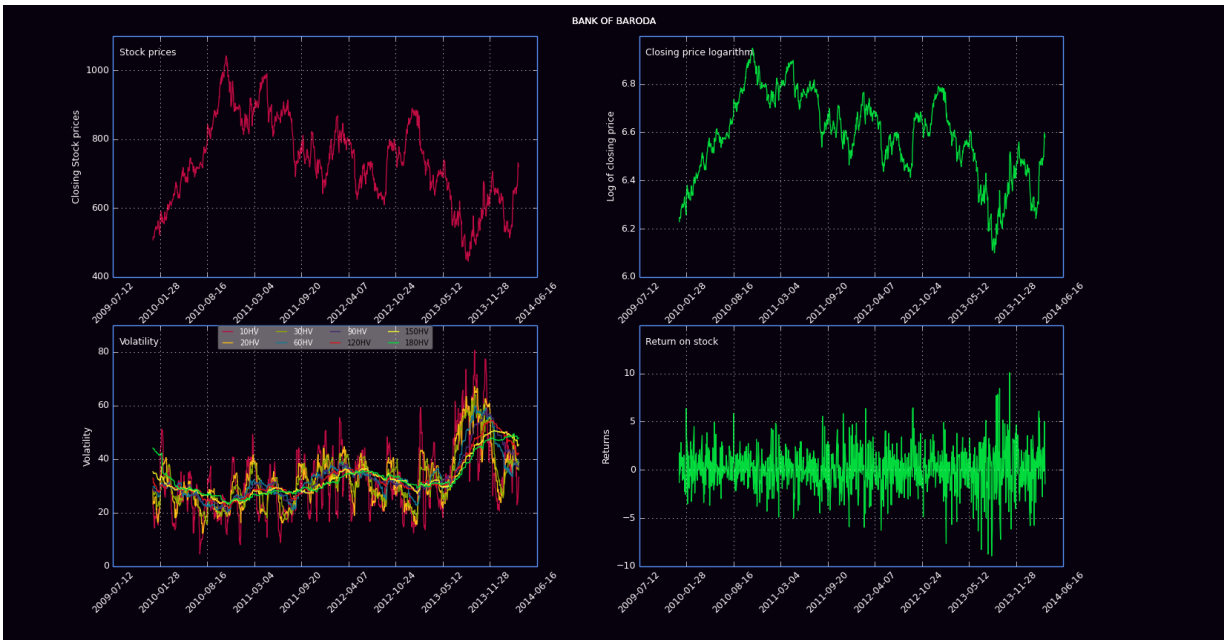
5.3.13 Powergrid Corporation Of India Ltd Data Sampling Plots



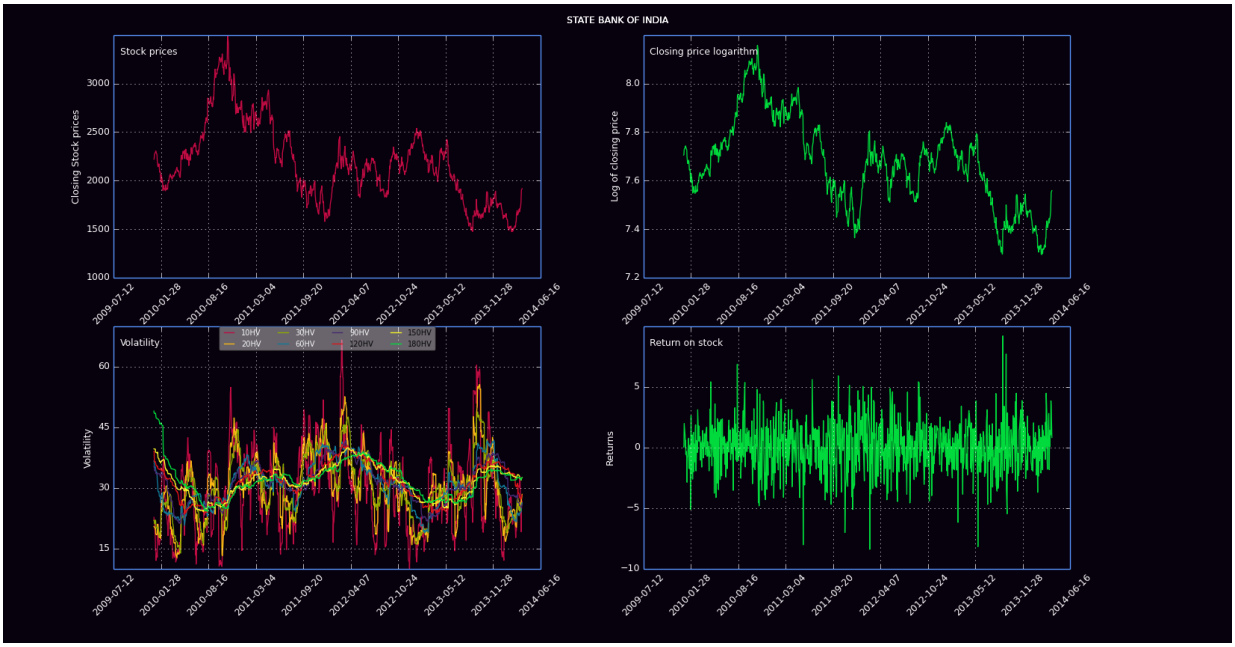
5.3.14 AXIS Bank Ltd Data Sampling Plots



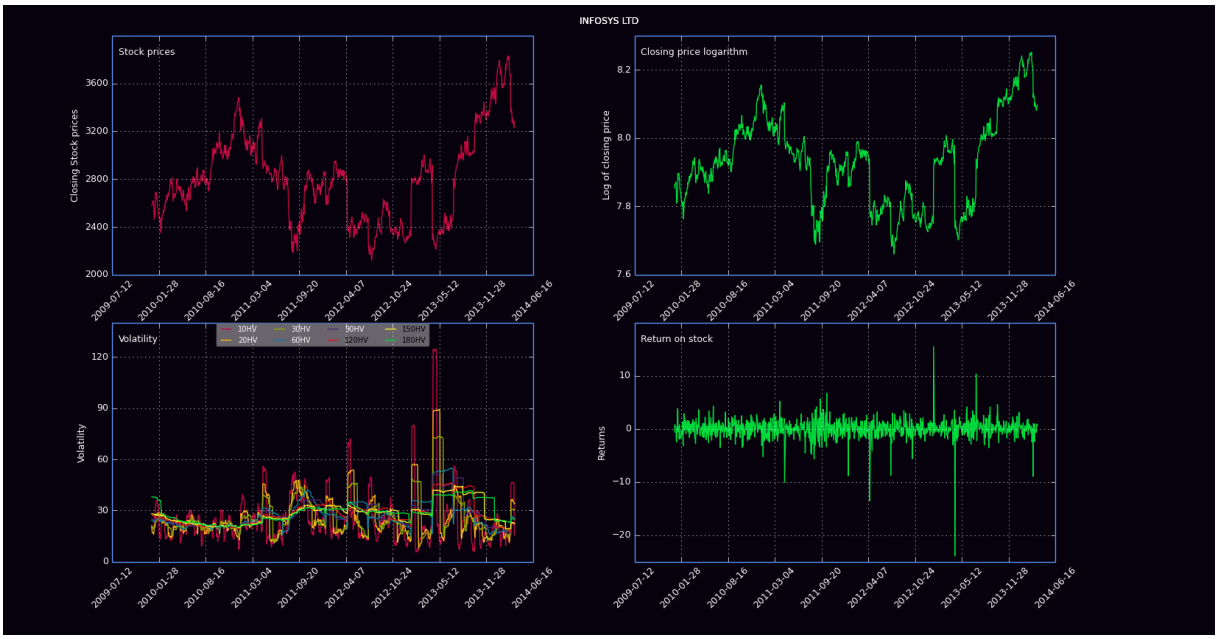
5.3.15 Bank Of Baroda Data Sampling Plots



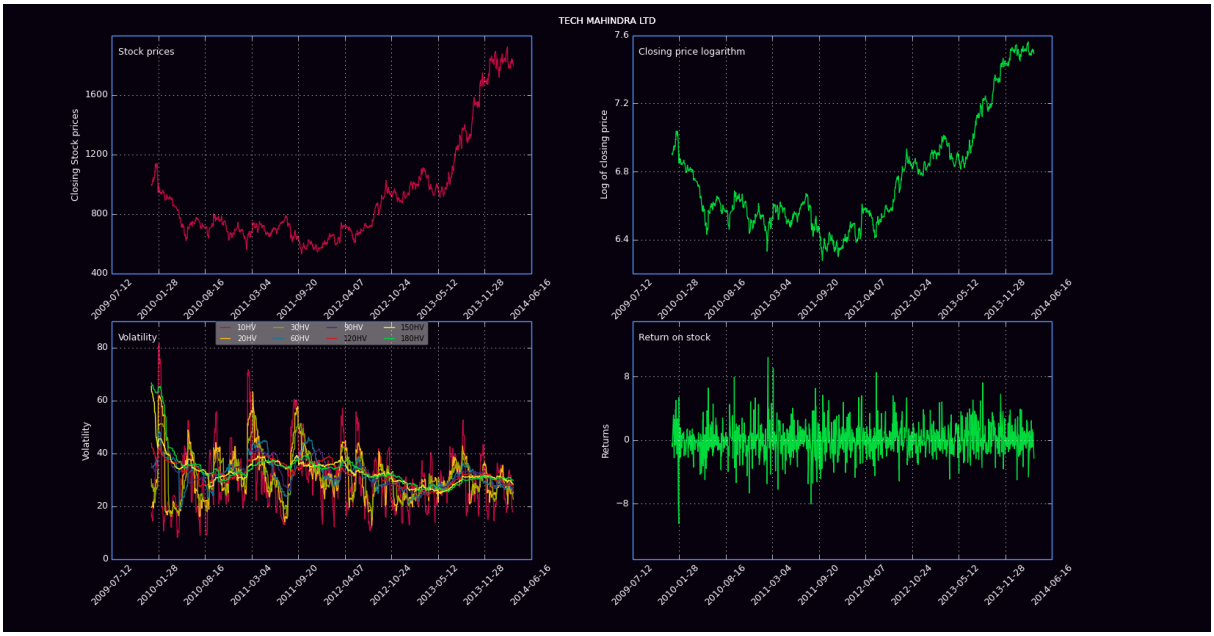
5.3.16 State Bank of India Data Sampling Plots



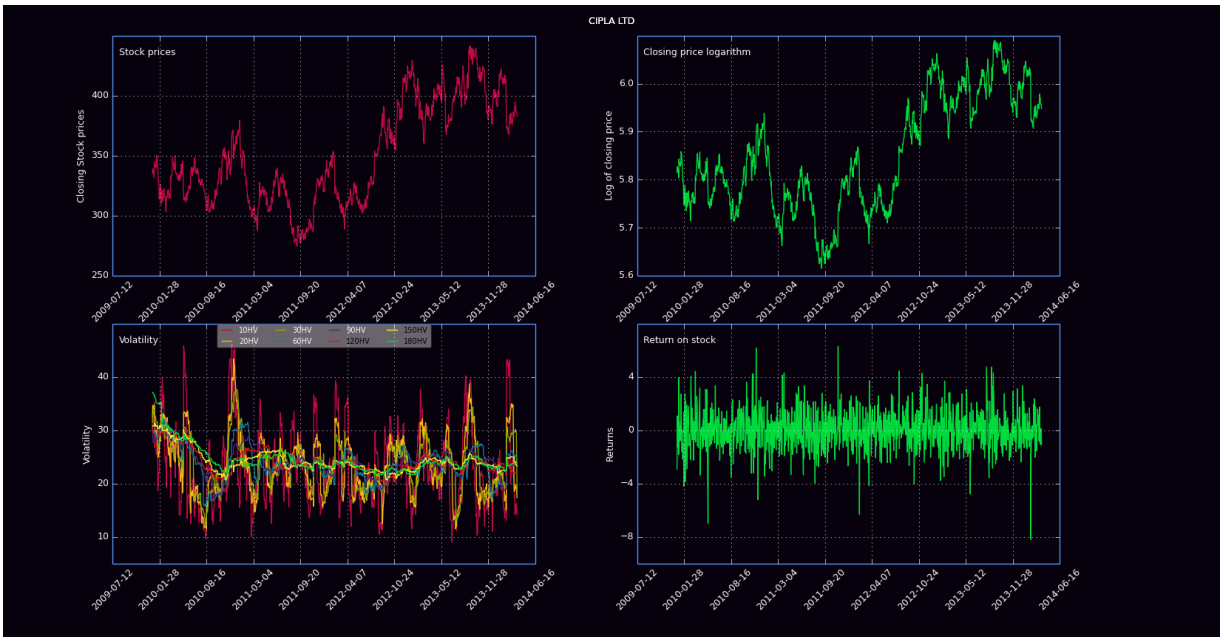
5.3.17 INFOSYS Ltd Data Sampling Plots



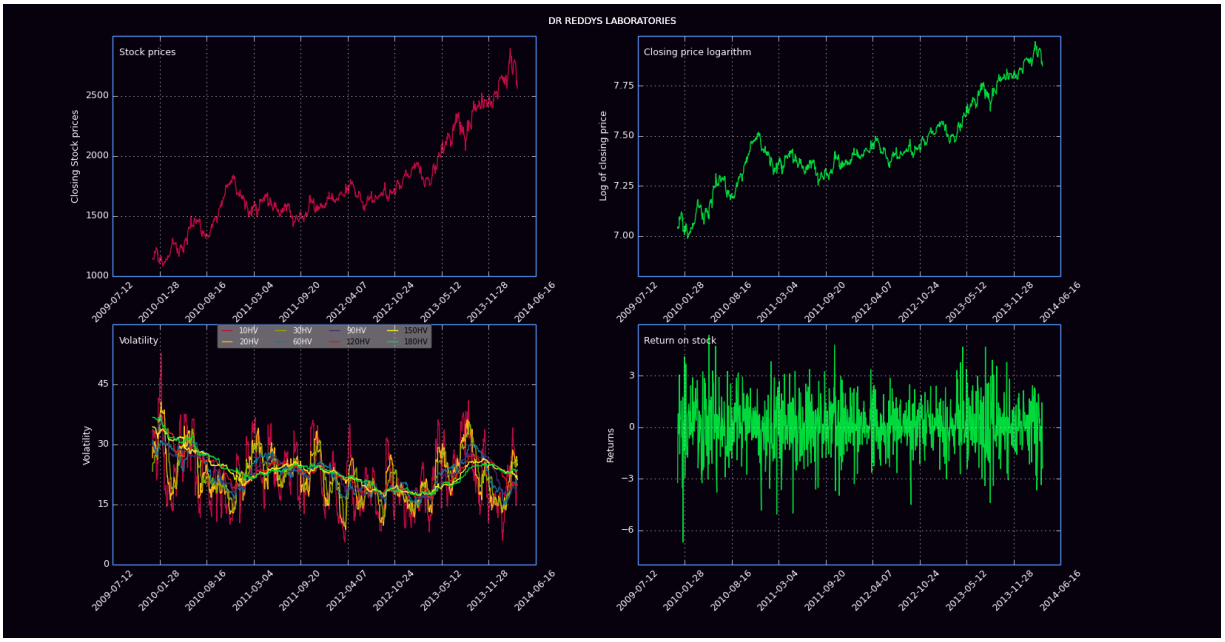
5.3.18 TECH MAHINDRA LTD Data Sampling Plots



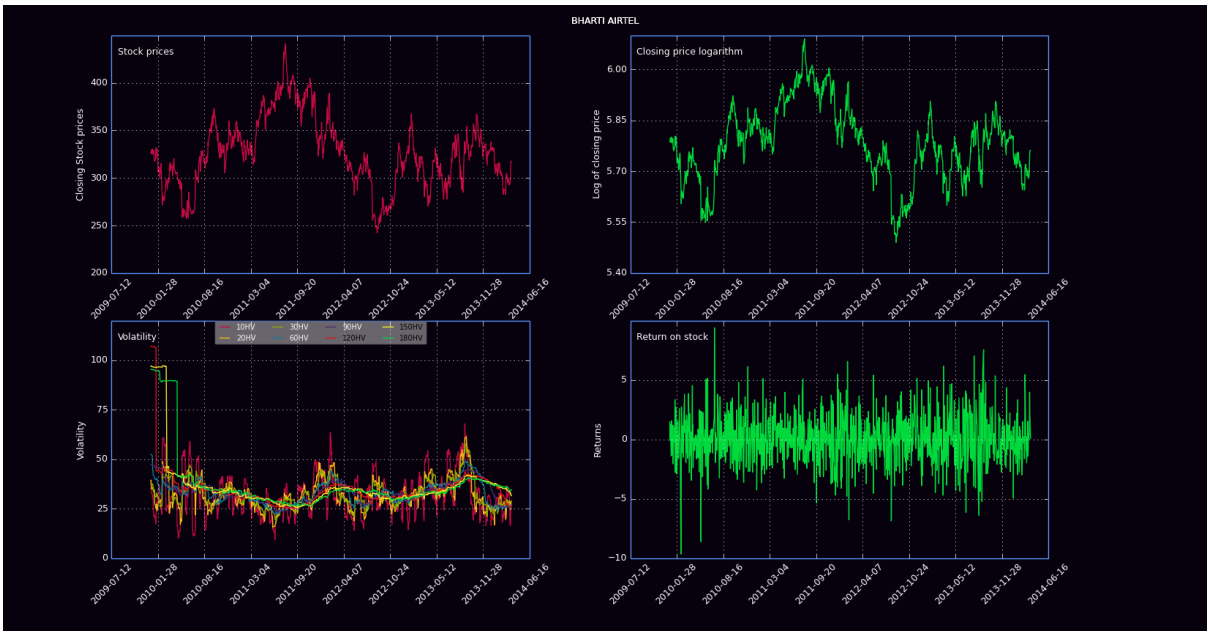
5.3.19 CIPLA LTD Data Sampling Plots



5.3.20 Dr. Reddy's Laboratories Ltd Data Sampling Plots



5.3.21 Bharti Airtel Ltd Data sampling Plots



Part V: Correlogram Analysis

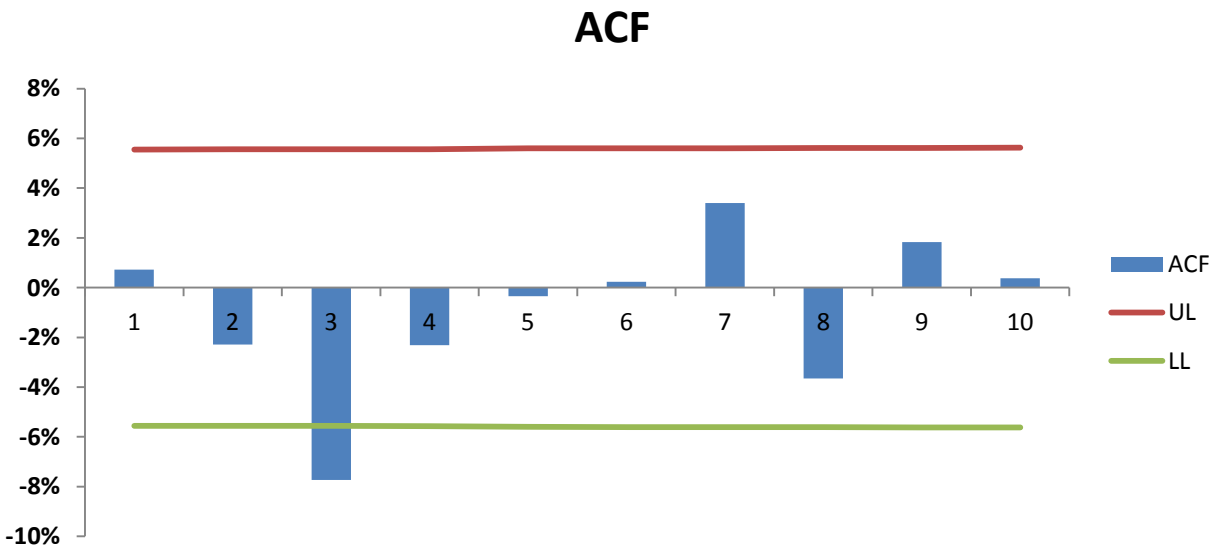
We run the correlogram analysis on the Log ratio of today's price to yesterday's stock closing prices or differenced (log returns), time series. The log returns do not exhibit strong interdependence, though lag order 3 in the Reliance stock shows marginal significance.

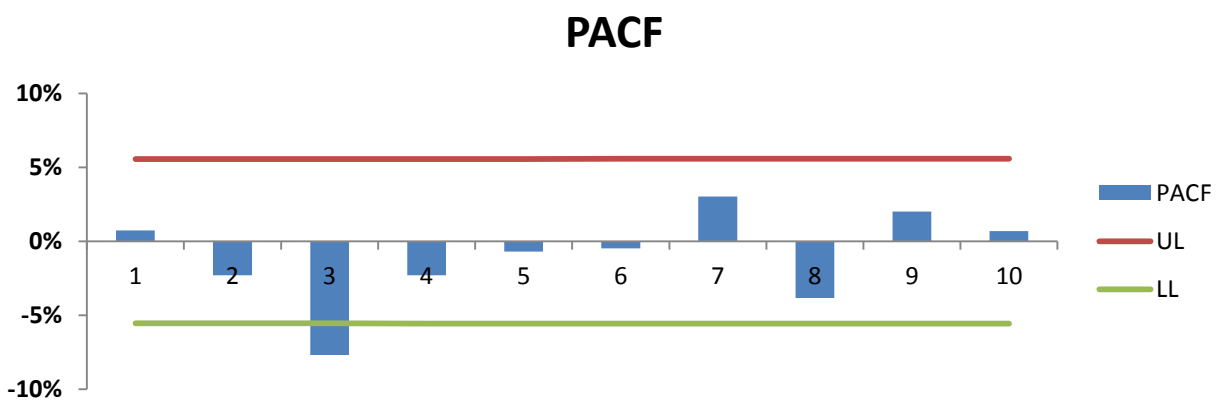
1) Does the log return time series exhibit white noise (no serial correlation) (Ljung- Box)—Refer below a specimen for Reliance Industries Stock.

Table no. 5.12 ACF and PACF (Reliance Industries Stock)

Correlogram Analysis (Reliance Industries Stock)						
Lag	**ACF**	**UL**	**LL**	**PACF**	**UL**	**LL**
1	0.72%	5.55%	-5.55%	0.72%	5.55%	-5.55%
2	-2.29%	5.56%	-5.56%	-2.30%	5.56%	-5.56%
3	-7.74%	5.56%	-5.56%	-7.70%	5.56%	-5.56%
4	-2.31%	5.56%	-5.56%	-2.29%	5.56%	-5.56%
5	-0.34%	5.60%	-5.60%	-0.70%	5.56%	-5.56%
6	0.24%	5.61%	-5.61%	-0.49%	5.57%	-5.57%
7	3.40%	5.61%	-5.61%	3.02%	5.57%	-5.57%
8	-3.65%	5.61%	-5.61%	-3.84%	5.57%	-5.57%
9	1.83%	5.62%	-5.62%	2.01%	5.57%	-5.57%
10	0.38%	5.63%	-5.63%	0.69%	5.57%	-5.57%

Plot 5.4 ACF and PACF Plots (Reliance Industries Stock)





2) Does the daily log returns time series distribution possesses fat tails (aka Excess kurtosis > 0), which may happen if these squared returns are correlated (aka ARCH EFFECT).

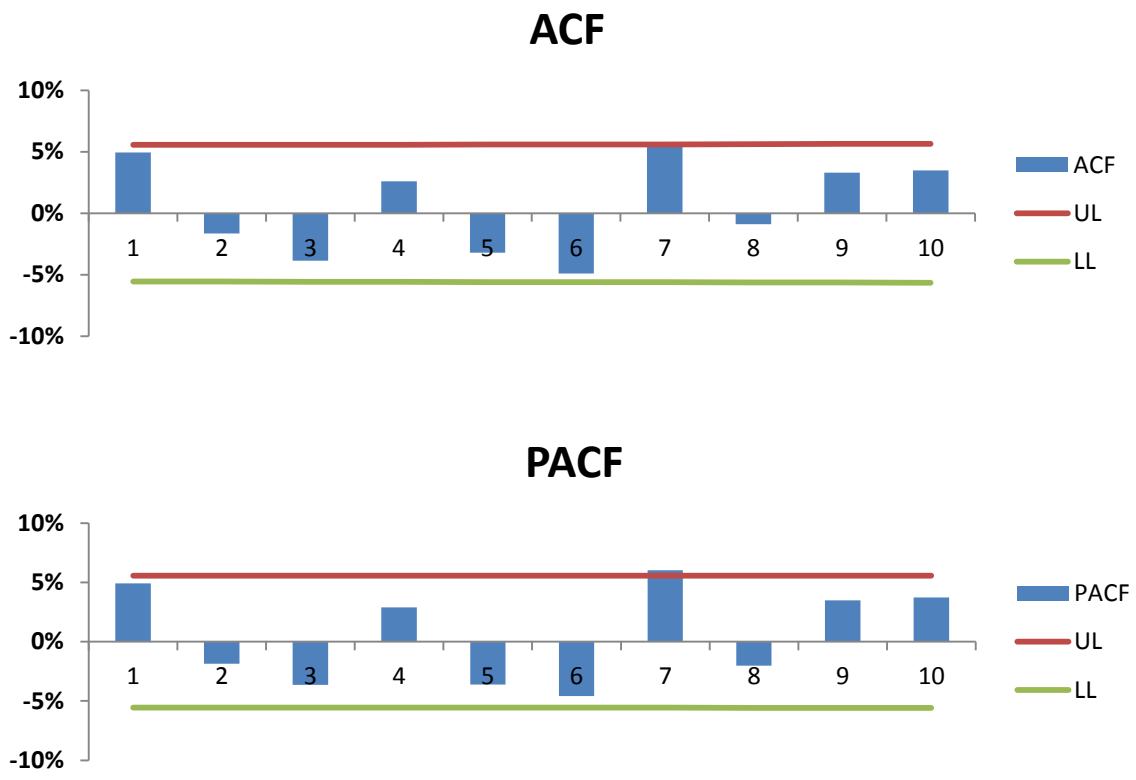
Table 5.13 Summary (White Noise, Normality, Arch Effect) RELIANCE INDUSTRIES STOCK

Test	p-value	SIG?
White-noise	15.34%	TRUE
Normal Distributed?	0.00%	FALSE
ARCH Effect?	100.00%	FALSE

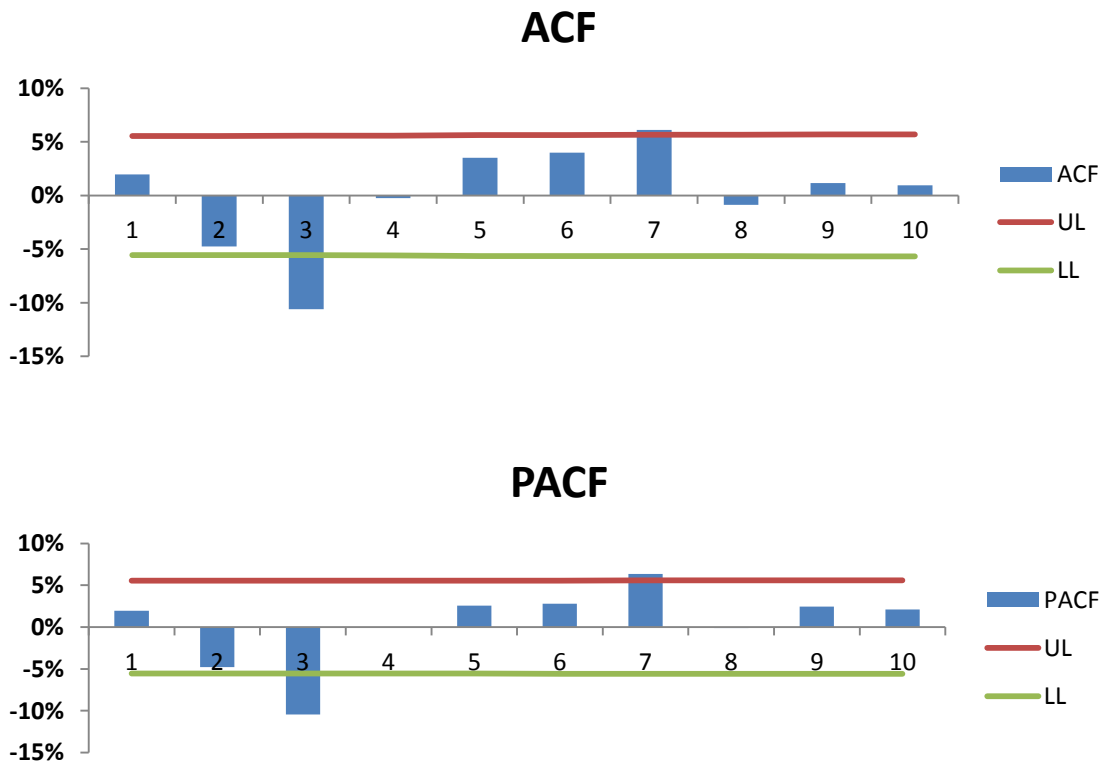
Here it shows that there is no ARCH effect found in Reliance Stock Returns. Hence we conclude that squared returns are not serially correlated hence we infer that there seems to **be no Conditional Heteroscedasticity** in log returns of this example security.

Refer Correlogram analysis plots.

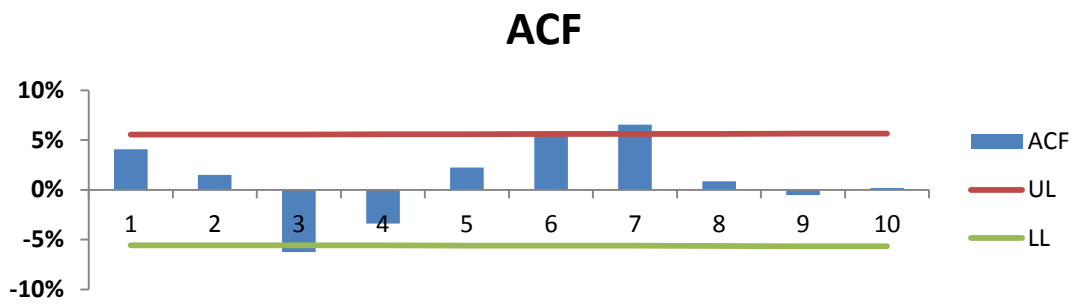
5.4.1 S & P CNX Nifty Correlogram Analysis Plots

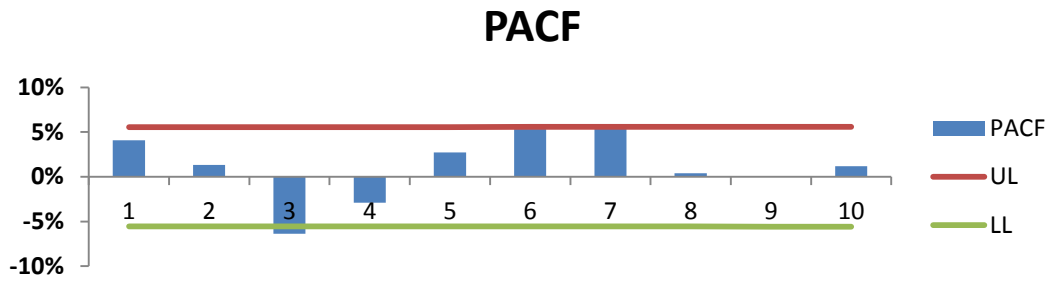


5.4.2 Hero Moto Corp Correlogram Analysis Plots

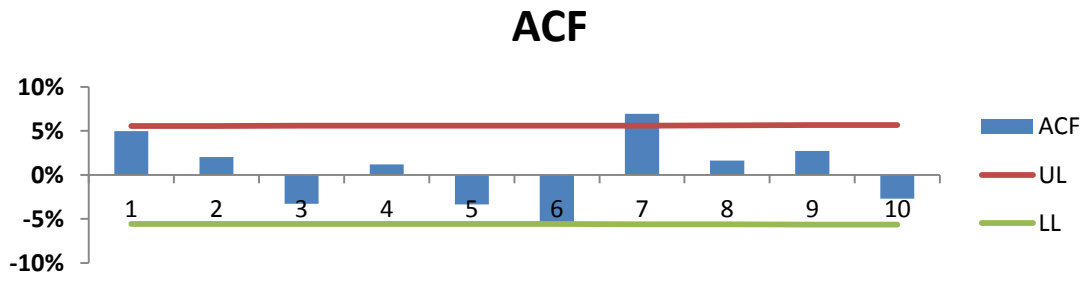


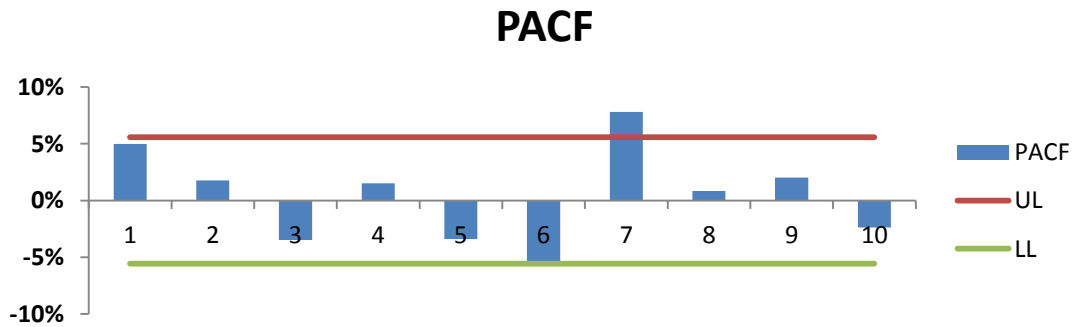
5.4.3 Maruti Suzuki Ltd Correlogram Analysis Plots



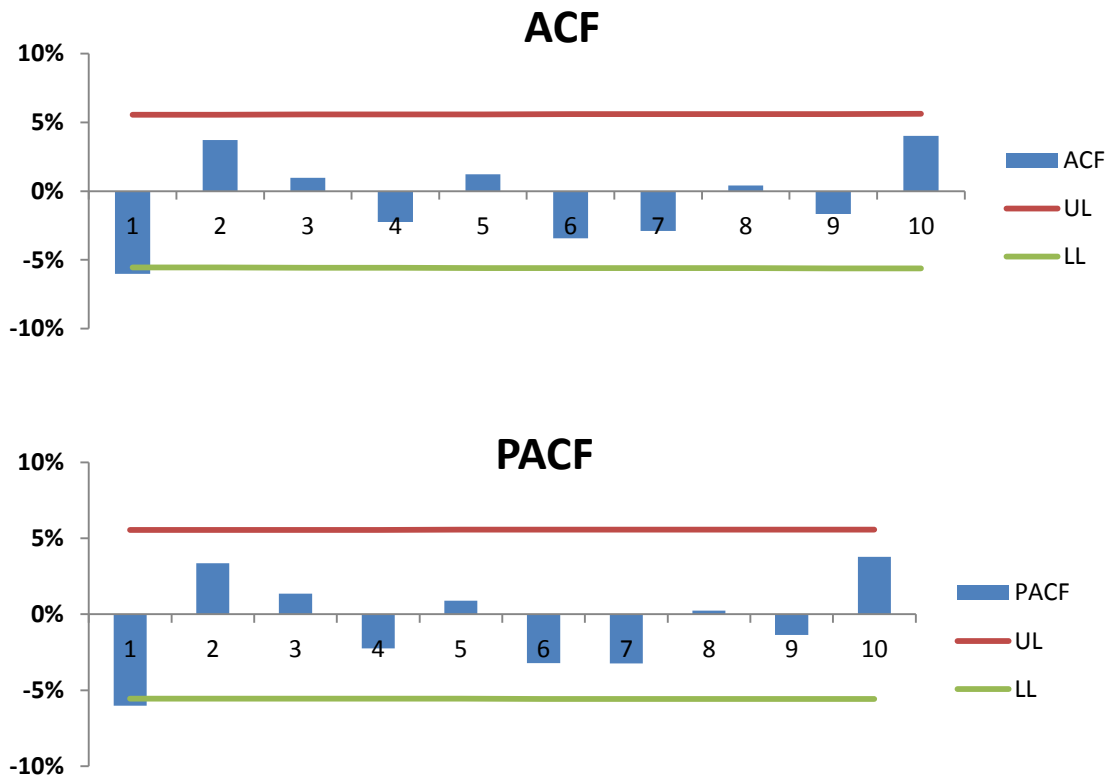


5.4.4 ACC Ltd Correlogram Analysis Plots

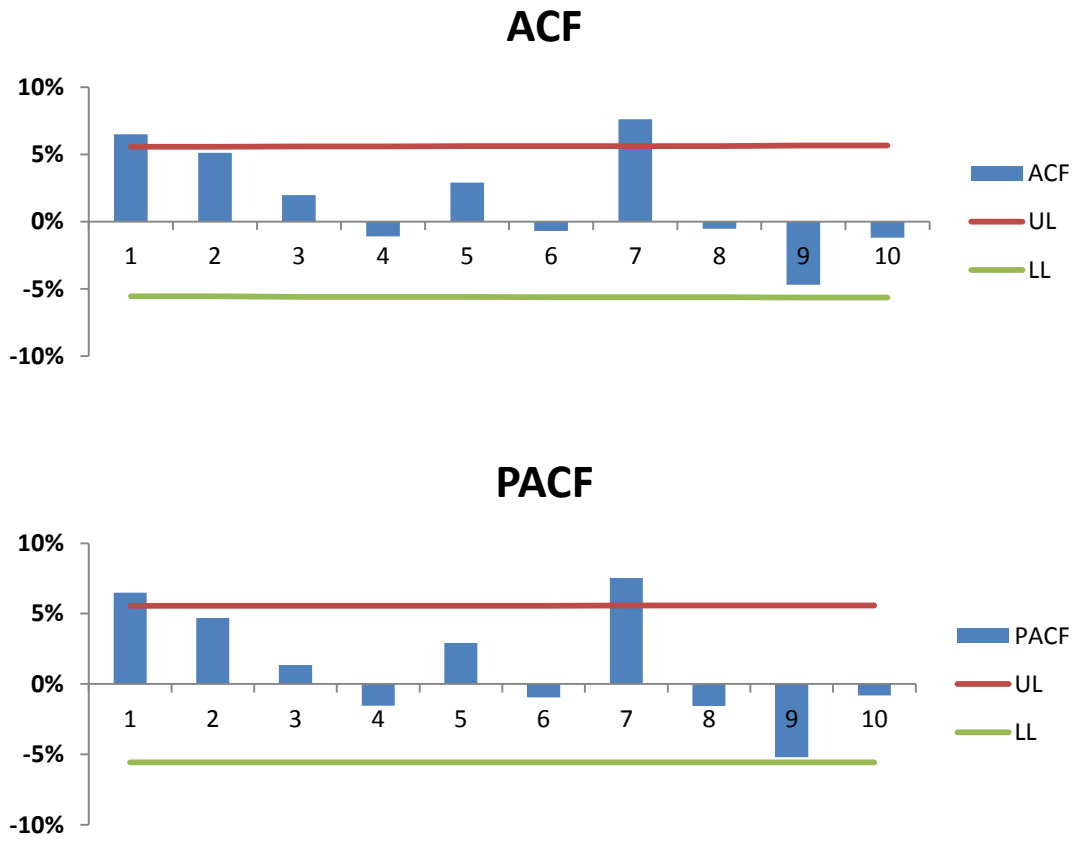




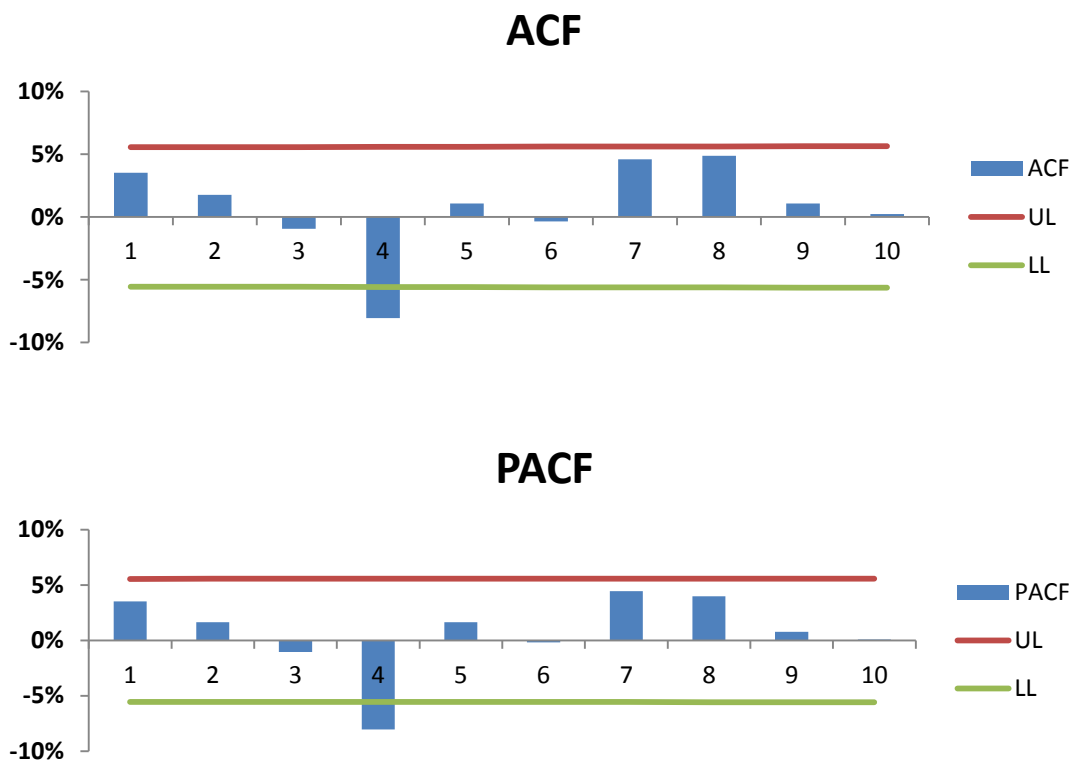
5.4.5 Ambuja Cement Ltd Correlogram Analysis Plots



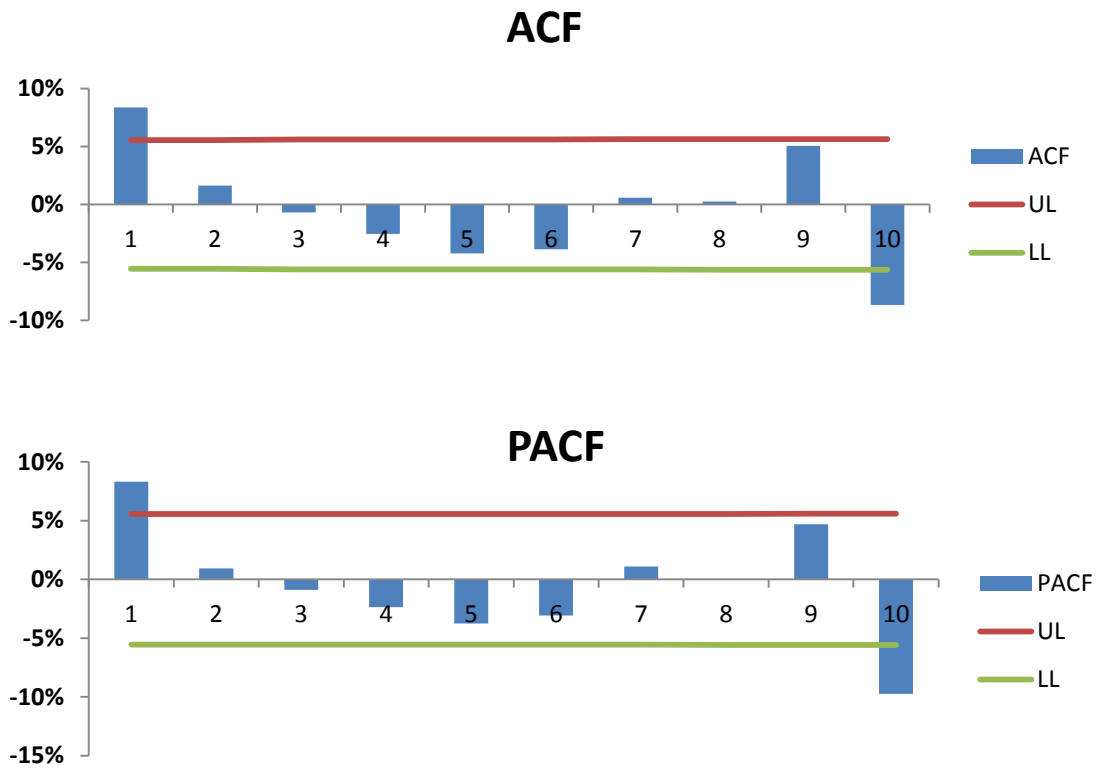
5.4.6 Grasim Industries Ltd Correlogram Analysis Plots



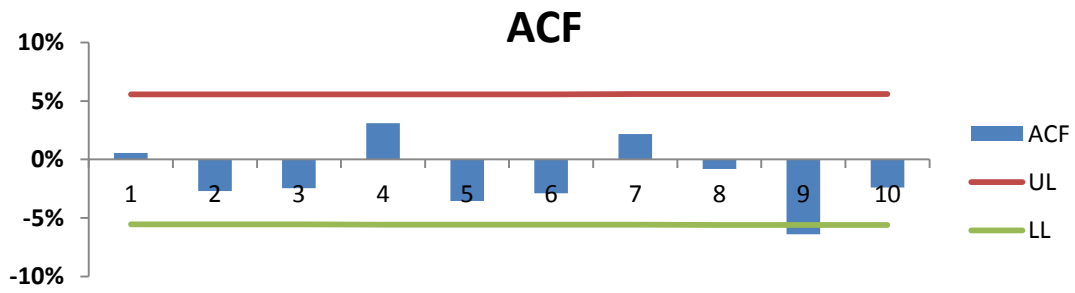
5.4.7 Ultratec Cement Ltd Correlogram Analysis Plots

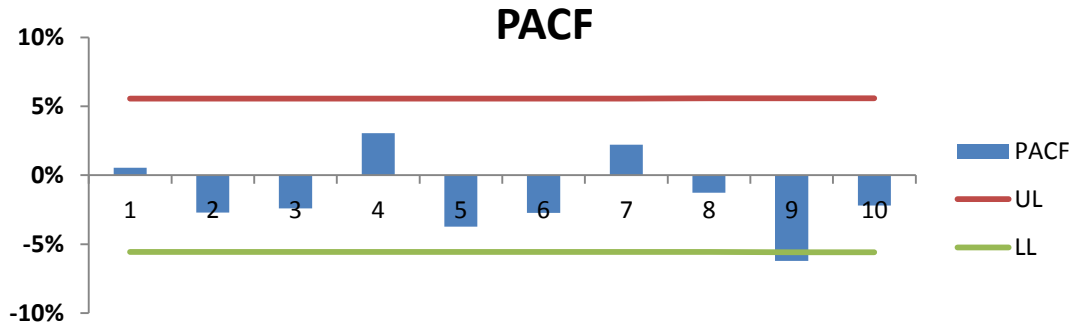


5.4.8 DLF Ltd Correlogram Analysis Plots

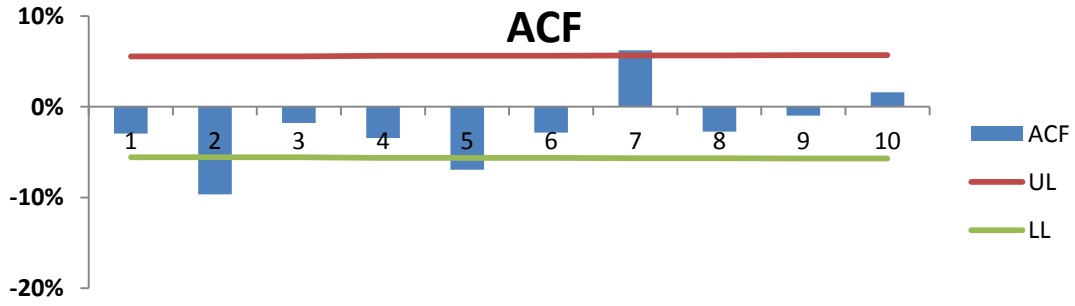


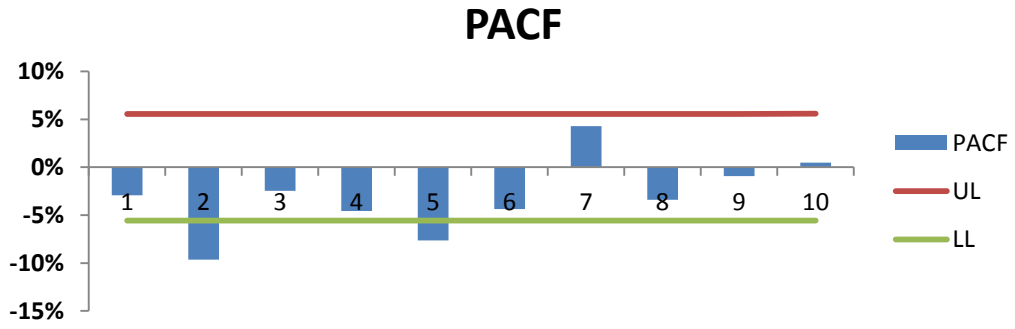
5.4.9 Hindustan Lever Ltd Correlogram Analysis Plots



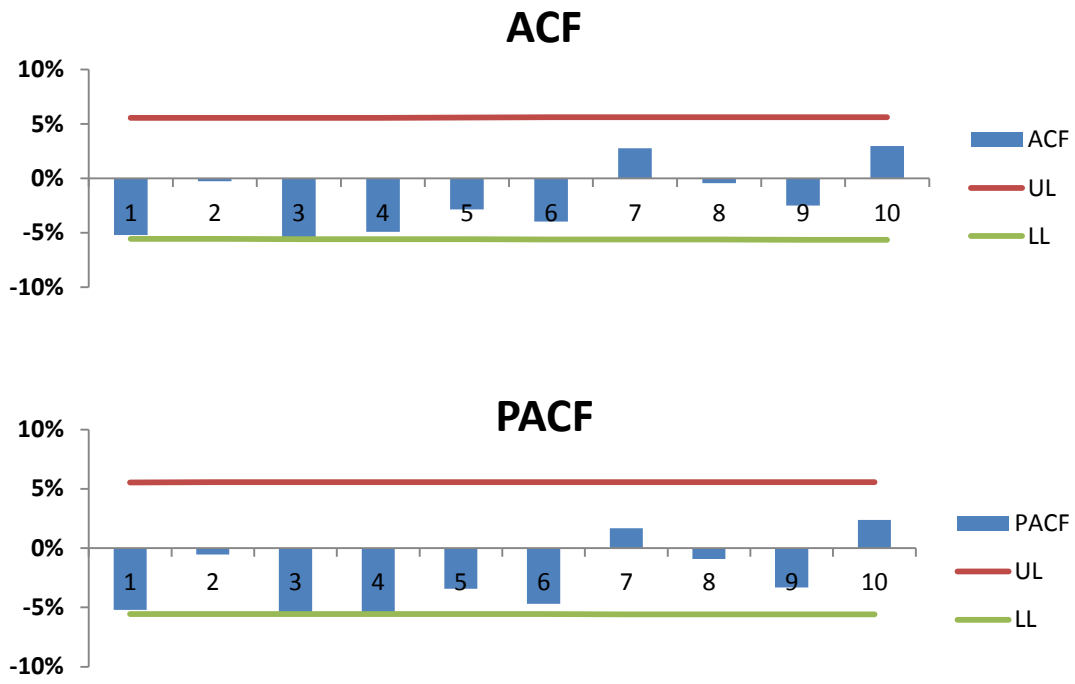


5.4.10 Cairn India Ltd Correlogram Analysis Plots

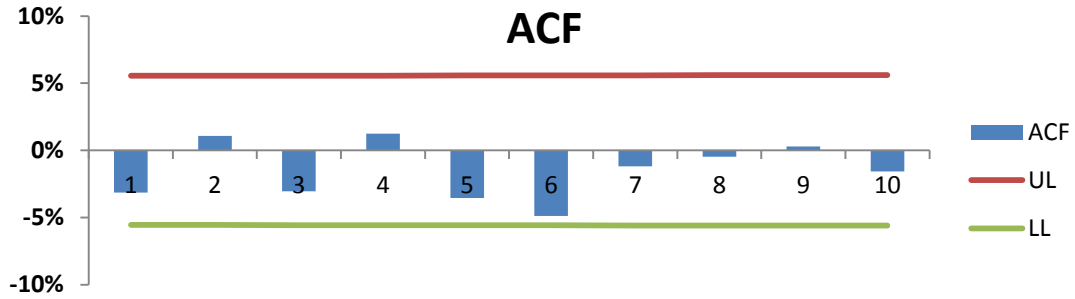


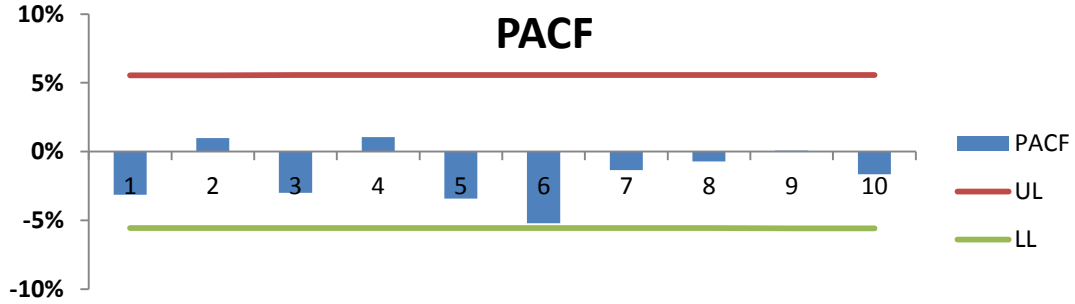


5.4.11 GAILIndia Ltd Correlogram Analysis Plots

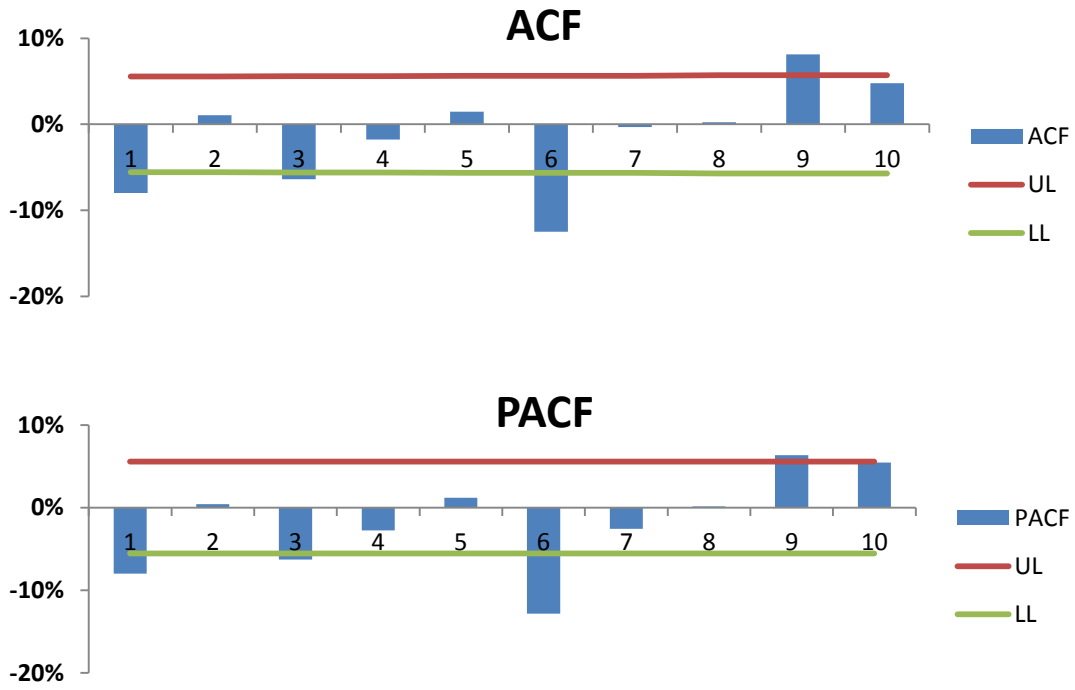


5.4.12 NTPC Ltd Correlogram Analysis Plots

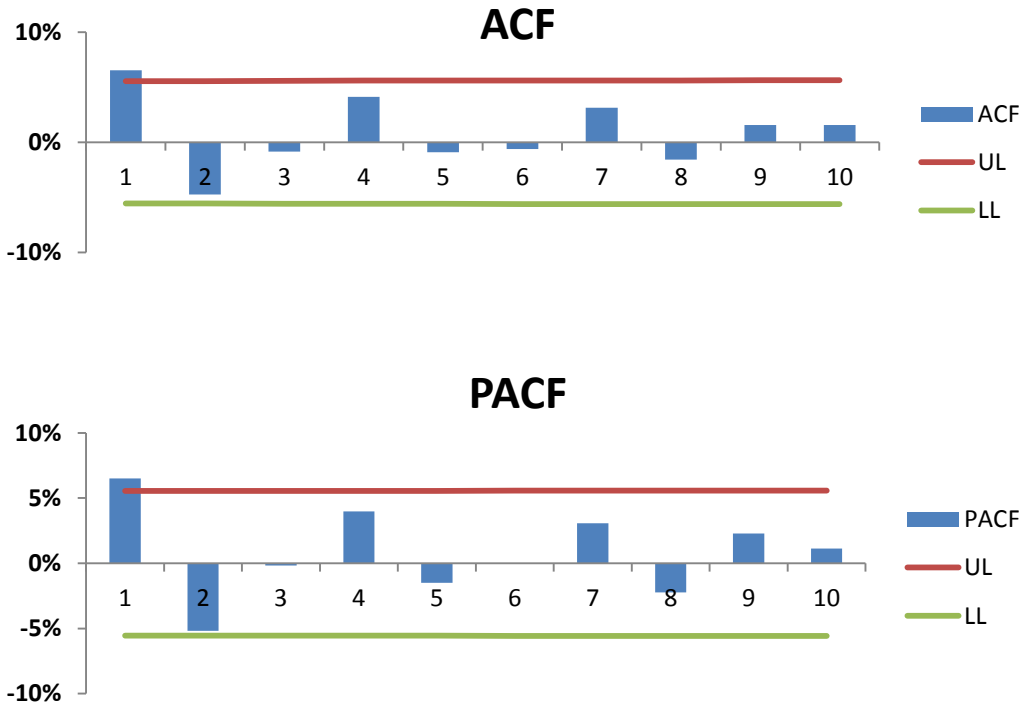




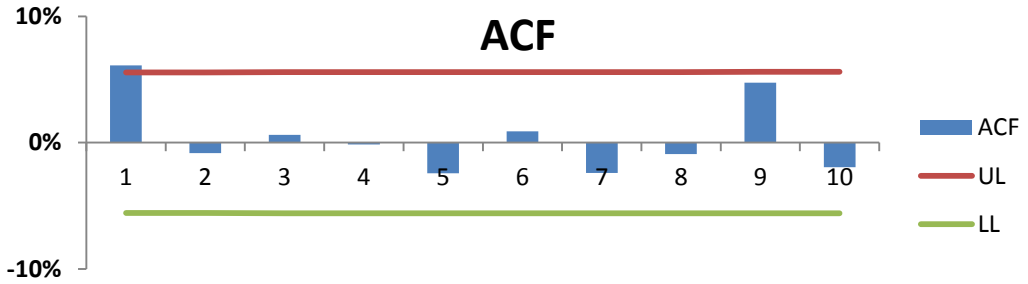
5.4.13 Powergrid Corporation of India Ltd Correlogram Analysis Plots

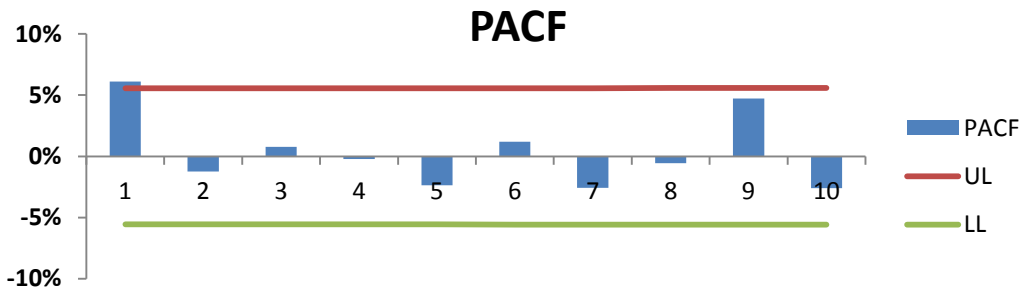


5.4.14 Axis Bank Ltd Correlogram Analysis Plots

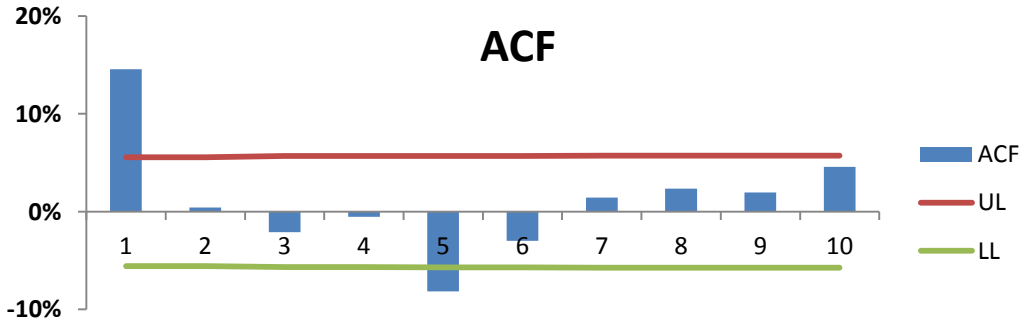


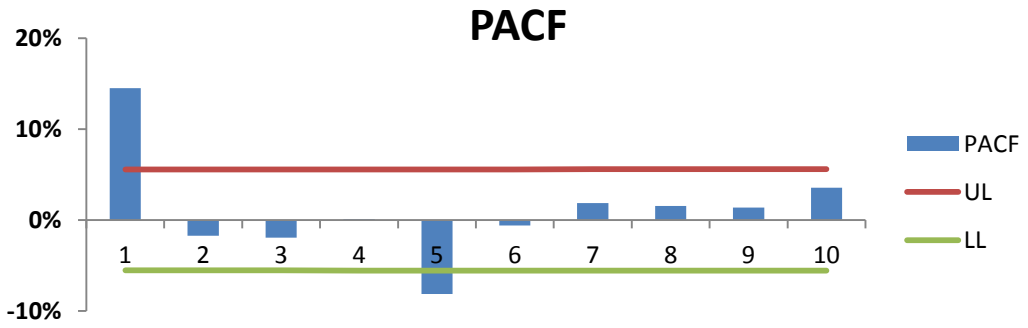
5.4.15 Bank Of Baroda Ltd Correlogram Analysis Plots



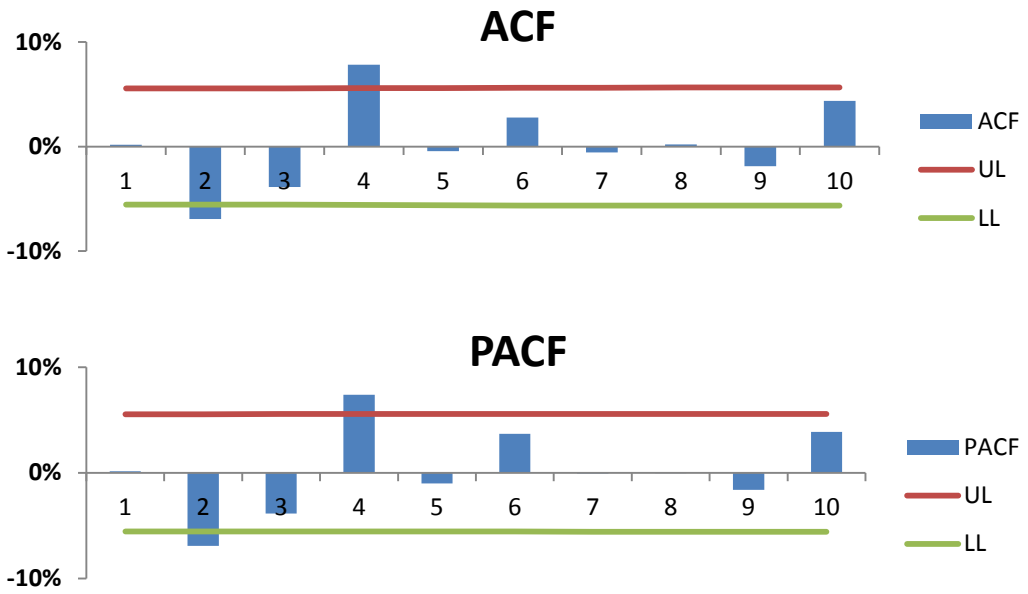


5.4.16 State Bank of India Ltd Correlogram Analysis Plots

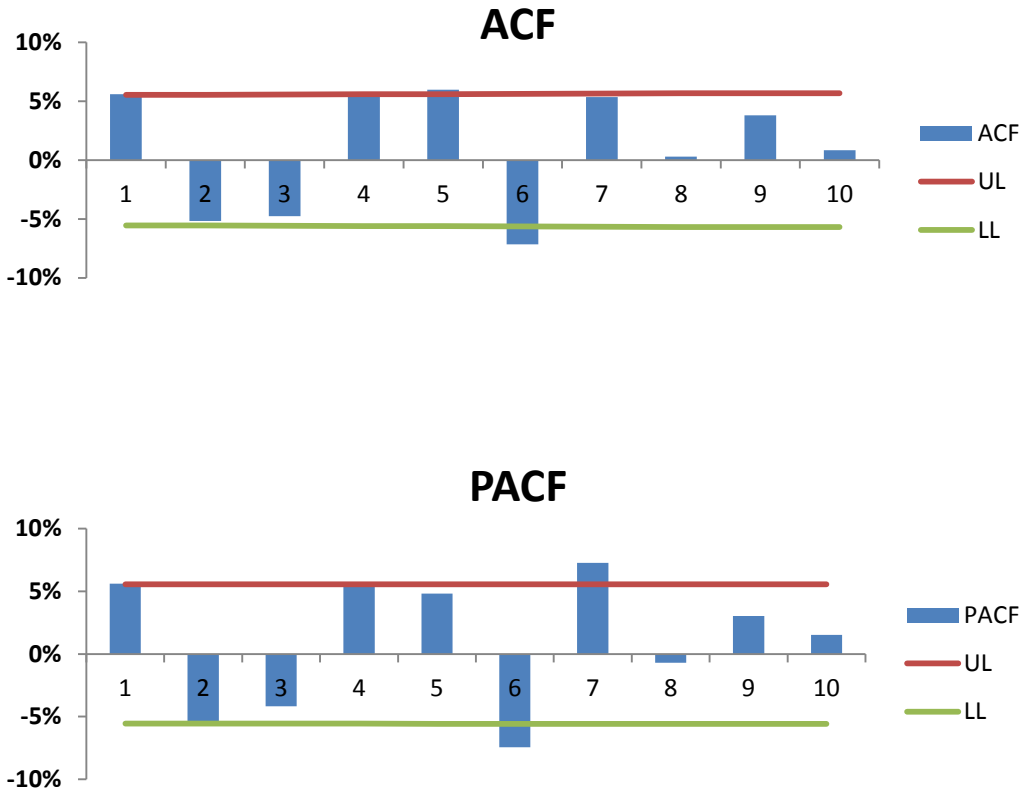




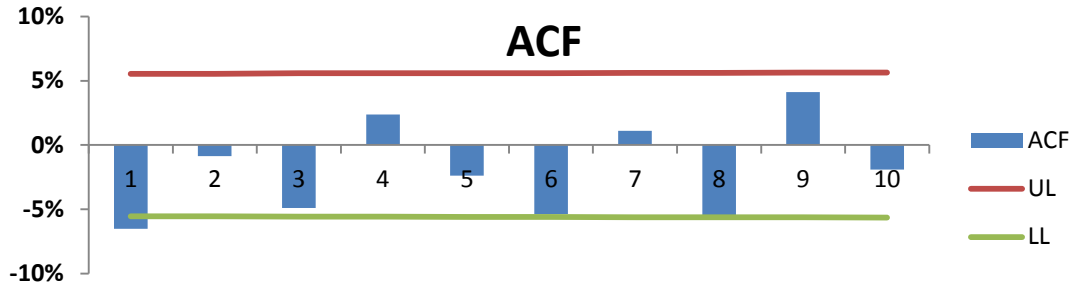
5.4.17 INFOSYS Ltd Correlogram Analysis Plots

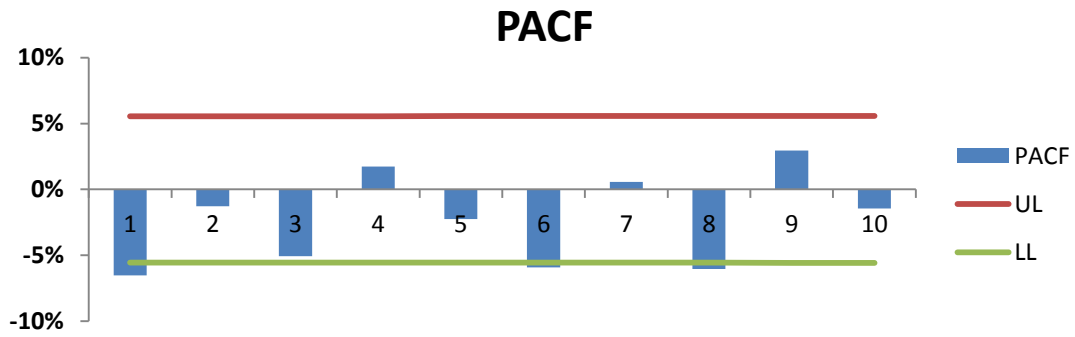


5.4.18 Tech Mahindra Ltd Correlogram Analysis Plots

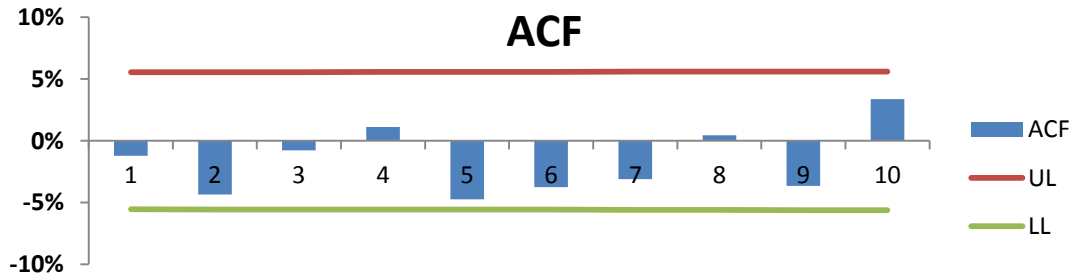


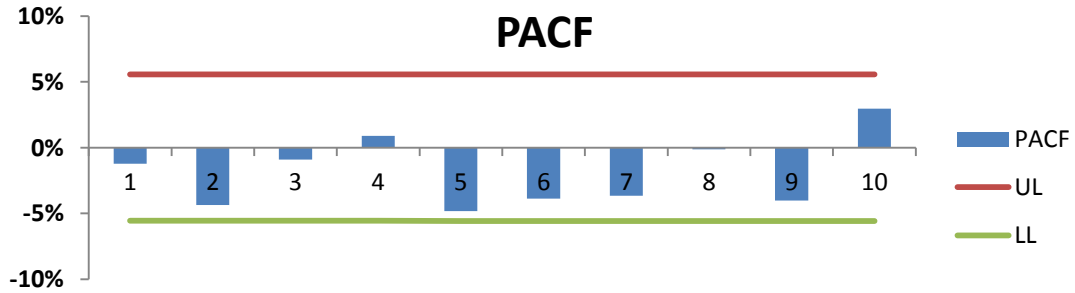
5.4.19 CIPLA Ltd Correlogram Analysis Plots



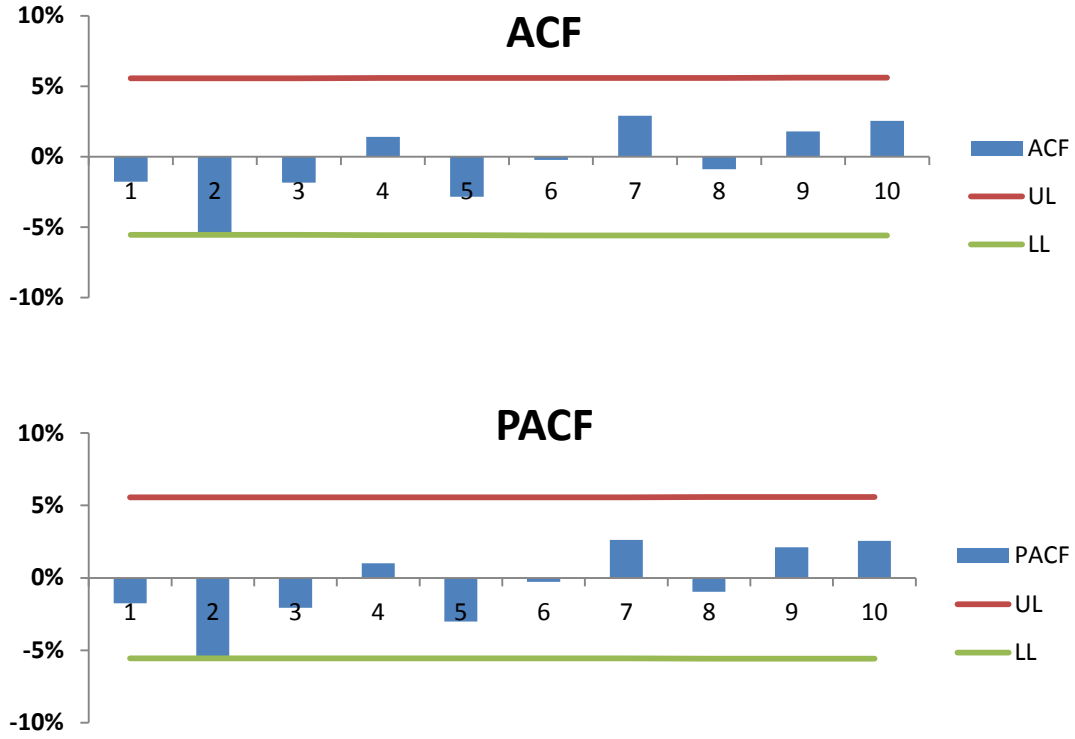


5.4.20 Dr, Reddy's Laboratories Ltd Correlogram Analysis Plots





5.4.21 Bharti Airtel Ltd Correlogram Analysis Plots



Part VI: Smoothing

Assuming the trend to be deterministic (non-stochastic), we can use the Holt- Winter's Double Exponential Smoothing Function (Desmth), which can track the data pretty well and the forecast may well look in line with the original curve. Earlier we had made an assumption that the trend is deterministic (non-stochastic), but the price is more like a random walk process, so the trend we observe may well be an anomaly? Which can occur in a random walk.

Proof:-The ADF (THE AUGMENTED DICKEY-FULLER UNIT-ROOT TEST), in NumXL, can test for the presence of a unit root (that is random walk),in the presence of drift and/or trend. (1-L) $y_t = \nabla y_t = \alpha + \gamma\, y_{t-1} + \beta * t + \ldots\ldots\ldots$

The ADF test is basically to test for the NULL HYPOTHESIS:-$H_0 : \gamma = 0$.

Refer a table specimen attaching the analysis in NumXL of RELIANCE INDUSTRIES stock:-

Table 5.14 Stationary Test (Reliance Industries Stocks)

Test	Stat	P-Value	C.V.	Stationary?	5.0%
ADF					
No Const	-22.3	0.1%	-1.9	TRUE	
Const-Only	-22.3	0.1%	-2.9	TRUE	
Const+ Trend	-22.3	0.0%	-1.6	TRUE	
Const+Trend+Trend^2	-22.3	0.0%	-1.6	TRUE	

As is evident from the table above, the unit root existence in all four different formulations above stands confirmed as true.

refer table 7

Table 5.15 Stationary Test: Table 7

Table 7:- Stationary Test								5.00%
	ADF(AUGMENTED DICKEY-FULLER TEST)							
	No Const		*Const-Only*		*Const + Trend*		*Const+Trend+Trend^2*	
Company	**P-Value**	**Stationary?**	**P-Value**	**Stationary?**	**P-Value**	**Stationary?**	**P-Value**	**Stationary?**
S&P CNX NIFTY (NSE)								
S&P CNX NIFTY (NSE)	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
AUTOMOBILES								
1) BAJAJ AUTO LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
2) HERO MOTOCORP LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
3) MAHINDRA & MAHINDRA LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
4) MARUTI SUZUKI LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
5) TATA MOTORS LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
CEMENT & CEMENT PRODUCTS								
6) ACC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
7) AMBUJA CEMENTS LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
8) GRASIM INDUSTRIES LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
9) ULTRATECH CEMENT CO LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
CONSTRUCTION								
10) DLF LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
11) LARSEN & TOUBRO LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
CONSUMER GOODS								
12) ASIAN PAINTS LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
13) HINDUSTAN UNILEVER LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
14) ITC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
ENERGY								
15) BHARAT PETROLEUM CORP.LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
16) CAIRN INDIA LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
17) GAIL (INDIA) LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
18) NTPC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
19) ONGC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE

20) POWERGRID LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
21) RELIANCE INDUSTRIES LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
22) TATA POWER COMPANY LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
FINANCIAL SERVICES								
23) AXIS BANK LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
24) BANK OF BARODA	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
25) HDFC BANK LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
26) HOUSING DEVPMT FIN CORPN.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
27) ICICI BANK LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
28) IDFC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
29) INDUSIND BANK LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
30) KOTAK MAHINDRA BANK	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
31) PUNJAB NATIONAL BANK	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
32) STATE BANK OF INDIA	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
INDUSTRIAL MANUFACTURING								
33) BHARAT HEAVY ELECTRICALS LTD	0.10%	TRUE	**0.10%**	TRUE	**0.00%**	TRUE	0.00%	TRUE
INFORMATION TECHNOLOGY								
34) HINDUSTAN COMPUTERS LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
35) INFOSYS LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
36) TATA CONSULTANCY SERVICES LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
37) TECH MAHINDRA LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
38) WIPRO LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
MEDIA & ENTERTAINMENT								
39) ZEE ENTERTAINMENT ENTERPRISES	0.10%	TRUE	**0.10%**	TRUE	**0.00%**	TRUE	0.00%	TRUE
METALS								
40) COAL INDIA * (FOUR YEARS)	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
41) HINDALCO INDUSTRIES LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE

42) JINDAL POWER & STEEL	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
43) NMDC LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
44) SESA STERLITE LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
45) TATA STEEL LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
PHARMACEUTICALS								
46) CIPLA LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
47) DR. REDDY'S LABORATORIES LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
48) LUPIN INDIA LTD	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
49) SUN PHARMACEUTICALS LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE
TELECOM								
50) BHARTI AIRTEL LTD.	0.10%	TRUE	0.10%	TRUE	0.00%	TRUE	0.00%	TRUE

Part VII: **Time Series Modelling**

We have extensively analysed all nifty fifty stocks including the index returns, using the following models all having order one.

1) ARMA (1, 1) 2) GARCH) (1, 1) MODEL 3) GARCH-M (1, 1) MODEL 4) EGARCH (1, 1) Model. For the last three models we have employed three different shock/residual/innovations, distribution namely, -- 1) Gaussian Distribution 2) Student's t distribution and 3) Generalized error distribution. (GED).

Part VIII: **Volatility Forecasting**

A) Model Specification B) Model Calibration C) Model Forecasting.

We have forecasted using the optimal model in each stock modelling exercise.

Refer Table 5.16: Annualised Historical Volatility Estimators: Table 8

Table 5.17: Simple Linear Regression Analysis: Table 9

Table 5.18: Forecast of Out - of – Sample Volatility: Table 10

Volatility Forecast Plots

Table 5.16 Annualised Historical Volatility Estimators: Table 8

Table 8 :- ANNUALISED SD (HISTORICAL VOLATILITY) – EXTREME VALUE ESTIMATORS

						RS								5.00%
Company	TRADITIONAL	SUM OF SQUARES	PARKINSON			GARMAN KLASS			ROGERS-SATCHELL			YANG-ZHANG		
	Vol	Vol	Vol	Efficency		Vol	Efficency		Vol	Efficency		Vol	Efficency	
				Trad	SOS		Trad	SOS		Trad	SOS		Trad	SOS
S&P CNX NIFTY (NSE)														
S&P CNX NIFTY (NSE)	20.57%	20.59%	18.02%	130.29%	130.49%	17.56%	137.23%	137.45%	17.96%	131.18%	131.38%	16.61%	153.46%	153.70%
AUTOMOBILES														
1) BAJAJ AUTO LTD	43.32%	43.33%	34.04%	162.00%	162.06%	35.29%	150.70%	150.76%	35.91%	145.57%	145.63%	33.20%	170.30%	170.37%
2) HERO MOTOCORP LTD	31.88%	31.89%	32.38%	96.97%	96.98%	32.93%	93.74%	93.75%	33.06%	93.03%	93.04%	30.56%	108.83%	108.85%
3) MAHINDRA & MAHINDRA LTD.	45.99%	45.99%	36.04%	162.85%	162.82%	37.13%	153.41%	153.38%	37.59%	149.69%	149.66%	34.75%	175.21%	175.09%
4) MARUTI SUZUKI LTD.	31.64%	31.65%	32.71%	93.54%	93.60%	33.30%	90.28%	90.33%	33.29%	90.31%	90.36%	30.78%	105.65%	105.71%
5) TATA MOTORS LTD.	86.48%	86.45%	41.87%	426.51%	426.23%	41.81%	427.88%	427.59%	42.10%	421.98%	421.70%	38.92%	493.66%	493.33%
CEMENT & CEMENT PRODUCTS														
6) ACC LTD	29.00%	29.01%	30.62%	89.66%	89.72%	31.44%	85.08%	85.14%	31.49%	84.81%	84.86%	29.11%	99.22%	99.28%
7) AMBUJA CEMENTS LTD	33.87%	33.88%	37.14%	83.17%	83.23%	38.27%	78.32%	78.38%	38.95%	75.63%	75.68%	36.01%	88.47%	88.54%
8) GRASIM INDUSTRIES LTD	28.93%	28.93%	30.30%	91.17%	91.16%	31.44%	84.65%	84.65%	31.96%	81.94%	81.93%	29.55%	95.86%	95.85%
9) ULTRATECH CEMENT CO LTD	28.59%	28.64%	35.63%	64.39%	64.59%	37.43%	58.36%	58.54%	39.10%	53.48%	53.65%	36.15%	62.57%	62.76%
CONSTRUCTION														
10) DLF LTD	49.11%	49.09%	47.41%	107.31%	107.22%	47.53%	106.77%	106.68%	47.47%	107.05%	106.96%	43.88%	125.23%	125.13%
11) LARSEN & TOUBRO LTD	38.78%	38.78%	32.83%	139.61%	139.56%	33.40%	134.87%	134.83%	34.25%	128.25%	128.20%	31.66%	150.03%	149.98%
CONSUMER GOODS														
12) ASIAN PAINTS LTD	106.79%	106.75%	30.90%	1194.19%	1193.25%	32.16%	1102.79%	1101.92%	33.82%	997.27%	996.49%	31.27%	1166.67%	1165.75%
13) HINDUSTAN UNILEVER LTD	26.05%	26.07%	27.58%	89.25%	89.36%	28.14%	85.69%	85.80%	28.83%	81.68%	81.79%	26.65%	95.56%	95.68%
14) ITC LTD	41.09%	41.09%	28.18%	212.73%	212.64%	28.69%	205.10%	205.02%	29.36%	195.88%	195.80%	27.15%	229.15%	229.06%
ENERGY														
15) BHARAT PETROLEUM CORP.LTD	46.74%	46.72%	37.50%	155.31%	155.19%	38.66%	146.16%	146.05%	39.35%	141.06%	140.95%	36.38%	165.02%	164.89%
16) CAIRN INDIA LTD	30.91%	30.90%	30.65%	101.68%	101.66%	31.30%	97.50%	97.48%	31.32%	97.40%	97.38%	28.95%	113.94%	113.92%
17) GAIL (INDIA) LTD.	27.81%	27.80%	33.74%	67.93%	67.90%	35.17%	62.52%	62.49%	36.53%	57.94%	57.91%	33.78%	67.78%	67.75%
18) NTPC LTD	25.96%	25.95%	27.82%	87.06%	87.02%	28.72%	81.70%	81.67%	29.80%	75.88%	75.85%	27.55%	88.77%	88.73%
19) ONGC LTD	71.62%	71.60%	33.50%	457.05%	456.80%	34.77%	424.34%	424.12%	36.01%	395.54%	395.33%	33.29%	462.73%	462.48%
20) POWERGRID LTD	24.68%	24.67%	28.66%	74.20%	74.14%	30.09%	67.29%	67.24%	31.29%	62.24%	62.20%	28.93%	72.82%	72.76%
21) RELIANCE INDUSTRIES LTD	44.32%	44.30%	28.68%	238.80%	238.67%	28.90%	235.14%	235.01%	29.59%	224.32%	224.19%	27.36%	262.43%	262.28%
22) TATA POWER COMPANY LTD	109.24%	109.23%	34.98%	975.25%	975.13%	36.15%	913.28%	913.17%	36.73%	884.46%	884.35%	33.96%	1034.69%	1034.56%
FINANCIAL SERVICES														
23) AXIS BANK LTD	38.80%	38.82%	37.01%	109.90%	110.00%	37.32%	108.09%	108.18%	37.47%	107.19%	107.28%	34.65%	125.40%	125.51%
24) BANK OF BARODA	35.73%	35.74%	38.82%	84.69%	84.76%	39.24%	82.90%	82.97%	39.70%	81.00%	81.07%	36.70%	94.76%	94.84%
25) HDFC BANK LTD	78.31%	78.28%	44.42%	310.78%	310.53%									
26) HOUSING DEVPMT FIN CORPN.	77.71%	77.68%	32.73%	563.82%	563.41%	33.68%	532.39%	532.00%	35.08%	490.56%	490.20%	32.44%	573.88%	573.47%
27) ICICI BANK LTD	37.82%	37.84%	35.16%	115.68%	115.80%	35.54%	113.24%	113.36%	36.11%	109.68%	109.80%	33.39%	128.31%	128.45%
28) IDFC LTD	43.67%	43.67%	42.36%	106.28%	106.24%	42.26%	106.80%	106.76%	42.04%	107.93%	107.90%	38.87%	126.27%	126.23%
29) INDUSIND BANK LTD	42.01%	42.14%	46.94%	80.09%	80.57%	48.37%	75.54%	75.89%	49.67%	71.53%	71.96%	45.93%	83.68%	84.18%
30) KOTAK MAHINDRA BANK	46.40%	46.40%	38.18%	147.68%	147.66%	39.14%	140.55%	140.54%	39.52%	137.82%	137.81%	36.54%	161.23%	161.22%
31) PUNJAB NATIONAL BANK	34.32%	34.31%	36.07%	90.53%	90.51%	36.37%	89.03%	89.01%	36.19%	89.91%	89.88%	33.46%	105.18%	105.15%
32) STATE BANK OF INDIA	34.48%	34.48%	31.69%	118.37%	118.33%	31.22%	121.99%	121.95%	30.86%	124.87%	124.82%	28.53%	146.08%	146.03%

INDUSTRIAL MANUFACTURING														
33) BHARAT HEAVY ELECTRICALS LTD	**82.25%**	**82.26%**	**34.34%**	573.55%	573.65%	**34.33%**	574.11%	574.21%	**34.25%**	576.66%	576.76%	**31.67%**	674.61%	674.73%
INFORMATION TECHNOLOGY														
34) HINDUSTAN COMPUTERS LTD	**36.23%**	**36.37%**	**38.92%**	86.68%	87.35%	**39.73%**	83.17%	83.81%	**40.25%**	81.02%	81.65%	**37.22%**	94.78%	95.51%
35) INFOSYS LTD	**30.47%**	**30.48%**	**25.66%**	141.08%	141.15%	**26.28%**	134.42%	134.49%	**27.28%**	124.83%	124.90%	**25.22%**	146.04%	146.11%
36) TATA CONSULTANCY SERVICES LTD	**43.56%**	**43.58%**	**30.20%**	208.05%	208.22%	**30.78%**	200.27%	200.43%	**31.53%**	190.87%	191.02%	**29.15%**	223.30%	223.47%
37) TECH MAHINDRA LTD	**39.29%**	**39.35%**	**42.56%**	85.21%	85.46%	**43.02%**	83.41%	83.66%	**42.98%**	83.58%	83.83%	**39.73%**	97.78%	98.07%
38) WIPRO LTD	**37.73%**	**37.72%**	**33.21%**	129.04%	129.02%	**34.89%**	116.90%	116.89%	**36.84%**	104.87%	104.86%	**34.06%**	122.69%	122.67%
MEDIA & ENTERTAINMENT														
39) ZEE ENTERTAINMENT ENTERPRISES	**48.14%**	**48.14%**	**43.35%**	123.35%	123.33%	**45.33%**	112.81%	112.79%	**46.63%**	106.59%	106.57%	**43.11%**	124.69%	124.67%
METALS														
40) COAL INDIA * (FOUR YEARS)														
41) HINDALCO INDUSTRIES LTD	**43.91%**	**43.91%**	**42.29%**	107.81%	107.81%	**42.82%**	105.16%	105.16%	**43.16%**	103.49%	103.49%	**39.91%**	121.07%	121.07%
42) JINDAL POWER & STEEL	**88.85%**	**88.84%**	**41.52%**	458.00%	457.81%	**42.47%**	437.51%	437.53%	**43.29%**	421.24%	421.07%	**40.03%**	492.80%	492.60%
43) NMDC LTD	**40.13%**	**40.11%**	**41.83%**	92.05%	91.97%	**42.84%**	87.75%	87.68%	**43.48%**	85.19%	85.12%	**40.20%**	99.66%	99.58%
44) SESA STERLITE LTD	**44.66%**	**44.65%**	**43.82%**	103.89%	103.84%	**44.36%**	101.36%	101.32%	**44.29%**	101.68%	101.63%	**40.95%**	118.96%	118.90%
45) TATA STEEL LTD	**41.25%**	**41.24%**	**38.41%**	115.31%	115.26%	**38.02%**	117.71%	117.66%	**38.20%**	116.57%	116.52%	**35.32%**	136.37%	136.31%
PHARMACEUTICALS														
46) CIPLA LTD	**26.11%**	**26.11%**	**29.48%**	78.47%	78.47%	**30.66%**	72.54%	72.54%	**31.32%**	69.50%	69.50%	**28.96%**	81.31%	81.30%
47) DR. REDDY'S LABORATORIES LTD	**25.30%**	**25.38%**	**29.18%**	75.17%	75.64%	**30.57%**	68.46%	68.89%	**31.47%**	64.62%	65.02%	**29.10%**	75.59%	76.07%
48) LUPIN INDIA LTD	**77.65%**	**77.62%**	**33.92%**	524.04%	523.64%	**34.67%**	501.73%	501.34%	**35.35%**	482.67%	482.30%	**32.68%**	564.66%	564.22%
49) SUN PHARMACEUTICALS LTD.	**83.89%**	**83.86%**	**32.97%**	647.53%	647.07%	**34.53%**	590.22%	589.80%	**35.94%**	544.86%	544.48%	**33.23%**	637.42%	636.96%
TELECOM														
50) BHARTI AIRTEL LTD.	**47.25%**	**47.24%**	**37.47%**	159.04%	158.96%	**38.03%**	154.38%	154.30%	**38.78%**	148.45%	148.38%	**35.86%**	173.66%	173.58%

Table 5.17 Simple Linear Regression Analysis : Table 9

Table 9:- Linear Regression Analysis

5.00%

Company	Regression Statistics		ANOVA		Regression Coefficients						Residuals (standardized) Analysis									Chow Test (stability)	
					Intercept			X1			AVG		STDEV		SKEW		KURTOSIS		Normal?		
	R Square	Standard Error	P-Value	SIG?	Stats	P-Value	SIG?	Stats	P-Value	SIG?	Stats	SIG?	Stats	SIG?	Stats	SIG?	Stats	SIG?	HO	P-Value	Stable?
S&P CNX NIFTY (NSE)																					
S&P CNX NIFTY (NSE)																					
AUTOMOBILES																					
1) BAJAJ AUTO LTD	9.8%	2.59%	24.6%	FALSE	0.05%	23.21%	FALSE	0.660651	0.00%	TRUE	0.00	FALSE	1.000184	FALSE	-16.1847	TRUE	442.2068	TRUE	FALSE	66.56%	TRUE
2) HERO MOTOCORP LTD	18.1%	1.82%	88.6%	FALSE	0.0%	33.97%	FALSE	0.659563	0.00%	TRUE	0.000299789	FALSE	1.001856	FALSE	0.561045	TRUE	7.313972	TRUE	FALSE	28.91%	TRUE
3) MAHINDRA & MAHINDRA LTD.	23.2%	2.54%	78.1%	FALSE	0.0%	47.07%	FALSE	1.07563	0.00%	TRUE	0.00012159	FALSE	1.000353	FALSE	-14.8765	TRUE	395.6806	TRUE	FALSE	5.96%	TRUE
4) MARUTI SUZUKI LTD.	24.2%	1.74%	90.3%	FALSE	0.0%	30.21%	FALSE	0.756619	0.00%	TRUE	-5.19385E-05	FALSE	1.000494	FALSE	-0.12244	FALSE	4.715258	TRUE	FALSE	28.86%	TRUE
5) TATA MOTORS LTD.	13.0%	5.09%	55.3%	FALSE	0.0%	41.36%	FALSE	1.514479	0.00%	TRUE	-0.000148767	FALSE	1.001456	FALSE	-25.9331	TRUE	827.5286	TRUE	FALSE	62.39%	TRUE
CEMENT & CEMENT PRODUCTS																					
6) ACC LTD	30.91%	1.52%	9.13%	FALSE	0.02%	31.77%	FALSE	0.783601	0.00%	TRUE	-1.27108E-05	FALSE	1.000483	FALSE	0.203706	TRUE	2.036989	TRUE	FALSE	50.02%	TRUE
7) AMBUJA CEMENTS LTD	25.58%	1.84%	51.95%	FALSE	0.03%	27.82%	FALSE	0.832761	0.00%	TRUE	7.04966E-06	FALSE	1.000454	FALSE	0.283785	TRUE	2.104513	TRUE	FALSE	54.10%	TRUE
8) GRASIM INDUSTRIES LTD	27.48%	1.55%	25.10%	FALSE	0.00%	46.71%	FALSE	0.737141	0.00%	TRUE	0.000113246	FALSE	1.000902	FALSE	-3.13921	TRUE	52.92518	TRUE	FALSE	15.25%	TRUE
9) ULTRATECH CEMENT CO LTD	21.16%	1.60%	40.54%	FALSE	0.07%	5.47%	FALSE	0.639328	0.00%	TRUE	0.000104184	FALSE	1.000627	FALSE	0.032782	FALSE	1.914605	TRUE	FALSE	11.36%	TRUE
CONSTRUCTION																					
10) DLF LTD	47.30%	2.25%	92.26%	FALSE	-0.10%	5.22%	FALSE	1.6417	0.00%	TRUE	-0.000140556	FALSE	1.00067	FALSE	0.418047	TRUE	3.482018	TRUE	FALSE	33.37%	TRUE
11) LARSEN & TOUBRO LTD	43.59%	1.84%	37.29%	FALSE	-0.03%	30.09%	FALSE	1.244644	0.00%	TRUE	3.67645E-05	FALSE	1.000638	FALSE	-8.68819	TRUE	194.0714	TRUE	FALSE	66.60%	TRUE
CONSUMER GOODS																					
12) ASIAN PAINTS LTD	1.19%	6.69%	32.81%	FALSE	-0.06%	36.67%	FALSE	0.567114	0.01%	TRUE	-4.57518E-05	FALSE	1.000508	FALSE	-32.5309	TRUE	1117.639	TRUE	FALSE	8.21%	TRUE
13) HINDUSTAN UNILEVER LTD	11.77%	1.54%	1.52%	TRUE	0.05%	13.58%	FALSE	0.434446	0.00%	TRUE	-6.72276E-06	FALSE	1.000393	FALSE	1.137513	TRUE	11.1285	TRUE	FALSE	38.81%	TRUE
14) ITC LTD	10.49%	2.45%	0.38%	TRUE	0.01%	43.50%	FALSE	0.646973	0.00%	TRUE	2.52479E-05	FALSE	1.00023	FALSE	-19.2912	TRUE	557.0101	TRUE	FALSE	5.92%	TRUE
ENERGY																					
15) BHARAT PETROLEUM CORP.LTD	7.39%	2.84%	21.02%	FALSE	-0.02%	40.07%	FALSE	0.617479	0.00%	TRUE	7.18414E-05	FALSE	1.000328	FALSE	-12.2871	TRUE	312.0362	TRUE	FALSE	66.98%	TRUE
16) CAIRN INDIA LTD	29.56%	1.64%	36.26%	FALSE	0.00%	47.68%	FALSE	0.816728	0.00%	TRUE	-0.000122196	FALSE	1.000843	FALSE	0.170679	TRUE	2.427203	TRUE	FALSE	30.39%	TRUE
17) GAIL (INDIA) LTD.	22.62%	1.54%	45.58%	FALSE	-0.01%	43.26%	FALSE	0.642789	0.00%	TRUE	7.35919E-05	FALSE	1.000473	FALSE	0.173858	TRUE	0.977601	TRUE	FALSE	28.12%	TRUE
18) NTPC LTD	28.54%	1.38%	45.50%	FALSE	-0.07%	2.92%	FALSE	0.674049	0.00%	TRUE	-7.64139E-05	FALSE	1.000435	FALSE	-0.93212	TRUE	9.959738	TRUE	FALSE	4.57%	FALSE
19) ONGC LTD	7.01%	4.35%	46.24%	FALSE	-0.13%	14.21%	FALSE	0.921721	0.00%	TRUE	-4.97413E-06	FALSE	1.000605	FALSE	-28.3636	TRUE	931.8983	TRUE	FALSE	14.99%	TRUE
20) POWERGRID LTD	30.95%	1.29%	9.29%	FALSE	-0.03%	19.64%	FALSE	0.667413	0.00%	TRUE	0.000114284	FALSE	1.001053	FALSE	-0.51193	TRUE	5.935304	TRUE	FALSE		
21) RELIANCE INDUSTRIES LTD	29.69%	2.34%	20.85%	FALSE	-0.12%	4.00%	FALSE	1.173735	0.00%	TRUE	-1.48437E-05	FALSE	1.000861	FALSE	-21.4125	TRUE	639.4395	TRUE	FALSE	65.74%	TRUE
22) TATA POWER COMPANY LTD	3.03%	6.78%	19.77%	FALSE	-0.24%	10.88%	FALSE	0.924053	0.00%	TRUE	-4.52491E-06	FALSE	1.000152	FALSE	-32.0848	TRUE	1096.743	TRUE	FALSE	21.93%	TRUE
FINANCIAL SERVICES																					
23) AXIS BANK LTD	53.12%	1.67%	23.98%	FALSE	0.01%	38.52%	FALSE	1.374443	0.00%	TRUE	-0.000194849	FALSE	1.001189	FALSE	0.171501	TRUE	2.485683	TRUE	FALSE	26.91%	TRUE
24) BANK OF BARODA	33.19%	1.84%	49.43%	FALSE	0.03%	29.71%	FALSE	1.000501	0.00%	TRUE	-6.36108E-05	FALSE	1.000471	FALSE	0.421242	TRUE	3.824878	TRUE	FALSE	8.46%	TRUE
25) HDFC BANK LTD	6.12%	4.70%	83.05%	FALSE	-0.08%	27.06%	FALSE	0.925392	0.00%	TRUE	1.2798E-05	FALSE	1.000043	FALSE	-32.1937	TRUE	1101.956	TRUE	FALSE	21.50%	TRUE
26) HOUSING DEVPMT FIN CORPN.	7.39%	4.71%	81.99%	FALSE	-0.11%	21.11%	FALSE	1.026552	0.00%	TRUE	5.72527E-05	FALSE	1.000369	FALSE	-30.8135	TRUE	1039.536	TRUE	FALSE	16.69%	TRUE
27) ICICI BANK LTD	65.35%	1.40%	67.53%	FALSE	0.01%	41.57%	FALSE	1.485961	0.00%	TRUE	-0.00011112	FALSE	1.000871	FALSE	0.421655	TRUE	2.894284	TRUE	FALSE	53.56%	TRUE
28) IDFC LTD	49.85%	1.95%	17.88%	FALSE	-0.03%	26.98%	FALSE	1.498776	0.00%	TRUE	-7.75651E-05	FALSE	1.000634	FALSE	0.120364	FALSE	2.827779	TRUE	FALSE	44.45%	TRUE
29) INDUSIND BANK LTD	38.12%	2.08%	75.05%	FALSE	0.14%	0.96%	TRUE	1.260702	0.00%	TRUE	-0.000239802	FALSE	1.001177	FALSE	0.775584	TRUE	4.011269	TRUE	FALSE	11.35%	TRUE
30) KOTAK MAHINDRA BANK	28.23%	2.48%	2.89%	TRUE	0.00%	49.13%	FALSE	1.198117	0.00%	TRUE	-3.85155E-05	FALSE	1.000838	FALSE	-15.6007	TRUE	424.7738	TRUE	FALSE	56.62%	TRUE
31) PUNJAB NATIONAL BANK	39.76%	1.68%	66.47%	FALSE	-0.02%	35.63%	FALSE	1.051732	0.00%	TRUE	-0.000149297	FALSE	1.000739	FALSE	0.148465	TRUE	2.758528	TRUE	FALSE	12.75%	TRUE
32) STATE BANK OF INDIA	51.90%	1.51%	52.54%	FALSE	-0.03%	24.36%	FALSE	1.207444	0.00%	TRUE	-6.86371E-05	FALSE	1.000467	FALSE	0.258736	TRUE	3.715655	TRUE	FALSE	27.82%	TRUE

INDUSTRIAL MANUFACTURING																					
33) BHARAT HEAVY ELECTRICALS LTD	9.46%	4.93%	**36.07%**	FALSE	**-0.24%**	4.39%	FALSE	1.229419	0.00%	TRUE	-5.8684E-05	FALSE	1.000894	FALSE	-27.9433	TRUE	910.0093	TRUE	FALSE	12.37%	TRUE
INFORMATION TECHNOLOGY																					
34) HINDUSTAN COMPUTERS LTD	28.38%	1.93%	7.45%	FALSE	0.15%	0.29%	TRUE	0.938214	0.00%	TRUE	-7.01082E-05	FALSE	1.000986	FALSE	0.39161	TRUE	3.300456	TRUE	FALSE	29.25%	TRUE
35) INFOSYS LTD	23.93%	1.68%	26.64%	FALSE	0.02%	30.46%	FALSE	0.72464	0.00%	TRUE	5.97408E-05	FALSE	1.000449	FALSE	-2.48169	TRUE	43.63888	TRUE	FALSE	41.90%	TRUE
36) TATA CONSULTANCY SERVICES LTD	12.66%	2.57%	9.03%	FALSE	0.06%	19.66%	FALSE	0.753421	0.00%	TRUE	8.69363E-05	FALSE	1.000296	FALSE	-16.1186	TRUE	442.9272	TRUE	FALSE	27.26%	TRUE
37) TECH MAHINDRA LTD	18.22%	2.24%	7.46%	FALSE	0.10%	5.78%	FALSE	0.815119	0.00%	TRUE	-0.000175744	FALSE	1.000946	FALSE	1.492684	TRUE	10.28958	TRUE	FALSE	60.50%	TRUE
38) WIPRO LTD	14.07%	2.20%	43.73%	FALSE	0.02%	0.385365	FALSE	0.687753	0.00%	TRUE	1.49231E-05	FALSE	1.000354	FALSE	-9.82028	TRUE	222.2778	TRUE	FALSE	26.25%	TRUE
MEDIA & ENTERTAINMENT																					
39) ZEE ENTERTAINMENT ENTERPRISES	9.73%	2.88%	**56.02%**	FALSE	**0.03%**	35.98%	FALSE	0.730084	0.00%	TRUE	-6.23678E-05	FALSE	1.000453	FALSE	-10.5692	TRUE	253.847	TRUE	FALSE	10.81%	TRUE
METALS																					
40) COAL INDIA * (FOUR YEARS)	13.39%	1.72%	6.92%	FALSE	-0.02%	33.76%	FALSE	0.602707	0.00%	TRUE	4.94928E-05	FALSE	1.000659	FALSE	-0.0624	FALSE	4.228853	TRUE	FALSE	68.22%	TRUE
41) HINDALCO INDUSTRIES LTD	44.14%	2.07%	6.40%	FALSE	-0.01%	43.19%	FALSE	1.418017	0.00%	TRUE	-0.00027198	FALSE	1.001971	FALSE	0.263001	TRUE	1.730052	TRUE	FALSE	29.55%	TRUE
42) JINDAL POWER & STEEL	8.21%	5.37%	26.97%	FALSE	-0.19%	10.78%	FALSE	1.237549	0.00%	TRUE	-4.48586E-06	FALSE	1.000106	FALSE	-28.475	TRUE	934.9704	TRUE	FALSE	21.54%	TRUE
43) NMDC LTD	23.81%	2.21%	49.43%	FALSE	-0.07%	13.52%	FALSE	0.951768	0.00%	TRUE	3.85982E-05	FALSE	1.000545	FALSE	1.439901	TRUE	9.590701	TRUE	FALSE	66.64%	TRUE
44) SESA STERLITE LTD	32.11%	2.32%	76.50%	FALSE	-0.03%	34.31%	FALSE	1.22996	0.00%	TRUE	-0.000126876	FALSE	1.000815	FALSE	0.605128	TRUE	4.060082	TRUE	FALSE	17.83%	TRUE
45) TATA STEEL LTD	48.50%	1.87%	23.98%	FALSE	-0.04%	24.06%	FALSE	1.396078	0.00%	TRUE	-0.000254917	FALSE	1.001283	FALSE	0.662689	TRUE	3.87136	TRUE	FALSE	65.31%	TRUE
PHARMACEUTICALS																					
46) CIPLA LTD	15.02%	1.52%	79.22%	FALSE	0.01%	37.33%	FALSE	0.491926	0.00%	TRUE	-3.68646E-07	FALSE	1.000445	FALSE	-0.20215	TRUE	3.82267	TRUE	FALSE	42.01%	TRUE
47) DR. REDDY'S LABORATORIES LTD	12.93%	1.49%	0.31%	TRUE	0.11%	0.60%	TRUE	0.442092	0.00%	TRUE	-7.53039E-06	FALSE	1.000441	FALSE	0.332761	TRUE	2.923216	TRUE	FALSE	24.82%	TRUE
48) LUPIN INDIA LTD	1.38%	4.86%	12.37%	FALSE	0.00%	49.86%	FALSE	0.44334	0.00%	TRUE	-4.43913E-05	FALSE	1.000451	FALSE	-28.9692	TRUE	957.4864	TRUE	FALSE	23.68%	TRUE
49) SUN PHARMACEUTICALS LTD.	2.85%	5.21%	50.79%	FALSE	-0.09%	26.50%	FALSE	0.688496	0.00%	TRUE	9.16093E-05	FALSE	1.000513	FALSE	-25.0801	TRUE	739.6287	TRUE	FALSE	24.15%	TRUE
TELECOM																					
50) BHARTI AIRTEL LTD.	13.94%	2.76%	21.44%	FALSE	-0.11%	8.64%	FALSE	0.857396	0.00%	TRUE	0.000174862	FALSE	1.00086	FALSE	-11.9788	TRUE	292.1103	TRUE	FALSE	52.75%	TRUE

Table 5.18 Out – of – Sample Volatility Forecast: Table 10

SUMMARY TABLE 10:- FORECAST OF OUT-OF-THE -SAMPLE VOLATILITY (%)				
Company	OPTIMAL MODEL	INNOVATION	DAILY VOLATILITY (%)	ANNUALISED VOLATILITY (%)
S&P CNX NIFTY (NSE)			LONG -RUN CONDITIONAL VOLATILITY & TERM STRUCTURE	
S&P CNX NIFTY (NSE)	EGARCH (1,1)	GED	3.74%	59.29%
AUTOMOBILES				
1) BAJAJ AUTO LTD	EGARCH (1,1)	t Distribution	2.70%	42.36%
2) HERO MOTOCORP LTD	EGARCH (1,1)	t Distribution	2.10%	33.35%
3) MAHINDRA & MAHINDRA LTD.	EGARCH (1,1)	t Distribution	2.60%	41.25%
4) MARUTI SUZUKI LTD.	GARCH (1,1)	NORMAL	2.00%	31.75%
5) TATA MOTORS LTD.	EGARCH (1,1)	t Distribution	2.96%	47.01%
CEMENT & CEMENT PRODUCTS				
6) ACC LTD	GARCH (1,1)	t Distribution	1.97%	31.21%
7) AMBUJA CEMENTS LTD	GARCH (1,1)	t Distribution	2.16%	34.29%
8) GRASIM INDUSTRIES LTD	EGARCH (1,1)	t Distribution	1.81%	28.77%
9) ULTRATECH CEMENT CO LTD	GARCH (1,1)	GED	1.82%	28.86%
CONSTRUCTION				
10) DLF LTD	EGARCH (1,1)	t Distribution	2.96%	47.02%
11) LARSEN & TOUBRO LTD	GARCH (1,1)	t Distribution	2.52%	39.98%
CONSUMER GOODS				
12) ASIAN PAINTS LTD	EGARCH (1,1)	t Distribution	1.66%	26.41%
13) HINDUSTAN UNILEVER LTD	EGARCH (1,1)	t Distribution	1.60%	25.33%
14) ITC LTD	EGARCH (1,1)	t Distribution	1.72%	27.28%
ENERGY				
15) BHARAT PETROLEUM CORP.LTD	EGARCH (1,1)	t Distribution	2.29%	36.32%
16) CAIRN INDIA LTD	GARCH (1,1)	GED	2.06%	32.64%
17) GAIL (INDIA) LTD.	GARCH (1,1)	t Distribution	1.75%	27.79%
18) NTPC LTD	GARCH (1,1)	t Distribution	1.68%	26.69%
19) ONGC LTD	EGARCH (1,1)	t Distribution	2.03%	32.17%
20) POWERGRID LTD	EGARCH (1,1)	t Distribution	1.65%	26.18%
21) RELIANCE INDUSTRIES LTD	EGARCH (1,1)	t Distribution	1.96%	31.04%
22) TATA POWER COMPANY LTD	PROBLEM AREA		6.89%	109.31%
FINANCIAL SERVICES				
23) AXIS BANK LTD	EGARCH (1,1)	GED	2.95%	46.76%
24) BANK OF BARODA	GARCH (1,1)	t Distribution	2.53%	40.09%
25) HDFC BANK LTD	EGARCH (1,1)	t Distribution	1.75%	27.71%
26) HOUSING DEVPMT FIN CORPN.	EGARCH (1,1)	t Distribution	2.00%	31.69%
27) ICICI BANK LTD	EGARCH (1,1)	t Distribution	6.58%	104.47%
28) IDFC LTD	EGARCH (1,1)	GED	6.35%	100.79%
29) INDUSIND BANK LTD	GARCH (1,1)	t Distribution	5.70%	90.41%

30) KOTAK MAHINDRA BANK	EGARCH (1,1)	t Distribution	2.94%	46.68%
31) PUNJAB NATIONAL BANK	EGARCH (1,1)	t Distribution	3.60%	57.19%
32) STATE BANK OF INDIA	EGARCH (1,1)	t Distribution	2.32%	36.82%
INDUSTRIAL MANUFACTURING				
33) BHARAT HEAVY ELECTRICALS LTD	EGARCH (1,1)	t Distribution	2.31%	36.65%
INFORMATION TECHNOLOGY				
34) HINDUSTAN COMPUTERS LTD	EGARCH (1,1)	GED	4.51%	71.62%
35) INFOSYS LTD	EGARCH (1,1)	t Distribution	1.65%	26.20%
36) TATA CONSULTANCY SERVICES LTD	EGARCH (1,1)	t Distribution	1.93%	30.68%
37) TECH MAHINDRA LTD	GARCH (1,1)	GED	2.35%	37.30%
38) WIPRO LTD	PROBLEM AREA		NOT COMPUTED	
MEDIA & ENTERTAINMENT				
39) ZEE ENTERTAINMENT ENTERPRISES	EGARCH (1,1)	t Distribution	2.67%	42.44%
METALS				
40) COAL INDIA * (FOUR YEARS)	GARCH (1,1)	t Distribution	1.95%	30.88%
41) HINDALCO INDUSTRIES LTD	GARCH (1,1)	t Distribution	4.37%	69.39%
42) JINDAL POWER & STEEL	EGARCH (1,1)	t Distribution	2.62%	41.64%
43) NMDC LTD	GARCH (1,1)	GED	10.59%	168.12%
44) SESA STERLITE LTD	EGARCH (1,1)	t Distribution	3.06%	48.54%
45) TATA STEEL LTD	EGARCH (1,1)	t Distribution	6.64%	105.35%
PHARMACEUTICALS				
46) CIPLA LTD	EGARCH (1,1)	t Distribution	2.85%	45.23%
47) DR. REDDY'S LABORATORIES LTD	EGARCH (1,1)	GED	1.75%	27.72%
48) LUPIN INDIA LTD	PROBLEM AREA		NOT COMPUTED	
49) SUN PHARMACEUTICALS LTD.	EGARCH (1,1)	t Distribution	1.83%	29.06%
TELECOM				
50) BHARTI AIRTEL LTD.	GARCH- M (1,1)	t Distribution	2.34%	37.16%

Optimal Model For Forecasting Volatility Tables and Plots

Table 5.19 S & P CNX Nifty Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	LLF	AIC	DECISION
1) ARMA (1,1)	3648.57	-7289.15	
2) GARCH (1,1) NORMAL	3789.85	-7573.70	
3) GARCH (1,1),t DISTBTN	3809.92	-7611.85	
4) GARCH (1,1),GED	3807.74	-7607.47	
5) GARCH-M (1,1),NORMAL	3655.01	-7302.03	
6)GARCH-M (1,1),t DISTBTN	3749.78	-7489.55	
7) GARCH-M (1,1),GED	3655.01	-7300.03	
8) EGARCH (1,1),NORMAL	3807.06	-7604.13	
9) EGARCH (1,1),t DISTBTN	3818.71	-7625.42	
10) EGARCH (1,1),GED	3821.99	-7631.97	OPTIMAL

VOL	ANNUAL
3.74%	59.29%

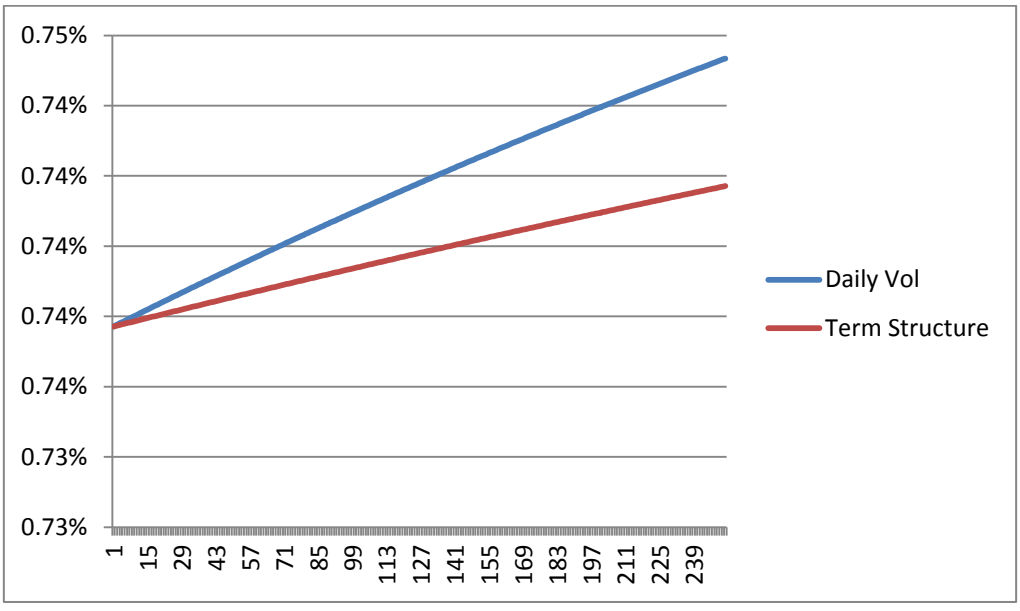


Table 5.20 Hero Moto Corp Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3101.48**	**-6194.97**	
2) GARCH (1,1) NORMAL	**3157.40**	**-6308.81**	
3) GARCH (1,1),t DISTBTN	**3237.69**	**-6467.38**	
4) GARCH (1,1),GED	**3226.75**	**-6445.51**	
5) GARCH-M (1,1),NORMAL	**3122.19**	**-6236.38**	
6)GARCH-M (1,1),t DISTBTN	**3222.52**	**-6435.04**	
7) GARCH-M (1,1),GED	**3122.19**	**-6234.38**	
8) EGARCH (1,1),NORMAL	**3154.92**	**-6299.85**	
9) EGARCH (1,1),t DISTBTN	**3242.31**	**-6472.62**	**OPTIMAL**
10) EGARCH (1,1),GED	**3226.75**	**-6445.51**	

VOL	ANNUAL
2.10%	33.35%

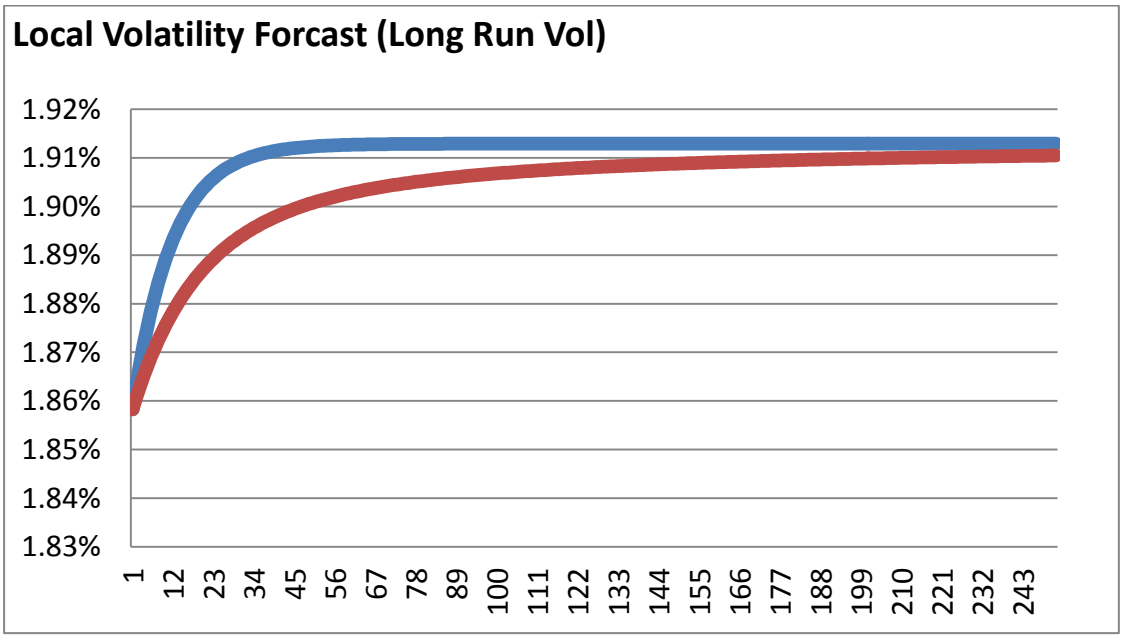


Table 5.21 Maruti Suzuki Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	LLF	AIC	DECISION
1) ARMA (1,1)	3111.85	-6215.69	
2) GARCH (1,1) NORMAL	3128.83	-6251.65	
3) GARCH (1,1),t DISTBTN	3179.73	-6351.47	OPTIMAL
4) GARCH (1,1),GED	3174.13	-6340.27	
5) GARCH-M (1,1),NORMAL	3122.60	-6237.21	
6)GARCH-M (1,1),t DISTBTN	3174.51	-6339.02	
7) GARCH-M (1,1),GED	3122.60	-6235.21	
8) EGARCH (1,1),NORMAL	3125.91	-6241.81	
9) EGARCH (1,1),t DISTBTN	3177.09	-6342.19	
10) EGARCH (1,1),GED	3172.06	-6332.12	

VOL	ANNUAL
2.00%	31.75%

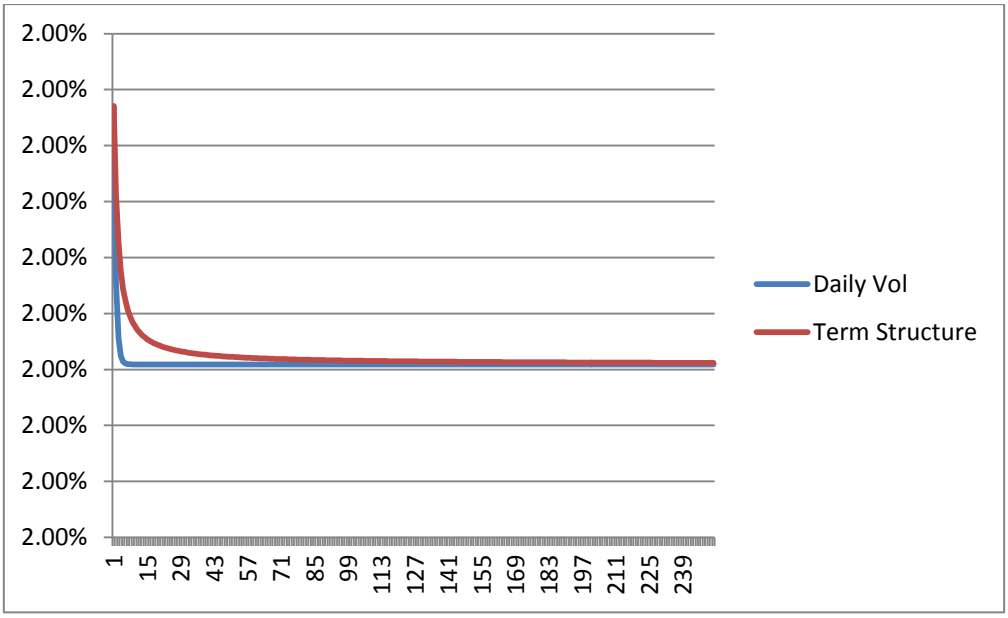


Table 5.22 ACC Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3221.13**	**-6434.25**	
2) GARCH (1,1) NORMAL	**3263.33**	**-6520.65**	
3) GARCH (1,1),t DISTBTN	**3319.16**	**-6630.33**	**OPTIMAL**
4) GARCH (1,1),GED	**3317.05**	**-6626.09**	
5) GARCH-M (1,1),NORMAL	**3246.36**	**-6484.72**	
6)GARCH-M (1,1),t DISTBTN	**3299.02**	**-6588.05**	
7) GARCH-M (1,1),GED	**3246.36**	**-6482.72**	
8) EGARCH (1,1),NORMAL	**3261.91**	**-6513.83**	
9) EGARCH (1,1),t DISTBTN	**3317.95**	**-6623.90**	
10) EGARCH (1,1),GED	**3316.49**	**-6620.97**	

VOL	ANNUAL
1.97%	31.21%

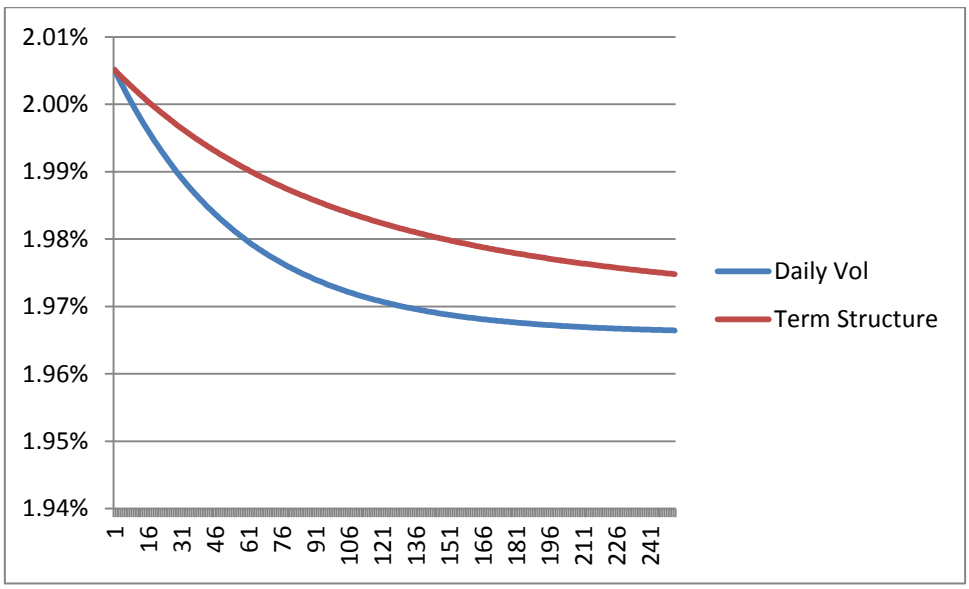


Table 5.23 Ambuja Cement Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3028.29**	**-6048.58**	
2) GARCH (1,1) NORMAL	**3051.38**	**-6096.76**	
3) GARCH (1,1),t DISTBTN	**3086.70**	**-6165.41**	**OPTIMAL**
4) GARCH (1,1),GED	**3086.59**	**-6165.18**	
5) GARCH-M (1,1),NORMAL	**3029.50**	**-6050.99**	
6)GARCH-M (1,1),t DISTBTN	**3075.29**	**-6140.59**	
7) GARCH-M (1,1),GED	**3074.34**	**-6138.68**	
8) EGARCH (1,1),NORMAL	**3031.57**	**-6053.13**	
9) EGARCH (1,1),t DISTBTN	**3086.19**	**-6160.37**	
10) EGARCH (1,1),GED	**3086.59**	**-6165.18**	

VOL	ANNUAL
2.16%	34.29%

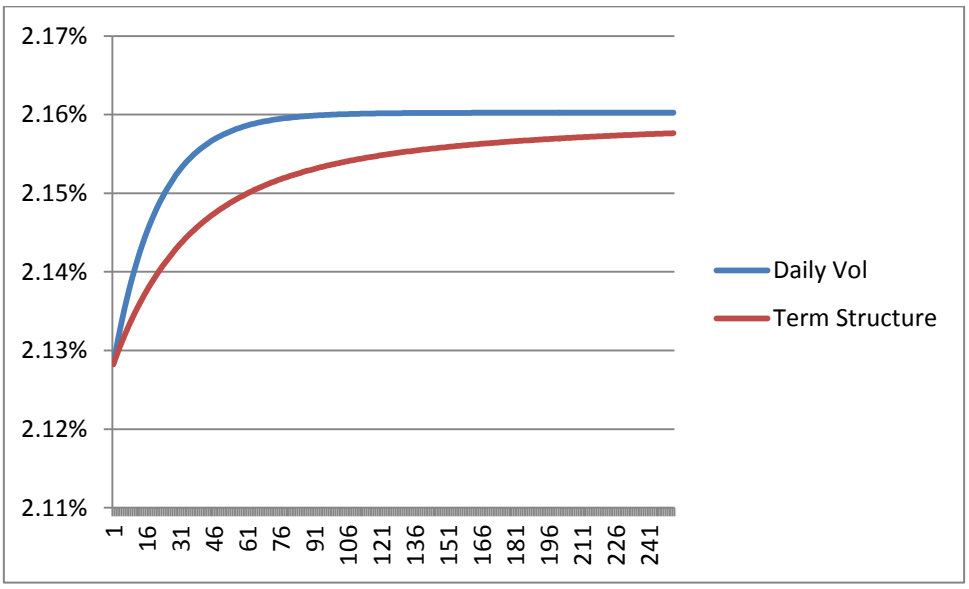


Table 5.24 Grasim Industries Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	3226.45	-6444.90	
2) GARCH (1,1) NORMAL	3335.05	-6664.10	
3) GARCH (1,1),t DISTBTN	3373.69	-6739.38	
4) GARCH (1,1),GED	3239.46	-6470.92	
5) GARCH-M (1,1),NORMAL	3239.46	-6470.92	
6)GARCH-M (1,1),t DISTBTN	3373.69	-6739.38	
7) GARCH-M (1,1),GED	3389.60	-6771.21	
8) EGARCH (1,1),NORMAL	3338.40	-6666.80	
9) EGARCH (1,1),t DISTBTN	3402.35	-6792.70	OPTIMAL
10) EGARCH (1,1),GED	3393.05	-6774.11	

VOL	ANNUAL
1.81%	28.77%

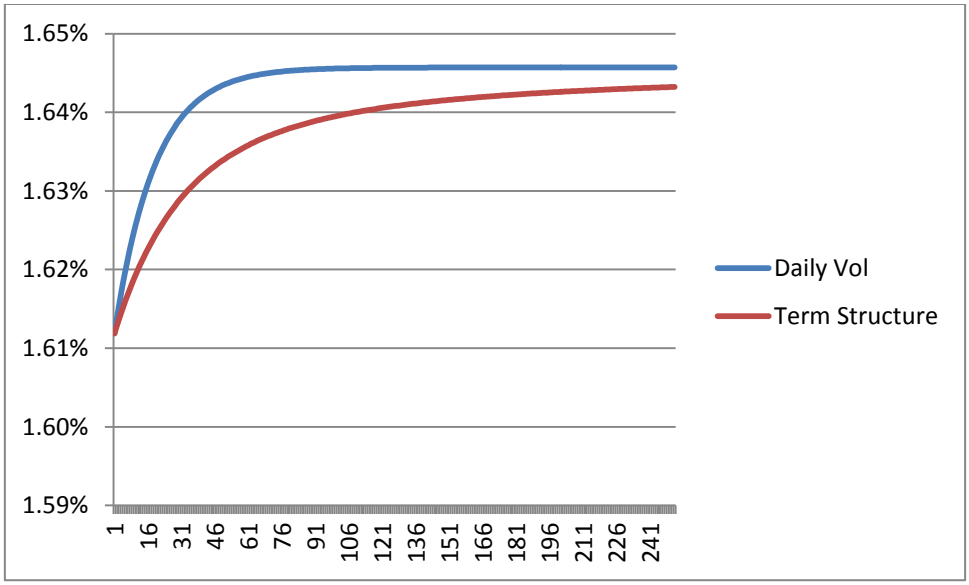


Table 5.25 Ultratech Cement Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3237.74**	**-6467.48**	
2) GARCH (1,1) NORMAL	**3272.17**	**-6538.33**	
3) GARCH (1,1),t DISTBTN	**3309.41**	**-6610.82**	
4) GARCH (1,1),GED	**3331.09**	**-6654.17**	**OPTIMAL**
5) GARCH-M (1,1),NORMAL	**3244.72**	**-6481.43**	
6)GARCH-M (1,1),t DISTBTN	**3307.43**	**-6604.86**	
7) GARCH-M (1,1),GED	**3312.19**	**-6614.38**	
8) EGARCH (1,1),NORMAL	**3253.39**	**-6496.77**	
9) EGARCH (1,1),t DISTBTN	**3315.08**	**-6618.17**	
10) EGARCH (1,1),GED	**3318.46**	**-6624.91**	

VOL	ANNUAL
1.82%	28.86%

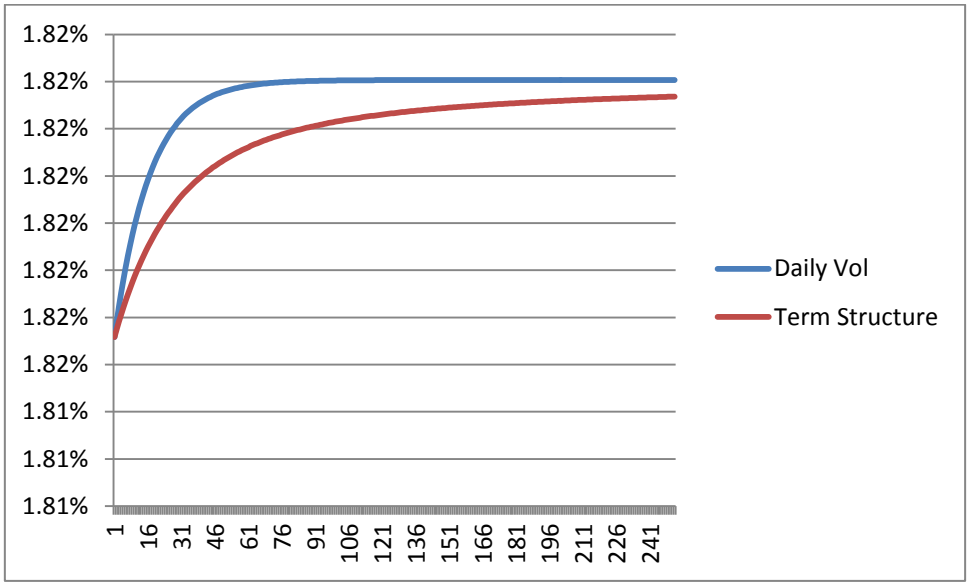


Table 5.26 DLF Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**2567.39**	**-5126.77**	
2) GARCH (1,1) NORMAL	**2657.95**	**-5309.90**	
3) GARCH (1,1),t DISTBTN	**2668.35**	**-5328.69**	**OPTIMAL**
4) GARCH (1,1),GED	**2666.81**	**-5325.63**	
5) GARCH-M (1,1),NORMAL	**2607.65**	**-5207.31**	
6)GARCH-M (1,1),t DISTBTN	**2634.29**	**-5258.57**	
7) GARCH-M (1,1),GED	**2607.65**	**-5205.31**	
8) EGARCH (1,1),NORMAL	**2649.69**	**-5289.37**	
9) EGARCH (1,1),t DISTBTN	**2662.09**	**-5312.19**	
10) EGARCH (1,1),GED	**2660.41**	**-5308.83**	

VOL	ANNUAL
2.96%	47.02%

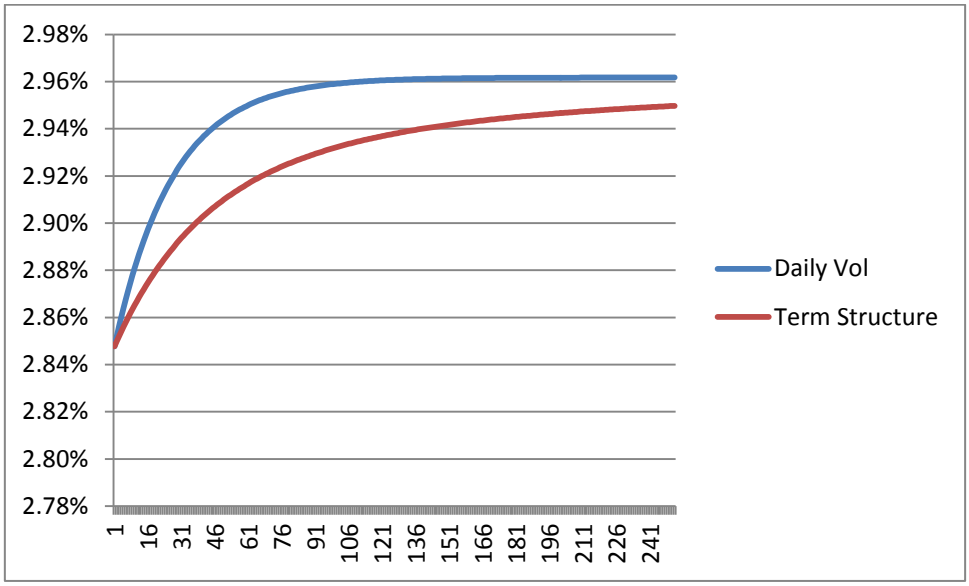


Table 5.27 Hindustan Lever Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3352.84**	**-6697.67**	
2) GARCH (1,1) NORMAL	**3443.81**	**-6881.63**	
3) GARCH (1,1),t DISTBTN	**3487.14**	**-6966.28**	
4) GARCH (1,1),GED	**3483.06**	**-6958.13**	
5) GARCH-M (1,1),NORMAL	**3408.53**	**-6809.06**	
6)GARCH-M (1,1),t DISTBTN	**3462.44**	**-6914.87**	
7) GARCH-M (1,1),GED	**3408.53**	**-6807.06**	
8) EGARCH (1,1),NORMAL	**3446.87**	**-6883.75**	
9) EGARCH (1,1),t DISTBTN	**3491.17**	**-6970.34**	**OPTIMAL**
10) EGARCH (1,1),GED	**3486.09**	**-6960.17**	

VOL	ANNUAL
1.60%	25.33%

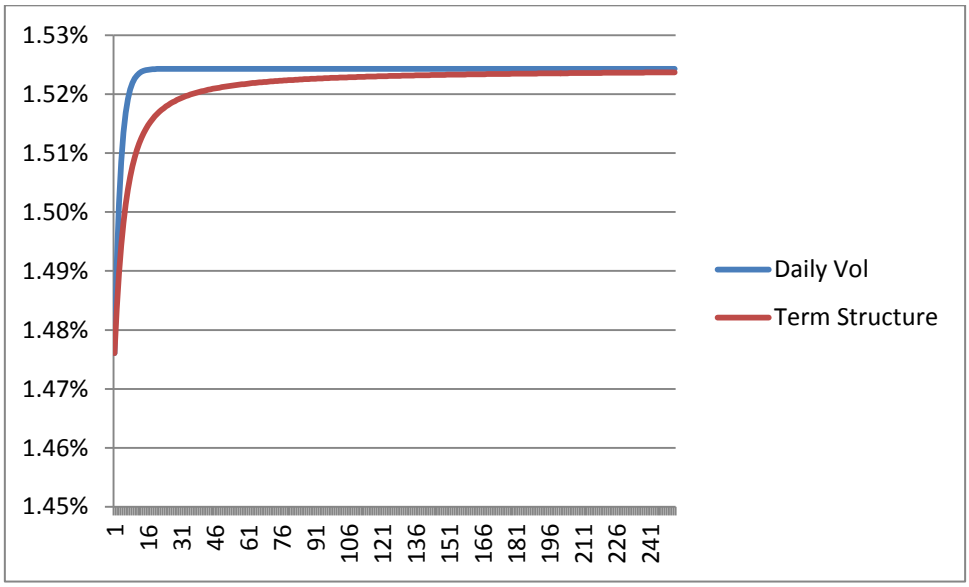


Table 5.28 Cairn India Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3148.56**	**-6289.13**	
2) GARCH (1,1) NORMAL	**3235.21**	**-6464.42**	
3) GARCH (1,1),t DISTBTN	**3262.07**	**-6516.14**	
4) GARCH (1,1),GED	**3263.82**	**-6519.64**	**OPTIMAL**
5) GARCH-M (1,1),NORMAL	**3162.09**	**-6316.18**	
6)GARCH-M (1,1),t DISTBTN	**3211.53**	**-6413.05**	
7) GARCH-M (1,1),GED	**3162.09**	**-6314.18**	
8) EGARCH (1,1),NORMAL	**3243.17**	**-6476.35**	
9) EGARCH (1,1),t DISTBTN	**3262.53**	**-6513.06**	
10) EGARCH (1,1),GED	**3247.29**	**-6482.58**	

VOL	ANNUAL
2.06%	32.64%

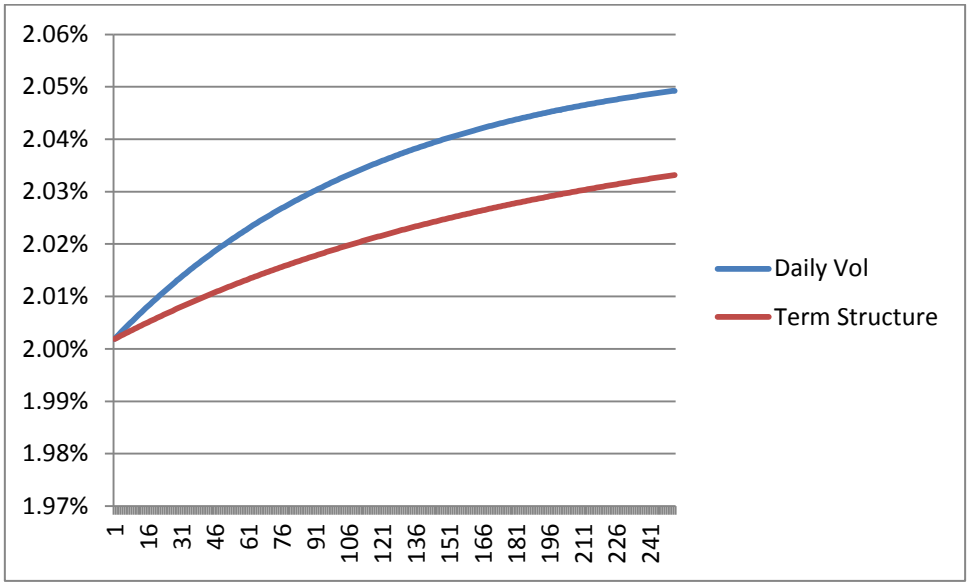


Table 5.29 GAIL (INDIA) Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	3276.73	-6545.45	
2) GARCH (1,1) NORMAL	3301.10	-6596.21	
3) GARCH (1,1),t DISTBTN	3315.95	-6623.91	OPTIMAL
4) GARCH (1,1),GED	3314.41	-6620.81	
5) GARCH-M (1,1),NORMAL	3273.99	-6539.98	
6)GARCH-M (1,1),t DISTBTN	3297.84	-6585.68	
7) GARCH-M (1,1),GED	3273.99	-6537.98	
8) EGARCH (1,1),NORMAL	3275.76	-6541.52	
9) EGARCH (1,1),t DISTBTN	3313.83	-6615.66	
10) EGARCH (1,1),GED	3314.01	-6616.01	

VOL	ANNUAL
1.75%	27.79%

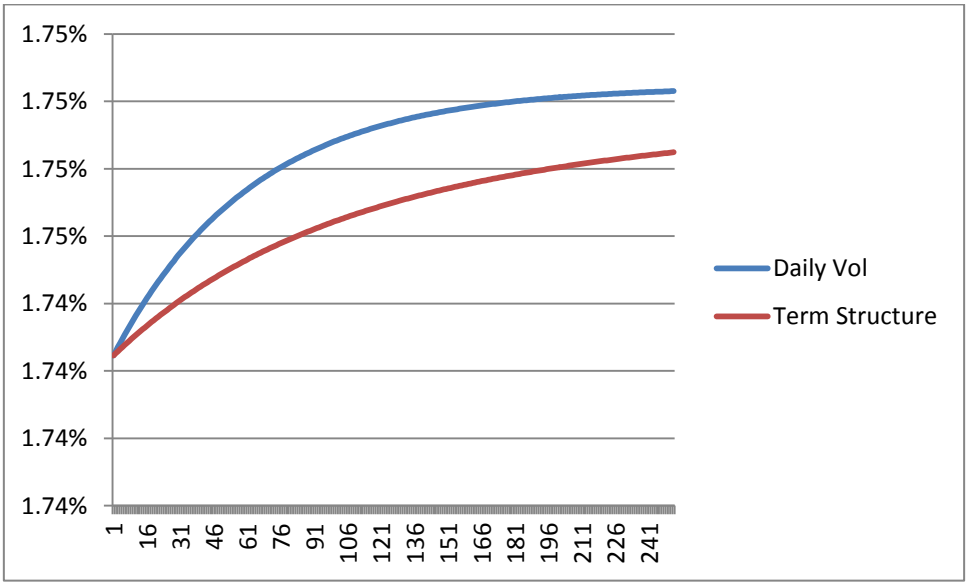


Table 5.30 NTPC Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3358.38**	**-6708.76**	
2) GARCH (1,1) NORMAL	**3377.46**	**-6748.93**	
3) GARCH (1,1),t DISTBTN	**3459.45**	**-6910.91**	**OPTIMAL**
4) GARCH (1,1),GED	**3445.55**	**-6883.11**	
5) GARCH-M (1,1),NORMAL	**3360.74**	**-6713.47**	
6)GARCH-M (1,1),t DISTBTN	**3438.90**	**-6867.79**	
7) GARCH-M (1,1),GED	**3360.74**	**-6711.47**	
8) EGARCH (1,1),NORMAL	**3397.97**	**-6785.94**	
9) EGARCH (1,1),t DISTBTN	**3443.02**	**-6874.05**	
10) EGARCH (1,1),GED	**3432.74**	**-6853.48**	

VOL	ANNUAL
1.68%	26.69%

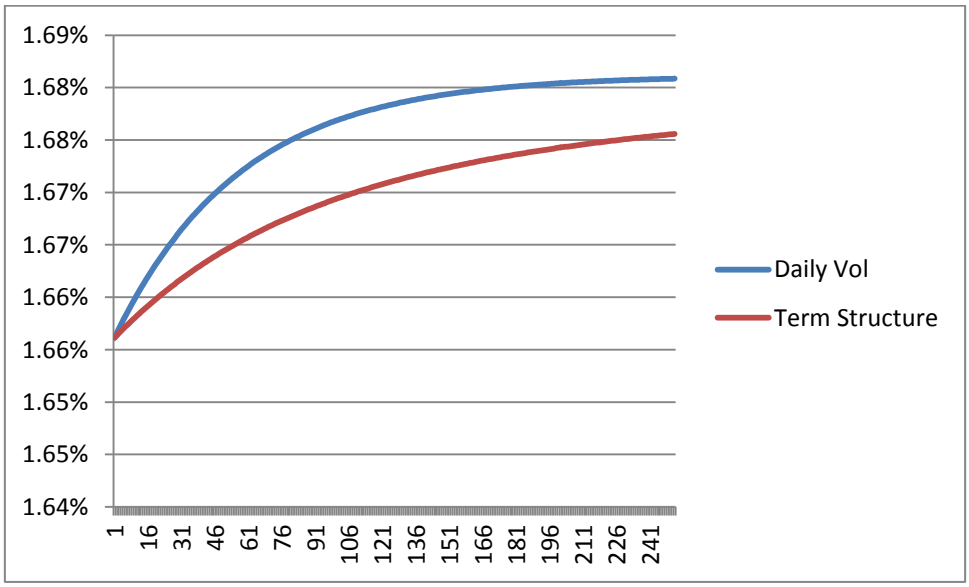


Table 5.31 Powergrid Corporation Of India Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	3424.33	-6840.67	
2) GARCH (1,1) NORMAL	3512.84	-7019.68	
3) GARCH (1,1),t DISTBTN	3551.15	-7094.30	
4) GARCH (1,1),GED	3551.18	-7094.36	
5) GARCH-M (1,1),NORMAL	3422.96	-6837.91	
6)GARCH-M (1,1),t DISTBTN	3524.41	-7038.82	
7) GARCH-M (1,1),GED	3422.96	-6835.91	
8) EGARCH (1,1),NORMAL	3505.68	-7001.37	
9) EGARCH (1,1),t DISTBTN	3552.32	-7092.64	OPTIMAL
10) EGARCH (1,1),GED	3549.65	-7087.30	

VOL	ANNUAL
1.68%	26.69%

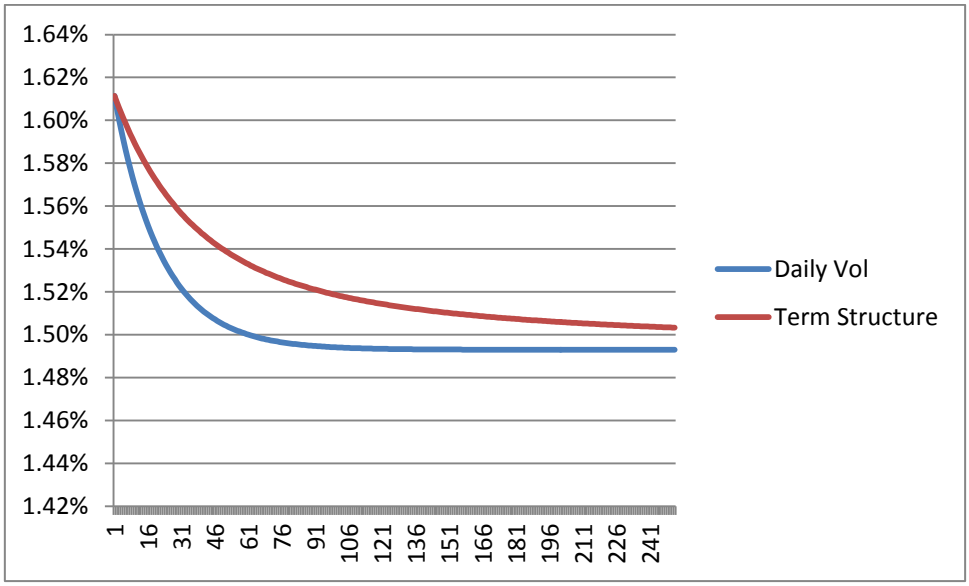


Table 5.32 Axis Bank Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**2860.13**	**-5712.25**	
2) GARCH (1,1) NORMAL	**2964.22**	**-5922.43**	
3) GARCH (1,1),t DISTBTN	**2968.33**	**-5928.66**	
4) GARCH (1,1),GED	**2969.32**	**-5930.65**	
5) GARCH-M (1,1),NORMAL	**2867.90**	**-5727.81**	
6)GARCH-M (1,1),t DISTBTN	**2902.42**	**-5794.85**	
7) GARCH-M (1,1),GED	**2867.90**	**-5725.81**	
8) EGARCH (1,1),NORMAL	**2965.86**	**-5921.73**	
9) EGARCH (1,1),t DISTBTN	**2967.97**	**-5923.94**	
10) EGARCH (1,1),GED	**2971.71**	**-5931.43**	**OPTIMAL**

VOL	ANNUAL
2.95%	46.76%

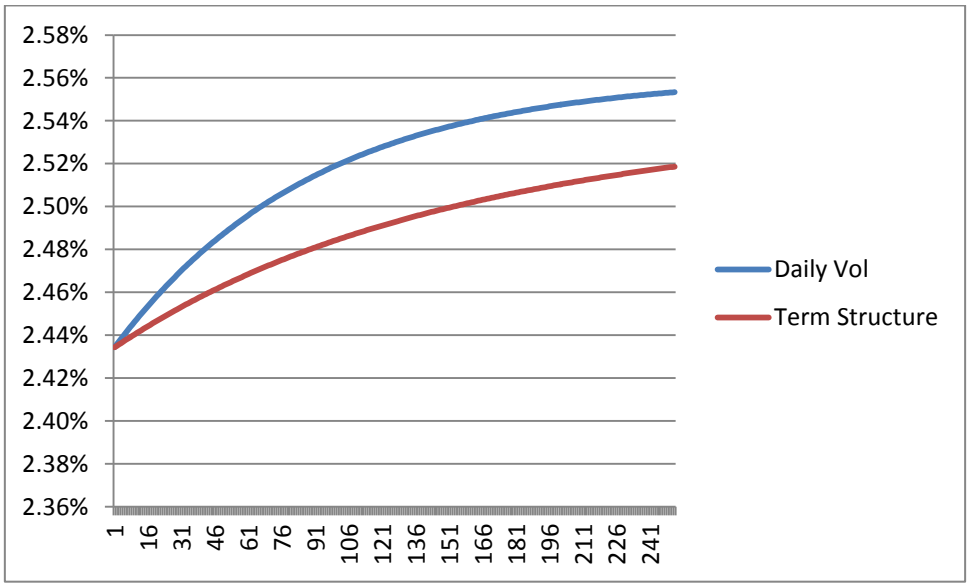


Table 5.33 Bank Of Baroda Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**2961.57**	**-5915.13**	
2) GARCH (1,1) NORMAL	**3025.05**	**-6044.10**	
3) GARCH (1,1),t DISTBTN	**3055.76**	**-6103.51**	**OPTIMAL**
4) GARCH (1,1),GED	**3055.63**	**-6103.26**	
5) GARCH-M (1,1),NORMAL	**2987.35**	**-5966.70**	
6)GARCH-M (1,1),t DISTBTN	**3035.39**	**-6060.79**	
7) GARCH-M (1,1),GED	**3055.76**	**-6101.51**	**OPTIMAL**
8) EGARCH (1,1),NORMAL	**3024.05**	**-6038.09**	
9) EGARCH (1,1),t DISTBTN	**3055.31**	**-6098.62**	
10) EGARCH (1,1),GED	**3053.29**	**-6094.58**	

VOL	ANNUAL
2.53%	40.09%

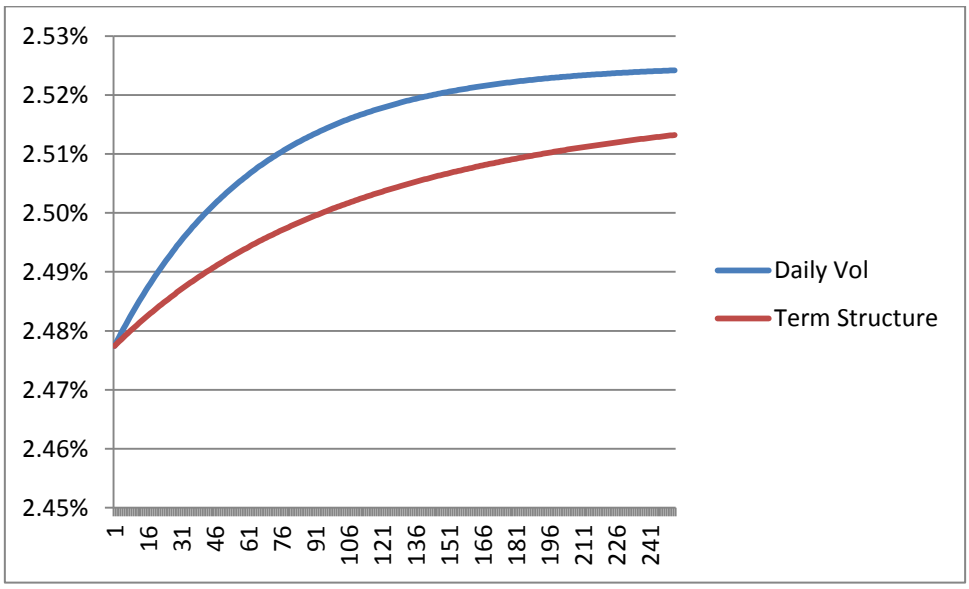


Table 5.34 State Bank Of India Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3017.09**	**-6026.18**	
2) GARCH (1,1) NORMAL	**3057.48**	**-6108.95**	
3) GARCH (1,1),t DISTBTN	**3091.53**	**-6175.06**	
4) GARCH (1,1),GED	**3083.76**	**-6159.51**	
5) GARCH-M (1,1),NORMAL	**3030.92**	**-6053.85**	
6)GARCH-M (1,1),t DISTBTN	**3071.18**	**-6132.36**	
7) GARCH-M (1,1),GED	**3083.76**	**-6159.51**	
8) EGARCH (1,1),NORMAL	**3060.32**	**-6110.65**	
9) EGARCH (1,1),t DISTBTN	**3092.88**	**-6173.76**	**OPTIMAL**
10) EGARCH (1,1),GED	**3085.36**	**-6158.72**	

VOL	ANNUAL
2.32%	36.82%

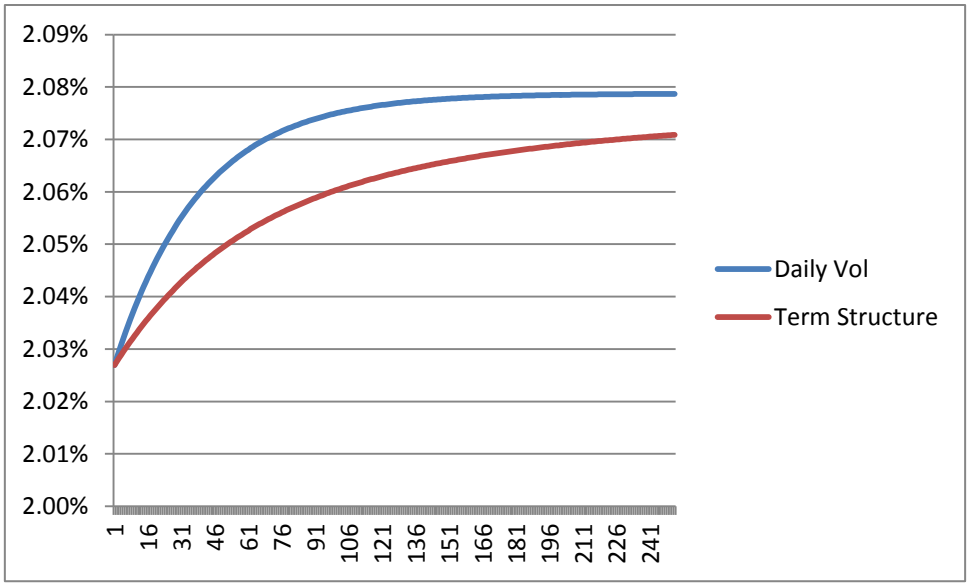


Table 5.35 INFOSYS Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3157.61**	**-6307.22**	
2) GARCH (1,1) NORMAL	**3231.03**	**-6456.06**	
3) GARCH (1,1),t DISTBTN	**3424.59**	**-6841.19**	
4) GARCH (1,1),GED	**3386.34**	**-6764.68**	
5) GARCH-M (1,1),NORMAL	**3185.33**	**-6362.67**	
6)GARCH-M (1,1),t DISTBTN	**3424.51**	**-6839.03**	
7) GARCH-M (1,1),GED	**3185.33**	**-6360.67**	
8) EGARCH (1,1),NORMAL	**3234.41**	**-6458.83**	
9) EGARCH (1,1),t DISTBTN	**3429.22**	**-6846.45**	**OPTIMAL**
10) EGARCH (1,1),GED	**3399.67**	**-6787.33**	

VOL	ANNUAL
1.65%	26.20%

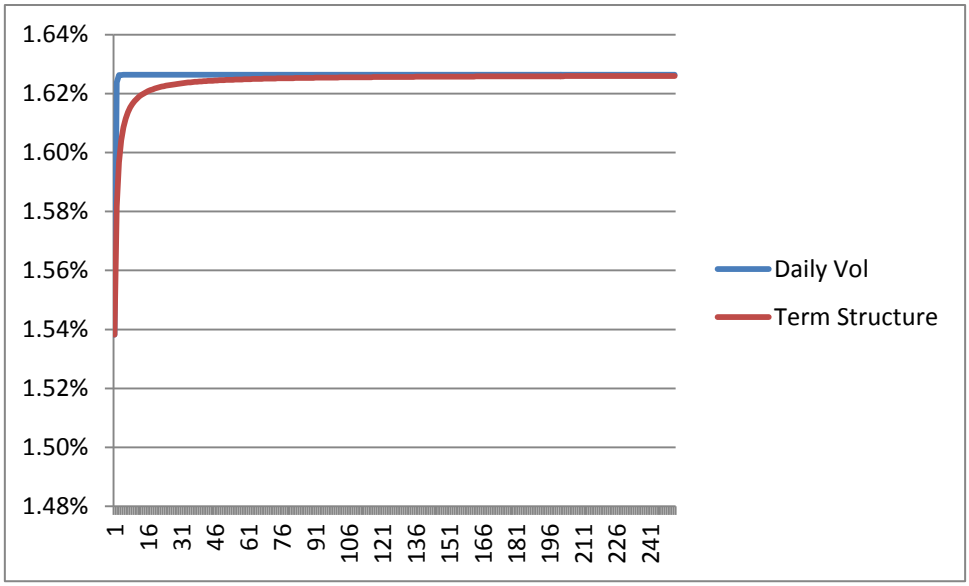


Table 5.36 Tech Mahindra Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**2843.48**	**-5678.96**	
2) GARCH (1,1) NORMAL	**2992.42**	**-5978.84**	
3) GARCH (1,1),t DISTBTN	**3013.06**	**-6018.11**	
4) GARCH (1,1),GED	**3013.13**	**-6018.25**	**OPTIMAL**
5) GARCH-M (1,1),NORMAL	**2889.71**	**-5771.43**	
6)GARCH-M (1,1),t DISTBTN	**2996.34**	**-5982.69**	
7) GARCH-M (1,1),GED	**2889.71**	**-5769.43**	
8) EGARCH (1,1),NORMAL	**2985.54**	**-5961.09**	
9) EGARCH (1,1),t DISTBTN	**3011.07**	**-6010.15**	
10) EGARCH (1,1),GED	**3011.48**	**-6010.97**	

VOL	ANNUAL
2.35%	37.30%

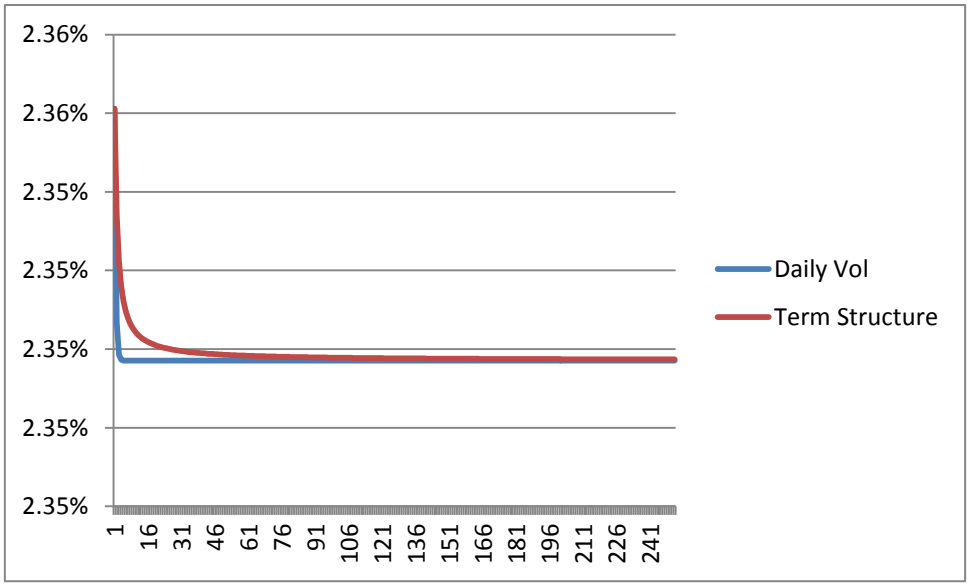


Table 5.37 CIPLA Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3353.65**	**-6699.31**	
2) GARCH (1,1) NORMAL	**3380.27**	**-6754.54**	
3) GARCH (1,1),t DISTBTN	**3420.08**	**-6832.16**	
4) GARCH (1,1),GED	**3415.27**	**-6822.54**	
5) GARCH-M (1,1),NORMAL	**3363.64**	**-6719.29**	
6)GARCH-M (1,1),t DISTBTN	**3409.06**	**-6808.13**	
7) GARCH-M (1,1),GED	**3403.21**	**-6796.42**	
8) EGARCH (1,1),NORMAL	**3383.08**	**-6756.16**	
9) EGARCH (1,1),t DISTBTN	**3424.59**	**-6837.17**	**OPTIMAL**
10) EGARCH (1,1),GED	**3419.82**	**-6827.65**	

VOL	ANNUAL
2.85%	45.23%

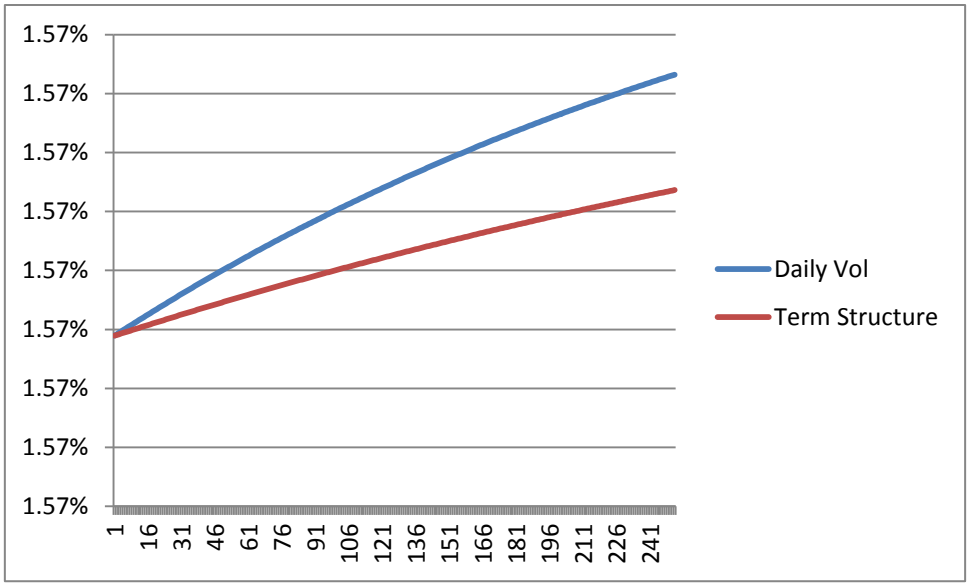


Table 5.38 Dr. Reddy's Laboratories Ltd Volatility Forecast (1 year ahead)

SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**3391.38**	**-6774.76**	
2) GARCH (1,1) NORMAL	**3448.30**	**-6890.60**	
3) GARCH (1,1),t DISTBTN	**3474.54**	**-6941.07**	
4) GARCH (1,1),GED	**3475.74**	**-6943.49**	
5) GARCH-M (1,1),NORMAL	**3399.10**	**-6790.19**	
6)GARCH-M (1,1),t DISTBTN	**3440.86**	**-6871.72**	
7) GARCH-M (1,1),GED	**3399.10**	**-6788.19**	
8) EGARCH (1,1),NORMAL	**3449.91**	**-6889.83**	
9) EGARCH (1,1),t DISTBTN	**3474.25**	**-6936.49**	
10) EGARCH (1,1),GED	**3476.07**	**-6940.13**	**OPTIMAL**

VOL	ANNUAL
1.75%	27.72%

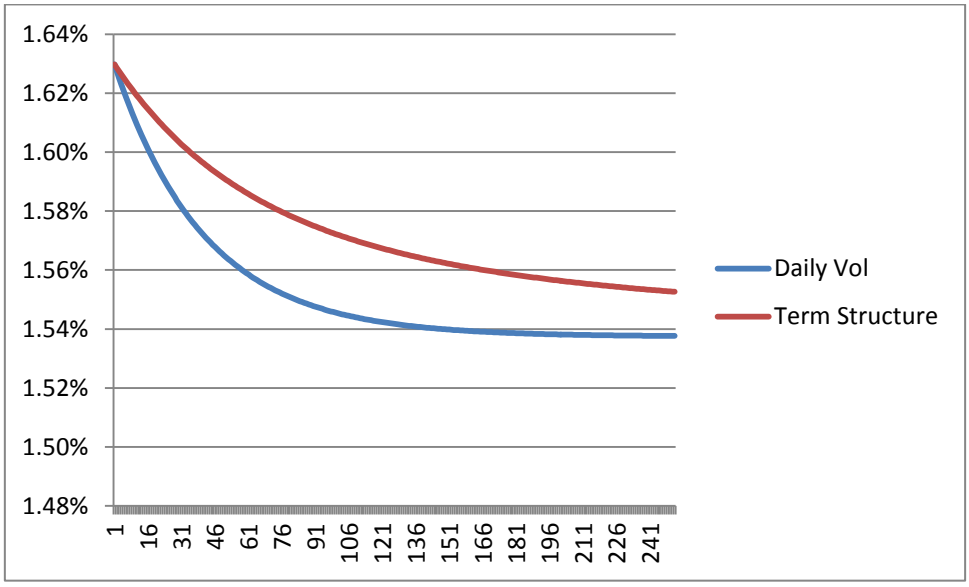
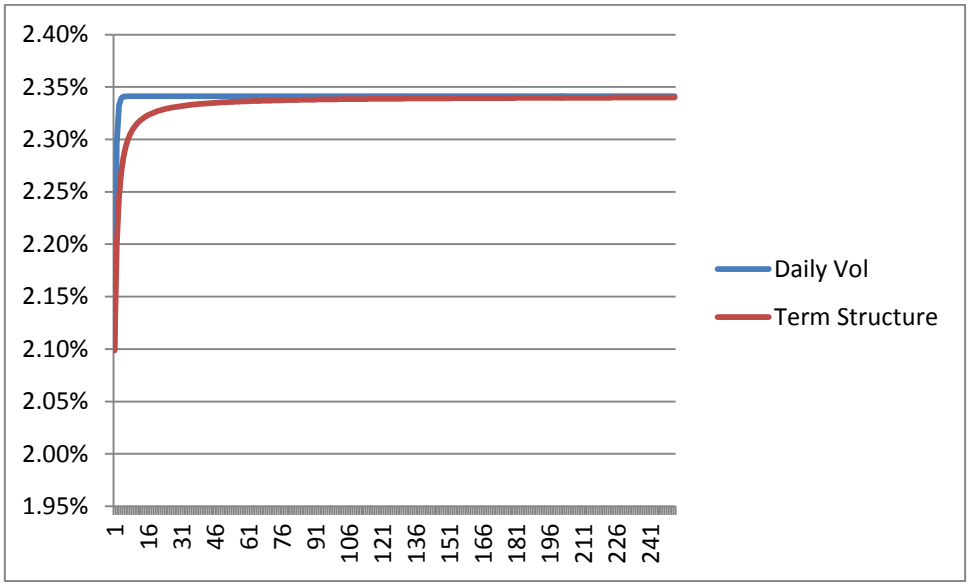


Table 5.39 Bharti Airtel Ltd Volatility Forecast (1 year ahead)

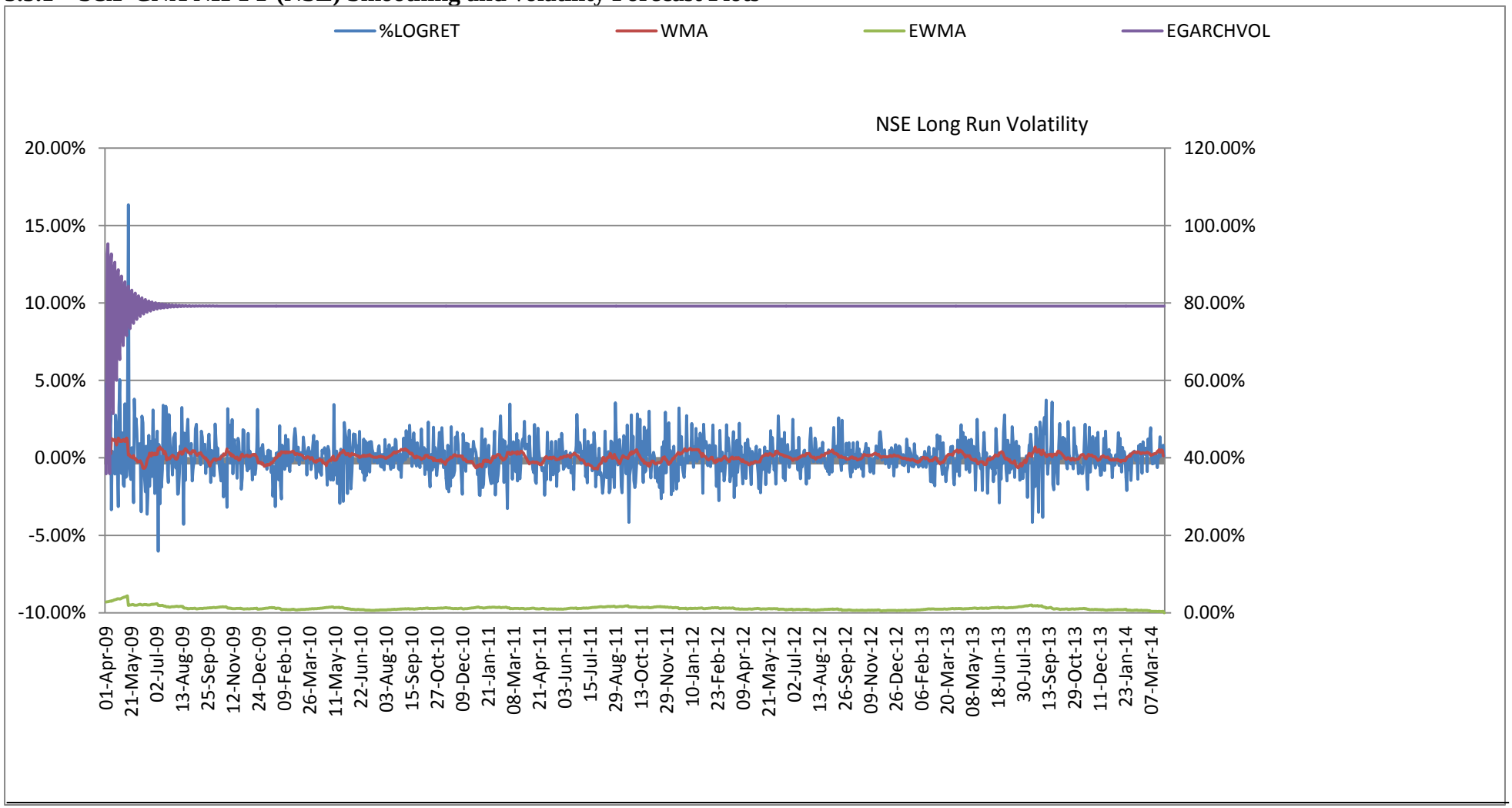
SUMMARY TABLE			
VOLATILITY ESTIMATORS	**LLF**	**AIC**	**DECISION**
1) ARMA (1,1)	**2612.09**	**-5216.18**	
2) GARCH (1,1) NORMAL	**2614.37**	**-5222.73**	
3) GARCH (1,1),t DISTBTN	**3004.23**	**-6000.46**	
4) GARCH (1,1),GED	**2939.20**	**-5870.40**	
5) GARCH-M (1,1),NORMAL	**2611.31**	**-5214.63**	
6)GARCH-M (1,1),t DISTBTN	**3004.32**	**-5998.63**	**OPTIMAL**
7) GARCH-M (1,1),GED	**2611.31**	**-5212.63**	
8) EGARCH (1,1),NORMAL	**2646.47**	**-5282.94**	
9) EGARCH (1,1),t DISTBTN	**3003.00**	**-5994.00**	
10) EGARCH (1,1),GED	**2960.28**	**-5908.57**	

VOL	ANNUAL
2.34%	37.16%

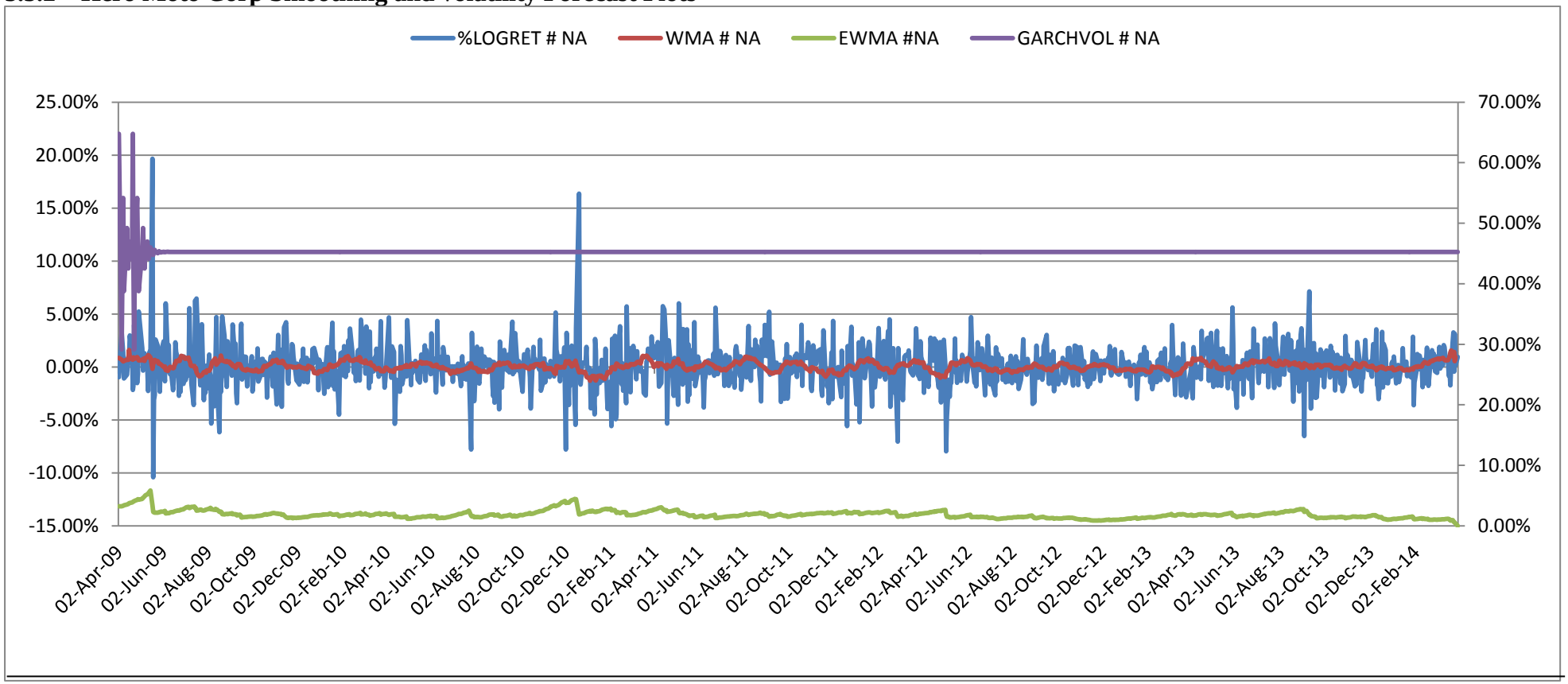


Refer smoothing plots.

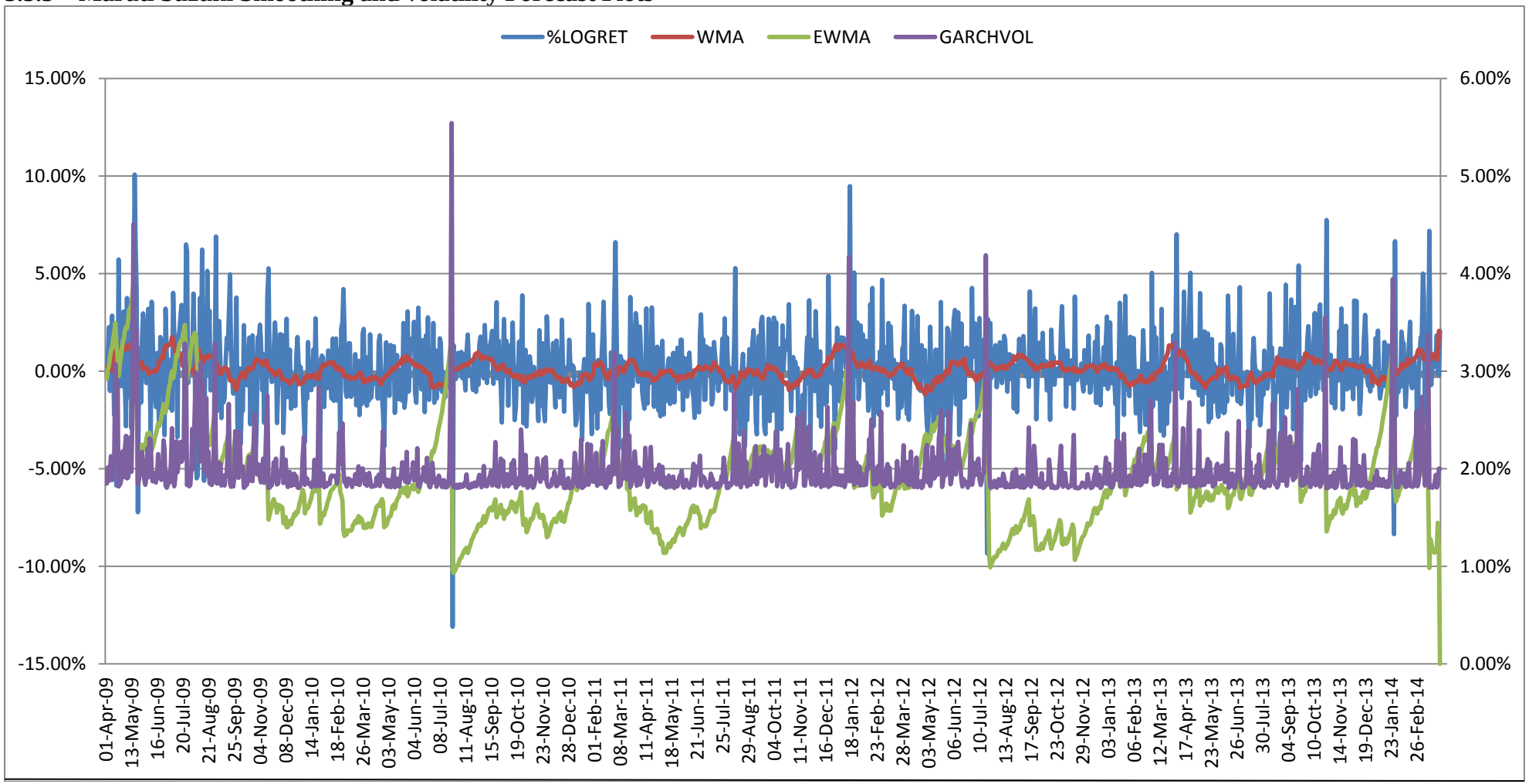
5.5.1 S&P CNX NIFTY (NSE) Smoothing and volatility Forecast Plots



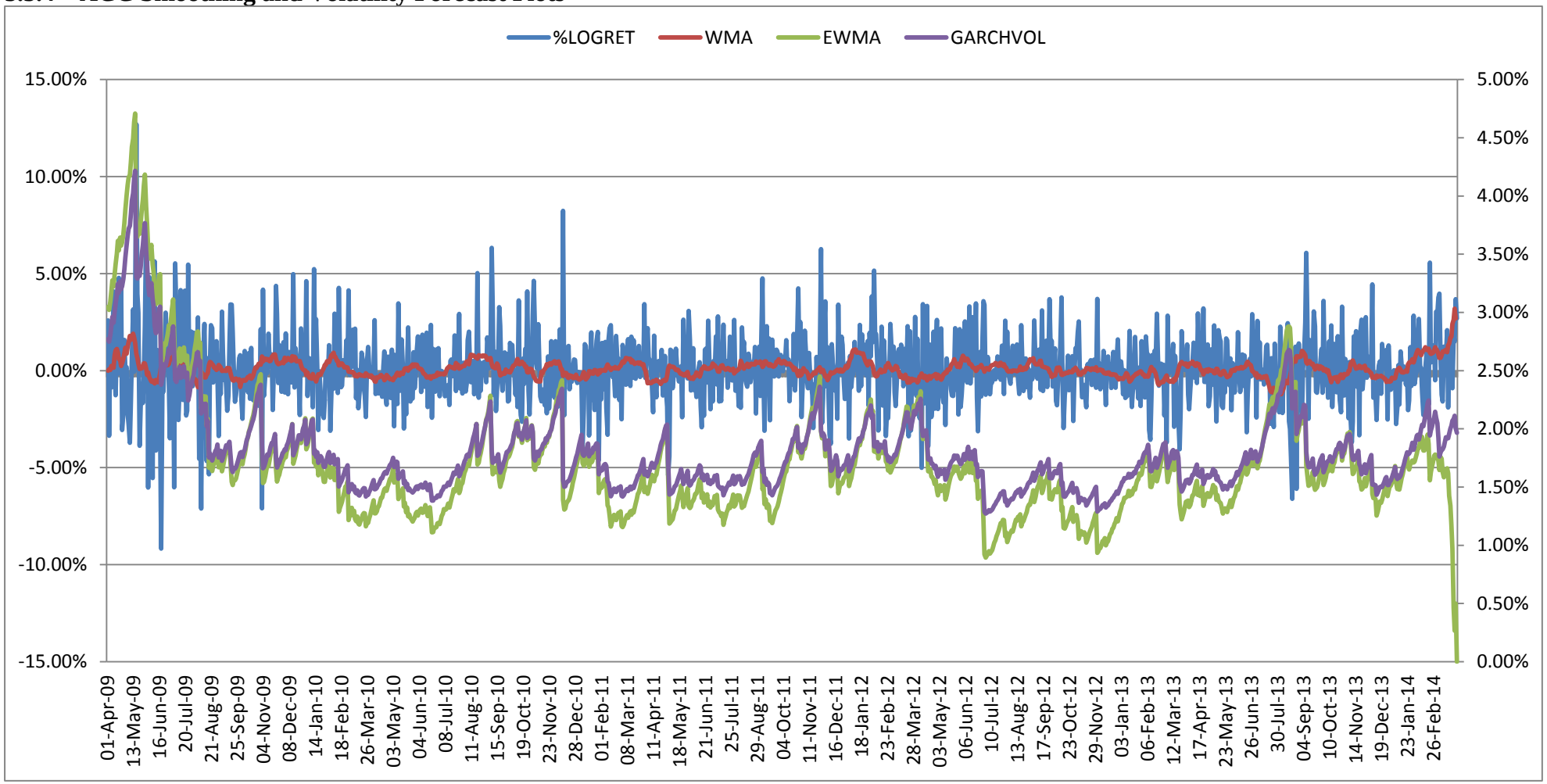
5.5.2 Hero Moto Corp Smoothing and volatility Forecast Plots



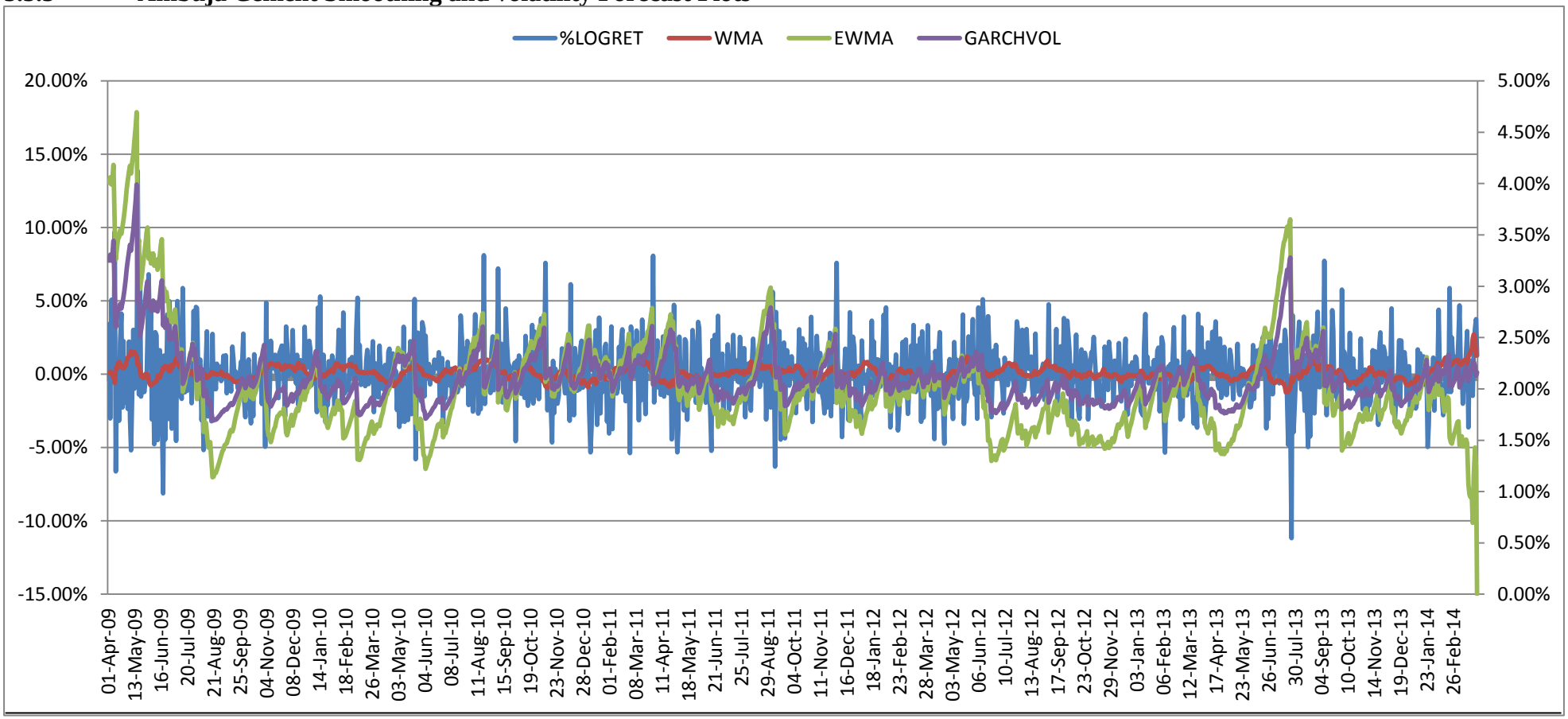
5.5.3 Maruti Suzuki Smoothing and volatility Forecast Plots



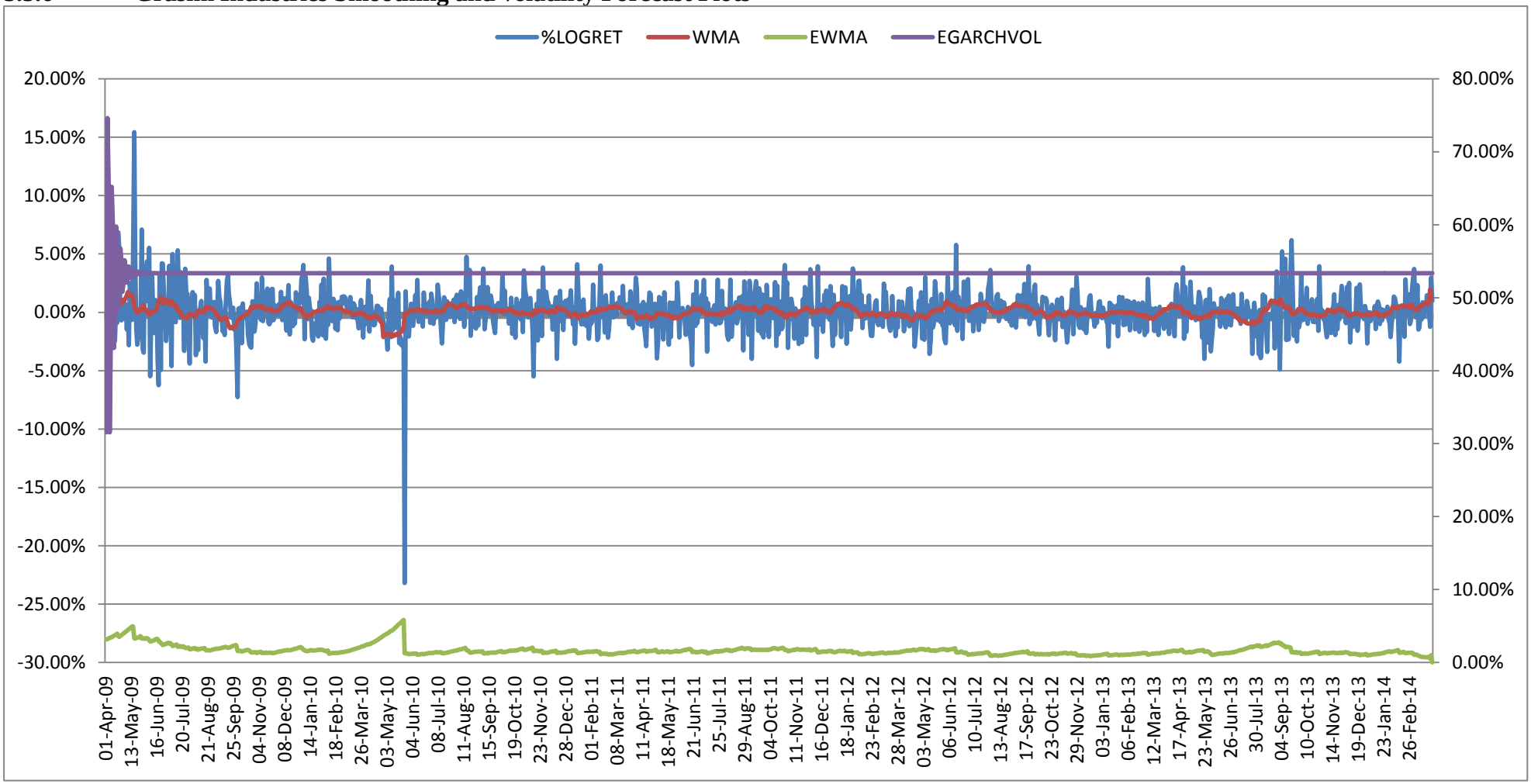
5.5.4 ACC Smoothing and Volatility Forecast Plots



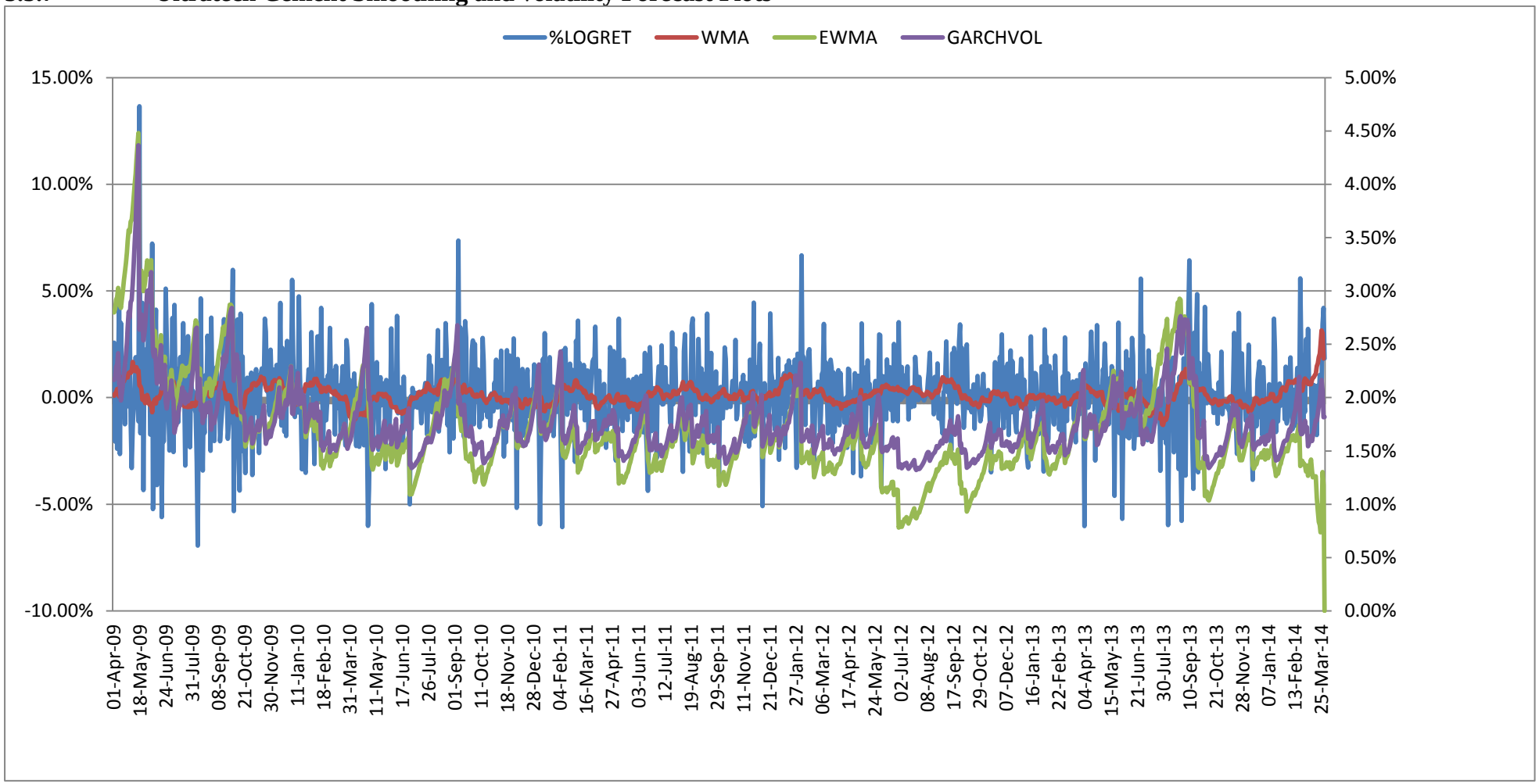
5.5.5 Ambuja Cement Smoothing and volatility Forecast Plots



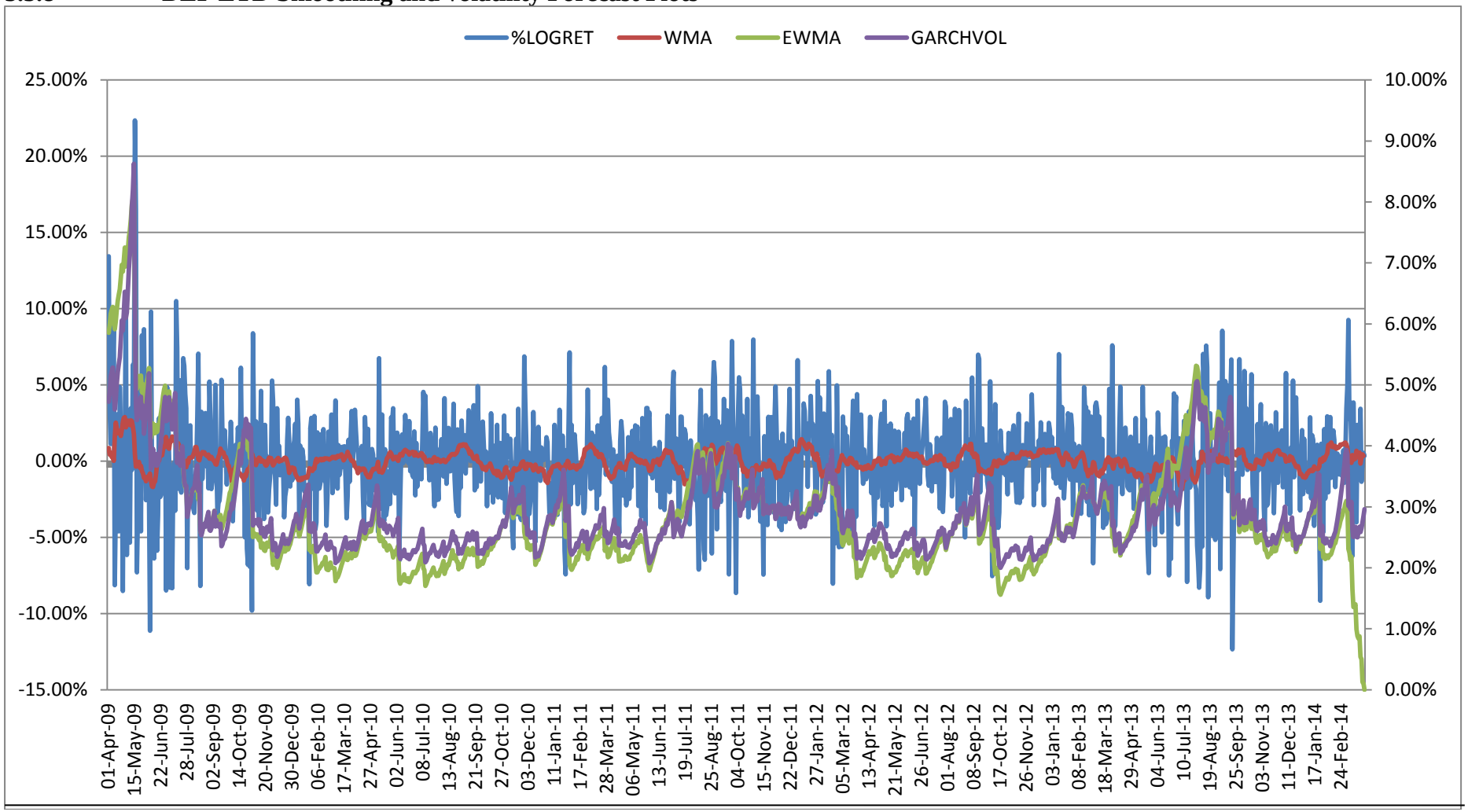
5.5.6 Grasim Industries Smoothing and volatility Forecast Plots



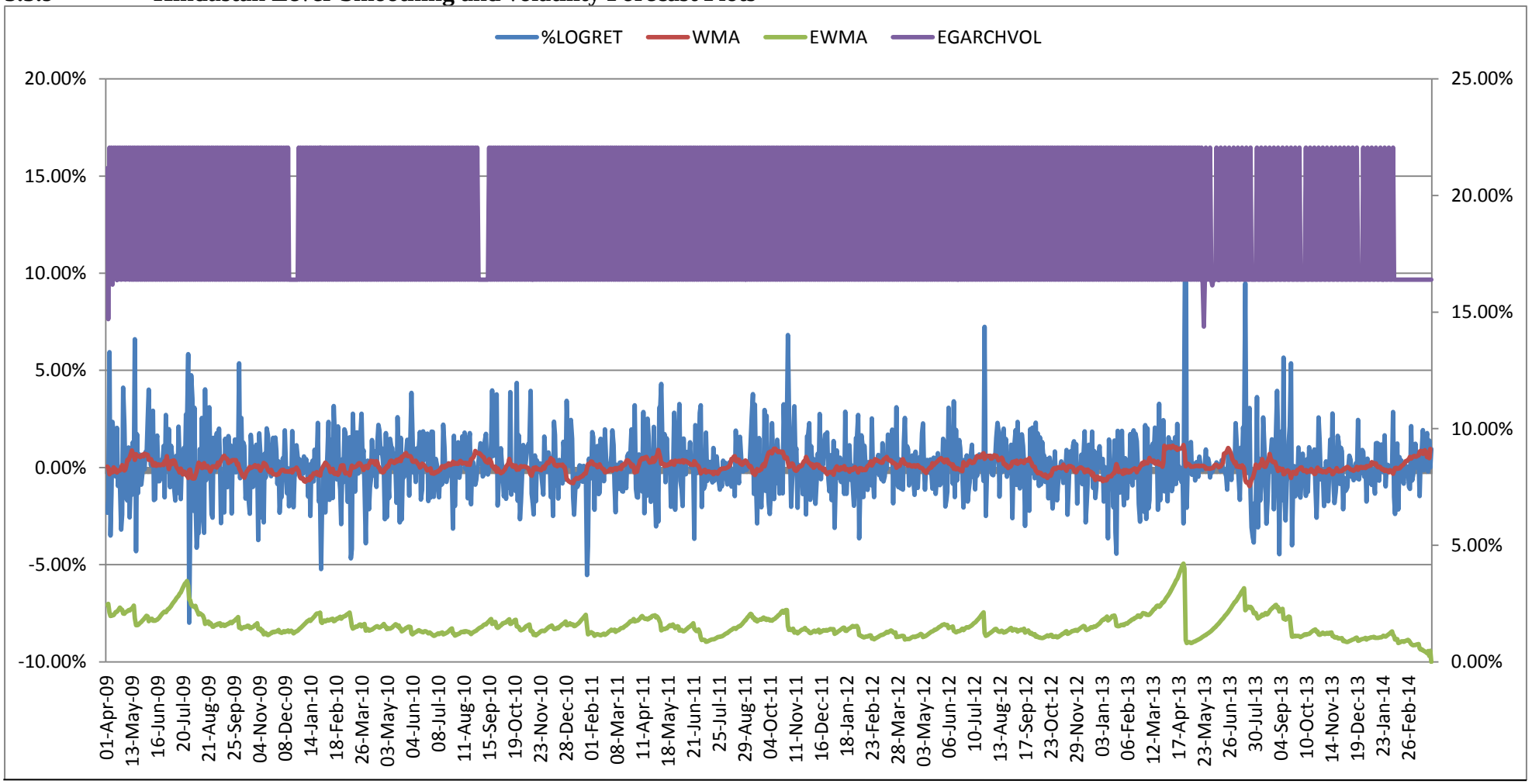
5.5.7 Ultratech Cement Smoothing and volatility Forecast Plots



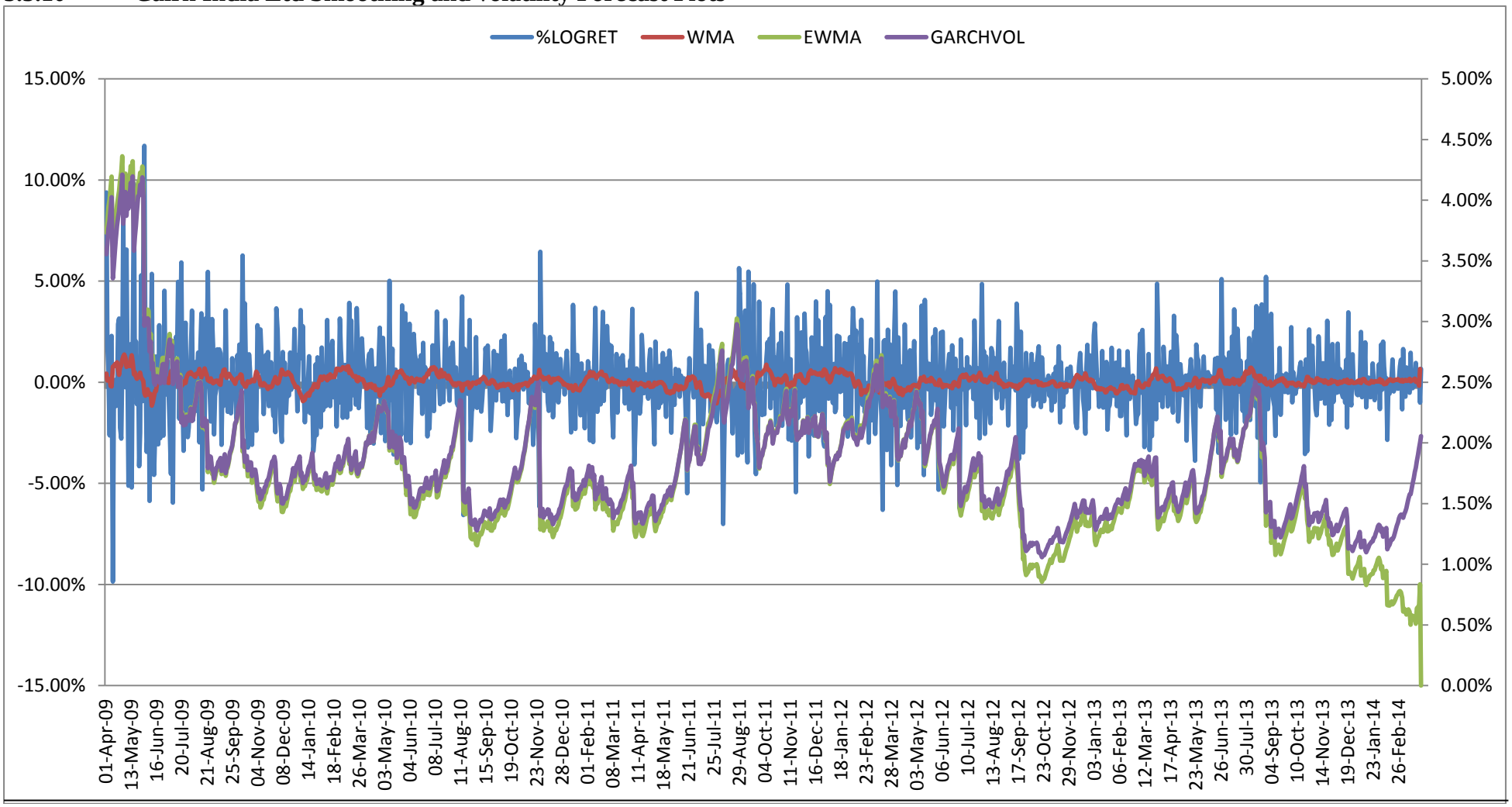
5.5.8 DLF LTD Smoothing and volatility Forecast Plots



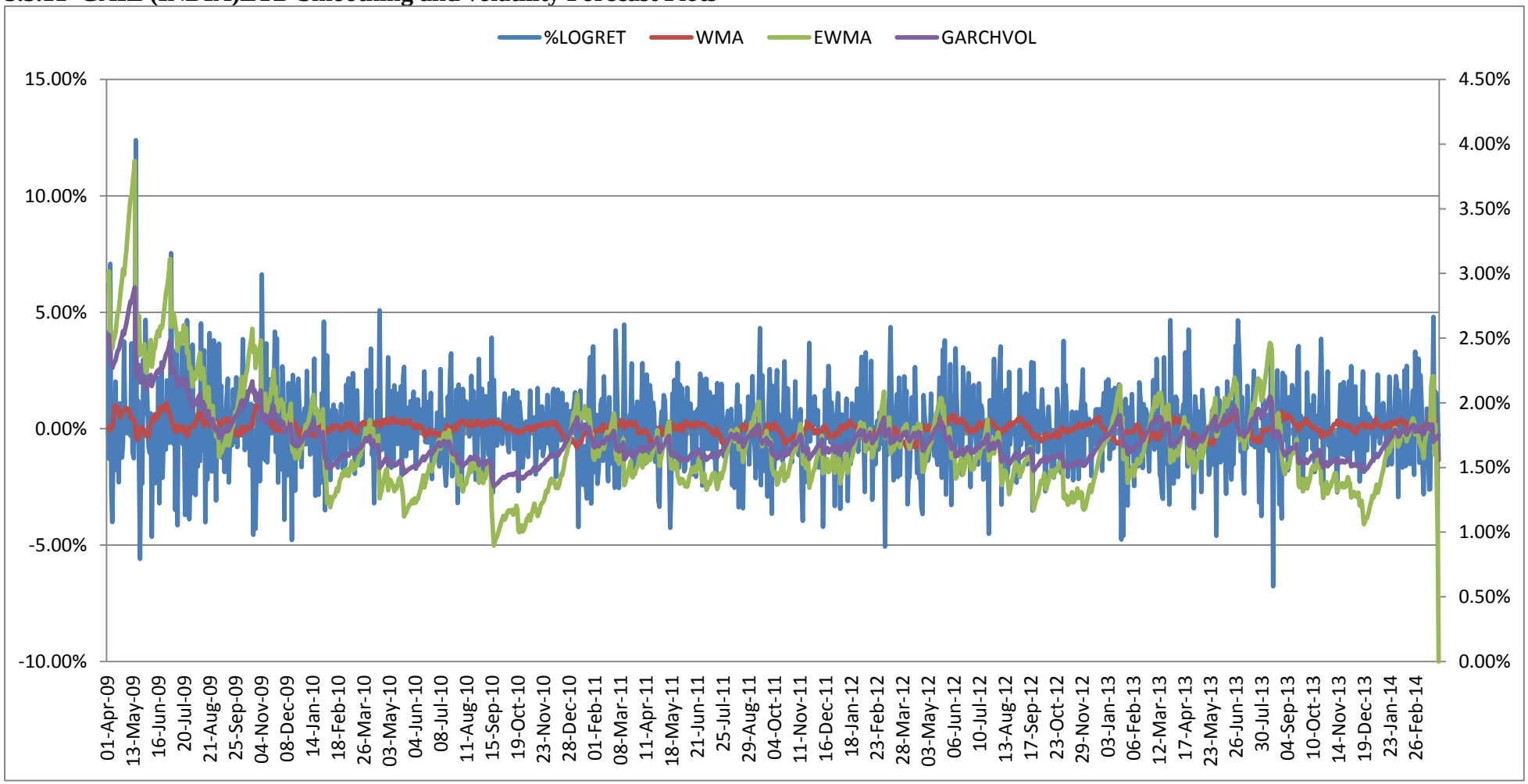
5.5.9 Hindustan Lever Smoothing and volatility Forecast Plots



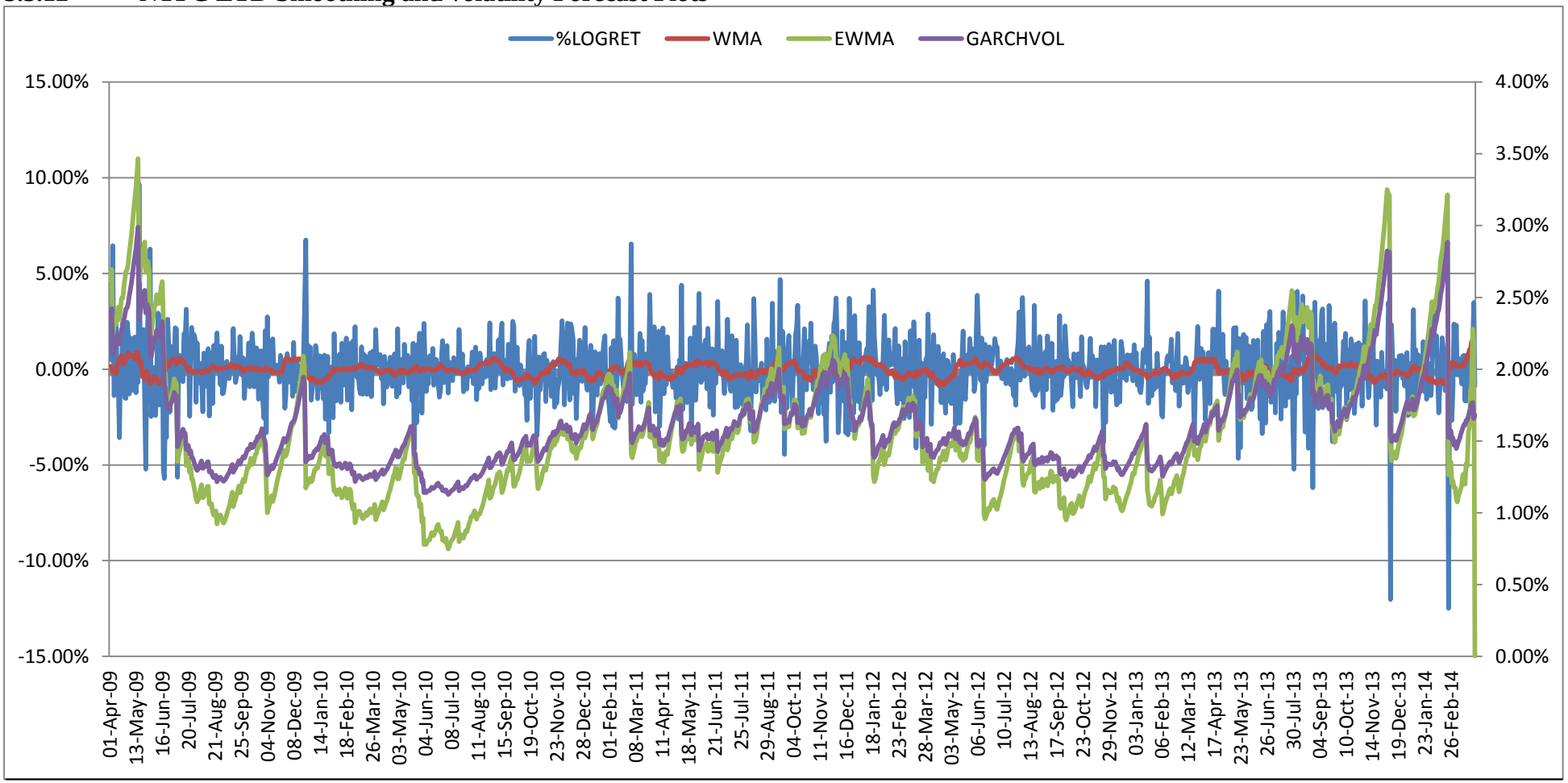
5.5.10 Cairn India Ltd Smoothing and volatility Forecast Plots



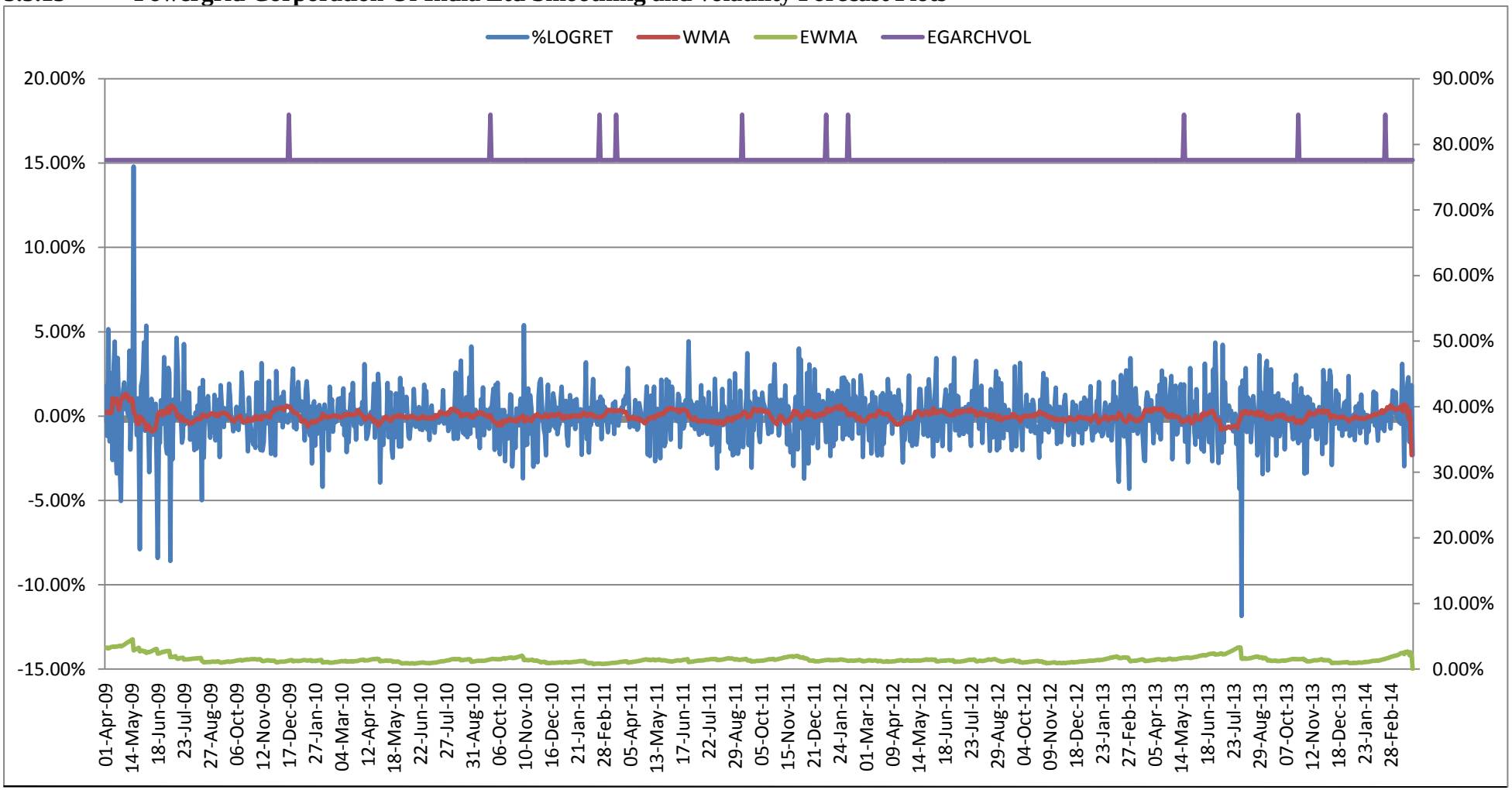
5.5.11 GAIL (INDIA)LTD Smoothing and volatility Forecast Plots



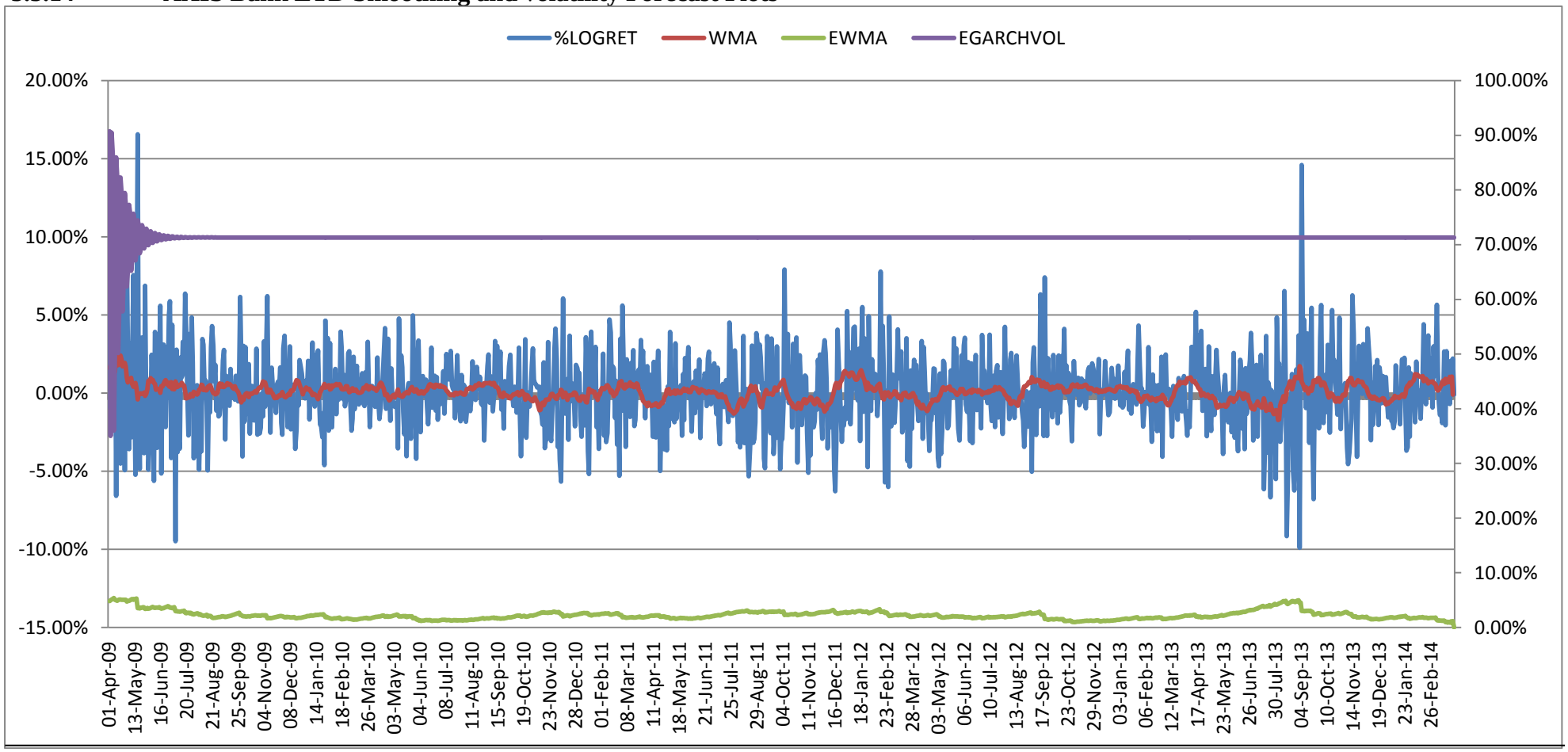
5.5.12 NTPC LTD Smoothing and volatility Forecast Plots



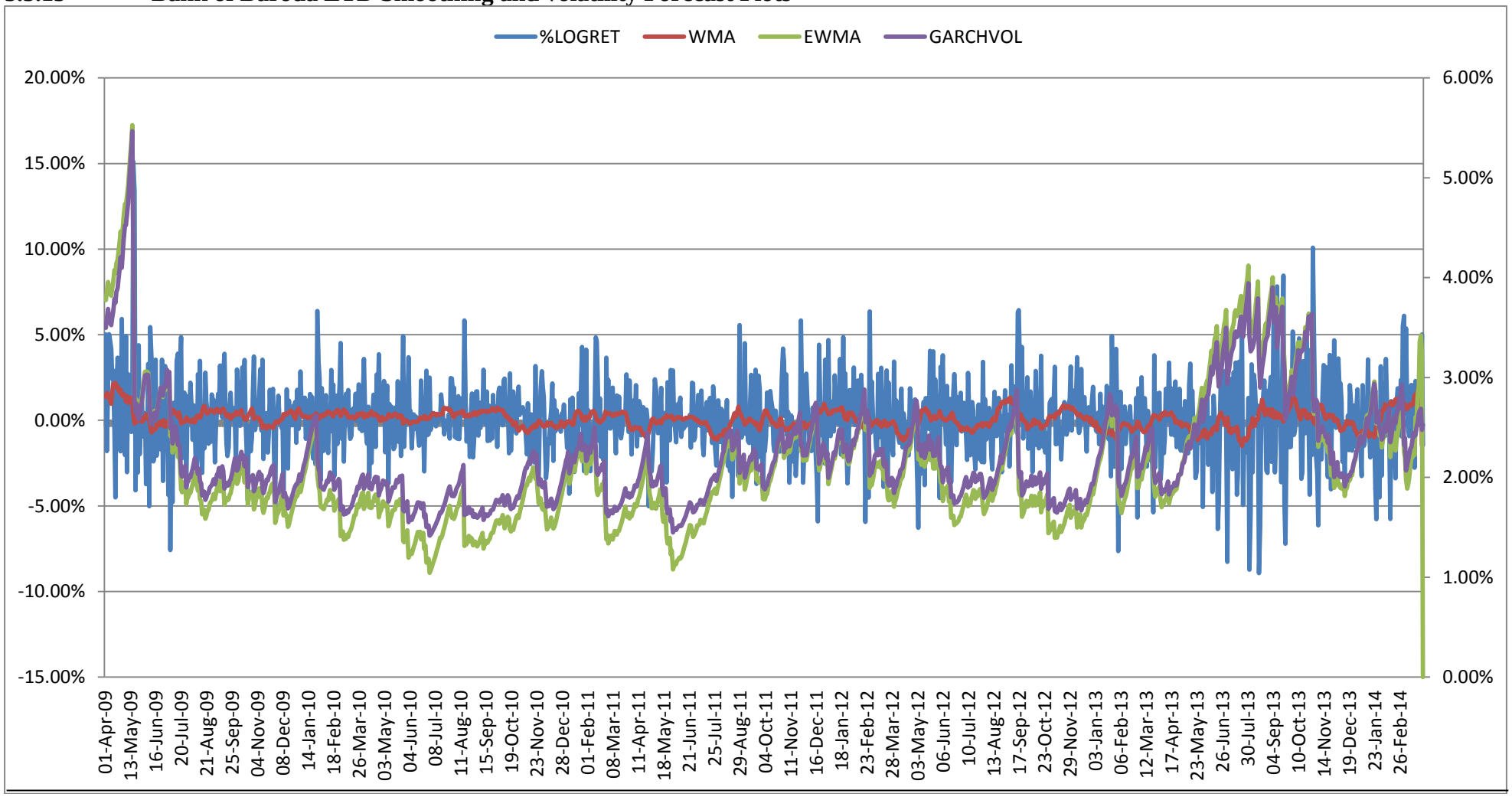
5.5.13 Powergrid Corporation Of India Ltd Smoothing and volatility Forecast Plots



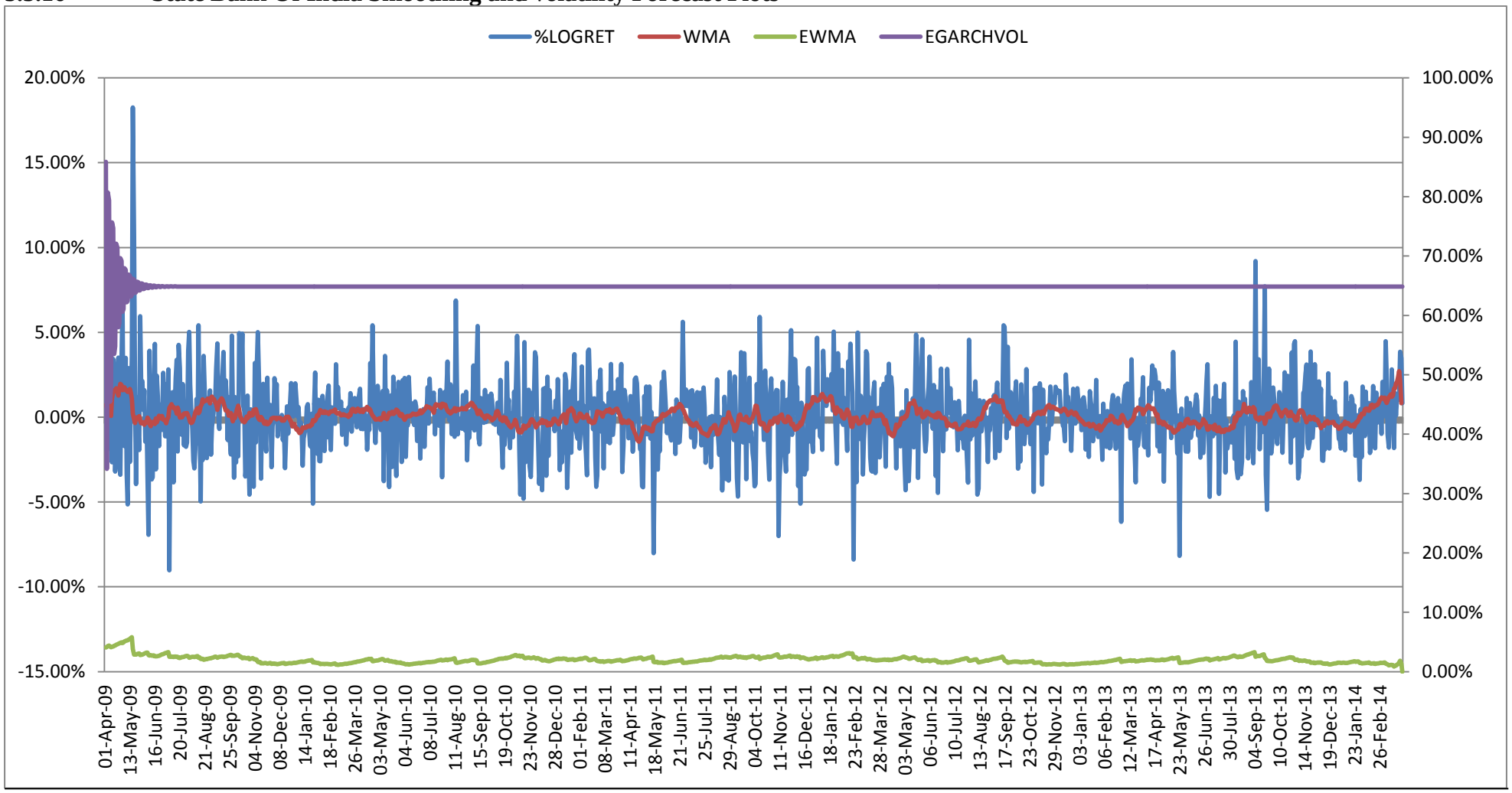
5.5.14 AXIS Bank LTD Smoothing and volatility Forecast Plots



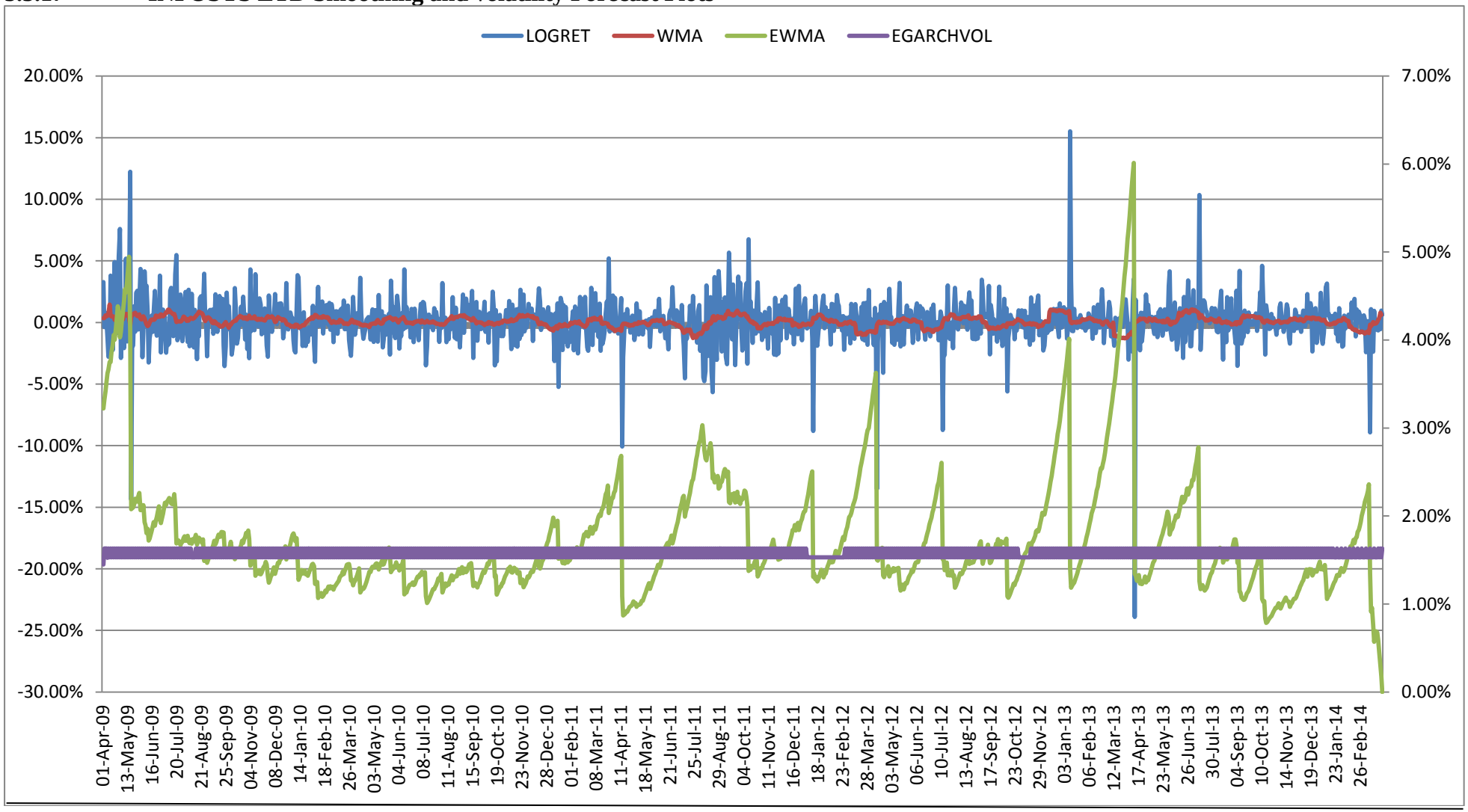
5.5.15 Bank of Baroda LTD Smoothing and volatility Forecast Plots



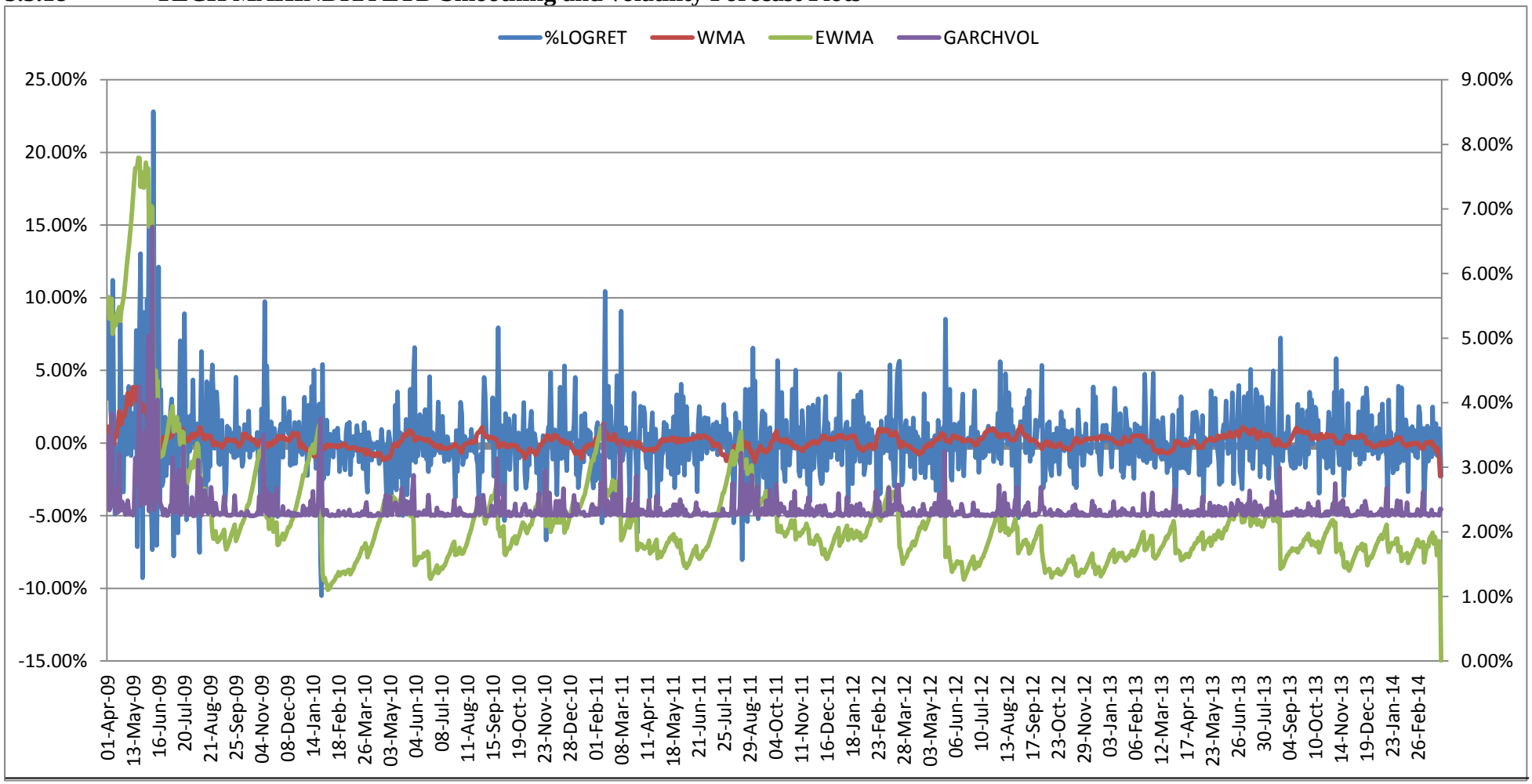
5.5.16 State Bank Of India Smoothing and volatility Forecast Plots



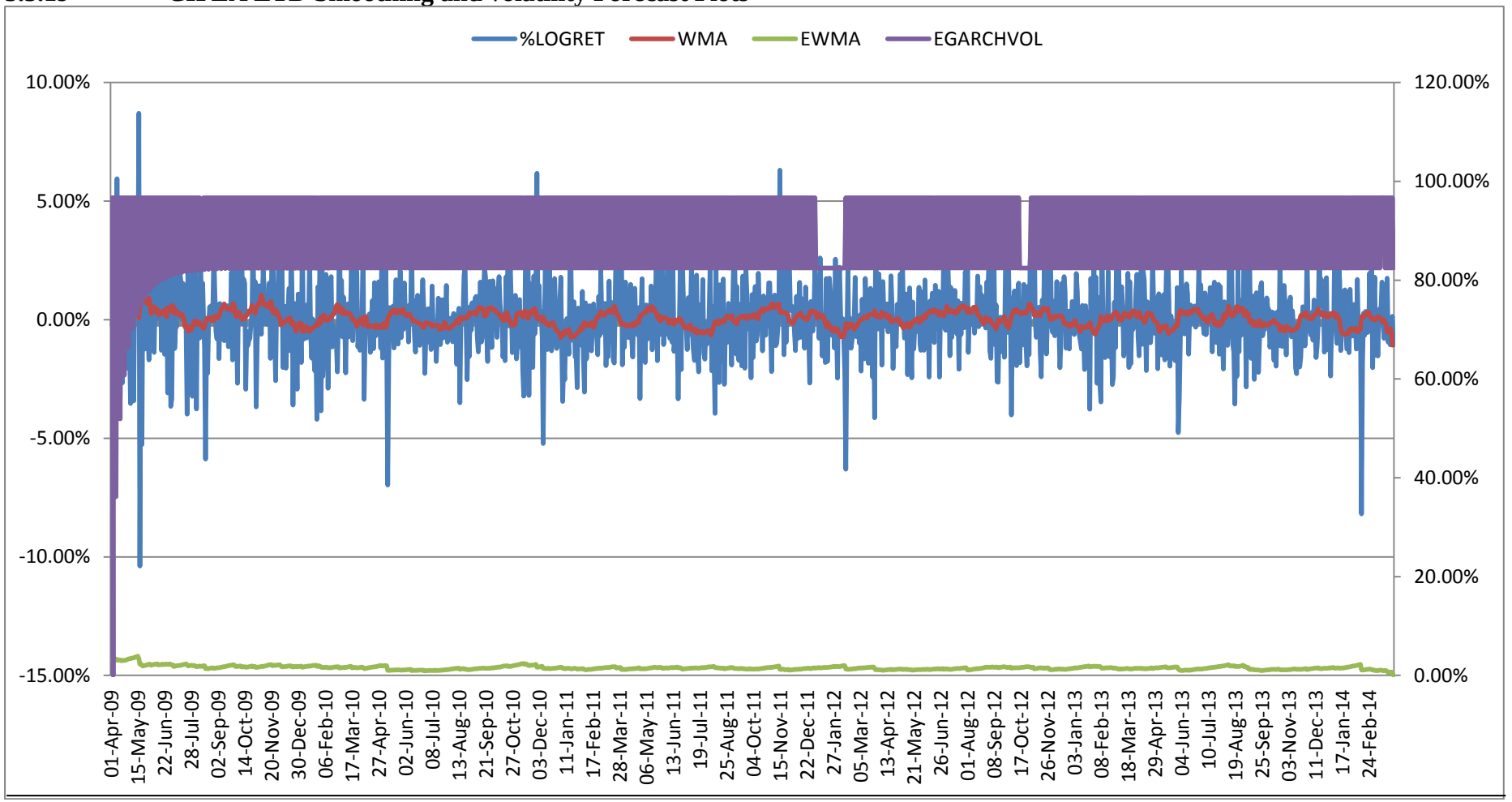
5.5.17 INFOSYS LTD Smoothing and volatility Forecast Plots



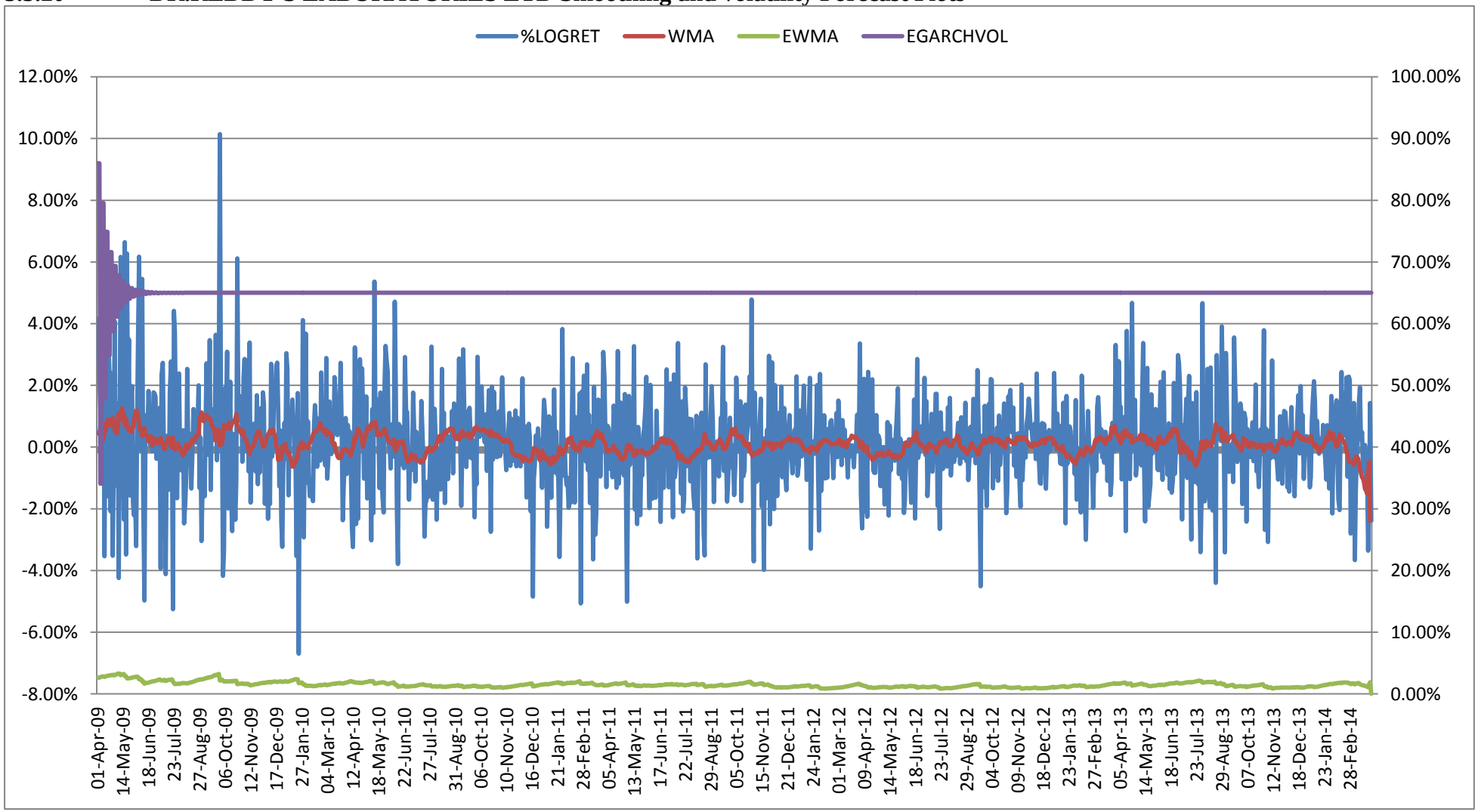
5.5.18 TECH MAHINDRA LTD Smoothing and volatility Forecast Plots



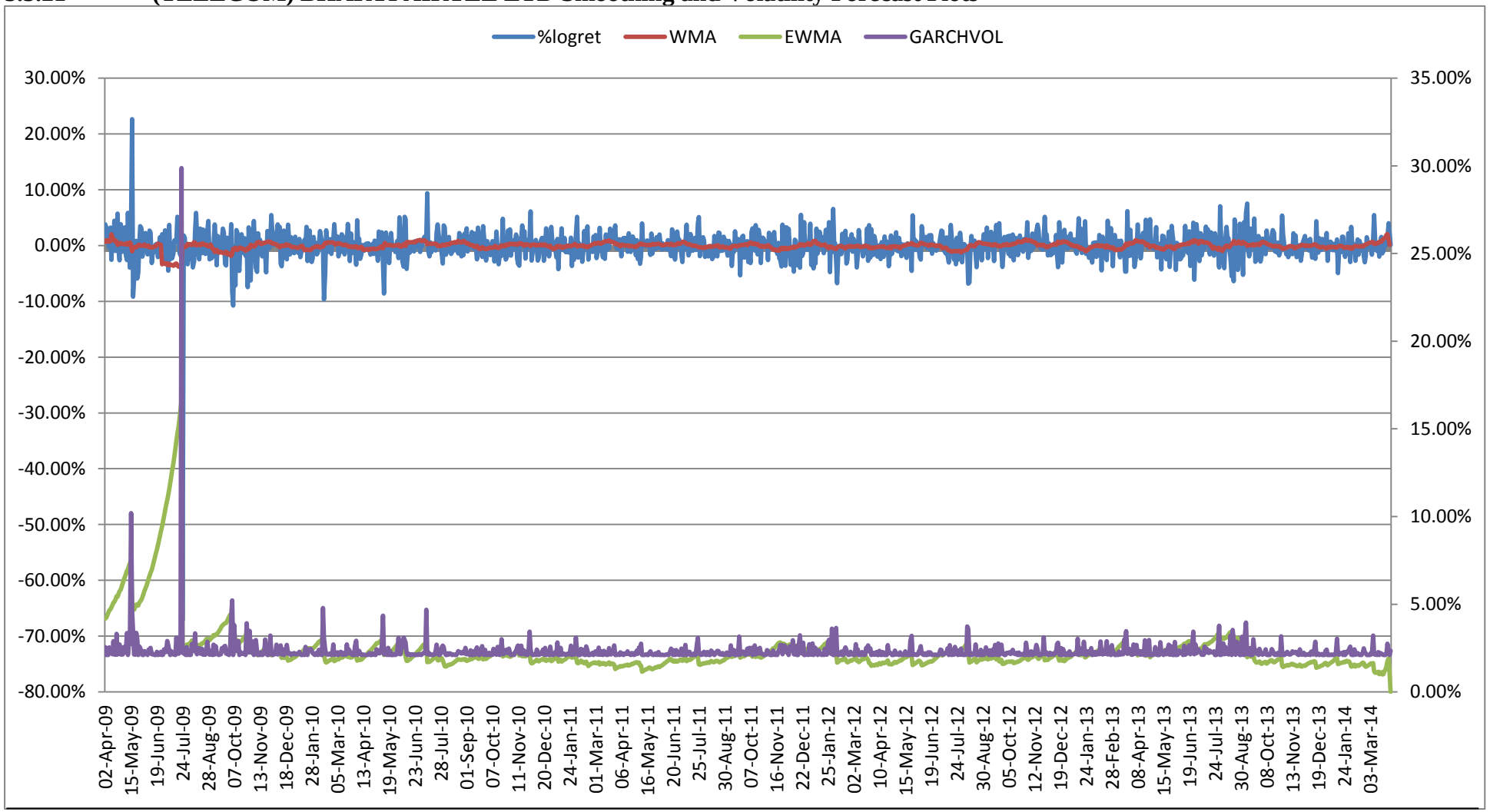
5.5.19 CIPLA LTD Smoothing and volatility Forecast Plots



5.5.20 DR.REDDY'S LABORATORIES LTD Smoothing and volatility Forecast Plots



5.5.21 (TELECOM) BHARTI AIRTEL LTD Smoothing and Volatility Forecast Plots



Part IX: Observations and Findings on Secondary Data

1) **Tables 1, 2, 3 are self-explanatory and contains results of hypothesis testing done**

2) **White Noise Test (Ljung-Box Test Statistic)**

Q:- Is There Are A Significant Serial Correlation In The Stock Daily Returns Of The Time Series Data?

If The P Value > 5 % We Accept The Ho:-$\rho_1 = \rho_2 = \rho_3 = \ldots\ldots\ldots = \rho_m = 0$, Implying That There Is No Statistically Significant Serial (Auto) Correlation As Indicated By The Daily Log Returns. Here M Indicates The Max Number Of Lags, Which Can Be Arbitrarily Chosen, But We Obtain Best Results By Choosing M= Ln (N), Where N Is Number Of Sample Observations, We Get A Value Of M = 7.2 And Hence We Have Considered A Max Lag Of 8 Cases Except For Coal India Stock Which Has Fewer Observations Hence We Observe That In This Case We Have Taken Only Seven Lags.

White Noise Effect → Conditional Mean → Arma/Arima

The Following Stocks Have Depicted Significant Correlation In The Daily Log Returns.

Table 5.40 Auto Correlation in Lag Order Number

Sr. No.	COMPANY STOCK NAME	AUTO CORRELATION FOUND IN LAG ORDER NO.
1)	BAJAJ AUTO	1
2)	HERO MOTO CORP	3 to 8
3)	MARUTI SUZUKI	6 to 8
4)	ACC	7, 8
5)	AMBUJA CEMENTS	1, 2
6)	GRASIM	1, 2, 3, 7, 8
7)	ULTRATECH CEMENT	4, 8
8)	DLF	1 to 6
9)	L& T	1,2, 3, 7, 8

10)	CAIRN	2 to 8
11)	GAIL	4, 6
12)	POWERGRID	All 8 Lags
13)	RELIANCE	3
14)	AXIS BANK	1 to 4
15)	BANK OF BARODA	1
16)	ICICI BANK	All 8 Lags
17)	INDUSIND BANK	7, 8
18)	PUNJAB NATIONAL BANK	All 8 Lags
19)	STATE BANK OF INDIA	All 8 Lags
20)	HCL	2 to 8
21)	INFOSYS	2 to 8
22)	TECH MAHINDRA	All 8 Lags
23)	NMDC	All 8 Lags
24)	SESA STERLITE	7
25)	TATA STEEL	2 to 8
26)	CIPLA	1, 3, 6, 8

3) Arch Test (Auto Regressive Heteroscedasticity) Test

a) Means Of Detecting Presence Of Fat Tails In The Underlying Empirical Data Distribution, And If That Were True What Would This Test Tell You, That A Test For Excess Kurtosis Could Not?

b) In Sum Arch Test Helps Us To Detect A Time Varying Phenomenon, In The Conditional Volatility And Thus Suggests Different Types Of Models To Capture These Dynamics

c) Arch Effect → Conditional Volatility → Arch/Garch/Garch-M/Egarch Models.

d) H0:- $\rho_1 = \rho_2 = \rho_3 = \ldots\ldots\ldots\ldots = \rho_m = 0$, Here ρ , Is The Population Autocorrelation Function For Squared Time Series ($y_t = x_t^2$)

e) The Arch Test Is A Vital Tool For Examining The Time Dynamics Of The Second Moment (Conditional Variance). The Presence Of An Significant Excess Kurtosis Is Not Indicative Of A Time Varying Volatility, But The Reverse Is True.

f) A Significant Arch Effect Identifies A Time-Varying Conditional Volatility, Volatility Clustering (Or Mean Reversion), And As A Result, The Presence Of A Fat Tailed Distribution (That Is Excess Kurtosis > 0).

g) P < 5%, We Reject H0:- True. Which Means That We Have A Time Varying Kurtosis (4th Moment), And Also Suggests Time Varying Phenomenon In Conditional Volatility. Following Stocks Have Been Observed To Have A Significant Arch Effect :-

HEROMOTOCORP, MAHINDRA & MAHINDRA, ACC, MARUTI SUZUKI, AMBUJA CEMENTS (FOR LAG 2), ULTRATECH CEMENT, DLF, HINDUSTAN UNILEVER, CAIRN, GAIL (LAG 4 TO LAG 8), POWERGRID (LAG 6 TO LAG 8), AXIS BANK, BANK OF BARODA, ICICI, IDFC, PUNJAB NATIONAL BANK, SBI, HINDUSTAN COMPUTERS LTD, INFOSYS (LAG 1 AND LAG 2), TECH MAHINDRA, HINDALCO, NMDC, SESA STERLITE, TATA STEEL, CIPLA, DR REDDY'S LABORATORIES.

4) Correlogram Analysis

a) We Have Established That The Log Daily Returns Distribution Has Fat Tails And May Be Fatter On Left Side Than On The Right, But Where Is The Time Varying Claim Coming From?

b) Using The Acf/Pacf Plots We Proceed To Model The Conditional Volatility As An Arma (Aka Garch).

c) Many Financial Time Series Data Sets Exhibits Time Interdependency Among Their Values. This Is Important To Detect And Will Eventually Factor In To Improve The Forecast Quality Of Model.

d) Correlogram Is a Key Tool to Explore the Interdependency of Observation Values, And It Can Also Be Used as A tool To Identify the Model and to Estimate the Order of Components of the Model.

e) We Need To Observe Each Plots Of Acf/Pacf, And See If The Bars Are Within The Upper And Lower Limit, Which Indicates No Serial Correlation In Squared Log Returns, If Not Identify Which Lag Number Has Significant Serial Correlation.

f) We Did Find That Few Stocks Log Returns May Not Be Correlated, But May Be The Squared Return Values Are Correlated, Which Signals To Us The Appropriate Use Of An Arch/Garch Model, To Improve Our Forecast Of Out-Of Sample Observations.

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5) Stationarity In Time Series

a) We Apply An Indirect Test For Existence Of A Unit Root. Two Common Tests for Unit Root Are: - **ADF** (Augmented Dickey-Fuller) Test and KPSS **(Kwiatkowski-Phillips-Schmidt-Shin)** Test.

b) The Adf Test Incorporates A Deterministic Trend (And Squared Trend), So It Allows A Stationary Process To Occur.

c) All P Values Using The Adf Test Are Less Than 5 %, Which Means The H0 Is True, Implying Presence Of Unit Root (Or Corroboration Of Random Walk Model Process).

d) Mathematically A Stationary Process Is A Stochastic Process Whose Joint Probability Distribution Does Not Change When Shifted In Time Or Space. Consequently The Parameters Such As Mean And Variance, Also Does Not Change As A Result Of A Shift In Time Or Position. This Is Often Referred To As Strict- Form Of Stationary Process. The Data Sample Plots Look Stationary

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CHAPTER 6

GANN ANALYSIS

Gann Square of Nine, a square root calculator is employed on Indian Stock Markets for select twenty sample securities. An important tool not only for intraday traders but also for investors on long term basis.

Decision to Buy/Sell, Target and support and resistance levels, and stop loss order for buy and sell decisions for investors and speculators alike.

All quotes were taken as at 21st March 2014 when Sun appears to be at 0 degree Aries Sign in east, spring or vernal equinox. These quotes are enclosed in parentheses next to name of securities (our Sample of select twenty stocks) in the first column, along with Resistance and Support Price levels, five values each and the prices at which to buy the security at or above followed by targets which are calculated by multiplying the Resistance levels by a factor of 0.9995,followed by Prices at or below which to sell and target levels for the same are obtained by multiplying the support levels by a factor of 1.0005, also indicated are the stop loss orders for buy and sell.

Source:- Gann Calculator-- Pivottrading.net by Sourabh Gandhi : free download on cell phone from internet.

Refer Tables 6.1 and 6.2

TABLE 6.1 GANN SUPPORT AND RESISTANCE PRICE LEVELS

VERNAL EQUINOX	ALL QUOTES TAKEN AS AT 21ST MARCH 2014, WHEN SUN APPEARS TO BE AT 0DEGREES ARIES SIGN										EAST
		RESISTANCE					SUPPORT				
NAME OF THE STOCK/INDEX	NUMBER 1										
	CENTER ONE	1	2	3	4	5	1	2	3	4	5
S & P CNX NIFTY (NSE INDIA) (6493.20)	6241	6520.56	6540.76	6561	6581.26	6601.56	6460.14	6440.06	6420.01	6400	6380.01
HERO MOTO CORP (2068.15)	1936	2081.64	2093.06	2104.51	2116	2127.51	2047.56	2036.26	2025	2013.76	2002.56
MARUTI SUZUKI LTD (1868.55)	1764	1881.39	1892.25	1903.14	1914.06	1925.01	1849	1838.26	1827.56	1816.89	1806.25
ACC LTD (1270.15)	1156	1287.01	1296	1305.01	1314.06	1323.14	1260.25	1251.39	1242.56	1233.76	1225
AMBUJA CEMENTS (184.5)	144	189.06	192.51	196	199.51	203.06	178.89	175.56	172.26	169	165.76
GRASIM INDUSTRIES (2744.30)	2601	2769.39	2782.56	2795.76	2809	2822.26	2730.06	2717.01	2704	2691.01	2678.06
ULTRATECH CEMENTS LTD (1955.30)	1849	1969.14	1980.25	1991.39	2002.56	2013.76	1936	1925.01	1914.06	1903.14	1892.25
DLF LTD (171.10)	144	175.56	178.89	182.25	185.64	189.06	165.76	162.56	159.39	156.25	153.14
HINDUSTAN UNILEVER LTD (571.70)	484	582.01	588.06	594.14	600.25	606.39	564.06	558.14	552.25	546.39	540.56
CAIRN INDIA LTD (330.05)	289	337.64	342.25	346.89	351.56	356.26	324	319.51	315.06	310.64	306.25
GAIL (INDIA) (353.05)	289	361	365.76	370.56	375.39	380.25	346.89	342.25	337.64	333.06	328.51
NTPC (113.85)	81	118.26	121	123.76	126.56	129.39	110.25	107.64	105.06	102.51	100
POWERGRID (100.85)	81	105.06	107.64	110.25	112.89	115.56	97.51	95.06	92.64	90.25	87.89
CIPLA (387.95)	324	395.01	400	405.01	410.06	415.14	380.25	375.39	370.56	365.76	361
DR.REDDY'S LABORATORIES (2778.6)	2601	2795.76	2809	2822.26	2835.56	2848.89	2756.25	2743.14	2730.06	2717.01	2704
AXIS BANK LTD (1394.25)	1296	1406.25	1415.64	1425.06	1434.51	1444	1378.26	1369	1359.76	1350.56	1341.39
BANK OF BARODA (656.15)	576	663.06	669.51	676	682.51	689.06	643.89	637.56	631.26	625	618.76
STATE BANK OF INDIA (1702.15)	1600	1722.25	1732.64	1743.06	1753.51	1764	1691.26	1681	1670.76	1660.56	1650.39
INFOSYS LTD (3305.65)	3136	3320.64	3335.06	3349.51	3364	3378.51	3277.56	3263.26	3249	3234.76	3220.56
TECH MAHINDRA (1808.95)	1681	1827.56	1838.26	1849	1859.76	1870.56	1795.64	1785.06	1774.51	1764	1753.51
BHARTI AIRTEL (292.45)	256	297.56	301.89	306.25	310.64	315.06	284.76	280.56	276.39	272.25	268.14

GANN CALCULATORS CAN BE DOWNLOADED ON CELL PHONES WHICH CAN DISPLAY SUPPORT / RESISTANCE PRICE LEVELS

TABLE 6.2 GANN :- BUY/ SELL/ TARGET PRICE LEVELS AND STOP LOSS ORDER LEVELS												
NAME OF THE STOCK/INDEX	BUYAT/ABOVE	TARGETS				STOP LOSS	SELLAT/BELOW	TARGETS				STOP LOSS
		1	2	3	4			1	2	3	4	
S & P CNX NIFTY (NSE INDIA) (6493.20)	6500.39	6517.29	6537.48	6557.71	6577.96	6480.25	6480.25	6463.37	6443.28	6423.22	6403.2	6500.39
HERO MOTO CORP (2068.15)	2070.25	2080.59	2092.01	2103.45	2114.94	2058.89	2058.89	2048.58	2037.27	2026.01	2014.76	2070.25
MARUTI SUZUKI LTD (1868.55)	1870.56	1880.44	1891.3	1902.18	1913.1	1859.76	1859.76	1849.92	1839.17	1828.47	1817.79	1870.56
ACC LTD (1270.15)	1278.06	1286.36	1295.35	1304.35	1313.4	1269.14	1269.14	1260.88	1252.01	1243.18	1234.37	1278.06
AMBUJA CEMENTS (184.5)	185.64	188.96	192.41	195.9	199.41	182.25	182.25	178.97	175.64	172.34	169.08	185.64
GRASIM INDUSTRIES (2744.30)	2756.25	2768	2781.16	2794.36	2807.59	2743.14	2743.14	2731.42	2718.36	2705.35	2692.35	2756.25
ULTRATECH CEMENTS LTD (1955.30)	1958.06	1968.15	1979.25	1990.39	2001.55	1947.01	1947.01	1936.96	1925.97	1915.01	1904.09	1958.06
DLF LTD (171.10)	172.26	175.47	178.8	182.15	185.54	169	169	165.84	162.64	159.46	156.32	172.26
HINDUSTAN UNILEVER LTD (571.70)	576	581.71	587.76	593.84	599.94	570.01	570.01	564.34	558.41	552.52	546.66	576
CAIRN INDIA LTD (330.05)	333.06	337.47	342.07	346.71	351.38	328.51	328.51	324.16	319.66	315.21	310.79	333.06
GAIL (INDIA) (353.05)	356.26	360.81	365.57	370.37	375.2	351.56	351.56	347.06	342.42	337.8	333.22	356.26
NTPC (113.85)	115.56	118.2	120.93	123.69	126.49	112.89	112.89	110.3	107.69	105.11	102.56	115.86
POWERGRID (100.85)	102.51	105	107.58	110.19	112.83	100	100	97.55	95.1	92.68	90.29	102.51
CIPLA (387.95)	390.06	394.81	399.8	404.8	409.85	385.14	385.14	380.44	375.57	370.74	365.94	390.06
DR.REDDY'S LABORATORIES (2778.6)	2782.56	2794.36	2807.59	2820.84	2834.14	2769.39	2769.39	2757.62	2744.51	2731.42	2718.36	2782.56
AXIS BANK LTD (1394.25)	1396.89	1405.54	1414.93	1424.34	1433.79	1387.56	1387.56	1378.94	1369.68	1360.43	1351.23	1396.89
BANK OF BARODA (656.15)	656.64	662.72	669.17	675.66	682.16	650.25	650.25	644.21	637.87	631.57	625.31	656.64
STATE BANK OF INDIA (1702.15)	1711.89	1721.38	1731.77	1742.18	1752.63	1701.56	1701.56	1692.1	1681.84	1671.59	1661.39	1711.89
INFOSYS LTD (3305.65)	3306.25	3318.97	3333.39	3347.83	3362.31	3291.89	3291.89	3279.19	3264.89	3250.62	3236.37	3306.25
TECH MAHINDRA (1808.95)	1816.89	1826.64	1837.34	1848.07	1858.83	1806.25	1806.25	1796.53	1785.95	1775.39	1764.88	1816.89
BHARTI AIRTEL (292.45)	293.26	297.41	301.73	306.09	310.48	289	289	284.9	280.7	276.52	272.38	293.26

CHAPTER 7

Portfolio Management

The ultimate objective of this research was to build an optimal portfolio of twenty sample stocks of the NSE (Nifty Fifty) population, carefully chosen to possess low risk and fulfilling the data adequacy and no abnormalities found in the data analysis section including the exploratory data analysis and data sampling plots.

Table 7.1: **Excess Return to Risk Ratio of NSE Nifty Fifty Population**.

All 50 stocks of NSE Ltd considered, risk free rate of return assumed to be 7% per annum. We have taken the drift adjusted rate of return of these securities(Refer Table 1 of Data Analysis section) and beta of each security taken from simple linear regression analysis done by regressing the returns on each security versus the returns on NSE Market Index.(Refer Table 9 of data analysis section).

As per Sharpe's Methodology, we compute the excess returns on the stock to the systematic risk of each security $[R_i - R_f] / \beta_{i,}$ where R_i refers to adjusted rate of return earned on the security,R_f is the risk free rate of return and β_i is the systematic risk of security with respect to the Market beta considered to be 1.

Next we rank these securities in descending order from highest ratio to lowest value.

Table 7.2: Select Sample of Twenty Stocks from NSE Population.

Sample twenty securities were selected based on these rankings and other factors for building an optimal portfolio for the investor, like least risky assets, no abnormalities in the process of model forecasting exercise besides looking at the exploratory data analysis and other aberrations observed.

- Standard deviation (Total Risk or Volatility) of each security taken from Table 1 of Data analysis section.
- Compute the Total Variance on security by squaring the standard deviation on security returns.
- We compute the systematic variance as :($\beta_i)^2 * (\sigma_m)^2$ where market variance is the square of market standard deviation (σ_m), which is 20.64%.
- Residual Variance = Total Variance minus Systematic Variance.

Table 7.3: Sharpe's Portfolio Optimization Model[i] -Case A: When Short sales are not allowed

Sharpe's model emphasizes the role played by Idiosyncratic Volatility and we aim to construct corner portfolio from this sample twenty stocks by employing the cut-off point which is computed as under:

a) $[(R_i - R_F)* \beta_I]/ (\sigma_{e_i})^2$, where denominator of a) denotes residual or idiosyncratic volatility.

b) Take Cumulative value of a) above.

c) $\beta_i{}^2/ (\sigma_{e_i})^2$

d) Take the cumulative value of c) above.

e) Cut-off point: $C_i = \{(\sigma_m)^2 * \sum [(R_i - R_F) * \beta_I]/ (\sigma_{e_i})^2 \} / 1 + (\sigma_m)^2 \sum \beta_i{}^2/ (\sigma_{e_i})^2$

We take the highest value in the cut-off point column which is 0.210560559

Table 7.4: CASE B: When Short sales are permitted

a) $Z_i = \frac{\beta_i}{\sigma^2 e_i} * [[R_i - R_f] / \beta_{i,} - C_i]$, the second part of this formula is the relative investment in each security and the first part scales the weights on each security such that the total is 1.

b) Proportion of investment in each security is obtained as follows

$X_i = Z_i/ \sum Z_i$

c) Finally we compute the Portfolio Variance of this optimal portfolio thus constructed, which is computed as the sum of two components.

1) Systematic variance: $[(\sum X_i \beta_i)^2 * (\sigma_m)^2]$

2) Residual Variance: $[\sum X^2{}_i *(\sigma_{e_i})^2]$

When short sales are allowed formulae are same as in short sales not allowed except for the cut-off point which is the last cut-off point in the column of cut-off point and all twenty stocks are considered.

Table 7.5: Mutual Fund Performance Metrics[ii]

1) CAPM Returns (SML-- Security Market Line): E $[R_p]$ = R_f + β_p* (R_m - R_f), where (R_m - R_f) is the market price of risk or market risk premium.

2) CML Returns (Capital Market Line): $R_p = R_f + \frac{\sigma_p}{\sigma_m} * (R_m - R_f)$

3) Sharpe's Index = (R_p - R_f) / σ_p

4) Treynor's Index = (R_p - R_f) / β_p

5) Jensen's Alpha: Measures difference between the returns on portfolio and returns as stipulated by SML.

6) Adjusted Jensen's Alpha is Jensen's alpha metric divided by beta of the portfolio.

7) M2 Risk Adjusted Rate of return [iii]

$$R_{adj} = R_f + (R_p - R_f) * \frac{\sigma_m}{\sigma_p}$$

Table7.6:**Eugene Fama's Decomposition of excess returns: Four factor model**

1) Risk free rate of return

2) Impact of Systematic Risk: β_p* (R_m - R_f)

3) Impact of Imperfect Diversification: [$\frac{\sigma_p}{\sigma_m}$ - β_p] * (R_m - R_f)

4) Impact of Net Selectivity is the difference between the portfolio return and CML returns.

(Refer Tables 7.1 to 7.6 and Appendix 7 on Portfolio Management.)

Short sales is a concept commonly used in trading circles wherein without physical possession of shares the trader orders for stocks not held by him to buy or sell, for which regulatory norms are specified for trader to maintain a margin account with his bank.

We observe that for an incremental risk to be borne by the trader there is marked improvement in his portfolio returns, if short sales strategy is being resorted to by the trader.

Standard Finance textbooks contain these models and the Modern Portfolio Management Models proposes that the said models can be employed for individual assets as well as portfolios, hence Mutual fund performance metrics were suitably employed in this study on the select sample of twenty stocks from NSE Nifty Fifty Population, in arriving at the risk-return-utility triad for the investor.

Eugene Fama's decomposition of excess returns, four factor model was employed on the empirical data set of twenty stocks in ascertaining the issue of idiosyncratic volatility being priced in the Indian Stock Markets, indeed a revelation thereby challenging the Diversification conundrum.

All Tables Computed based on the following values:-

1) Risk free rate of return assumed 7%.
2) Market rate of return Computed as 17.64%.
3) Standard deviation of Market returns as 20.64%

[i] Source: Security Analysis & Portfolio Management, 6th Edition Donald.E.Fischer, Ronald.J.Jordan. Pearson Education, pg 610 to 615 chapter 18. Portfolio Selection.

[ii] Source: Investment Analysis & Portfolio Management, Prasanna Chandra, 2nd Edition, Tata McGraw Hill, pg. 585 to 607.

[iii] Source: Portfolio Construction, Management & Protection, Strong 4th Edition, Thomson pg. 503.

TABLE 7.1 RANKING OF SELECT SAMPLE TWENTY EQUITY STOCKS/PORTFOLIO SELECTED FROM NSE NIFTY FIFTY POPULATION

SECURITY	RETURN Ri	Ri - Rf	beta	(Ri - Rf)/beta	RANK NUMBER	SECURITY	(Ri - Rf)/beta
2. Hero Motocorp Ltd.	0.2016	0.1316	0.659563	0.19952605	1	47. Dr. Reddy's Laboratories	0.639685857
4. Maruti Suzuki Ltd.	0.2268	0.1568	0.756619	0.207237725	2	37. Tech Mahindra Ltd	0.470606132
6.ACC Ltd.	0.2268	0.1568	0.783601	0.200101838	3	9. Ultratech Cements Co.Ltd	0.402923069
7. Ambuja Cements Ltd.	0.252	0.182	0.832761	0.2185501	4	13. Hindustan Unilever Ltd.	0.360919424
8.Grasim Indts.Ltd.	0.1764	0.1064	0.737141	0.144341449	5	24. Bank of Baroda	0.232283626
9. Ultratech Cements Co.Ltd	0.3276	0.2576	0.639328	0.402923069	6	7. Ambuja Cements Ltd.	0.2185501
10. DLF Ltd.	0.126	0.056	1.6417	0.034110983	7	35.Infosys Ltd.	0.216383308
13. Hindustan Unilever Ltd.	0.2268	0.1568	0.434446	0.360919424	8	4. Maruti Suzuki Ltd.	0.207237725
16.CAIRN India Ltd.	0.1764	0.1064	0.816728	0.13027593	9	6.ACC Ltd.	0.200101838
17. GAIL (India) Ltd.	0.126	0.056	0.642789	0.087120346	10	2. Hero Motocorp Ltd.	0.19952605
18. NTPC Ltd.	-0.0504	-0.1204	0.674049	-0.178622029	11	23.Axis Bank Ltd.	0.187421377
20. Powergrid Ltd.	0.0504	-0.0196	0.667413	-0.029367124	12	8.Grasim Indts.Ltd.	0.144341449
23.Axis Bank Ltd.	0.3276	0.2576	1.374443	0.187421377	13	16.CAIRN India Ltd.	0.13027593
24. Bank of Baroda	0.3024	0.2324	1.000501	0.232283626	14	46. Cipla Ltd.	0.11383826
32. State Bank of India	0.1764	0.1064	1.207444	0.088120029	15	32. State Bank of India	0.088120029
35.Infosys Ltd.	0.2268	0.1568	0.72464	0.216383308	16	17. GAIL (India) Ltd.	0.087120346
37. Tech Mahindra Ltd	0.4536	0.3836	0.815119	0.470606132	17	10. DLF Ltd.	0.034110983
46. Cipla Ltd.	0.126	0.056	0.491926	0.11383826	18	20. Powergrid Ltd.	-0.029367124
47. Dr. Reddy's Laboratories	0.3528	0.2828	0.442092	0.639685857	19	50. Bharti Airtel Ltd.	-0.111033875
50. Bharti Airtel Ltd.	-0.0252	-0.0952	0.857396	-0.111033875	20	18. NTPC Ltd.	-0.178622029

TABLE 7.2 COMPUTATION OF VARIANCE FOR SELECT SAMPLE TWENTY EQUITY STOCKS									
RANKED SECURITY	RETURN Ri	Ri - Rf	beta	REWARD TO RISK RATIO	BETA SQUARED	STD DEV OF RETURNS	TOTAL VARIANCE	SYSTEMATIC VARIANCE	RESIDUAL VARIANCE
47. Dr. Reddy's Laboratories	0.3528	0.2828	0.442092	0.639685857	0.195445336	0.2524	0.06370576	0.008326159	0.055379601
37. Tech Mahindra Ltd	0.4536	0.3836	0.815119	0.470606132	0.664418984	0.3937	0.15499969	0.028304887	0.126694803
9. Ultratech Cements Co.Ltd	0.3276	0.2576	0.639328	0.402923069	0.408740292	0.2857	0.08162449	0.017412729	0.064211761
13. Hindustan Unilever Ltd.	0.2268	0.1568	0.434446	0.360919424	0.188743327	0.2603	0.06775609	0.008040647	0.059715443
24. Bank of Baroda	0.3024	0.2324	1.000501	0.232283626	1.001002251	0.3572	0.12759184	0.042643657	0.084948183
7. Ambuja Cements Ltd.	0.252	0.182	0.832761	0.2185501	0.693490883	0.3381	0.11431161	0.029543377	0.084768233
35.Infosys Ltd.	0.2268	0.1568	0.72464	0.216383308	0.52510313	0.3048	0.09290304	0.022369897	0.070533143
4. Maruti Suzuki Ltd.	0.2268	0.1568	0.756619	0.207237725	0.572472311	0.3159	0.09979281	0.02438787	0.07540494
6.ACC Ltd.	0.2268	0.1568	0.783601	0.200101838	0.614030527	0.2905	0.08439025	0.02615829	0.05823196
2. Hero Motocorp Ltd.	0.2016	0.1316	0.659563	0.19952605	0.435023351	0.3191	0.10182481	0.018532412	0.083292398
23.Axis Bank Ltd.	0.3276	0.2576	1.374443	0.187421377	1.88909356	0.3889	0.15124321	0.080477199	0.070766011
8.Grasim Indts.Ltd.	0.1764	0.1064	0.737141	0.144341449	0.543376854	0.2889	0.08346321	0.023148376	0.060314834
16.CAIRN India Ltd.	0.1764	0.1064	0.816728	0.13027593	0.667044626	0.3096	0.09585216	0.028416741	0.067435419
46. Cipla Ltd.	0.126	0.056	0.491926	0.11383826	0.241991189	0.2619	0.06859161	0.010309057	0.058282553
32. State Bank of India	0.1764	0.1064	1.207444	0.088120029	1.457921013	0.3445	0.11868025	0.062108835	0.056571415
17. GAIL (India) Ltd.	0.126	0.056	0.642789	0.087120346	0.413177699	0.2778	0.07717284	0.017601767	0.059571073
10. DLF Ltd.	0.126	0.056	1.6417	0.034110983	2.69517889	0.4905	0.24059025	0.114817208	0.125773042
20. Powergrid Ltd.	0.0504	-0.0196	0.667413	-0.02936712	0.445440113	0.2476	0.06130576	0.018976176	0.042329584
50. Bharti Airtel Ltd.	-0.0252	-0.0952	0.857396	-0.11103387	0.735127901	0.4731	0.22382361	0.031317154	0.192506456
18. NTPC Ltd.	-0.0504	-0.1204	0.674049	-0.17862203	0.454342054	0.2603	0.06775609	0.019355408	0.048400682

TABLE 7.3 SHARPE'S OPTIMIZATION MODEL : - SHORT SALES NOT ALLOWED												
Security	(Ri-Rf)/ Bi	Beta/res var	Zi	Xi = Zi/sum Zi	Adj Ret	Beta	Res Var	Wtd return	Wtd Beta	Res Var	Sys Var	Total Var
47. Dr. Reddy's Laboratories	0.639685857	7.982939416	3.4256813	0.402923133	0.3528	0.4421	0.055379601	0.142151281	0.178129094	0.008990715	0.001351727	0.010342442
37. Tech Mahindra Ltd	0.470606132	6.433720862	1.6730606	0.196782707	0.4536	0.8151	0.126694803	0.089260636	0.160401323	0.004906058	0.001096062	0.00600212
9. Ultratech Cements Co.Ltd	0.402923069	9.95655606	1.9152681	0.225270763	0.3276	0.6393	0.064211761	0.073798702	0.144021906	0.003258549	0.000883642	0.004142191
13. Hindustan Unilever Ltd.	0.360919424	7.275270476	1.0939014	0.128662929	0.2268	0.4344	0.059715443	0.029180752	0.055897095	0.000988538	0.000133106	0.001121644
24. Bank of Baroda	0.232283626	11.77777985	0.2558495	0.030092608	0.3024	1.0005	0.084948183	0.009100005	0.030107684	7.69261E-05	3.86166E-05	0.000115543
7. Ambuja Cements Ltd.	0.2185501	9.823975022	0.0784891	0.009231756	0.252	0.8328	0.084768233	0.002326403	0.007687847	7.2244E-06	2.51784E-06	9.74224E-06
35.Infosys Ltd.	0.216383308	10.27375179	0.0598215	0.007036106	0.2268	0.7246	0.070533143	0.001595789	0.005098644	3.49187E-06	1.10746E-06	4.59933E-06
		TOTAL	8.5020714	1			Total	0.347413567			Total	0.021738282
Market Variance	0.04260096										std dev	0.14743908

Summary Sheet Short Sales not allowed		
	Portfolio Return	34.74%
	Portfolio Std dev	14.74%
	Portfolio CV	42.44%

TABLE 7.4 SHARPE'S OPTIMIZATION MODEL : - SHORT SALES ALLOWED													
RANKED SECURITY	Final Cutoff	(Ri-Rf)/ Beta	Beta/res var	Zi	Xi = Zi/sum Zi	Adj Ret	Beta	Res Var	Wtd return	Wtd Beta	Res Var	Sys Var	Total Var
47. Dr. Reddy's Laboratories	0.083605095	0.639685857	7.982939416	4.071194019	0.614831316	0.3528	0.442092	0.0553796	0.21691249	0.27181201	0.02093446	0.00314743	0.024081895
37. Tech Mahindra Ltd	0.146541918	0.470606132	6.433720862	2.193301196	0.331232129	0.4536	0.815119	0.1266948	0.15024689	0.2699936	0.01390029	0.00310546	0.017005748
9. Ultratech Cements Co.Ltd	0.188807802	0.402923069	9.95655606	2.720370556	0.410830091	0.3276	0.639328	0.0642118	0.13458794	0.26265518	0.01083775	0.00293894	0.013776693
13. Hindustan Unilever Ltd.	0.201830359	0.360919424	7.275270476	1.682190972	0.254044313	0.2268	0.434446	0.0597154	0.05761725	0.11036854	0.00385395	0.00051893	0.004372877
24. Bank of Baroda	0.208530728	0.232283626	11.77777985	1.208218896	0.182465098	0.3024	1.000501	0.0849482	0.05517745	0.18255651	0.00282822	0.00141976	0.00424798
7. Ambuja Cements Ltd.	0.209858414	0.2185501	9.823975022	0.872870786	0.131820859	0.252	0.832761	0.0847682	0.03321886	0.10977527	0.001473	0.00051337	0.001986363
35.Infosys Ltd.	0.210560559	0.216383308	10.27375179	0.890572847	0.134494223	0.2268	0.72464	0.0705331	0.03050329	0.09745989	0.00127585	0.00040464	0.001680495
4. Maruti Suzuki Ltd.	0.210231976	0.207237725	10.03407735	0.778029353	0.117497915	0.2268	0.756619	0.0754049	0.02664853	0.08890116	0.00104102	0.00033669	0.001377716
6.ACC Ltd.	0.209008674	0.200101838	13.45654515	0.947378683	0.143073035	0.2268	0.783601	0.058232	0.03244896	0.11211217	0.001192	0.00053546	0.001727459
2. Hero Motocorp Ltd.	0.208473499	0.19952605	7.918645864	0.552935515	0.083504267	0.2016	0.659563	0.0832924	0.01683446	0.05507632	0.00058079	0.00012923	0.000710021
23.Axis Bank Ltd.	0.203760328	0.187421377	19.42236088	1.121104439	0.169309081	0.3276	1.374443	0.070766	0.05546565	0.23270568	0.00202855	0.00230692	0.004335472
8.Grasim Indts.Ltd.	0.199586281	0.144341449	12.22155391	0.178953226	0.027025498	0.1764	0.737141	0.0603148	0.0047673	0.0199216	4.4053E-05	1.6907E-05	6.09597E-05
16.CAIRN India Ltd.	0.194623185	0.13027593	12.11126167	0.006987103	0.001055192	0.1764	0.816728	0.0674354	0.00018614	0.0008618	7.5085E-08	3.164E-08	1.06725E-07
46. Cipla Ltd.	0.19226587	0.11383826	8.440364647	-0.133870602	-0.020217125	0.126	0.491926	0.0582826	-0.0025474	-0.00994533	2.3822E-05	4.2136E-06	2.80356E-05
32. State Bank of India	0.176295619	0.088120029	21.3437121	-0.887450034	-0.134022616	0.1764	1.207444	0.0565714	-0.0236416	-0.1618248	0.00101614	0.0011156	0.002131742
17. GAIL (India) Ltd.	0.172761221	0.087120346	10.79028736	-0.459436137	-0.069384	0.126	0.642789	0.0595711	-0.0087424	-0.04459927	0.00028678	8.4737E-05	0.000371521
10. DLF Ltd.	0.157635295	0.034110983	13.05287663	-1.24769887	-0.188427359	0.126	1.6417	0.125773	-0.0237418	-0.3093412	0.00446556	0.00407657	0.008542125
20. Powergrid Ltd.	0.148126419	-0.02936712	15.76705801	-2.508005124	-0.378758684	0.0504	0.667413	0.0423296	-0.0190894	-0.25278847	0.00607252	0.00272229	0.00879481
50. Bharti Airtel Ltd.	0.143430917	-0.11103387	4.45385583	-1.07218961	-0.161921968	-0.0252	0.857396	0.1925065	0.00408043	-0.13883125	0.00504727	0.0008211	0.005868369
18. NTPC Ltd.	0.129699021	-0.17862203	13.9264359	-4.293813337	-0.648451263	-0.0504	0.674049	0.0484007	0.03268194	-0.43708793	0.02035196	0.00813874	0.028490693
			Total	6.621643879	1		Total	0.77361496				Total	
Market Variance	0.04260096											Std Dev	0.359987614

SUMMARY SHEET WHEN SHORT SALES IS ALLOWED	
Portfolio Return	77.36%
Portfolio Std Dev	36%
Portfolio CV	46.53%

TABLE 7.5 MUTUAL FUND PERFORMANCE METRICS

RANKED SECURITY	Risk Prem on Stock	Beta	Std Dev	Beta*(Rm-Rf)	sd of stock/ sd of mkt	Reciprocal of Col F	CAPM RETURNS	CML RETURNS	SHARPE INDEX	TREYNOR INDEX	JENSEN'S ALPHA	Adjusted Jensen's alpha	M2 Risk Adj Return
47. Dr. Reddy's Laboratories	0.2828	0.442092	0.2524	0.047038589	1.22286822	0.8177496	0.1170386	0.2001132	1.12044374	0.639685857	0.235761411	0.533285857	0.301259588
37. Tech Mahindra Ltd	0.3836	0.815119	0.3937	0.086728662	1.90746124	0.52425705	0.1567287	0.2729539	0.97434595	0.470606132	0.296871338	0.364206132	0.271105004
9. Ultratech Cements Co.Ltd	0.2576	0.639328	0.2857	0.068024499	1.38420543	0.72243612	0.1380245	0.2172795	0.90164508	0.402923069	0.189575501	0.296523069	0.256099545
13. Hindustan Unilever Ltd.	0.1568	0.434446	0.2603	0.046225054	1.26114341	0.79293123	0.1162251	0.2041857	0.60238187	0.360919424	0.110574946	0.254519424	0.194331617
24. Bank of Baroda	0.2324	1.000501	0.3572	0.106453306	1.73062016	0.57782755	0.1764533	0.254138	0.6506159	0.232283626	0.125946694	0.125883626	0.204287122
7. Ambuja Cements Ltd.	0.182	0.832761	0.3381	0.08860577	1.6380814	0.61047028	0.1586058	0.2442919	0.53830228	0.2185501	0.09339423	0.1121501	0.18110559
35.Infosys Ltd.	0.1568	0.72464	0.3048	0.077101696	1.47674419	0.67716535	0.1471017	0.2271256	0.5144357	0.216383308	0.079698304	0.109983308	0.176179528
4. Maruti Suzuki Ltd.	0.1568	0.756619	0.3159	0.080504262	1.53052326	0.65337132	0.1505043	0.2328477	0.49635961	0.207237725	0.076295738	0.100837725	0.172448623
6.ACC Ltd.	0.1568	0.783601	0.2905	0.083375146	1.40746124	0.71049914	0.1533751	0.2197539	0.53975904	0.200101838	0.073424854	0.093701838	0.181406265
2. Hero Motocorp Ltd.	0.1316	0.659563	0.3191	0.070177503	1.54602713	0.64681918	0.1401775	0.2344973	0.4124099	0.19952605	0.061422497	0.09312605	0.155121404
23.Axis Bank Ltd.	0.2576	1.374443	0.3889	0.146240735	1.88420543	0.53072769	0.2162407	0.2704795	0.66238107	0.187421377	0.111359265	0.081021377	0.206715454
8.Grasim Indts.Ltd.	0.1064	0.737141	0.2889	0.078431802	1.3997093	0.71443406	0.1484318	0.2189291	0.36829353	0.144341449	0.027968198	0.037941449	0.146015784
16.CAIRN India Ltd.	0.1064	0.816728	0.3096	0.086899859	1.5	0.66666667	0.1568999	0.2296	0.34366925	0.13027593	0.019500141	0.02387593	0.140933333
46. Cipla Ltd.	0.056	0.491926	0.2619	0.052340926	1.26889535	0.78808706	0.1223409	0.2050105	0.21382207	0.11383826	0.003659074	0.00743826	0.114132875

32. State Bank of India	0.1064	1.207444	0.3445	0.128472042	1.66908915	0.59912917	0.198472	0.2475911	0.30885341	0.088120029	-0.02207204	-0.018279971	0.133747344
17. GAIL (India) Ltd.	0.056	0.642789	0.2778	0.06839275	1.34593023	0.74298056	0.1383927	0.213207	0.20158387	0.087120346	-0.01239275	-0.019279654	0.111606911
10. DLF Ltd.	0.056	1.6417	0.4905	0.17467688	2.37645349	0.42079511	0.2446769	0.3228547	0.11416922	0.034110983	-0.11867688	-0.072289017	0.093564526
20. Powergrid Ltd.	-0.0196	0.667413	0.2476	0.071012743	1.1996124	0.83360258	0.1410127	0.1976388	-0.0791599	-0.02936712	-0.09061274	-0.135767124	0.053661389
50. Bharti Airtel Ltd.	-0.0952	0.857396	0.4731	0.091226934	2.29215116	0.4362714	0.1612269	0.3138849	-0.201226	-0.11103387	-0.18642693	-0.217433875	0.028466963
18. NTPC Ltd.	-0.1204	0.674049	0.2603	0.071718814	1.26114341	0.79293123	0.1417188	0.2041857	-0.4625432	-0.17862203	-0.19211881	-0.285022029	-0.02546892

TABLE 7.6 EUGENE FAMA'S DECOMPOSITION OF EXCESS RETURN

RANKED SECURITY	Beta	beta-beta target	Risk premium Manager	risk premium investor	CAPM RETURN	CML RETURN	Risk premium due to Divfn	Risk Premium Net Selectivity	Actual Return	verify D+E+H+I	Riskfree Rate	double verify
47. Dr. Reddy's Laboratories	0.442092	-0.557908	-0.059361411	0.1064	0.117039	0.200113	0.083074589	0.152686822	0.3528	0.2828	0.07	0.3528
37. Tech Mahindra Ltd	0.815119	-0.184881	-0.019671338	0.1064	0.156729	0.272954	0.116225214	0.180646124	0.4536	0.3836	0.07	0.4536
9. Ultratech Cements Co.Ltd	0.639328	-0.360672	-0.038375501	0.1064	0.138024	0.217279	0.079254958	0.110320543	0.3276	0.2576	0.07	0.3276
13. Hindustan Unilever Ltd.	0.434446	-0.565554	-0.060174946	0.1064	0.116225	0.204186	0.087960605	0.022614341	0.2268	0.1568	0.07	0.2268
24. Bank of Baroda	1.000501	0.000501	5.33064E-05	0.1064	0.176453	0.254138	0.077684678	0.048262016	0.3024	0.2324	0.07	0.3024
7. Ambuja Cements Ltd.	0.832761	-0.167239	-0.01779423	0.1064	0.158606	0.244292	0.08568609	0.00770814	0.252	0.182	0.07	0.252
35.Infosys Ltd.	0.72464	-0.27536	-0.029298304	0.1064	0.147102	0.227126	0.080023885	-0.000325581	0.2268	0.1568	0.07	0.2268
4. Maruti Suzuki Ltd.	0.756619	-0.243381	-0.025895738	0.1064	0.150504	0.232848	0.082343413	-0.006047674	0.2268	0.1568	0.07	0.2268
6.ACC Ltd.	0.783601	-0.216399	-0.023024854	0.1064	0.153375	0.219754	0.06637873	0.007046124	0.2268	0.1568	0.07	0.2268
2. Hero Motocorp Ltd.	0.659563	-0.340437	-0.036222497	0.1064	0.140178	0.234497	0.094319784	-0.032897287	0.2016	0.1316	0.07	0.2016
23.Axis Bank Ltd.	1.374443	0.374443	0.039840735	0.1064	0.216241	0.270479	0.054238722	0.057120543	0.3276	0.2576	0.07	0.3276
8.Grasim Indts.Ltd.	0.737141	-0.262859	-0.027968198	0.1064	0.148432	0.218929	0.070497267	-0.04252907	0.1764	0.1064	0.07	0.1764
16.CAIRN India Ltd.	0.816728	-0.183272	-0.019500141	0.1064	0.1569	0.2296	0.072700141	-0.0532	0.1764	0.1064	0.07	0.1764
46. Cipla Ltd.	0.491926	-0.508074	-0.054059074	0.1064	0.122341	0.20501	0.082669539	-0.079010465	0.126	0.056	0.07	0.126
32. State Bank of India	1.207444	0.207444	0.022072042	0.1064	0.198472	0.247591	0.049119044	-0.071191085	0.1764	0.1064	0.07	0.1764
17. GAIL (India) Ltd.	0.642789	-0.357211	-0.03800725	0.1064	0.138393	0.213207	0.074814227	-0.087206977	0.126	0.056	0.07	0.126
10. DLF Ltd.	1.6417	0.6417	0.06827688	0.1064	0.244677	0.322855	0.078177771	-0.196854651	0.126	0.056	0.07	0.126
20. Powergrid Ltd.	0.667413	-0.332587	-0.035387257	0.1064	0.141013	0.197639	0.056626016	-0.14723876	0.0504	-0.0196	0.07	0.0504
50. Bharti Airtel Ltd.	0.857396	-0.142604	-0.015173066	0.1064	0.161227	0.313885	0.152657949	-0.339084884	-0.0252	-0.0952	0.07	-0.0252
18. NTPC Ltd.	0.674049	-0.325951	-0.034681186	0.1064	0.141719	0.204186	0.062466845	-0.254585659	-0.0504	-0.1204	0.07	-0.0504

CHAPTER 8

Observations & Findings: Summary

A) **Primary Data Analysis** reveals predicting the type of investor based on their demographic factors are significant. Reference base considered as Conservative Investor and the categorical dependent variable (Aggressive Investor and Moderate investor) versus this reference categorical variable reveals the following, using Multivariate Logistic Regression model.

a) As age increases there is greater likelihood of the Investor being conservative than being Aggressive.

b) Male Investors are more aggressive than Female Investors.

c) Higher Qualification and Occupation and increase in Income more aggressive the investor compared to conservative investor.

d) As age increases Investor is more moderate as compared to being conservative.

e) Males are moderate investors compared to females.

f) With increase in Income, Qualification, and Occupation Investor is more conservative as compared to being moderate

Sample responses of at least 1000 respondents would significantly impact predictability of type of investor based on the demographic variables opines the Researcher.

B) **Secondary Data Analysis** of the entire NSE Nifty Fifty Population revealed the following characteristics:

a) The returns are penalized due to the volatility present in the stocks and NSE Market index, and drift adjusted returns are higher than the returns received by the investor during sample study span of five years ended 2014. These drift adjusted returns are employed for portfolio construction.

b) Indian stock markets are indeed Volatile, with the NSE index having annualized volatility of 20.64%, with volatility on Power Grid Ltd stock having the lowest annualized volatility factor of 24.76% and the highest volatility being recorded by two

stocks Asian Paints Ltd & Tata Power company Ltd recording annualized volatility figures of 106.84% and 109.22% respectively during the sample study span 2009 to 2014.

c) Descriptive Statistics, hypothesis testing revealed the following features

1) Majority of the stock had mean daily returns of zero percent, wherein the Null Hypothesis of Mean Zero returns were accepted and few stocks and NSE Market index had 0.06% daily returns where the Null Hypothesis was rejected.

2) Daily standard deviation of NSE Market index was 1.3%,which was the lowest and daily standard deviation of stock ranged from as low as 1.56% registered by Power Grid Ltd to a high of 6.88% recorded by Tata Power Company ltd.

3) Almost all stocks barring a few assets had Skewness in the Mean daily returns, and about 50% stocks recording negative skewness index and rest displaying positive skewness to the right, despite taking Lognormal of the daily closing stock price ratios.

4) Excess Kurtosis (Leptokurtosis/Fat tails) were significantly observed in all staocks and the Market.

5) Median Daily Returns on all 50 stocks were different from their mean daily returns, leading to Non-Normality in the Empirical data set being analyzed for the sample period of five years.

6) 50% of the observations were observed to be between the two Quartiles (First and third).

7) Outliers were found in all stocks which caused skewness and kurtosis in the data set, which significantly influenced other parameters like beta of the security.

d) Normality Test:- All stocks and the Market Index Significantly rejected the Null Hypothesis of Normality, being confirmed by Jarque- Bera test, Shapiro-Wilk test and Doornick Chi-Square test.

e) White noise test using the Ljung-Box test for autocorrelation in the mean returns were significantly observed in over 50% of the stocks using a lag order of 8, with very few displaying serial autocorrelation in the first order lag.

f) Arch effect test using eight lags also displayed significant leptokurtic property in all stocks and index, which enabled detection of time varying phenomena in the conditional volatility and hence different models needed to be employed to capture these dynamics.

g) Auto correlation and Partial auto correlation plots (ACF & PACF) revealed time interdependency among returns and few stocks displaying no serial autocorrelation as indicated by the Correlelogram Analysis of plots.

h) Augmented Dickey Fuller test (ADF test) for the existence of random walk (unit root test) corroborates the use of Random Walk Model for Forecasting volatility in stock market returns, the stationary test in this regard led us to conclude that the data sample plots look stationary.

i) Historical Volatility estimators on the empirical data set revealed that the Yang-Zhang Historical Volatility Price range estimators were the most efficient in the class of extreme value estimators.

j) Simple linear regression model was undertaken by regressing all the 50 stock returns on the market returns data set for the five year period and beta of the individual asset were computed which revealed that the most aggressive stock happened to be DLF Ltd which had a beta of 1.6417 against the beta of the market of 1, and the most conservative amongst stocks was Hindustan Unilever asset which had the beta of 0.434446. Even Residual Diagnostic tests undertaken revealed asymmetries and leptokurtic property in the residuals of stock returns. Chow test was undertaken for testing the stability of beta parameter and all the securities displayed stability in the beta values.

k) Out of sample forecast (one step ahead or one year ahead) of Conditional volatility predominantly showed that GARCH & EGARCH Model was the best suited in forecasting long run conditional volatility in stock returns.

C) Gann Analysis can be successfully employed in the Indian Stock Markets in both Intraday as well long term prediction of stock prices, and can definitely help traders and investors in finding the support and resistance levels, besides helping the investors decide at what price or above to buy the stock and at what price or below to

sell the stock, also we can get the requisite target price levels and position at which to fix the stop loss order levels both for buy as well as sell decisions.

D) Portfolio Management: Traditional/Modern finance models are contained in most of the standard reference Financial Management books which was used for the Indian Stock Markets, prominent of them being:

1) Sharpe's Portfolio Optimization model: The role of Idiosyncratic Volatility in the Investors Realized returns were found significant for the sample set of twenty stocks carefully chosen to form an optimal portfolio for the Investor. When the short sales were not allowed only seven top stocks could be included in the optimal portfolio returning 34.74%, with a Volatility of 14.74% and Coefficient of Variation of 42.44% in the stock returns. When short sales were allowed on this select sample of twenty stocks catapulted the returns to 77.36%, with a portfolio standard deviation of 36% and coefficient of variation of 46.53%. Although the risk of loss significantly increases when an Investor resorts to short selling strategy of stocks, but researcher observed that for a steep increase in optimal portfolio returns when short sales were allowed is worth considering despite a marginal increase in the volatility of this optimal portfolio so constructed by employing successfully the Sharpe's Portfolio Optimization Model.

2) Finance theories and models such as the Sharpe's Single index model, and various models used is applicable for individual securities as well as a portfolio hence researcher found the various performance metrics similar to one used for Mutual Funds, and various mutual fund performance metrics were computed to reveal which securities were better in terms of giving risk adjusted rates of returns for the investor.

3) Eugene Fama's Decomposition of excess returns (four factor model) was significantly employed on the sample twenty securities which formed the optimal portfolio and it was found that idiosyncratic volatility is indeed priced in the Indian Stock Markets thereby challenging the Diversification Conundrum.

CHAPTER 9

CONCLUSIONS AND SCOPE FOR FUTURE RESEARCH

In-The- Sample Data analysis of the Empirical Financial Econometric Time series, revealed a few interesting facts, on the acceptance of " Non-Normality in the " Normal (Gaussian) Distributional Assumptions, theoretically found appropriate. Besides Skewness being observed, there were Evidences on the Leptokurtic Daily Log Returns data / (Excess Fat Tails)/ Mean Reversion/ Volatility Clustering, of the entire population NSE (NIFTY), Equity stocks, including NSE. The (Studentized) Residual Diagnostics on the error term revealed startling facts on the issues of Serial/Auto Correlation verified by "Correlogram Analysis plots" using a maximum and (optimum) lag of 8 periods, and General Auto regressive Conditional Heteroscedasticity (GARCH Model), extensively engaged as the most optimal model befitting the time series considered in this study, helping us arrive at one year ahead, long run Conditional Volatility Forecast estimates, which could be validated by 31st March 2015.NSE Market proxy index forecast stands at 59% for the year ending 31st March 2015.

Exploratory Research data plots, revealed the answer to the Question "**Is Volatility Constant?"** Japanese Candle stick plots for the entire span also revealed interesting patterns and trends in the stock price movements, over the five year period (daily frequency basis data study), and to top it we can further delve upon Gann Charts interspersed on these Candle stick plots, to forecast accurately trend reversal and stock price pattern predictability and using Astrology on Individual charts, we can correctly arrive at the stock price and to enable investors take a decision which enhances their success rate in the Investment Game. This needs further probity. Linear Regression Analysis revealed few aggressive stocks, as represented by their beta values, yet another measure of risk being adequately used in markets, instrumental in giving returns to the Investor. Multinomial Logistic Regression Model applied to Primary data collected on 425 respondents revealed, majority of the sample as Risk Moderate Investors, in terms of Risk Aversion Matrix, which the Researcher believes could be further researched by increasing the sample size to at least 1000 respondents, which could have further turned " **more significant"** explanatory demography factors in predicting the type of Investor.

The ultimate objective of the study being to construct a well-balanced diversified portfolio of equity stocks from the population NSE (NIFTY), based on the least risk perspective, and applying Sharpe's Portfolio Optimization Model, we constructed the top twenty equity stocks portfolio, which revealed significant role played by the Residual Variance, being important in giving returns to the investor's chosen portfolio. Thus settling the issue in favour of the role played by Idiosyncratic Volatility, and obtaining evidence that indeed, Idiosyncratic Volatility is priced in the Indian Stock Markets. Lastly, the revelations during the period of study, brought the Researcher closer to the chosen topic of study, that we humans inhibit the Mother Earth, and have been attracted to the sky, since Ages, Between the Heaven and the Earth, we have the ethereal medium, sinusoidal circles of energy cycling, from God to Humans, there is nothing in the Universe which is random, the changes are Periodic or Rhythmic, and it will not be difficult to accurately predict stock prices even in the short run.

APPENDIX 1:

STOCKONOMICS

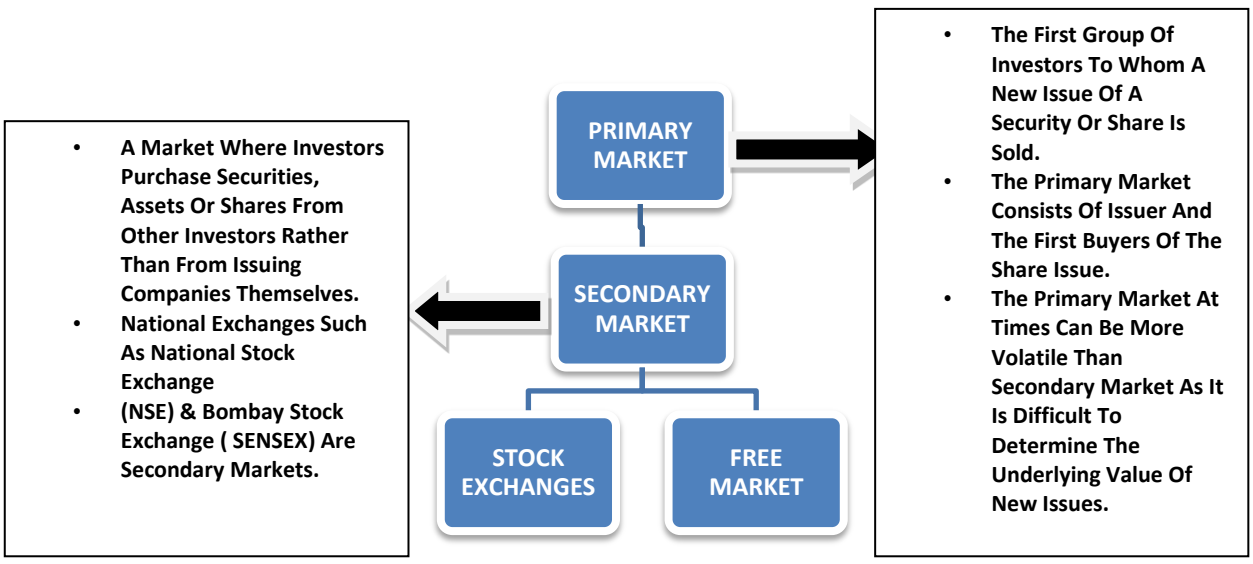
MACROECONOMICS OF THE INDIAN STOCK MARKETS ON INDIA INC

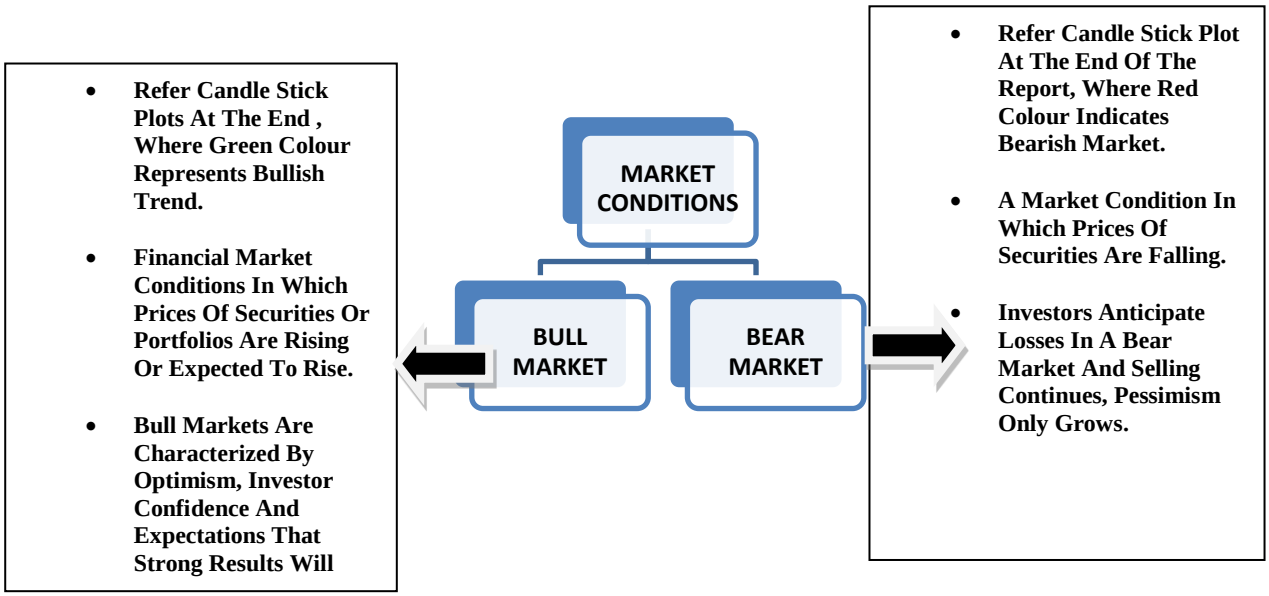
INDIAN STOCK MARKET

INTRODUCTION

- Stock/Share Market mean the same. Both terms describe an exchange in which buyers & sellers of stock/share may trade in a market with high liquidity.
- SHARE: - is a unit issued by a company at time of raising fund from market. A certificate issued to a person who applies for it and is given at a pre-determined value by a company. It is the smallest unit of ownership that may be bought /sold on/off an exchange, called share trading.
- STOCK: - With respect to stock market is total number of shares a person has in one company or in many companies. Stocks can be traded publicly in the stock market.
- STOCK MARKET: - 1) An organized market, where securities of Government/Semi- Government/Corporate entities are bought/sold. 2) Established for the purpose of assisting /regulating/controlling business in buying/selling/dealing in securities. 3) In stock market only those securities listed in the stock exchange are transacted.4) Individuals alone can buy and sell securities.

Types of Stock market:-





- **TYPES OF STOCKS:-**

1. BLUE CHIP:-Carries the highest value. Large, established firms, long record of profit, growth, Dividend pay-out, & good reputation.
2. Penny:-Low priced, speculative stocks, very risky. Stocks issued by companies with an erratic history of revenue and earnings.
3. Income: - Stocks that pay higher than average dividends over a sustained period. Dividends tend to be paid by established companies with stable earnings.
4. Value: - Stocks that are currently selling at a low price. Companies with good earnings and growth potential but stock prices do not reflect this are called value company stocks. These stocks are only temporarily out of favour and may experience growth.

- **MARKET CAPITALIZATION:-**

1) A measure of size of a business enterprise.
2) Total $ Market Value of all of a company's fully paid outstanding equity shares, calculated by multiplying a company's shares outstanding by the current market price per share (M.P.P.S)
3) Based on the size of the market cap, companies are divided primarily into large cap, mid cap, & small cap stocks.

   Large cap:-us $ 10 billion to us $ 100 billion

   Mid cap : -us $ 1 billion to us$ 10 billion

Small cap:-us $ 100 million to us$ 1 billion.

In India two reference benchmarks being popularly used are the BSE—SENSEX & NSE—S&P CNX NIFTY. In this study we will take up only NSE Nifty (fifty stocks). But a brief on BSE now follows:-

BSE CREDENTIALS: -(source: - World Federation of Exchanges) :-(WFE)

WFE regulates 52 stock exchanges across the globe promoting regulatory standards.

- Largest number of listed companies in the world. 5379 as at 31st May 2014.
- 10th largest exchange globally in terms of Market Capitalization.
- 4th most liquid exchange globally for Index Options.
- 9th largest in the world in terms of number of trades in equity shares.
- 3rd largest in the world in terms of number of currency options contract traded.
- 4th largest in the world in terms of number of currency futures contracts traded.
- Full bouquet of products including equity, equity derivatives, currency derivatives, Interest rate derivatives, Debt products, Security Lending & Borrowing platform, IPO, SME Platform, Mutual Funds, and ETF's, & Offer for Sale (OFS).
- Partnership with S&P DOW JONES INDICES on Index products.
- Exchange Technology from DEUTSCHE BOERSE group (Eurex platform)
- Cross listing of benchmark index—S&P BSE SENSEX in BRIC countries.

Over the past one year, the BSE SENSEX has witnessed the highest rise among all major stock market indices in the world. Between November 26, 2013 & November 26, 2014, the value of the Index increased by 39%. Among the 24 indices of the world's largest stock exchanges that TOI analysed, 11 registered double digit growth and the South Korean KOSPI was the only major index that witnessed a decline in this period. If we look at the five year returns, then the SENSEX would be the 6th best

in the world. Between November 25, 2009& November 26, 2014, the NASDAQ Index rose by 120%, highest in the world[1].

NAME OF INDEX	FROM 25/11/2009 5 YR RETURN	FROM 25/11/2011 3 YR RETURN	FROM 26/11/2013 1 YR RETURN	NEGATIVE RETURN
	FIGURES IN PERCENTAGE TERMS			
1) BSE Sensex India	65	80.9	39	-
2) Hang Seng Hongkong	6.6	36.3	1.8	-
3) Ibovespa Brazil	-	0.4	7.1	18.9
4) Dow Jones USA	70.4	58.7	10.9	-
5) Mex Ipc Mexico	42.4	29.2	8.9	-
6) Nasdaq USA	120	96.1	19.2	-
7) Shenzhen Se China	-	9.4	19.3	20.8
8) Dax Germany	70.9	80.5	6.7	-
9) Micex Russia	17.2	53.1	3.6	-
10) Cac 40 France	14.8	53.1	2.2	-
11) Nikkei 225 Japan	84.1	113	12	-

TABLE

1) SOURCE: - TIMES OF INDIA Dated: - 2nd December 2014—page 9—STATOISTICS

A YEAR OF GROWTH (REFER TABLE—Returns of Financial Markets – cut off 26th November 2014) (BLOOMBERG SOURCE)

"Sensex drops on Infosys, global cues: - Infosys founders reduced their stakes in the company, and also on account of global cues the benchmark SENSEX lost 339 points or 1.2% to close at 28119 points, the biggest drop since December 10.The Nifty was down 100 points or around 1.2% and ended at 8438 points. The market correction was led by stocks of IT (Information Technology), metals and financial services companies. The INFOSYS stock slipped more than 5% as almost 3.3crore shares were sold in small blocks. The shares were sold in the range of Rs, 1988-2014. The scrip

fell 4.9% to close at Rs. 1969 on BSE. Barring the FMCG index, this closed up around 0.8%, all other indices ended in red. The market breadth remained negative with 1154 stocks advancing against 1792 stocks declining.

NIFTY continued to trade below the psychological level of 8500 points on selling pressure from stocks in IT, Banks, Realty & to some extent consumer durables. The I.I.P (Index of Industrial Production) and Inflation data that are due in the coming week should drive the market. If the data is strong and reflective of improving economic growth, then the market correction could be contained. Market observers expect Volatility and minor correction in the coming days, and the market should remain sideways in coming trading sessions opined experts".[2]

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2) SOURCE: - TIMES OF INDIA DATED: - 9TH December 2014. Page 17.

NSE

- One of the largest stock exchanges in India.
- Biggest in terms of daily trading and turnover
- Thousands of companies listed with NSE and divided into different categories primarily depending upon market cap.
- Primarily stocks listed are divided into three categories on the basis of Market Capitalization: - LARGE, MID, SMALL. **Our study has for the population earmarked as S&P CNX NIFTY (fifty) stocks encompassing 12 industries /sectors.**
- Large cap stocks: - 1) Biggest & most reputed companies among all the listed companies in the stock exchange. 2) Mostly companies that are in business for years and making significant growth in terms of profit and asset accumulation. 3) Large cap stocks are considered for inclusion in NIFTY that is the PRIME INDEX OF INDIA. (NSE).
- Mid cap: - 1) Moderate market cap. Market cap between USD 2 BILLION TO USD 10 BILLION. 2) These stocks have great investment proposition as they have all the signs of rising in the market and give you good returns on your investment.
- Small cap: - 1) Market cap between USD 200 MILLION TO USD 2 BILLION. 2) Relatively new companies 3) More risky as these companies take too long to rise in the market.4) Not wise to invest in these companies for

long term, but you can invest in these stocks and do some margin trading if you have definite and trustworthy tips.

- Besides these three prominent stock categories in NSE, there are other categories like Microcap & Penny stocks. While Microcap segment has companies less than USD 300 MILLION Capital. Penny stocks are low priced stocks .Besides these classifications, stocks at NSE are also categorized on the basis of sectors/industries.
- NSE or National fifty comprises of 50 stocks, while BSE (SENSEX) consists of 30 stocks.
- Key terminology:- 1) Shareholding pattern:- Shares of a company may be held by promoters, financial institutions including foreign institutions, banks and other companies besides being held by public at large.
- FREE FLOAT: - Number of shares held by non- promoters or generally referred to as public holdings. These include holdings by banks and financial institutions.
- How is an INDEX calculated?
    1. Weights assigned based on market cap or free float. Change in price is first multiplied by weight assigned and then multiplied by total number of shares or free float shares to arrive at impact on Index.
    2. NSE has switched over to FREE FLOAT based method w.e. f 26th June 2009.Sensex is calculated by free float method and Nifty was calculated prior to 26/6/2009 by Market cap method. Categories like Government holdings in the capacity of strategic investor, shares held by promotes through ADR/GDR, strategic stakes by corporate bodies, investments under FDI (Foreign Direct Investments), and cross holding among others would be excluded, while computing under free float method.

WHY KNOW HOW AN INDEX IS CALCULATED?

1. Sensex & Nifty are barometers of INDIAN Stock Market and generally used as a benchmark to evaluate performance of a portfolio. Mutual Funds in general and Index based mutual funds maintain their portfolios based on Index weights. We can therefore expect buying in companies that have gained weight or selling off shares of those companies held which are losing weight.

2. Structuring an Investment Portfolio is about allocating funds to different assets like shares, gold, risk-free assets, realty and the ilk. Structuring an equity portfolio means allocating funds to buy shares of different industries and companies within the Index so as to have a diversified portfolio.
3. Asset allocation based on economic trends and portfolio restructuring based on principles of diversification account for almost 95% of success in the investment game. Market timing, Industry selection, & Stock selection account for only a very small percentage.

DIFFERENCE BEWTEEN NSE & BSE AND WHY SHOULD WE HAVE TWO EXCHANGES?

- Share/Stock Market is a massive ground for trading company stocks and derivatives, at a pre-determined or agreed price. These stocks are listed as securities in a stock exchange. A stock exchange is a kind of secure platform for stock brokers and traders for trading in stocks, bonds and other financial instruments. They also provide a platform for capital events such as payment of income & dividends. Securities traded on a stock exchange include shares of companies ,unit trusts, derivatives to pooled investment products and bonds. Every stock exchange has a key index which keeps track of most important or most traded stocks in that exchange.
- Two most prominent stock exchanges in India are the National Stock Exchange (NSE) & Bombay Stock Exchange (BSE), though other stock exchanges too exist, BSE& NSE accounts for majority of Equity trading in India (Over USD 1.6 TRILLION).
- NSE is located at Maharashtra, India and it is regarded as 9th largest in the world in terms of market cap. To trade in a company's share over the stock exchange it has to be listed there. There are over 1552 listings in NSE. However to 50 most traded companies (Market cap basis), shares are kept track of using NSE's key index called NIFTY (National Stock Exchange fifty).
- Bombay Stock Exchange (BSE) is located in the renowned Dalai Street, Mumbai. It is the 8th largest stock exchange in the world and 4th largest in Asia, on the basis of market capitalization of companies listed there (USD

1.63 TRILLION as on December 2010), with maximum number of companies listed, and this exchange is supposed to be the oldest stock exchange in Asia as well. The key index for BSE is SENSEX (Sensitive Index). Alike Nifty, which tracks the progress of top 50 company shares, Sense tracks the progress of top 30 company share values. Sensex is regarded as the driver of Stock markets in India domestically.

- In 1850's, for stock price discussions, (Gujjus & Parsis met) under banyan trees. Over time, the location of these meetings changed many times and number of brokers constantly increased. This nomadic movements ended in Dalal Street in 1874 and in 1875, became an official organization known as " The Native Share & Stock Brokers Association" .The BSE was first recognized stock exchange as per the Securities Contract Regulation Act (S.C.R.A.),by the Indian Government. BSE Sensex was created with the intention of regulating as well as measuring its performance. Contrast to this, NSE, however, does not have a long lineage. Some of the leading Financial Institutions promoted the BSE along with The Government of India, and was incorporated in the name of a tax paying company in November 1992. Only after a year BSE, came to be recognized as a full-fledged stock exchange.
- FREE FLOAT CAP METHOD has been adopted for calculating Index value in case of both BSE & NSE. The float and shares are used for trading other than the company's outstanding shares. This method's advantage is in its rationality. By not including restricted stocks, it eliminates their effect on Index calculations.
- While BSE is owned by the Government of India, a group of Financial Institutions like Banks, Insurance companies and others mutually own NSE. NSE's ownership and management operate as two disparate entities.
- On the issue of why do we need both, Number of listings is higher in BSE ,whereas trade volume is more in NSE.NSE is more liquid, as there are more number of buyers and sellers at a particular time for any listed stock in NSE than in BSE.
- NSE has maintained its slot as world's largest bourse in terms of volume in equity segment for the first quarter of 2013, while two bourses from China have replaced NYSE & NASDAQ of US at 2nd& 3rd rank respectively.

- NSE logged in a total of 36.6 Crore trades IN EQUITY SEGMENT DURING January – March 2013,making it the world's largest exchange in terms of number of equity trades as per the latest data compiled by World Federation of Exchanges (W.F.E).However, NSE, showed a month-on-month decline in terms of number of equity trades. From 13.8 crore in January 2013, number of trades dipped to 11.6 crore in February 2013 & fell further down to 11 Crore in March 2013.
- BSE another major Indian Bourse, which recorded a total of 7.7 Crore equity trades in January to March 2013, is placed at 7th spot. However like NSE, monthly equity trades on BSE fell to 2 crore in MARCH 2013,from 3 Crore in January 2013
- While total number of listed companies is much larger in case of BSE, the exchange lags behind NSE, in terms of volume and value of trades.
- NSE is followed by China's SHENZHEN SE & SHANGHAI SE, in the second and third positions respectively, with nearly thirty Crore equity trades each.

APPENDIX 2

Statistics & Applications to Finance.

Researcher, in his pursuit of ,estimating the population parameters [Mean (central tendency), standard deviation(σ) (Dispersion/ Scedasticity), Symmetric/Asymmetric,& kurtosis) of having described study of the population characteristics by ,studying the sample statistic (Mean (x), std deviation (s), coefficient of skewness to test Data set symmetric or not, kurtic nature of the curve, of the data distribution, under study, is assessed, purported to enhance, sound judgment and management principles benefiting all mankind.)

Brief of statistical metrics:-

I. Measures of central tendency:

Arithmetic Mean {Simple, Weighted, combined, moving }, Geometric mean{ Wealth ratio/Price Relative/Cumulative Wealth Index, time weighted Rate of Return}, Natural logarithms (lognormal) Returns and the Arithmetic average family.

II Measure of Dispersion

1. Traditional 5 number summary:
   Smallest value ---------Q_1-------Median Q2 -------- Q_3---------Largest value
2. Variation

a) Range(R) = H-L, H is highest & L is lowest value of given data distribution (discrete, continuous etc.)

b) Inter Quartile Range : $Q_3 - Q_1$

c) $Variance: s^2 = \sum_{i=1}^{n}[\frac{(x_i - \bar{x})^2}{n-1}]$

As sample size increases, the difference between ÷ by N or N-1 becomes smaller and smaller

d) Standard deviation (σ):- Traditional measure of risk, risk such as V.A.R. & other sophisticated tools not considered in this study.

e) Coefficient of variation $C.V.\% = \frac{Std.Dev}{Mean} \times 100$. Lower the C.V. % better.

Eg. Rahul Dravid is consistent batsman compared to Sachin Tendulkar? Most critical measure for evaluation of performance metrics.

III. SHAPE OF DISTRIBUTION:

How data scatters itself in the plane/space, two types of distribution generally speaking

a. Discrete series /function/probability/mass/density/frequency. Distribution: stepwise, ladder distribution,
b. Discontinuous series etc.

Pertinent to our study, is **Continuous** distribution.

1. Continuous probability density function: for a curve, such that Area under curve, over interval, i.e. probability that X, falls into that interval can be found by summing the probabilities in that interval.

Salient characteristic of this distribution

1. Area under a continuous probability density $f_n = 1$.
2. P (a<= x<=b), that R.V. (X) value will fall into a particular interval from a to b is equal to the area under the density curve between the points (values) a & b .
3. Area under a continuous provability density $f_n=1$.
4. P (a<=x<=b), that R.V. (X) value will fall into a particular interval from a to b is equal to the area under the density curve between the points (Values) a&b.

NOTE: - SHAPE OF DATA DISTRUBUTUION:

1. Normal probability density function in which the curve is bell shaped, having a single peak. The mean if of distribution lies at the centre of curve and the curve is symmetrical around a vertical line erected at the mean. The tails of curve extended indefinitely parallel to horizontal axis.

Normal probability distribution function:

Rel.Freq: $f(x) = \frac{e^{(-1/2)[x-\mu/]2}}{\sigma\sqrt{2}\prod}$, $-\infty < x < +\infty$

$\prod$ = 3.1416, e= Euler's Numbers=2.71828

- Also called "**GAUSIAN DISTRIBUTION**": German Mathematician, Karl Friedrich Gauss", early 19th century, while studying daily changes in stock market index.

THE
NORMAL
LAW OF ERROR
STANDS OUT IN THE
EXPERIENCE OF MANKIND AS
ONE OF THE BROADEST GENERALISATIONS
OF NATURAL PHILOSOPHY. IT SERVES AS THE GUIDING
INSTRUMENT RESEARCHERS IN THE PHYSICAL AND SOCIAL
SCIENCES AND IN MEDICINE AGRICULTURE AND ENGINEERING. IT
IS AN INDISPENSABLE TOOL FOR ANALYSIS AND INTERPRETATION
OF BASIC DATA OBTAINED BY OBSERVATION AND EXPERIMENT.

I. CHARACTERISTIC OF A NORMAL DISTRIBUTION.

1. For each pair (μ, σ), the curve of normal probability density function is bell-shaped and symmetric.
2. Normal curve is symmetric around a vertical line erected at the mean (μ), with respect to area under it, i.e. 50% of area of curve lies on both sides of mean and reflect mirror image of shape of curve on both sides of mean (μ).
   $\therefore P(x \leq \mu) = P(x \leq \mu) = 0.5$
3. Mean = Median = mode occurs, when highest value of probability density function occurs when value of a random variable $x=\mu$.
4. The two tails extend to infinity in go to direction and theoretically never touches the horizontal axis.
5. Total area under the curve = 1 or 100%
6. μ may be negative, zero or positive and it is the central location of normally distributed data set (σ) , the spread longer σ wider and flatter is normal curve.

II. STANDARD NORMAL DISTRIBUTION

* Use of Z the standardized normal variate

Z test statistics/Z score = **Z** = $\frac{\mathbf{x-\mu}}{\sigma}$

A normal probability distribution with $\mu=0$ and s.d=$\sigma=1$ is the standard normal probability distribution.

X ∽N (Mean, various / standard deviation) i.e. X ∽N(μ,σ) and we define, std normal variate Z such that

Z= x-μ/σ i.e. Z∽stdN(0,1)

III. Lognormal Distribution :- (LN) : Refer Appendix for understanding basic mathematics, covered under the ambit of " Power of E". Continuous compounding.

$$\mathbf{A = Pe^{rn}}, \quad \mathbf{S^t = S_0 e^r}$$

- ➔ One needs to also acquaint with Taylor series Expansion where in, first term yields bond duration and second term its convexity.
- ➔ Exponential function finds its utility for option pricing using Taylor series for finding Greeks of the B.S. Model [Black – Scholes]i.e. Delta, Gamma, Vega etc. are used in hedging, portfolio insurance, financial engineering and management.
- ➔ $\ln(e^x) = e(\ln^x) = x$
- ➔ ASSET PRICES (Eg. Stock prices tend to follow a log normal distribution. This distribution allows only $x_i \geq 0$.
- ➔ Log-normal is like the normal distribution but with thinner (fatter) tails. Hence log-normal distribution is skewed.
- ➔ $\ln S_t = S_0 e^r$, r the rate of return being an input to the exponent function and S_0 being constant, now taking ln we have normal distribution left, also as you know, the rate of return follows normal distribution and also taking natural logarithm of exponential function, leaves you with input r.

1st	moment:	Mean,
2nd	moment:	Variance,
3rd	moment:	Skewness
4th	moment:	Kurtosis

Skewness is a measure of lack of symmetry in the data, and is based on a statistic, that is a function of curved differences around Arithmetic mean/Lognormal mean Returns.

Kurtosis is a measure of relative concentration of values, in the center of distribution as compared with tails, and is based on differences around the arithmetic mean, raised to fourth power.

RIGHT (POSITIVE) SKEWED DISTRIBUTION	**LEFT (NEGATIVELY) SKEWED DISTRIBUTION**
Median $X_{Largest}$ is greater than median – $X_{smallest}$distance.	$X_{small}$to median >$X_{Large}$to median
Also Q_3 to $X_{Longest}$> Q_1 to $X_{smallest}$	$X_{small}Q_1 > Q_3$ to X_{Large}
75% of data distribution of observation between X_{small} to Q_3	Few small observations distort mean towards left tail. Heavy clustering of observations at night (high) side.
25% long right whisker at upper end of scale [BOX – AND – WHISKER PLOT] graph of 5 number summary	Long left whisker contains distribution of only smallest 25% of observations.
	75% of observation between Q_1 to $X_{Largest}$

19TH Century British Statesman Benjamin Disraeli: **"3 kinds of lies : LIES, DAMNEDLIES & STATISTICS",** How data vary around the mean (Avg/ Exponential lognormal mean returns).

EMPIRICAL RULE	**THE BIENAYME-CHEBYSHEV RULE**
In a bell shaped distribution approx 68% if observation are contained within a distance of ± 1 std deviation around mean	For heavily skewed data this is used

Approx 95% within $\pm 2s.d$& 99.7% within ±3s.d	
1/20 observation will be beyond 2s.d from mean ∴ observation not contained in interval μ±2σ could be considered OUTLIERS 3/100 will be beyond 3 stddevn from mean and hence observation in interval of μ±3σ are almost always considered outliers.	Given any data set, regardless of shape, the % of observation that are contained within distances around mean, must be at least $\left(\mathbf{1}-\frac{\mathbf{1}}{\boldsymbol{k^2}}\right)\times \mathbf{100}\%$ For e.g. If k = 2, at least 75% of all observation in any data set are contained within a distance of ±2 std deviation around mean At least $\frac{15}{16}$(88.89%)are contained within ±4 std deviation around mean

TAB 1: Interval	THE BIENAYME-CHEBYSHEV RULE	EMPIRICAL RULE
(μ-σ,μ+σ)	At least 0%	Approx 68%
(μ-2σ,μ+2σ)	At least 75%	Approx 95%
(μ-3σ,μ+3σ)	At least 88.89%	Approx 99.7%

- ➔ Lognormal distributions are infinitely invisible and a data set which arises from log normal distribution has a symmetric Lorenz curve.
- ➔ Economic Income of 97-99% of population is distributed log normally, wireless communication exhibits gauss law distribution and coefficient of friction, wear and tear also exhibits lognormal distribution [compounding, multiplicative growth rate, real wealth ratio etc.] as performance indicator, to be better based on lognormal distribution analysis.
- ➔ $X = \log_e[1+k]$ is normally distributed as- $-\infty < \times < \infty$ & in continuous time it's called G.B.M.(Geometric Brownian Motion) & stock price distribution is lognormal , which forms basis of BLACK-SCHOLES MODEL.

Remember, Lognormal, plays a crucial role in human & ecological risk assessment, hence every asset needs to exploit their basic properties.

➔ Log normal returns & Geometric mean returns give fairly good estimate of Weighted Rate of returns , which simple Arithmetic mean fails to deliver.

➔ It does not accept negative values

➔ Also using Symmetricity of returns $\mathbf{ln}\left(\frac{Pt}{Pt-1}\right) = -\mathbf{ln}(\frac{Pt-1}{Pt})$

When returns are continuously compounded when daily/monthly price ranges are small then returns calculated using simple arithmetic mean and continuous compounding gives identical values. Such is the power of 'e'.NATURAL LOGARITHMS [LN]: used for base e logarithms e is EULERS and e ≈ 2.7182.

If X ∽ N (μ,σ)…….A Taking log to the base e [LN] on both sides of ……A. We get, ln[x] $\sim N\ (\mu, \sigma)$……..B Where X is a log normal random variable and ln[x] is a normal variable.

⇨ Ln[X] = μ is median of N(μ,σ) ∴ X ∽exp [N(μ,σ)]

⇨ $(\mathbf{1} + \frac{\mathbf{1}}{\boldsymbol{n}})^{\boldsymbol{n}}$ = **?.**

Let n ∈ N, using Binomial Theorem, for +ve index.

$\mathbf{(1 + \frac{1}{n})^n = 1 + n.\frac{1}{n} + \frac{n(n-1)}{2!}.\frac{1}{n^2} + \ldots\ldots}$

$\mathbf{\therefore lim_{n\to\infty}\left(1 + \frac{1}{n}\right)^n = 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!}}$ = Exponential series = e.

$\mathbf{\therefore e = 1 + 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \ldots\ldots\ldots + \infty}$

which implies e > 2

$\mathbf{Similarly\ \frac{1}{4!} + \frac{1}{5!} + \ldots + \frac{1}{n!} = \frac{1}{4.3.2} + \frac{1}{5.4.3.2} + \ldots + \frac{1}{n!} < \frac{1}{2.2.2} + \frac{1}{2.2.2.2} + \ldots\ldots}$

$\mathbf{< \frac{1}{2^3} + \frac{1}{2^4} + \ldots + \frac{1}{2^{n-1}}}$

$\mathbf{\therefore \frac{1}{4!} + \frac{1}{5!} + \ldots + \infty \leq lim_{n\to\infty}\ \left[\frac{1}{2^3} + \frac{1}{2^4} + \ldots + \frac{1}{2^{n-1}}\right]}$

$\mathbf{\leq \frac{1/8}{1-\frac{1}{2}}}$

$\mathbf{\leq \frac{1}{4}}$

$\mathbf{\therefore e \leq 1 + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} = 2\frac{11}{12}}$

∴e< 3

∴ 2 < e < 3 ➔ e ≈ 2.71828(constant)

N.B. For n ≥ 2, we have

$$(1+\frac{1}{n})^{nx} = e^{x} = +\ 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots + \infty$$

$$1+nx\frac{1}{n} + n\frac{(nx1)}{2!}\frac{1}{n^2} + \ldots + \infty$$

$$\therefore 1 + x + \frac{x(x-1)/n}{2!} + \frac{\frac{x(x-1)(x-2)}{n \quad n}}{3!} + \ldots + \infty$$

$$\therefore \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^{nx} = [\ \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^{n}]^{x} = e^{x}$$ **……Exponential series.**

1. Pt = $P_0 e^{Rt}$ where R_t= ln (1+k) & k = (e^{Rt}-1) x 100%

   Taking natural log on both sides,

2. G.M. Returns = Exp[Avg log normal returns].

3. Gordon's Constant growth model used:

   $$1+ke = \frac{D1+P1}{Po} = \frac{Pt}{Po} \rightarrow Ke\% = \{\frac{Pt}{Po} - 1\} \times 100$$

   Taking natural log on both sides,

   $$\ln(1+Ke) = \ln(\frac{Pt}{Po})$$

   $$\therefore P_t = P_0 e^{Rt}$$ **where e = continuous compounding Rt = ln [1+Ke]**

Fundamental Pillar Of Finance

D.D.M : Dividend Discount Model(Gordon's Constant Growth Model)[1]

CASE : I :- Share Valuation with constant dividends:

The value of share with constant dividends is:

$$Po = \frac{D}{1+ks} + \frac{D}{(1+ks)^2} + \ldots\ldots\ldots + \frac{D}{(1+ks)^n} \quad n \to \infty \ (I)$$

Multiplying both sides by (1+Ks) gives:

$$Po = D + \frac{D}{1+ks} + \cdots\ldots\ldots + \frac{D}{(1+ks)^{n-1}} \quad n \to \infty \quad (II)$$

(II) – (I) Yields

$$Poks = D\left[1 - \frac{1}{(1+ks)}\right] \quad n \to \infty +$$

[1] Fundamental of Financial Management Prasanna Chandra Tata McGraw Hill pg:552-553

as $n \to \infty, \frac{1}{1+ks} \to 0$

so equation results in $Po = \frac{D}{ks}$

CASE II: :- Share Valuation with constant growth in dividends

$$Po = \frac{D_1}{1+ks} + D_1 \frac{1+g}{(1+ks)^2} + \cdots \ldots \ldots + D_1 \frac{(1+g)^n}{(1+ks)^{n+1}} \qquad n \to \infty$$

Multyplying Both sides $\frac{1+g}{1+ks}$ **gives:**

$$Po\left(\frac{1+g}{1+ks}\right) = \frac{D_1(1+g)}{(1+ks)^2} + \frac{D_1(1+g)^2}{(1+ks)^3} + \frac{D_1[(1+g)^{n+1}]}{(1+ks)^{n+2}} \quad n \to \infty$$

Further simplifying :

$$\frac{Po(ks-g)}{1+Ks} = D_1 \left[\frac{1}{1+ks} - \frac{(1+g)^{n+1}}{(1+ks)^{n+2}}\right] \quad n \to \infty$$

as $n \to \infty, \frac{(1+g)^{n+1}}{(1+Ks)^{n+2}} \to \infty$ **because g<k**

hence

$$\frac{Po(ks-g)}{1+ks} = \frac{D_1}{1+ks}$$

this means

$$Po = \frac{D_1}{ks-g}$$

Where , P_0 = Price per at beginning of years, 0

Y_0 = Earnings, per share at end of year 0.

1-b = Fraction of earnings from distribute by way of dividend.

b = Fraction ploughed back into business.

K = Rate of return required by shareholders.

r = Rate of return earned on investments made by from.

br= Growth rate of earnings and dividends.

Using dividend capitalism approach, the price per share is

$$P_0 = \frac{D}{1+K_S} + \frac{D}{(1+K_S)^2} + \frac{D}{(1+K_S)^3} + \ldots\ldots\ldots + \frac{D}{(1+K_S)^n} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots I$$

$$= \frac{E_0 (1-b)}{1+k} + \frac{E_1 (1-b)}{(1+k)} + \frac{E_2 (1-b)}{(1+k)^2} + \ldots\ldots\ldots\ldots \text{II}$$

∵ g = br, we get

$$P_0 = \frac{E_0 (1-b)}{(1+K)} + \frac{E_0 (1+br)(1-b)}{(1+k)^2} + \frac{E_0 (1+br)^2(1-b)}{(1+k)^3} + \ldots\ldots\ldots \text{III}$$

$$\therefore P_0 = \frac{E_0(1-b)}{k-br}$$

Miller & Modigliani have advanced the view that the value of a firm depends solely on its earnings power and is not influenced by the manner in which earnings are split between dividends and retained earnings….Dividends Irrelevance Theorem"

Earnings Price (E/P) Ratio as a Measure of Cost of Equity[2]

Earnings – Price (E/P) Ratio as a measure of cost of equity only under following two cases:

CASE A: -

Future Earnings are constant and 100% payout rates K_e. In the equation, the cost of equity is equal. $P = \sum_{t=1}^{\infty} \frac{D_t}{(1+K_e)^t} .....[D.D.M.]$

If future earnings are constant and 100% payout ratio
∴ $E_1 = E_2 = E_3 = ...,$ $E = D1 = D_2 = D_3. . . . D$

$$P = \sum_{t=1}^{\infty} \frac{E}{(1+K_e)^t} . . . . \ldots \text{[D.D.M.]}$$

Which leads to $K_e = \frac{E}{P}$

CASE B : -

Firm invests in projects that earn a rate of return of K_e(Cost of Equity capital) forever on the equity portion of finance.

Assume all equity capital structure and retention ratio is b (a constant) in each period.

∵ Reinvested funds, earn K_e %, earning, retained earning & dividends

Year	Earnings	Retained Earnings	Dividend
0	E_0	E_0 b	E_0 (1-b)

[2] Appendix22A Fundamental of Financial Management By Prasanna Chandra Tata McGraw Hill pg: 560-561

1	$E_0 + E_0 bk_e = E_0(1+bk_e)$	$E_0(1+bk_e)b$	$E_0(1+b\ k_e)(1-b)$
2	$E_0(1+bk_e) + E_0(1+bk_e)bk_e$	$E_0(1+bk_e)^2 b$	$E_0(1+bk_e)2(1-b)$
n	$E_0(1+bk_e)^n$	$E_0(1+bk_e)^n b$	$E_0(1+bk_e)^2(1-b)$

$\therefore K_e$ in the given equation is cost of Equity capital.

$$P = \sum_{t=1}^{\infty} \frac{E}{(1+K_e)^t} .....[D.D.M.]$$

We can deduce that $\therefore K_e = \frac{E_1}{P}$

Cost of Capital & Capital budgeting decisions:

Besides simple Arithmetic mean, time weighted Rate of Return, we also have money weighted Rate of Return, which is that rate, which equates

∑PV of cash inflows=∑**PV** of cash outflows, as you experience in a firm's capital budgeting exercise, instrumental in the firms cash operating from input, which reflects on price of share& growth.

It is the same rate of return which is the I.R.R. [Risk adjusted rate of return/ Discount Rate] used in evaluating investment decisions. On CAPEX [Capital expenditure / budget] decisions which also paves way for growth and development of the market.

In our discussion on risk free rate, when it comes to C.M.L. (C.A.P.M.), we also make a cursory mention of this I.R.R.

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1. M.J. GORDON, The Investment financing and valuation of the corporation, Home wood III; Richard Irwin, 1962
2. M.H. MILLER & F. MODIGALIANI :- " DIVIDEND POLICY GROWTH and valuation of shares, journal of business, vol 34 (October 1961), 411-433

APPENDIX 3

Stochastic Calculus

1) EFFICIENT MARKET

An Efficient Market is defined as a market where there are large number of Rational, Profit-Maximizes, actively competing, with each trying to predict future market value of individual securities and where important current information is almost freely available to all participants. In an efficient market, competition amongst many intelligent participants, leads to a situation where, at any point in time, actual prices of individual securities already reflect the effects of information based on events that have already occurred, and on events, which as of now, the market expects to take place in future. In an Efficient Market at any point in time, actual price of a security will be a good estimate of its intrinsic value.

In Financial Markets, dynamics of Stock Prices are reflected by uncertain movements of their value over time. One possible reason for Random Behavior of Asset Price is the E.M.H. (Efficient Market Hypothesis)—which basically states two things:

a) The past history of stock price is fully reflected in present prices.
b) Markets respond immediately to any new information about the stock.

These two assumptions implies that stock price changes are a "Markov Process",which means that Expected Future Value of a Stock depends only on its current price. Predictions remain uncertain and may be only expressed in terms of Probability Distributions. In this context, modeling stock price is concerned with modeling the arrival of new information, which affects the price. Therefore two important learning's are: 1) Probability Distribution, and 2) Information. These play a major role in modeling future stock prices. In other words, the future price of a stock can be predicted within a certain level of exactitude, if one can anticipate new information about stock.

2) MARKOV PROPERTY

States that the Expected Value of a Random Variable St, conditional on all past events only depends on the immediate previous value of the Random Variable St-1.This property can be expressed as:

E[St/I t-1] =E [St/St-1], where I t-1 is the Information available up to t-1.

3) ITO'S LEMMA

KIYOSHI ITO (September 7, 1915 --- November 2008):- Was a Japanese Mathematician whose work is now called ITO Calculus. The basic concept of this calculus is the ITO Integral and among the most important results is the ITO's LEMMA. The ITO Calculus facilitates mathematical understanding of random events. His theory is widely applied in various fields and is perhaps best known for its use in Financial Mathematics.

Most important result about manipulation of Random Variable, that is required to ITO's processes. It is as a function of the Random Variable, as what Taylor's theorem is to function of deterministic variable.

Consider a function of two variables(x, t),Taylor's expansion of this function up to the second order is expressed as:

$d G = (\partial G/\partial X)\, d X + (\partial G/\partial t)\, d t + \tfrac{1}{2}\left((\partial^2 G/\partial X^2)(d X)^2 + (\partial^2 G/\partial t^2)(d t)^2\right)$, where

$d X = a\, d t + b\, d B$,

$d G = \partial G/\partial X\,(a\, d t + b\, d B) + \partial G/\partial t + \tfrac{1}{2}\left((\partial^2 G/\partial X^2)(b^2\, d t)\right)$

$d G = \left((\partial G/\partial X)(a) + \partial G/\partial t + \tfrac{1}{2}\left((\partial^2 G/\partial X^2)(b^2)\right)\right) d t + (\partial G/\partial X)(d B)$

This is the ITO's LEMMA, THAT CAN BE APPLIED TO ANY STOCHASTIC VARIABLE THAT FOLLOWS AN ITO PROCESS.

4) PRICE ADJUSTMENT RULE

If there is a Market Surplus or Glut (Excess Supply), prices fall, ending the glut. Whilst a Shortage (Excess Demand), causes prices to rise. However instead of price adjustment—or, more likely, simultaneously with price adjustment- quantities may adjust: A Market Surplus leads to a cut back in quantity supplied, while a shortage causes a cut-back in the quantity demanded. The 'Short Side' of the Market dominates, with the quantity demanded constraining supply in the first case and limited quantity supplied constraining demand in the second.

5) BROWNIAN MOTION:- Robert. Brown a Botanist first realized the Brownian motion (also called **WIENER PROCESS**).NORBERT.WIENER (1894-1964) at MIT; in 1920's.He explained Brownian motion in terms of Modern Probability Theory. Further Robert. Brown when trying to describe motion exhibited by particles immersed in a gas or liquid discovered this type of motion, hence named

after Brown. The particles were essentially being bombarded by molecules present within the matter causing displacement or movement.

FISCHER BLACK (1938-1995) :- in 1975.Due to hi early demise, Black did not share the Noble Prize awarded to Scholes & Merton in 1997.

MYRON SCHOLES:- (Born in 1941) at a press conference at STANFORD, in October 1997, after the announcement that he and Merton had been awarded the NOBEL Prize for Economics.

ROBERT C.MERTON:- Son of Sociologist Robert. K. Merton. Born in 1944, he was the first to understand fully the game- theoretic nature of BLACK-SCHOLES PRICING.

The Wiener Process has no drift but you would see one if you looked at a particular part of picture. Drift is easily obscured by volatility. As can be observed in case of Bajaj Auto, refer above, there seems to be upward drift, but as apparent drift is always produced by volatility, the evidence of drift is not strong from a theoretical perspective. Also drift cannot be estimated very well from the data, but volatility can be estimated from data, BLACK SCHOLES PRICING, ignores drift. It only uses volatility, which can be estimated from past data, which is enough to determine an ARBITRAGE PROCESS.

Definition of Brownian Motion:- The Brownian Motion is a fundamental process that serves as a part of many different processes. It refers to either :-

1) The physical phenomenon that small particles immersed in a fluid, move randomly, or

2) The Mathematical Models used to describe these random movements.

It is scaling limit of Random Walk in one dimension as the time-step goes to zero that is, the number of steps becomes large. The family portraits shows, that scaled random walk tends to a Brownian Motion when the number of steps at random in fig 3 increases.

Properties of Brownian Motion:-

1) Continuity:-Bt has a continuous path and B (t = 0) =zero.

2) Normality:- The increment of the Brownian process in the time interval of length t between two moments S & (S+t) , is B S+t - Bs. This increment is Normally distributed, with Mean zero and Variance equal to time increment t.

B S+t- BS ~ N (0 , t)

3) Markov Property :- The conditional distribution B (t) given information up to time S < t depends only on the B (S).

Generalized Random Walk:-

The generalized Random Walk also called " BROWNIAN MOTION WITH DRIFT",Is a Stochastic process Bt. For given constants μ and σ ,the process has following form:

Bt = μt + σWt

Where t represents time and Wt is a random walk process as described before under the section "Random Walk". Wt can be written as :- **Wt = ε √ t**

Where ε is a random number drawn from a standard normal distribution. The process described by 5.3 above is Normally distributed with Mean μ * t and Variance $\sigma^2 * t$.

If we define mean of Brownian motion process as E (Bt) and its variance as V(X) we have:-

E[Bt] = E[μ t +σ Wt]

= E [μ t] + E [σ Wt]

= μ t + σ E[Wt]

This is because the function mean is linear.Using the fact that mean of Random Walk is zero,i.e.

E[Wt] = 0,we finally have:- E[Bt] = μ t

For the Variance of the process Bt, we have, according to function variance we have:

Variance (Bt) = **Var(μ t + σ Wt)**

= E [(μ t +σWt)^2] - [E (μ t + σ Wt)]^2

Using again the linearity property of mean function, first term in the right side of this equality is equal to:

$$E\,[(\mu t)^2] + E\,[(\sigma Wt)^2] + 2\,E\,[\mu\sigma t\,Wt]$$

$$= (\mu t)^2 + \sigma^2 t\;E\,[(Wt^2)] + 2\,\mu t\,\sigma\,E[Wt]$$

The second term of equality is equal to mean of the process E [Bt], because of E [Wt] = zero, we have

$$E\,[(\mu t + \sigma Wt)^2] = (\mu t)^2 + \sigma^2 E[Wt^2] + 0$$

According to definition of Variance we have:

$$E\,[Wt^2] = Var\,(Wt) + [E(Wt)]^2 = t + 0 = t$$ **,therefore:**

$$E\,[(\mu t + \sigma Wt)^2] = (\mu t)^2 + \sigma^2\,E\,[Wt^2] + 0$$

$$= (\mu t)^2 + t$$

Finally, $Var\,(Bt) = (\mu t)^2 + t - (\mu t)^2 = t$

The above figure shows the Generalized Brownian process given by [5.3],with its components.It consists of a random walk process (below) with a drift (line).The result is an increasing process if the constant μ is positive or a decreasing one if the constant μ is negative.

Ifwe now compare the closing price process plot in fig.with the generalized Brownian Motion in Fig

We can conclude that the two processes show the same behavior in time. This statement is the first Step towards the mathematical modeling of the stock's closing price.

6) STOCK PRICE MODELING

Notice the similarities between BrownianMotion & the stock price process. However there is doubt about Brownian motion as a global model for stock behavior. This is because of property (2) of Brownian motion ,which says that the process is Normally Distributed with mean equal to zero and hence negative with probability ½.,whereas stock price normally grows at some rate,One way to solve this problem is to model the stock price as asum of a positive,deterministic function of time and a Brownian Motion.

In the real world of Financial Markets, Investors & Financial Analysts are generally more interested in profit or loss of stock over a time period that is, increase or decrease in price,than the price itself.Therefore modeling a behavior of stock price can be made through its relative change in time. We use Stochastic Differential Equations (S.D.E.) , to model stock returns, and its solution used to find a mathematical model of stock price.

STOCK RETURN

Akin to the particle being bombarded in Brownian Motion, Stock prices deviate from a steady state, as a result of being jolted by trades that is ask and bid in Financial Markets. Consider price St at time t and an expected rate of return μ, then return or relative change in its price during the next period of time dt can be decomposed in two parts:

Part 1 :- A predictable , deterministic ,anticipated, non-stochastic part that is expected return from the stock held during a time period dt. This return = μSdt.

Part 2:- A stochastic and unexpected part, which reflects the random changes in stock price during time interval dt, as response to external effects such as unexpected news on stock.

A reasonable assumption is to take this contribution, as proportional to stock for some constant σ and a random walk process d Bt , this unexpected part of return = σ St d Bt.

This definition of daily return leads to the stochastic differential equation followed by stock price.

d St = μ St dt + σ St dBt Aliter

d St/St = μdt + σ d Bt

The stochastic differential equation 6.1 is Brownian Motion with" DRIFT " Followed by stock price St. Equation 6.2 is Instantaneous rate of return on St. The return on St in period of time dt follows an ITO'S process, which can be written for every time interval dt between two consecutive instants as follows:

d St/ St = d(ln St) = ln (St)- ln (St-1) = ln(St/St-1)

therefore, ln(St / St-1) = μdt + σ d Bt

SOLUTION OF STOCHASTIC DIFFERENTIAL EQUATION:

Solution St of formula can be found by applying the now famous ITO's formula.

For any function G (X, t) of two variables X & t where X satisfies following S.D.E.

d X = a dt +b d Bt where a and b are some constants., and d B t is a Brownian motion.

The general form of ITO's formula is:

$$\mathbf{d\,G = \left[\left(\frac{\partial G}{\partial X}\right) a + \left(\partial G/\partial t\right) + \tfrac{1}{2}\left(\partial^2 G/\partial X^2\right) b^2\right] dt + \left(\partial G/\partial X\right) d\,B}$$

Let's consider function**: - G = ln (St)** where St satisfies formula and applying it we get:

$$\mathbf{\frac{\partial G}{\partial S} = 1/St \;,\; \frac{\partial^2 G}{\partial S^2} = -1/St^2, \text{ and } \partial G/\partial S = 0}$$

Inserting these into the ITO's formula yields as follows:

$$\mathbf{d\,(\ln St) = [(\mu St * 1/St) + \tfrac{1}{2}\sigma^2 St^2 * (-1/St^2)]dt + \sigma St * (1/St)\, d\,Bt}$$

$$\mathbf{= \ln(St) - \ln(St-1) = \ln(St/St-1) = (\mu - \tfrac{1}{2}\sigma^2)\, dt + \sigma\epsilon\sqrt{dt}}$$

It follows that dln(St) has a Brownian Motion with DRIFT. It has a Normal Distribution with **mean = $(\mu - 1/2\sigma^2) * dt$ and variance $\sigma^2 * dt$**.

Solution of St can then be easily written as follows:

$$\mathbf{Ln\,(St) = \ln St\text{-}1 + (\mu - \tfrac{1}{2}\sigma^2)dt + \sigma\epsilon\sqrt{dt}}$$

Hence: - $\mathbf{St = St\text{-}1 * \exp(\mu - \tfrac{1}{2}\sigma^2)dt + \sigma\epsilon\sqrt{dt}}$

The solution is Geometric Brownian Motion Model of future stock price. It can be extended to any period of time t. In this case future stock price St can be derived from initial value S0, just by applying on period of time t when time dt = t.

PARAMETRIC ESTIMATION

DRIFT & VOLATILITY of Stock, supposed to be known, and if not available needs to be estimated from Historical Data, which is the starting step undertaken in this study. For example refer Bajaj auto file, considering the daily lognormal returns of the Bajaj auto stock prices for the five year period under study, we obtained the mean daily return of 0.000954392 (0.095%) and daily volatility average 0.027302911 (2.73%). Our study delves into continuous-time series, hence the daily mean return obtained for the study period with respect to Bajaj Auto is penalized for the risk or volatility, therefore to get the annualized returns for the stock, hitherto referred as drift or annualized or adjusted mean return we proceed as under:-

Step 1:- 0.095% = $\mu - (1/2\ \sigma^2)$. Hence we get the daily μ as equal to (0.095% + $0.5*\sigma^2$) = 0.13271165%.

Step 2:- Annualized Return = 0.13271165%*252 days in a year (assumed 252 trading days here throughout this study) = 33.44% (refer also the next section for this on volatility)

Step 3:- Annualized Historical volatility = daily mean standard deviation * sqrt(252 trading days in a year) = 0.027302911* sqrt(252) = 0.433420275 (43.34%)

VOLATILITY

Is a constant characteristic of a stock expressed as an annualized percentage .It gives an idea about stability of Stock Price .Relatively high volatility means that the stock price varies continuously within relatively large intervals, measured by the standard deviation of Price Returns (Fairly established standard practice). Practical way of estimating empirically, the Stock Volatility is to observe historical data at fixed intervals of time, say daily closing prices.

Denote Si as stock closing price at the end of ith trading period and τ is the length of time interval between two consecutive trading periods expressed in years, where $\tau = ti - t\,i - 1$ for positive integer i. If u I is logarithm (natural) of daily return on stock price over short time interval τ that is, ui=ln(Si/Si-1) for i= 1,2,3,…….n

Then the unbiased estimator u bar of logarithmic returns is given by:

ubar = 1/n (Σui),And the estimator of standard deviation of ui's is given as:-

υ = **square root[(1/n-1)* Σ (ui –u bar)² or**

= squareroot [(1/n-1) * Σ ui² - ((1/(n*(n-1))*(Σui)² where u bar is unbiased estimator of logarithmetic returns ui.

We have seen that the estimator of standard deviation of daily returns on stock = $\boldsymbol{\sigma} * \sqrt{\boldsymbol{\tau}}$ .It follows that σ can simply be estimated as $\boldsymbol{\sigma} * = \boldsymbol{\upsilon} / \sqrt{\boldsymbol{t}}$

With a standard error equal to $\boldsymbol{\sigma} * / (\sqrt{\mathbf{2n}})$.

DRIFT:- Using result given in above, and an unbiased estimator of daily return given above,we get the expected annual rate of return or drift μ as follows:

ubar = $(\mu - \frac{1}{2}\sigma^2)\tau$, thus

$\mu = (\text{ubar}/\tau) + (\frac{1}{2}\sigma^2)$

When is method of scaling Volatility appropriate?

1) Returns are Independently & Identically distributed.
2) Prices are log normally distributed (that is their behavior is generated by Geometric Brownian Motion)
3) Volatility is calculated from log stock prices.

However, daily (or high frequency) stock prices are generally not independently and identically distributed, as well as having more noise than less frequency data. In this case Diebold etal(1998) showed that scaling volatility to a longer time horizon can amplify fluctuations in the data, scaled volatilities are often overestimated.

VOLATILITY CLUSTERING:- Volatility is the conditional variance of Asset Return, a measure used to quantify the riskiness of an asset. Empirical studies reveal that volatility tends to increase with the square root of time, as time increases and the increase is continuous with it being rare to observe Volatility Jumps. Volatility is usually stationary, meaning it varies within a fixed range and is hence finite. There are a number of different types of Volatility (title of this study),such as Historical Volatility, which is calculated from past Asset Returns of asset or Implied Volatility, which is obtained inversely or indirectly (Black Scholes model for Pricing Options

In Financial Derivatives),from a Model that has been accepted. It is worth noting that Volatility does not actually imply a direction of dispersion.

Volatility Clustering is a phenomenon of spells of high Amplitude that alternates with spells of low amplitude. That is to say, if at time t, the volatility is high then, at next consecutive time t+1, the asset return will also tend to have high volatility. This characteristic contradicts Independent & Identically distributed assumption that is traditionally assumed to be a stylized fact of log returns. Empirical studies of Returns have shown that extreme values do not normally appear unpredictably but rather they happen after the occurrence of larger than normal movements in return value. Periods of high volatility in returns will commonly follow a "CRASH v/s BUBBLE" pattern swinging from higher than average positive values to lower than average negative values and back again. During periods of low volatility, also called "DOLDRUMS", returns stay much closer to mean value with little deviation

HISTORY OF HISTORICAL VOLATILITY SO FAR (SINCE 1971)

CHRONOLOGY:--

1) 1971:- Fixed Exchange Rate System (Bretton Woods Agreement) broke down leading to flexible currency exchange rates (this was the genesis of volatility in the currency markets).
2) 1973:- First oil crisis, created high volatility in Interest rates, and was followed by high Inflation – which not only marked the start of volatility in interest rates but also volatility in GDP.
3) 1987:- US STOCK MARKETS collapse in October, was harbinger of extreme volatility in the EQUITY MARKETS, this event was also a landmark event due to two reasons:-
   a) Portfolio Insurance Models as applied to equities became a major subject for analysis both for practitioners 7 academicians. &
   b) For the first time Option Traders realized that the BLACK-SCHOLES MODEL of constant volatilities was unstable and the phenomenon of VOLATILITY SMILE was discovered.
4) 1989 :- Japanese Stock Market (NIKKEI 225), crashed towards end of this year and within three years the Stock Index had lost more than 50% of its value, which led to a long and dark period in Japanese Capital Markets and real economy which lasted

for almost 11 years and its after effects caused high volatility in both the Equity & Bond markets.

5) 1994:- Bond markets in US, crashed which was eventually followed by 6 consecutive hikes in short term interest rates, and once again it was proved beyond doubt that, volatility is not only the preserve of equity markets but is also rampant in bond markets.
6) 1997:- The Asian Financial crisis in July 1997, brought back nightmares of Foreign Exchange volatilities which eventually wiped out about 75% of the dollar capitalization of equities in Malaysia, Korea, Indonesia, & Thailand.
7) 1998:- Russian debt default ignited, another round of financial crisis in the global financial markets and finally ended up with the bankruptcy of Long term Capital Management, the behemoth hedge fund.
8) 2000:- Finally after a long bull run the sunset on NASDAQ In early 2000 and the values of Internet, Technology & New Economy Stocks melted away in decline that had no precedent which lasted for almost four years, this was when the equity volatilities reached an all time peak (as measured by VIX—SO CALLED FEAR GAUGE)
9) 2008 Crisis and when will next crisis be?

STOCK PRICE DISTRIBUTION

Having so far covered the mathematical form of Geometric Brownian Motion, to better understand the model, we need to derive other necessary features like the Probability Density Function of Mean and Confidence intervals.

LN DENSITY FUNCTION

A Random variable Q has a ln distribution if V = ln(Q),had a Normal Distribution. Suppose that V is Q (m,s) that is, it is Normally Distributed with mean m and standard deviation s.The probability density function for V is given by:-

$$f(V)=(1/\sqrt{2\Pi S})* \exp\left[-1/2(V-m/s)^2\right]$$

The lognormal probability density function of Random Variable can be obtained, realizing that for equal probability under Normal & Log normal probability density functions, incremental areas should also be equal, hence f(V)d V = h(Q)d Q, hence ,dividing both sides by dQ we get:

h(Q)=f(V)d V/d Q, Using the first order derivative for V =ln (Q) WE GET:

d V = d (ln (Q)) i.e., d V =d Q/Q. By putting d V in h (Q) We get:

Probability density function of lognormal distribution of variable Q as:-

$h(Q)=[(1/\sqrt{2\Pi})*sQ\ ]EXP\ [\ -1/2(LN(Q)-m/s)^2]$

Mean Lognormal Distribution:-

Using probability density function, mean of variable Q, is given by the following integral

$E[Q] = \int Q\, h(Q) dQ$,by putting Q = EXP (V) & d Q = EXP (V)d V IN THE ABOVE INTEGRAL WE HAVE:-

$E[Q] = \int (Q/sQ\sqrt{2\Pi})*EXP(-1/2(\ln (Q) - m/s)^2]\ d\ Q$

$= \int (1/s\sqrt{2\Pi})*exp(V)*exp[-1/2(v-m/s)^2]d\ V$

$= \int (1/s\ \sqrt{\ }\ 2\Pi)*exp[\ -\ (v-m-s^2)^2/2s^2]*exp(ms^2+s\hat{}4)/2s^2)d\ V.$

$=[EXP(m+(s^2/2)]*\int (1/s\sqrt{2\Pi})exp[\ -\ (v-m-s^2)^2/2s^2]d\ V$

The integral in this expression is integral of a Normal Density function with Mean $(m+s^2)$,& standard deviation (s) and is hence equal to 1.It follows that the expectation of lognormal variable Q is:

$E\ [Q] = EXP\ (\ m\ +(s^2/2)$

STOCK EXPECTED VALUE

According to results of previous section,the variable Y = ln St is Normally Distributed with Mean $\ln(S0)+(\mu - \frac{1}{2}\sigma^2) * t$ and variance$\sigma^2 * t$.

The Expected value E [St] of stock price at future time t is given by:-

$E[St] = exp[(\ ln(So)\ ) + (\ \mu - \frac{1}{2}\ \sigma^2) * t + \sigma^2 * t]$

$= exp\ [(\ ln\ S0) * exp\ ((\ \mu +\sigma^2/2) * t)$

$= S0 * exp\ ((\ \mu +\sigma^2/2) * t)$

CONFIDENCE INTERVALS

The variableln (St) follows a Normal Distribution with Mean :ln (S0) + (μ – $1/2\sigma^2$) $*$ t and Variance $\sigma^2 * t$.A confidence interval of 95% level of the variable ln (St) is given by:-

[Ln(S0)+(μ – 1/2σ^2) $*$ t] – 1.96 * $\sigma\sqrt{t}$<= ln (St) < = ln(S0) + (μ – 1/2σ^2)t + 1.96*$\sigma\sqrt{t}$

Hence by taking exponentials in 8.5 equation we get the 95% confidence interval of lognormally distributed variable [St],which takes the following form.

Exp((ln (S0) + (μ – ½ σ^2) t) – 1.96 * $\sigma\sqrt{t}$< = St <= exp((ln(S0)+ (μ – 1/2σ^2)t)+ 1.96*$\sigma\sqrt{t}$.

DRIFT AND NOISE

- Stock prices have been studied for over a century in order to detect technical patterns with very little success.But Index returns have been found to be a Random Walk with an upward drift.
- On a daily basis, or weekly basis, the upward drift or "INDEX DRIFT" As its also called is indeed imperceptible.
- Mathematically, Index is considered as a " **SUB-MARTINGALE"**. A Martingale is a random series in which each number is equal to the previous number plus a random factor. For a Martingale, most accurate prediction for the next number is the previous number, because random factor is unpredictable and is only a source of error.
- A sub-Martingale is a class of Martingales in which the base number is steadily increasing over time, but still has a random component.
- Over longer periods, Index drift overwhelms noise:-The combination of noise and Index drift helps explain why both " Buy& Hold" and trading strategies work on Index. Buy and Hold Focuses on drift and trading profits from noise. Both Drift & Noise have the potential to push the price upward

MOMENTUM,MEAN-REVERSION AND MARKET CYCLES

Mean reversion is the tendency for a price or factor or Economic Indicator to revert to a mean value over time. For example the US G.D.P. rates tended to be mean reverting over a period of few years. Average annual rate for Us over past 28 years is 3%, and after years in which it is lower, it tends to rise and vice-versa.

Momentum is the opposite of Mean-Reversion, and is the tendency for a variable to keep moving in the same direction. Both Mean Reversion & Momentum are not mutually exclusive, so long as they exist in different time frames.

For over 80 years of available stock market data, neither Mean reversion ,Nor Momentum has been conclusively evidenced in major broad stock market indices, by any leading academic research.

7) GEOMETRIC BROWNIAN MOTION – MODEL(G.B.M.)

The assumptions on which G.B.M. model is most widely used in Stock Price Modeling, meet the Financial Market Laws & Rules, imposed by Market Efficiency Hypothesis. These rules and laws suppose that only present information about a stock being efficient is employed to determine the future price of this stock. According to G.B.M, the returns on a certain stock in successive and equal periods of time are independent and identically distributed random variable which is normally distributed, thus they form a Markov Process.

Theoretically, G.B.M, serves to be a good way of modeling future stock prices. Albeit the shortcoming of using this model for pricing behavior over shorter periods of time, but it is more accurate when used for modeling stock prices over longer periods of time. This is due to the fact that the expected rate of return and volatility of a stock are assumed to be constant. To assess model accuracy, it is hence recommended to model these parameters as a Stochastic function of time and not as constants. Thus G.B.M is a Stochastic Markov Process.

8) STOCK PRICE BEHAVIOR

STOCK DEFINITION: - In Finance, a Stock represents a share in the ownership of an Incorporated company. Stocks are evidences of ownership, or Equity. Investors buy stocks in the hope that it will yield Income by way of Dividends and Capital Appreciation, or growth in Value of such Capital Investments from time to time. Shares of widely held companies are traded on Stock Market. Stockholding is

popular because stocks represent ownership of capital that can be easily transferred by means of Organized Trading in Stock Markets.

STOCK PRICE PROCESS

Refer Fig Below :- which displays how the price of a Financial Stock varies with time.(Example Zee Entertainment)

The Horizontal (x axis), represents time in years, and the Vertical (y axis) is the daily closing price of a stock during one year.



The price behavior shows the same behavior as a Stochastic Process called " Brownian Motion". Thus some properties of stock price process can be derived from those of Brownian motion process.

RANDOM WALK (DRUNKARDS WALK):- Is the first step in understanding Brownian Motion. A Random Walk is a formalization of the intuitive idea of taking successive steps. The simplest random walk is a path constructed according to following rules:-

For an Integer n, n>0, we define Random Walk Process at time t, { Wn(t), t > 0 } as follows:-

1) Initial value of process is :-Wn (0) = zero.
2) The layer spacing between two successive jumps is equal to 1/n.

3) The Up & Down jumps are equal, each having same size of 1/ (√ n),occurring with equal probability.

In other words, if we consider a sequence of Independent Binomial Variable Xi, taking values +1 or -1, with equal probability that is ½,then value of Random Walk at the ith step is defined as follows:-

Wn(i/n) = (Wn (i-1/n)) + (Xi/√ n) for all I >= 1

The above figure shows the first two steps of Wn. At time 1 , process has only two values with same probability. It moves up to value √ (1/n) with 0.5 probability and moves down to value – 1/(√n) with same 0.5 probability. In this case the Mean & Variance of process are:-

E[Wn (1)] = 0.5 * 1/√ n + 0.5 * (-1/√ n) = zero.

Variance [Wn(1)] = E [Wn (1) – E (Wn(1)] ²

= 0.5* (1/√ n – 0)² + 0.5* (-1/√n – 0)² = 1/n.

Using same procedure to obtain the value of Random Walk at time 2 ,which equals 2/n. Random Walk at time 2 is obtained as follows:

Wn(2/n) =(Wn (1/n))+(Xi /√ n)) .

As shown in figure above, Wn (2/n) can have three different states:

The state 2*(1/√ n) with probability 0.25 if Wn (1/n) = √ n and Xi = +1

The state 0 with probability 2*0.25 = 0.5 if from state √ n the random walk goes down that is, Xi = -1, or jumps up from state – 1/√n that is Xi = +1.

In the state -2/√ n process goes down from state -1/√n with probability 0.25,and here Xi = -1.

The Mean & Variance of Random Walk process after second step can be calculated in same way as before. Thus we have:

E[Wn(2/n)] = (2/√n)(0.25) + 0* 0.5 + (-2/√n)*(0.25) = zero and hence the variance:

Variance [Wn (2/n)] = E [Wn (2/n) – E (Wn (2/n))]²

= 0.25*(-2/√n – 0)² +0.25* (0-0)² + 0.25* (2/√n – 0)² =2/n.

As is illustrated using various plots in this study, the process starts from value zero and randomly makes a series of three successive "up" jumps followed by 5 successive down jump . At the end of random walk seems to show a different behavior like an up and down process. But what does the random walk look like if n gets larger and larger that is the intervals of time becomes smaller and smaller?

Looking at the above familial portraits, appear to be setting down towards something as the number of steps n increases. The moves of Size (1/√ n) seems to force some kind of convergence. According to probability theory the process Wn(t) has a Normal Distribution with Mean zero & Variance equal to t. Of course this needs proof.

PROOF:-Let X1,X2,---- Xn, be a series of n independent and identically distributed Binomial Random Variables taking values -1 and +1 with probability equal to 0.5.

Starting from Wn(0) = zero ,we have:

Wn(1/n) = Wn (0)+ (X1/√ n) = X1/√n

Wn(2/ n) = Wn (1/n) + X2/√ n which equals =(X1/√n) + (X2/√n) = 1/√n (X1+X2)

. . . . . .

. . . . . .

Wn (i-1/n) = Wn (i-2/n) +(X i-1/√n) = 1/√ n (X1+X2+……. Xi-1)

Wn (i/n) = Wn(i-1/n) +(Xi/√ n) = 1/√n (X1+X2+X3+…… Xi) for all I > = 1

And so using recursive formulae, we get value of Random Walk at time after n steps starting from initial value at time zero (Wn (0)) that is:-

Wn (t) = 1/√ n (Σ Xi)

We multiply Numerator & Denominator, by √ t, we have:

Wn (t) = √t (Σ Xi / √nt)

According to the Central Limit Theorem (C.L.T.), Equation tends to standardized Normal Distribution with Mean zero and Variance 1 i.e. N (0,1).Hence random walk process Wn (t) tends to N (0,t)

Stochastic Calculus is very important in Mathematical Modeling of Financial processes, due to the underlying random nature of Financial Markets. Most academic articles in Finance have a 'pure' mathematical theme.

THE MARKOV PROPERTY

The Expected Value of Random Variable S(Stock price),conditional upon all of the past events only depends on the previous value S(t-1).This is the Markov Property. We say that the Random Walk, has no memory (forgetfulness property or Memory less),beyond where it is now. Note that it does not have to be the case that the expected value of random variable S, is same as previous value.

This can be generalized to say that, given information about Sj, for some values of 1<= j <1,then the only information that is of use to us in estimating Si is the value of Sj for largest j for which we have information. All the financial models have Markov property. This is of fundamental importance in modeling in Finance. Also we will show examples where system has a small amount of memory, meaning that one or two other pieces of information are important. And couple of examples where all of Random Walk Path contains relevant information.

THE MARTINGALE PROPERTY

If in a coin tossing experiment say, you know how much money you have won say after the fifth toss. Your expected winnings after sixth toss,and indeed any number of tosses, if we keep playing, are just the amount you already hold. That is the conditional expectation of your winnings at any time in the future is just the amount you already hold.

E[Si / Sj, j<i] = Sj.

QUADRATIC VARIATION

We now define the quadratic variation of random walk. This is defined by: $\Sigma (Sj - Sj\text{-}1)^2$. Because you either win or lose an amount \$1 after each toss, $| Sj - Sj\text{-}1| = 1$.Thus quadratic variation is always i. $\Sigma (Sj - Sj\text{-}1)^2 = i$,we use the coin tossing experiment, that will lead us to a continuous **time random walk.**

BROWNIAN MOTION

Let us restrict time allowed for 6 tosses to a period t, so each toss will take a time t/6,second the size of the bet will not be \$1, but $\sqrt{t/6}$, this new experiment clearly still possesses, both the Markov & Martingale properties, and its quadratic variation measures over the whole experiment is $\Sigma (Sj - Sj\text{-}1)^2 = 6 * (\sqrt{t/6})^2 = t$. The experiment is set such that the quadratic variation is just the time taken for the experiment. We can speed up the game by having n tosses in the allowed time t, with an amount $\sqrt{t/n}$, riding on each throw. Again the Markov & Martingale properties are retained and the quadratic variation is still $\Sigma (Sj - Sj\text{-}1)^2 = n * (\sqrt{t/n})^2 = t$. Now making n larger and larger, speeding up the game, decreasing the time between tosses, with a smaller amount for each bet. But we choose new scaling very carefully, the time-step is decreasing like 1/n, but bet size only decreases by $1/\sqrt{n}$. As we go to limit $n = \infty$, the resulting random walk stays finite. It has an expectation, conditional on a starting value zero, of $E[S (t)] = 0$,and a variance $E[S (t)^2] = t$. S (t) is used to denote the amount you have won or the value of random variable after a time interval t. The limiting process for this random walk as the time steps go to zero is called Brownian Motion, and will denote it by X(t).

The important properties of Brownian motion are as follows:-

1) Finiteness:- Any other scaling of the bet size or 'increments' with time step would have resulted in either a random walk going to ∞ in a finite time, or a limit in which there was no motion at all. It is important that the increment scales with square root of time step.
2) Continuity:- Paths are continuous, there are no discontinuities. Brownian Motion is the continuous –time limit of our discrete time random walk.
3) Markov:- The conditional distribution of X(t) given information up until $r<t$ depends only on X(r).
4) Martingale:- Given information up until $r <t$ the conditional expectation of X(t) is X(r).

5) Quadratic Variation:- If we divide the time 0 to t, in a partition with n+1 partition points ti = it/n,then $\Sigma (X(tj) - X(t\ j-1))^2$ tends to t (technically almost surely).
6) Normality:- Over finite time increments t i-1 to ti, X(Ti)- X (ti-1) is Normally Distributed with mean zero and variance t i- t i-1.

Having built up the idea and properties of Brownian Motion from a series of experiments, we can discard the experiment to leave the Brownian Motion defined by its properties. These properties will be very important for our Financial Models.

STOCHASTIC INTEGRATION:-

We define a stochastic integral by :$W(t) = \int f(r)\, d\, X\, (r) = Lim\ \Sigma\ f\ (t\ j-1)(X(t\ j-\ X(\ t\ j-1))$ with $t\ j = jt/n$. The function f(t) which is being integrated is evaluated in the summation at left hand point t j-1.It will be crucially important that each function evaluation does not know about the random increment that multiplies it, that is the integration is non-anticipatory. In financial terms, we will see that we take some action such as choosing a portfolio and only then does the stock price moves. This choice of integration is natural in finance, ensuring that we use no information about the future in our current actions.

STOCHASTIC DIFFERENTIAL EQUATIONS (S.D.E.)

Stochastic Integrals are important for any theory of stochastic calculus since they can be meaningfully defined (and this definition leads to some important properties).It is very common to use a shorthand notation for expressions such as:

$W(t) = \int f(r) d\, X\, (r)$

That short hand comes from differentiating and is $d\, W = f(t)\, d\, X$

Here d X IS INCREMENT IN x that is a normal random variable with mean zero and standard deviation $\sqrt{}$ dt. Equations are meant to be equivalent. One of the reasons for this shorthand is that equation looks a lot like an ordinary differential equation. We do not do further step of dividing by dt to make it look exactly like an ordinary differential equation because then we would have the difficult task of defining d X /dt. Pursuing this idea further, imagine what might be meant by : $d\, W = g(t)dt + f(t)\, d\, X$ .This is simply short hand for : $W\ (t) = \int g(r)\, dr + \int f(r)\, d\, X\ (r)$

Equations like this are called stochastic differential equations. Their precise meaning comes however from the technically more accurate equivalent stochastic integral

THE MEAN SQUARE LIMIT

This term is useful in the precise definition of stochastic integration.

Examine the quantity:- $E[\Sigma (X (t j) – X(t j-1))^2 - t)^2]$

Where $t j = jt/n$. This can be expanded as :

$E [\Sigma (X (t j)- X (t j-1))^4 + 2 \Sigma \Sigma (X(t j)- X (t j-1))^2(X (t j)- X (t j-1))^2 - 2t \Sigma (X(tj)- X(t j-1))^2+ t^2$.

Since X(t j)-X(t j-1) is Normally distributed with mean zero and variance t/n, we have:-

$E [(X(t j)- X (t j-1))^2] = t/n$ and $E [(X (t j) – X (t j-1))^4) = 3t^2 / n^2$

Thus becomes :

$n * 3t^2/n^2 + n (n-1) t^2/n^2 - 2 t n t/n + t^2 =0$ (1/n).As n tends to ∞ this tends to zero. We therefore say that $\Sigma (X (Tj)-X (t j-1))^2 = t$, in the mean square limit. This is often written for obvious reasons as

$\int (d X)^2 = t$. Hence equality referred to subsequently is equality in mean square sense.

FUNCTIONS OF STOCHASTIC VARIABLES AND ITO’s LEMMA

If we consider a function:- $F(X) = X^2$,if it's true, then $d F = 2X d X$? NO. The ordinary rules of calculus do not generally hold in a stochastic experiment? Then what are the rules of calculus? Thus we set about to derive the most important rule of stochastic calculus. ITO’S LEMMA. The derivation is Heuristic rather than being rigorous, bit its transparent, we play with various time scales, first time scale is very verysmall. We will denote this by $d t/n=h$.

This time scale is so small that the function F(X (t+h)) can be approximated by a TAYLOR SERIES.

$F(X(t+h) - F(X(t)) = (X(t+h)-X(t))d\ F/d\ X\ (X\ (t))+1/2\ (X(t+h)-X(t))^2\ d^2\ F/d\ X^2\ (X\ (t))+---------$

From this it follows and using relevant approximations the above expression approximates to simply,

$F(X(t+nh))- F(X(t)) = F(X(t+dt))-F(X(t))$

The second is just the definition of $\int (d\ F / d\ X) * d\ X$,and the last is $\frac{1}{2}\ d^2\ F/d\ X^2\ (X\ (t))dt$ in mean square sense.Thus we have :

$F(\ X(t+dt)) - F(\ X(t))= \int(\ d\ F/\ d\ X\ )(\ X\ (r)d\ X\ (r) + \frac{1}{2} \int\ d^2F/d\ X^2\ (X\ (r\ ))\ d\ r$

We can now extend this to longer time intervals from zero up to t, over which F does vary substantially to get:

$F\ (X(t)) =\ F(\ X(0)\ ) + \int\ d\ F/d\ X\ (\ X\ (\ r)\ )\ d\ X\ (r) + \frac{1}{2} \int d^2\ F/d\ X^2\ (X(\ r)\ )\ d\ r$

This is the integral version of ITO's LEMMA, which is usually written as :

$d\ F = d\ F\ /d\ X\ + \frac{1}{2}\ d^2\ F\ /\ d\ X^2\ )dt$ (ITO'S LEMMA)

APPENDIX 4:

NumXL

Part: - I: NumXL [1]

INTRODUCTION: - NUMXL is a suite of time series add-ins for Microsoft Excel. Once loaded, NumXLintegrates scores of time series functions, along with a rich set of user interfaces and tools to assist in data analysis.

Module: - Description

1. Data Preparation
2. Descriptive Statistics
3. Time series Smoothing
4. Correlogram Analysis
5. Modeling
6. Calibration
7. Residual Diagnosis
8. Forecast.

Module 1:- Data preparation:-

a) Data layout in Excel b) Data Sampling c) Stationarity d) Homogeneity e) Outliers (Influencers) f) Concentration of Values.

a) Data layout in Excel: - Display the dates and closing stock prices in adjacent columns in the same spreadsheet. Although the date component is not needed for modeling, it gives us a general idea about the chronological order of the values. We would choose for our study throughout ascending order, which means the first value corresponds to the earliest observation. Num XL assumes an ascending order by default.

b) Data Sampling: - We begin by examining the sampling assumptions. A Time Series will generally contain observations that are equally spaced over time, where the value of each observation is available (that is there are no missing values). Please note that the sample period is the trading day (not the calendar day). We need to visually inspect the data to see that it meets the sampling assumptions, defined by Econometric & Time series theories:

[1] **(**Source: - NumXL free download)

1) Is the underlying process stable? (Homogeneity).
2) Does the Variance & Auto- Covariance remain the same throughout the sample span? (Stationarity).
3) Do we have observations with unusual values? (Outliers/Influencers).
4) Are the values of observations well spread out?

c) Stationarity: - For this, we are mainly concerned with the stability of Variances&Covariances throughout the sample. This assumption is pivotal for time series theories, so how do we check for it? Paradoxically, we begin by testing for non-stationary conditions, primarily: 1) The presence of unit root (RANDOM WALK) &/or, 2) The presence of deterministic trend. If we cannot find them we conclude that the data is stationary. For this we plot using original data for a deterministic trend or random walk (possibly with a drift).

d) Homogeneity: - We need to ascertain whether the underlying process underwent any structural changes during the span of the sample data under observation. Structural changes are those changes caused by events that permanently alter the statistical properties of the stochastic process. A structural change can be triggered by new changes in policies, passing new laws, or any major development (exogenous) during the span of the sample. To examine the homogeneity or lack thereof, we shall look at the data plot along with WMA (Weighted Moving Average) & EWMA (Exponentially Weighted Moving Average), and try to identify any permanent changes in the mean, variance or any signs of trend or Random Walk. We shall use the 20 day (Window—h) equally weighted moving average along with the original data, to deduce any evidence of a sudden permanent change in the underlying process mean.

e) Outliers: - An outlier is an observation, which is numerically distant from rest of data that is one that appears to deviate markedly from other members of the sample in which it occurs. The mere presence of outliers in our data may change the mean level in the uncontaminated time series, or it might suggest that the underlying distribution has fat tails. A quick way to do this is to use the robust measure of IQR (Inter Quartile Range which is Q3-Q1.

Lower limit: - Q1 – 1.5*IQR Upper limit: - Q3 + 1.5*IQR

f) Concentration of values: - To detect the issues associated with the concentration of values, we ask the following questions.

- Are the volatility/ Variance changing in relation to observation levels?
- Are the data values capped or floor leveled?
- Does the distribution show a skew in either direction?

If we find any of the above, we need to employ, data transformation techniques on the input data stream, such as the Box-Cox Transformation. Statisticians George Box &David Cox developed a procedure to identify an appropriate exponent lambda, which is used to transform the data into a normal shape. The lambda value indicates the power to which all data should be raised in order to do this, the Box-Cox Transformation searches from λ = -5 to λ = +5 until the optimal value for lambda is obtained. We have already incorporated this in the data by choosing the value of lambda as equal to zero, implying by doing so we are getting our data values close to Normality. The log (Box-Cox with zero lambdas) transformation improves the distribution of values, especially at the right tail.

Goal: - We wish to have the values of the observations to be distributed close to a Normal Distribution.

ARCH Model

ARCH models based on the variance of the error term at time it depends on the realized values of the squared error terms in previous time periods. The model is specified as:

$$y_t = u_t$$

$$u_t \sim N(0, h_t)$$

$$h_t = \alpha_0 + \sum_{t=1}^{q} \alpha_j u_{t-i}^2$$

This model is referred to as ARCH (q), where q refers to the order of the lagged squared returns included in the model. If we use ARCH (1) model it becomes

$$h_t = \alpha_0 + \alpha_1 u_{t-1}^2 \qquad (3)$$

Since h_t is a conditional variance, its value must always be strictly positive; a negative variance at any point in time would be meaningless. To have positive conditional

variance estimates, all of the coefficients in the conditional variance are usually required to be non-negative.

$\alpha_0 > 0$, $\alpha_1 \geq 0$

GARCH Model

Bollerslev (1986) and Taylor (1986) developed the GARCH (p, q) model. The model allows the conditional variance of variable to be dependent upon previous lags; first lag of the squared residual from the mean equation and present news about the volatility from the previous period, which is as follows:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{i=1}^{p} \beta_i h_{t-i} \tag{4}$$

In the literature most used and simple model is the GARCH (1, 1) process, for which the conditional variance can be written as follows:

$$h_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1} \tag{5}$$

Under the hypothesis of covariance stationarity, the unconditional variance h_t can be found by taking the unconditional expectation of equation 5.

We find that

$$h = \alpha_0 + \alpha_1 h + \beta_1 h \tag{6}$$

Solving the equation 5 we have

$$h = \frac{\alpha_0}{1 - \alpha_1 - \beta_1} \tag{7}$$

For this unconditional variance to exist, it must be the case that $\alpha_1 + \beta_1 < 1$ and for it to be positive, we require that $\alpha_0 > 0$.

Exponential GARCH

Exponential GARCH (EGARCH) proposed by Nelson (1991) who has form of leverage effects in its equation. In the EGARCH the following form gives model the specification for the conditional covariance:

$$\log(h_t) = \alpha_0 + \sum_{j=1}^{q} \beta_j \log(h_{t-j}) + \sum_{i=1}^{p} \alpha_i \left| \frac{u_{t=i}}{\sqrt{h_{t=i}}} \right| + \sum_{k=1}^{r} \gamma_k \frac{u_{t-k}}{\sqrt{h_{t-k}}} \quad (9)$$

Two advantages stated in Brooks (2008) for the pure GARCH specification; by using $\log(h_t)$ even if the parameters are negative, will be positive and asymmetries are allowed for under the EGARCH formulation.

In the equation γ_k represent leverage effects which accounts for the asymmetry of the model. While the basic GARCH model requires the restrictions the EGARCH model allows unrestricted estimation of the variance (Thomas and Mitchell2005:16).

If $\gamma_k < 0$ it indicates leverage effect exist and if $\gamma_k \neq 0$ impact is asymmetric. The meaning of leverage effect bad news increase volatility.

Applying process of GARCH models to return series, it is often found that GARCH residuals still tend to be heavy tailed. To accommodate this, rather than to use normal distribution the Student's t and GED distribution used to employ ARCH/GARCH type models (Mittnik et al. 2002:98).

The news impact is asymmetric on the other words bad news increase volatility. In the E-GARCH model negative and significant leverage effect parameter indicating the existence of the leverage effect in returns. If GED parameter (r) equals two it means normal distribution if it is less than two it means leptokurtic distribution. In all models r is less than two and statistically significant which indicate that RPX is leptokurtic. This result is consistent with the skewness values shown in Table 1.

After all model are estimated ARCH effect is tested and except GJR-GARCH model in normal distributionis rejected at10% level, the null hypothesis that there is no ARCH effect cannot be rejected for all models (see: Appendix).

The in-sample evidence provides the history performance of models. We estimate estimated variance for all models for full sample period using static forecast. Then we compare forecasting performance of models which are used in this paper. We consider four statistics as the forecasting error criterions which are employed in Wang and Wu (2012). Four measures are used to evaluate the forecast accuracy for full sample namely, Mean Square Error (MSE) and Mean Absolute Error (MAE):

$$MSE_1 = n^{-1}\sum_{t-1}^{n}\left(\sigma_t^2 - \hat{\sigma}_t^2\right)^2$$

$$MSE_1 = n^{-1}\sum_{t-1}^{n}\left(\sigma_t - \hat{\sigma}_t\right)^2 \quad (12)$$

$$MAE_1 = n^{-1}\sum_{t-1}^{n}\left|\sigma_t^2 - \hat{\sigma}_t^2\right| \quad (13)$$

$$MAE_2 = n^{-1}\sum_{t-1}^{n}\left|\sigma_t - \hat{\sigma}_t\right| \quad (14)$$

Where, n is the number of forecasts, σ_t^2 is the actual volatility and $\hat{\sigma}_t^2$ is the volatility forecast at day t.

Conclusion

This paper examined three GARCH models namely GARCH, GJR-GARCH and EGARCH model with three different distributions which are Normal, Student-t and Generalized Error distributions for comparing their forecasting power for volatility of the return of Czech stock market, PX index.

All models are employed and their coefficients are interpreted. The results show that significant ARCH and GARCH effects are present in the data indicates that return volatility can be characterized by significant persistence and asymmetric effects consistent with papers Rockinger and Urga (2012), Haroutounian and Price (2010), Vošvrda And Žikeš (2004) which has GARCH type models to Czech stock market.

Finally we compare the in-sample-forecasting performance of all nine models. The evidence shows that the EGARCH model has a best-forecast performance under most of the loss criterions

Legend: - Description of Various Parameters in these Models

SNO.	SYMBOL	DESCRIPTION
1)	μ	LONG-RUN MEAN (mu) (all models)
2)	∅1	First Coefficient of AR Component (ARMA MODEL)
3)	∅1	First coefficient of AR Component(ARMA MODEL)
4)	σ	Standard deviation of Residuals/Innovation(ARMA MODEL)
5)	LLF	Uses the log-likelihood method to measure goodness of fit (all models)
6)	AIC	Uses the Akaike Information criterion method to measure goodness of fit.
7)	CHECK	examines the values of model's parameters for stability, stationarity,Invertibility and Causality. (Value 1 mostly ideal for all models)
8)	KURTOSIS	Excess kurtosis (aka fat tails)
9)	NOISE?	Determines if observations are not significantly Auto – correlated.
10)	NORMAL?	Determines if observations are Normally Distributed.
11)	ARCH?	Determines if observations exhibit a significant ARCH Effect.
12)	TARGET	Targets the desired sample statistic value.
13)	SIG?	Determines if the calculated statistics are significantly different from the Target value.
14)	$\alpha 0$	Constant in the conditional volatility equation. (GARCH MODELS)
15)	$\alpha 1$	First coefficient of ARCH component (GARCH MODELS)
16)	$\beta 1$	First coefficient of GARCH component (GARCH MODELS)
17)	υ	Degrees of freedom of the Innovations/Shocks distribution. (t distribution
18)	λ	Risk- Premium lambda (GARCH M MODEL)
19)	ϒ1	First Leverage coefficient (EGARCH MODEL)

GARCH Analysis:-

Enables us to model and forecast the conditional variance or volatility, instead of conditional mean of a variable. The analysis of conditional variance is useful on account of a) pricing of options b) improving the estimation of forecast intervals.

Here the conditional variance in time t depends on past errors, and variances. They are designed to model time varying volatility, in particular. Volatility Clustering, a feature often displayed by financial market series. The variance at time t is expected to be higher when past errors and variances were higher in past and vice - versa.

The phenomenon of time varying volatility is well known and generated a vast body of econometric literature following the seminal contributions by Engle (1982), Bollerslev (1986) & Taylor (1986), introducing the (generalized) Auto regressive Conditional heteroscedastic (GARCH) process and stochastic volatility models respectively.

Descriptive Statistics: - Example Hindustan Unilever (2009-2014)

Descriptive Statistics	
AVERAGE:	0.08%
STD DEV:	1.64%
SKEW:	1.05
EXCESS-KURTOSIS:	9.20
MEDIAN:	0.02%
MIN:	-7.99%
MAX:	16.03%
Q 1:	-0.84%
Q 3:	0.99%

Summary

- Mean (Average) is close to zero.
- Density (mass) distribution is significantly positively skewed.
- Density distribution has fat tails.
- Half of the observations lie between minus 0.84% to + 0.99 %.
- Median is lesser than average, distribution is positively skewed (right skew), and that the distribution has right fat tails.
- Quartiles (Q1, Q3), inscribes 50% of values in the sample. Interquartile range (IQR) is used to characterize data, when there may be extremities that may skew the data. IQR is a relatively robust statistic (also sometimes called "Resistant") compared to range (Max value – Min value), and the standard deviation.

Significance Test

Significance Test		**5.00%**
Target	**P-Value**	**SIG?**
0.000	5.25%	FALSE
0.000	0.00%	TRUE
0.000	0.00%	TRUE

Table 2: - Significance values given are for mean, skewness and kurtosis respectively.

Null hypothesis for mean: - Sample estimate is close to zero. Since the p value as reported in table 2 above is 5.25 % which is greater than our level of significance (5 %), which is the probability of committing a Type-1 error, or rejecting the null hypothesis when indeed it's true.Whenever the **p-value is lesser than 5 % we decide to reject the null hypothesis**. Here we accept the null hypothesis that the sample mean is zero (close to zero, and hence infer statistically that the mean daily return on Hindustan lever stock for the study period (2009-2014) which is 0.08% is indeed close to zero, which implies that differences if any can be attributable to sampling fluctuation and thereby accept our null hypothesis of saying that the mean log daily returns on Hindustan lever ltd stock is

zero. But the same cannot be said for skewness and kurtosis p values as the null hypothesis statesH0:- Skewness is zero and kurtosis is zero. Observe that the p value of significance obtained for both is zero percent which being individually less than 5 % we reject the Null hypothesis thereby inferring that the sample log returns on Hindustan Lever stock is asymmetric and has fat tails at the right side of the data distribution

White Noise/Normal Distribution/Arch Effect

		5%
Test	**p-value**	**SIG?**
White-noise	63.50%	TRUE
Normal Distributed?	0.00%	FALSE
ARCH Effect?	0.00%	TRUE

Table: - 3:-Let's address the following questions.

QUESTION 1:-Does The Log returns Time series of Hindustan Lever stock for the selected period of study five years (1/4/2009 to 31/3/2010) exhibit WHITE NOISE? (Aka no serial correlation) or (no auto correlation)?

To answer this question, we shall use the descriptive statistics wizard and check the white noise test (LJUNG- BOX) TEST function. Observe that the p value of significance is very high at 63.5% and significance displays true remark, meaning thereby that Null Hypothesis is accepted and the answer to our question is yes, this financial time series of Hindustan Lever ltd stock's log returns does not exhibit significant serial correlation, as mentioned earlier if the computed p value happens to be greater than 5 % level of significance, we accept the null hypothesis.

QUESTION:-2:- On the question of whether the log returns are normally distributed—we infer that the p value which is 0% is less than 5% we reject the null hypothesis which states that the log normal distribution on Hindustan Lever stock is normally distributed, is false meaning thereby that there is statistical evidence to the effect stating that the data on daily log returns of this stock for the period under study is not normally distributed.

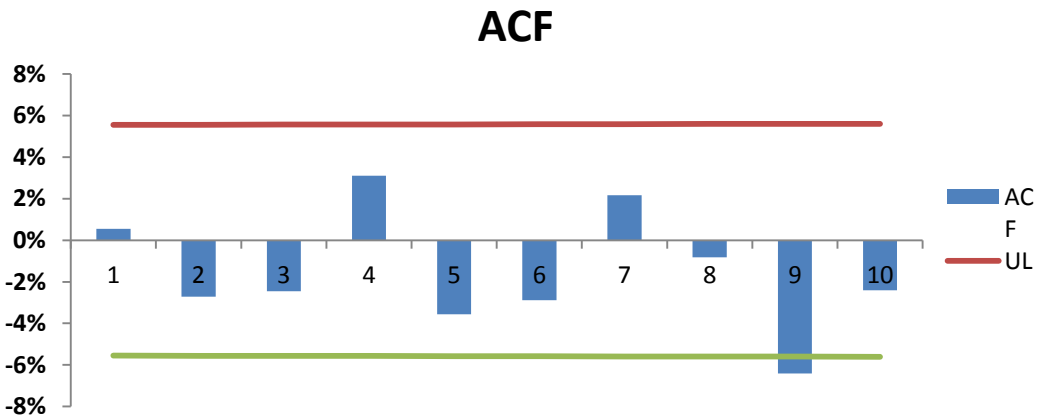
Coupled with the fact that the descriptive section results displayed shows that the daily log returns time series distribution possesses fat tails (excess kurtosis, value = 9.20) which may occur if the squared returns are correlated (aka ARCH EFFECT).

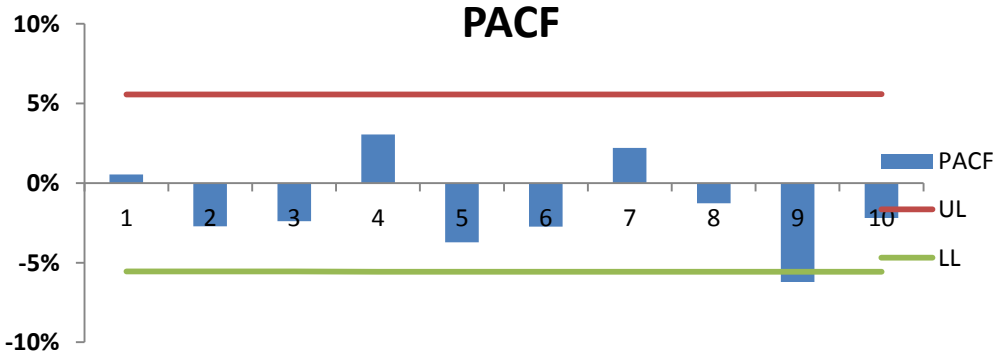
QUESTION:-3:- Does the daily log returns on Hindustan Lever stock exhibit an ARCH Effect? That is, is the squared daily log returns correlated or more like a white noise distribution?

Examining the ARCH effect test results, we conclude that squared returns are serially correlated which implies that it's possible that we encounter a conditional heteroscedasticity in log returns. Observe that the p value is 0%, which is less than 5 %, and hence we reject the null hypothesis or say that it is true, which means we reject the null hypothesis that the squared returns are not serially (aka auto correlated).

Correlogram Analysis:-

Figure shows: - Hindustan Lever auto correlation (ACF) and partial auto correlation functions (PACF):-





Correlogram Analysis						
Lag	**ACF**	**UL**	**LL**	**PACF**	**UL**	**LL**
1	0.55%	5.55%	-5.55%	0.55%	5.55%	-5.55%
2	-2.71%	5.56%	-5.56%	-2.71%	5.56%	-5.56%
3	-2.45%	5.56%	-5.56%	-2.40%	5.56%	-5.56%
4	3.10%	5.57%	-5.57%	3.06%	5.56%	-5.56%
5	-3.56%	5.57%	-5.57%	-3.72%	5.56%	-5.56%
6	-2.88%	5.58%	-5.58%	-2.73%	5.57%	-5.57%
7	2.17%	5.59%	-5.59%	2.21%	5.57%	-5.57%
8	-0.82%	5.59%	-5.59%	-1.28%	5.57%	-5.57%
9	-6.41%	5.60%	-5.60%	-6.22%	5.57%	-5.57%
10	-2.41%	5.60%	-5.60%	-2.19%	5.57%	-5.57%

While examining the correlogram analysis of squared log returns refer plot as well as tabled values:-

Firstly correlogram analysis is a key tool used to explore the interdependency of observation values, and it can also serve the purpose of identifying an opportune model and thereby estimate the order of its components. In our example we found that daily log returns are not correlated but their squared values are indeed correlated. As a result it's opportune to employ ARCH/GARCH MODEL for modeling Hindustan lever stock returns to trace the actual or close to actual volatility.

Time Series Modeling

NuM XL supports numerous time series models: - ARMA (Acronym for auto regressive moving average model), ARIMA, AIRLINE, AND GARCH MODEL OR ITS FAMILY. We have restricted our study by using (p,q) the orders of the ARMA ,GARCH,GARCH-M & EGARCH Models to order (1,1) only most popular and commonly used in financial Time Series Modeling of Stock/Index Returns.

Let us begin by considering a GARCH (1, 1) Model:-

yt=μ + at

at=σt*εt

εt~ Ø(0, 1)

$$\sigma t^2 = \propto 0 + \propto 1at - 1^2 + \beta 1\sigma t - 1^2$$

Using NuM XL toolbar, locate and click on GARCH icon. The GARCH wizard dialog box pops up. In input data field specify cells range for the sample data. Next enter the values of ARCH & GARCH component orders as one (1).For innovations distribution we shall use the default as Gaussian distribution, although we have the famous t distribution as well as the GENERAL ERROR DISTRIBUTION for the GARCH FAMILY, WHICH IS WORKED OUT IN DETAILS.

Next we instruct the GARCH wizard to generate and augment the "GOODNESS OF FIT" calculations and along with it the "RESIDUALS DIAGNOSIS" sections in model output table. By default selected cell is used for output range value. Following table will be generated in your worksheet.

Illustration GARCH (1, 1)

GARCH(1,1)		**Goodness-of-fit**		
Param	Value	LLF	AIC	CHECK
μ	0.00	3408.53	-6811.06	1
α_0	0.00			
α_1	0.09			
β_1	0.09			

Residuals (standardized) Analysis							
	AVG	**STDEV**	**SKEW**	**KURTOSIS**	**Noise?**	**Normal?**	**ARCH?**
	0.00	0.96	0.67	3.65	TRUE	FALSE	TRUE
Target	0.00	1.00	0.00	0.00			
SIG?	FALSE	TRUE	TRUE	TRUE			

The table one above shows the model's parameters values which are set by a quick guess (initial guestimates) and hence are not optimal values at all, even the model to model

values differ significantly both in terms of optimality check as well as the parameters and its resulting outputs.

The model ought to be calibrated before we can gauge its fit or consider the same for forecasting purposes. In the top right table is displayed the goodness of fit measure readings for Hindustan Lever Daily log stock returns. The wizard created for us, the LLF (LOG LIKELIHOOD FUNCTION VALUES AND, AIC(AKAIKE INFORMATION CRITERION) formulas on the corresponding cells. At the bottom of this same table we obtained, RESIDUALS (STANDARDIZED) ANALYSIS, INTERPRETED AS UNDER:-

Average: -	FALSE: -	**GOOD/DESIRABLE**
Standard Deviation: -	TRUE: -	**BAD/UNDESIRABLE**
Skewness: -	TRUE:-	**BAD / UNDESIRABLE**
Kurtosis: -	TRUE: -	**BAD/UNDESIRABLE**
NOISE?: -	TRUE:-	**GOOD/DESIRABLE**
Normal distribution?:-	FALSE:-	**BAD/UNDESIRABLE**
ARCH EFFECT ?:-	TRUE:-	**BAD/UNDESIRABLE.**

Inthe residual diagnosis table, the wizard created a series of statistical test (formulae), for standardized residuals that is $\{\varepsilon t\}$, to help us verify the GARCH assumption:-

$\varepsilon t \sim i.i.d \sim \emptyset(0,1)$

The generated formulas reference the model's parametric cells and input data cells range, so when you calibrate (or modify) the values of model's parameter latest and best (optimal values).which means from majority of undesirable features obtained using GARCH (1,1) MODEL, we have a suspect model, and hence we propose to ask the following questions to this model.

QUESTION 1:- What are the optimal values for GARCH (1, 1), given input data?

QUESTION 2:- Given the calibrated model, how well does the model fit the input data?

QUESTION 3:- Do the Residuals address the assumptions underlying the model?

QUESTION 4:- Are there similar models to consider (eg EGARCH, GARCH-M)? How do we rank them and decide which of them to use?

Next step in our analysis is the Model Calibration phase.

Model Calibration:-

Here we need to find optimal values for the model's parameters- a process referred to as "Calibration". Once calibrated we can examine the residuals for the model's assumptions and compare this model with other models.NuMXL supports numerous time series models, and fortunately, the calibration process using Num XL is the same for all models. In a nutshell, a calibration is an " Optimization Action Problem", where we search for a set of parameter values that Maximizes the value of a Utility Function (log likelihood function—LLF) /and minimizes the AIC (Akaike Information Criterion), while complying with one constraint , the stability of the model.

What do we mean by model stability? For an ARMA Model, the underlying process has a finite unconditional (long-run) Mean & Variance (that is the roots of the characteristic equation are outside the unit circle). For GARCH &GARCH variant models, in addition to the constraint, the variance model must guarantee positive values for the conditional variance. Fortunately, NumXL, lumps together model specific constraints with a function: - ARMA_CHECK, GARCH_CHECK ETC) which returns one (1) for a stable model, otherwise reports a zero value.

We use the solver for this optimization process.

Solver Parameters

Set Objective: - L

To: - Max.

By changing variable cells: - J3: $J $6

Subject to the constraints: - N3 >= 0.99999

Non negativity of unconstrained variables

Solving method: - GRG Non-linear

Click on SOLVER button

After 14 odd iterations solver finds an optimum solution

Keep solver solution.—ok.

Once we accept the solver solution, new set of parameters values are copied to your work sheet.

The optimal results using GARCH (1, 1) are as follows:-

GARCH(1,1)		**Goodness-of-fit**		
Param	Value	LLF	AIC	CHECK
μ	0.00	3443.81	-6881.63	1
α_0	0.00			
α_1	0.38			
β_1	0.15			

Residuals (standardized) Analysis					
AVG	**STDEV**	**SKEW**	**KURTOSIS**	**Noise?**	**Normal?**
0.00	1.00	0.51	2.79	**TRUE**	FALSE
0.00	1.00	0.00	0.00		
FALSE	**FALSE**	**TRUE**	**TRUE**		

Note that LLF Changed from 3408.53, to 3443.81, yet the model is valid and stable as check value is maintained at 1.

The calibrated parametric values improved the overall fit of the model with input data, but is this the right model?. We need to examine the assumptions of GARCH and whether they are met or not needs to be seen next.

Looking at the residual diagnosis table, we observe the following points: - barring the STD deviation result which has turned from true to false post optimization, rest all others maintain their status quo, and remember it's the standard deviation (volatility) which is our subject topic under study.

In a nutshell, a time series model draws some patterns for evolution of values over time and assumes the error term (residuals/noise/shock), to be independent and following a particular probability distribution, could be Gaussian Innovation, or Student's t (William Gosset), or generalized error distribution.

The objective of time series analysis is "Forecasting", so by ensuring that our model properly fits the data and meets all assumptions, we can have faith in the projected forecast.

The standardized residual diagnosis includes the following hypothesis testing

1) Population Mean (H0 :-μ =0)
2) Population Standard Deviation (H0:- σ =1)
3) Population Skewness(H0:-S =0)
4) Population Excess Kurtosis (H0:- K=0)
5) Whiten Noise or Serial Correlation (H0:- $\rho 1 = \rho 2 = \rho 3 = \cdots . = \rho K = 0$)
6) Normality Test
7) ARCH Effect Test.

   The first four tests examine the distribution center, dispersion, symmetry and fat end tails. The normality test compliments these tests by assuming a specific distribution a GAUSSIAN, where εt~ ∅ (0,1)

   The white noise and ARCH EFFECT tests address a different concern namely, independence of residual observations: - ε t ~ $i.i.d$.since the independence test is quite a complex topic; we simplify it by examining the linear and quadratic order dependency.

Analysis of Residual diagnosis table:-

a) The population mean (average) test shows that the sample average is zero (same as target) .As a result the residuals distribution has a mean of zero.
b) The population standard deviation (STDEV) test shows that the sample data standard deviation is 1 (same as target).
c) Population skewness test shows that sample skewness is slightly different from zero, which tells us that the residual distribution is close to being symmetric, but not symmetric.
d) The population excess kurtosis, indicates sample kurtosis to be significantly different from that of a normal distribution (that is excess kurtosis is zero) .The residual distribution tails are not normal.
e) The normality test shows the t the standardized residuals are not sampled from a normal population.
f) Now let us examine the interdependence concern among the values of residuals. The first order dependence (linear) or serial (auto) correlation using WHITE

NOISE TEST (LJUNG BOX), the test shows no sign of significant serial correlation.

g) Let us examine the second order dependence (quadratic), or ARCH EFFECT. The arch effect shows insignificant serial correlation in the squared residuals or the absence of an ARCH EFFECT.

As a result, the standardized residuals are independent and identically Non GAUSSIAN Distributed. Thus the GARCH Model assumption is not fully met, hence we check using EGARCH AND Use the innovation t distribution and the findings are reported as under:-

EGARCH(1,1) & t-dist(v)		**Optimal**		**Goodness-of-fit**	
Param	Value		LLF	AIC	CHECK
μ	0.00		3491.17	-6970.34	1
α_0	-3.02				
α_1	0.53				
γ_1	0.04				
β_1	0.69				
ν	5.53				

	Residuals (standardized) Analysis						
	AVG	**STDEV**	**SKEW**	**KURTOSIS**	**Noise?**	**Normal?**	**ARCH?**
	0.03	1.00	0.50	3.43	**TRUE**	FALSE	**FALSE**
Target	0.00	1.00	0.00	3.91			
SIG?	**FALSE**	**FALSE**	**TRUE**	**TRUE**			

Observe from this optimal table we have got the maximum value for the log likelihood function as 3491.17,bettering the previous value of 3443.81,but the other conclusions same as enlisted for seven points as above for the hypothesis testing mode. We have also tried and tested other models in a few cases using the MODELS LIKE :- ARMA (2,2), ARMA (3,3), GARCH (2,2),, INTEGRATED ARMA (ARIMA (1,1)), Sarima And A Few More But We Choose To Narrow Done In Our Study To Employ Simple Arma And

Garch, And Egarch All (1,1) Models, Albeit Using The Innovations:- 1) Gaussian Or Normal Distribution 2) Studentized (t Distribution 3) Generalized Error Function Distribution For Comparison Purposes.

PART II: -Time Series Forecasting

Num XL uses the following syntax commands:

Syntax

GARCH_FORECI (X, Order, Mean, Alphas, Betas, Innovation, V, T, Alpha-Level, Upper)

X: - is the univariate time series data (a one dimensional array of cells e.g. rows or columns).

Order is the time order of the data series (that is whether the first data point corresponds to the earliest or latest date (earliest date = 1 (default, and latest date =0)

Mean: - is the GARCH MODEL MEAN (mu)

Alphas: - are the parameters of the ARCH (p).

Betas: - are the parameters of the GARCH (q) component model (starting with the lowest lag)

Innovation: - is the probability distribution function of the innovations/residuals/shocks/noise. 1= Gaussian, 2= t Distribution, 3= Generalized Error Distribution Function. If missing, a Gaussian distribution is assumed.

ϑ (nu) is the shape parameter (or degrees of freedom) of innovations/residuals probability distribution function.

T is the forecast time horizon (expressed in terms of steps beyond end of the time series)

Alpha Level: - is the statistical significance level. If missing a default of 5% is assumed.

Upper: - If true, returns the upper confidence interval limit, otherwise returns lower limit.

REFERENCE

1.NumXL An Add in Feature of MS Excel, freely downloadable.

APPENDIX 5

Regression Fundamentals

Econometric Series (Financial Time series)

Gauss-Markov theorem assumptions (OLS estimation technique) (Ordinary Least Squares)

The Population Regression Function (P.R.F.) is expressed as:-

$Y_i = \alpha + \beta_1 X_{1i} + \beta_2 X_{2I} + \ldots\ldots\ldots\ldots\ldots + \sigma_i$ ---------- (A)

- Model is linear in parameters, and is correctly specified.
- Independent Variables (Xi's) are Non-Stochastic.
- The Expectation of error term is zero (E[σ_i] = 0
- The Variance of error termsσ_i^2 is constant (Homoscedasticity).
- The error terms are uncorrelated – E[σ_i ,σ_J] =0, FOR $\exists$ i $\neq j$.
- There is no linear relationship between the Independent Variables in a Multiple Linear Regression model.

If the above assumptions hold true in a data set, we may infer that the OLS Estimators are B.L.U.E. (Best, Linear, Unbiased (Asymptotic), Estimator and are considered Efficient.

- Error terms are independent of explanatory variables. Cov (σ_i,Xi) = 0
- Explanatory Variables are measured without error, or the error term absorbs all the possible measurement errors.
- Explanatory Variables are not perfectly linearly correlated. There is no "Multicorrelation",otherwise the parameter of the relation becomes indeterminate and the method of least squares breaks down. (When$r_{xi,xj} \neq 1$). On the other extreme if $r_{xi,xj} \neq 0$, the variables are called orthogonal and there are problems of multicollinearity while estimating parameters of relationships.
- Macro variables are correctly aggregated.
- Estimated relationships are identifiable.
- Relationships are correctly estimated.

A.S. Goldberger says " As Sample size increases, issues of statistical significance becomes much less important, but issues of economic (practical) significance becomes critical, as with very large samples almost any Null Hypothesis will be rejected".

Problems In Regression

1) Heteroscedasticity
2) Multicollinearity
3) Autocorrelation.

1) Heteroscedasticity

- Assumed $\sigma_i^2 = k^2X^2$, where k (a constant) is estimated from the model, this problem is more likely to occur in cross-sectional data than time series data.
- CONSEQUENCES OF HETEROSCEDASTICITY
  1) We cannot apply the formula as, VAR (β_0 CAP), VAR (β_1 CAP), the estimators, to conduct the tests of significance.
  2) If σi is heteroscedastic, then σ_i^2 is not a constant finite number. It changes with X. In the presence of heteroscedasticity, these OLS estimators do not have "Minimum Variance Property" Therefore estimators are inefficient in small samples &asymptotically inefficient in large samples. However the parametric estimates are still statistically unbiased, as expected values of (β_0 CAP,β_1 CAP), do not involve σ_i^2 or do not require the assumption of constantσ_i^2.

2) Multicollinearity

- If r ($r_{xi,xj} \neq 1$) $\neq$ 1, the application of OLS depends on a crucial condition, that the explanatory variables are not perfectly linearly correlated. If this is violated that is if there exists a perfect linear correlation among some or all of the explanatory variables then the variables are multicollinear.
- Ragnar Frisch " The broader definition of multicollinearity implies that it is not a condition that exists or does not exist, it is a phenomena inherent in most economic relationships due to the sheer nature of economic phenomena".
- Reasons for presence of multicollinearity

1) In various phases of business cycle, all economic variables tend to move in the same direction. Thus growth and trends in time series are serious causes of multicollinearity.
2) Some econometric models use lagged values of certain variables as independent explanatory variables, for example, consumption is explained with current as well as past income or investment is taken as a function of distributed lags of past level of economic activity.

- Consequences of Multicollinearity
  1) Even if multicollinearity is high, OLS estimators are still BLUE.
  2) Multicollinearity is essentially a sample regression phenomenon that is even if X's are not linearly related in the population; they may be related in a particular sample from which we estimate the PRF.
  3) L.R.KLEIN:-"Multicollinearity is not necessarily a problem unless it is high, relative to the overall degree of multiple correlation among all variables simultaneously.
  4) Increasing standard errors appear when we include inter correlated variables as explanatory variables in the function.
  5) Due to large standard error, confidence intervals for corresponding population parameters tend to be larger and probability of accepting a false hypothesis that is "Type II Error" increases.
  6) Presence of multicollinearity may give rise to danger of misspecification as we may reject a variable whose standard error appears high, although it may be an important determinant of the variation of dependent variable.
  7) As estimated standard error increases with multicollinearity, the computed t values become smaller and lead to acceptance of Null hypothesis i.e.: -$\beta's$ = 0.
  8) There is high overall R^2& insignificant t.

3) Autocorrelation

- Correlation between members of series of observations ordered in time or space as in a time series or cross sectional data.

- An important assumption of OLS is successive values of a random variable σ_i are temporarily independent: - COV(ui,uj) = 0 , for all I $\neq j$. Violation of this assumption leads to stochastic variables being auto correlated or serially correlated.
- Sources of Autocorrelation
    1) Inertia: - Given economic data in time series form, it exhibits business cycle as states of nature of an economy, such as boom & recession, have momentum built into them. Therefore in regression analysis of time series data, successive observations are likely to be interdependent.
    2) Excluded Variables: - The omitted explanatory variables, if auto correlated, exert their influence on error or residual term, whose values then is auto correlated. This is called quasi autocorrelation in the random disturbance error term.
    3) Misspecified Form: - When the model is misspecified mathematically, different from the true form, the errors or residual terms may be correlated.
    4) Presence Of Lagged Variables: - Can lead to autoregression,as one explanatory variable is lagged.
    5) Data Manipulated: - Some interpolation and smoothing is done to time series data, which affects the error term and successive error terms getting correlated.
- Consequences of Autocorrelation
    1) When the stochastic disturbance (noise/error/residual) term shows serial correlation value, as well as the standard error of the estimated parameter is affected. However OLS estimates are statistically unbiased as long as the error terms and explanatory variables are uncorrelated.
    2) When the residuals are auto correlated the variances of OLS estimates are likely to be large.
    3) Variance of random term, may be seriously under estimated in the presence of auto correlated error terms, which is most serious in case of positive correlation of error terms and of positively auto correlated X's,in successive time periods.
    4) When the residuals are auto correlated, predictions based on OLS estimates will be inefficient, as variance of such an estimate is larger than the variance of estimate based on any other econometric method.

- **Residual Tests for Regression of In-Sample Realized Volatility**

Future realized volatility of In-Sample period are estimated by the classical linear regression model which as stated before has following five major assumptions:-

1) $E[\varepsilon_t] = 0$
2) VAR ($[\varepsilon_t]$) = $\sigma^2 < \infty$
3) COV(εi,εj) =0
4) COV (εt, Xt) = 0
5) $\varepsilon_t \sim N(0, \sigma^2)$

These assumptions make OLS Technique have substantive desirable properties and the HO that the test concerning the parametric estimates can be conducted validly.

- Violations of any of these assumptions can lead to some problems, such as both the parameter estimates and the standard errors associated with them are wrong, and the distributions assumed for the test are not appropriate.
- In order to confirm that the volatility forecasts are efficient and our inferences based on the coefficient estimates of regression for in-sample realized volatility are correct, the residual diagnostic tests were conducted.

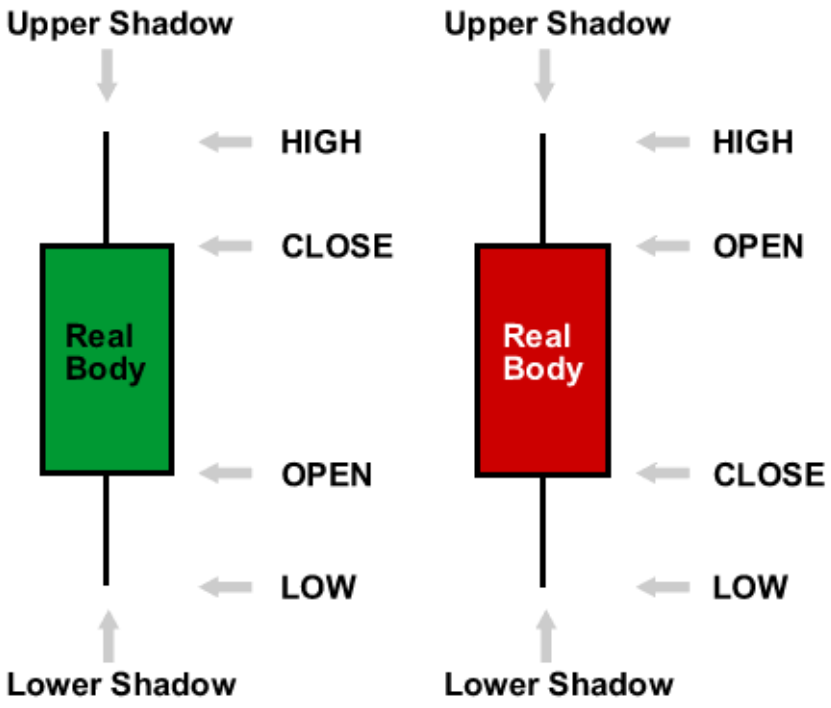
1) Due to coefficient α are highly significant for all regressions, thus the first assumption is not violated, that is if a constant is included in the regression model, the first assumption that the mean of the residuals are equal to zero will never be violated.
2) In terms of xt of the fourth assumption as above, it denotes that the independent variable of the regression equation. If the independent variable is stochastic and uncorrelated with residual, then the estimates of the OLS are consistent and unbiased.

REFERENCE

1) Damodar. Gujrati; Principles of Econometrics, Second Edition.
2) My own notes

Appendix 6

Japanese Candlestick Plots (Basics)



LEGEND:- Green color candle stick represent Bullish sentiments, while the red color candle stick represent bearish trend.

- These candlesticks are created exactly from the intraday prices:-open, high, low and close stock prices.

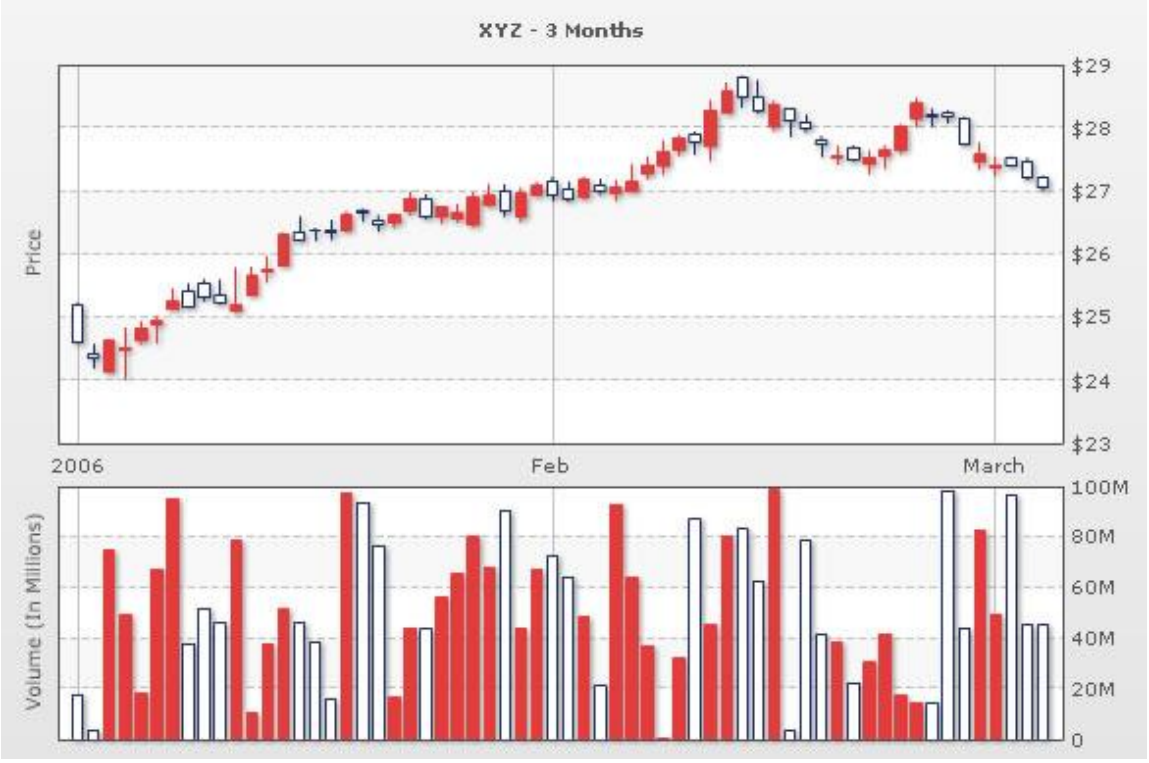
- The real benefit of using candlestick plots accrues due to better visual representation of the movement of stock prices, which facilitates quicker identification of short-term sentiments of the market.
- Candle sentiment (Psychology of the single candle)- answers three primary question:-

  1) Who is in control? 2) The Bulls? 3) The Bears?
- Green color candle sticks, implies buyers are willing to pay higher prices, size of the green candle, larger it is more bullish than small green candle sized bodies. Similarly the red candles indicate that the sellers are in control, and larger the size of the red body, more bearish sentiments are evident as compared to smaller red sized candles.
- Larger the tails on the lower end of red candle sticks, and larger the tails on the upper end of the green candle sticks implies significant rejection of lower prices/ significant rejection of higher prices respectively, thereby implying that in the first case of red candles of this bullet point, trend implied is bullish, and in the same vein for green colour candles bearish trend is implied.
- DOJI:- Equal tails above or below any candle suggests bearish rejection of higher prices and bullish rejection of lower prices, denotes sideways trend.
- We can observe three stages in the candle pattern plots:

  1) Trend 2) Pattern 3) Confirmation.
- We can decipher several patterns such as: -a) Bearish reversal pattern b) Bullish reversal pattern c) Sideways trend d) Bullish Engulfing pattern etc.
- A pictorial representation of candlesticks plots as displayed below, have been attempted for all fifty stocks and NSE Nifty index, which displays candlestick plots on the top panel, and volume of stock traded in the bottom panel.

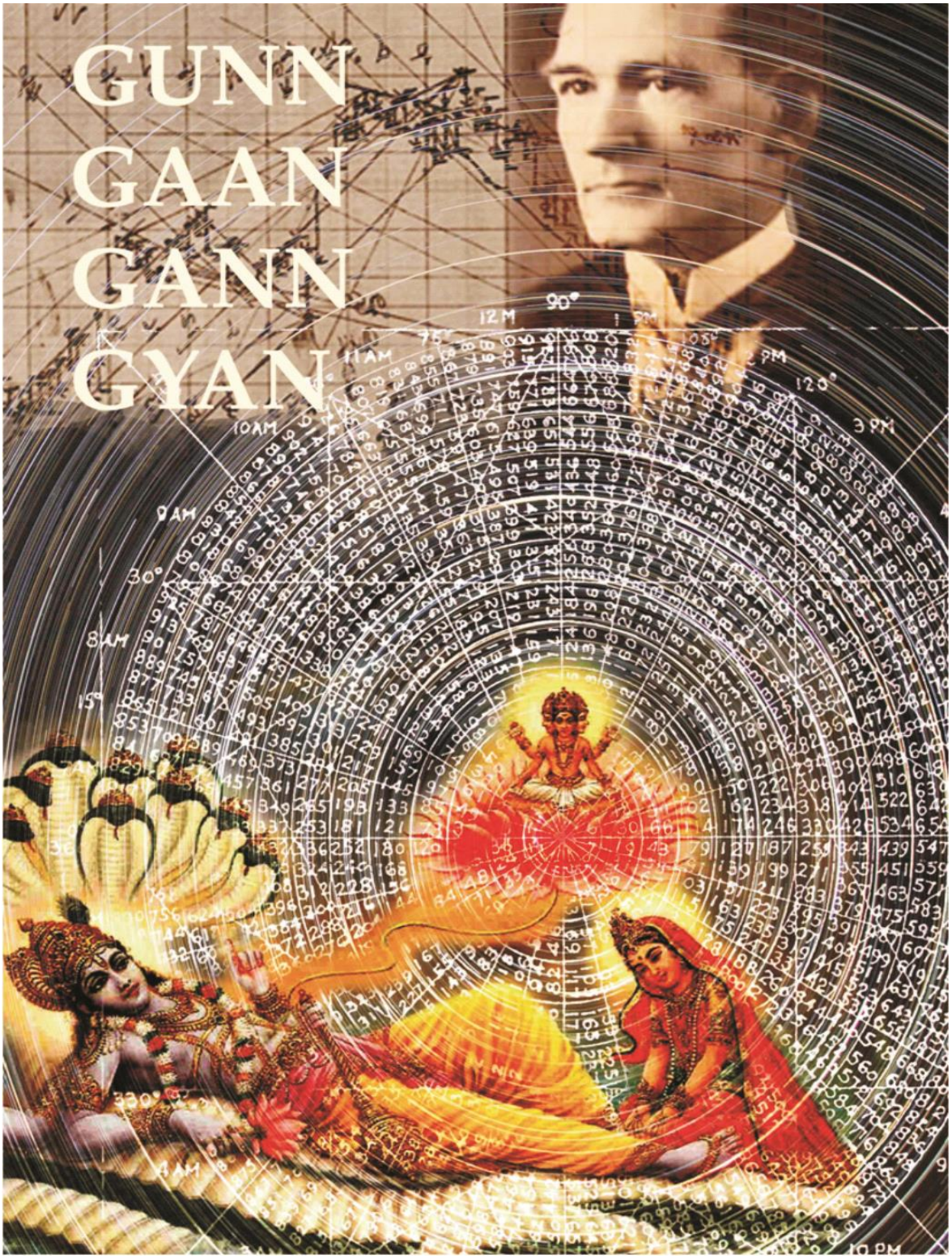
Candlestick Charting Pattern





APPENDIX 7

GANN ANALYSIS



A) Computation of Degrees, given Price

Case 1: O is at the centre of the grid. Angles in Degrees =MOD (180* $P^{\frac{1}{2}}$ - 225), 360.

Case 2: 1 is at the centre of the grid. Angles in Degrees = MOD((180* $(P-1)^{\frac{1}{2}}$ - 225),360).

Case 2: For example, NSE Market Index was quoted in news at **8797**, dated 3rd February 2015,page 20," SENSEX at 1- wk low, ahead of RBI Policy", we want to find the angle given this index value.

B) Computation of the Ring number given the stock price/Index value?

Ring Number = Round (((SQRT(Price) - 0.22/2),0)

Illustrative example on NSE Market (Nifty), our population, quoted at 8797.

Step 1: Find the ring number given this value index at 8797?

Ring number = [Sqrt (8797) - 0.22] ÷ 2 = 46.78616189

Step 2: Round up this to get answer as Ring Number 47. We say that 8797 lies on the ring which is numbered 47 or cycle number 47, whether clockwise or anti clock wise, does not matter.

Step 3: Find the 315° number to 8797?

= (Ring number * 2 +1)²

= (47 * 2 +1)²

= 9025, which is the ending of 47th ring, on which the square of 95 an odd number ends. Hence 9025 is at 315° from the given index 8797.

Step 4:- To find the zero degree angle on this ring?

= [Ring number * 2 +1]² - [7 * Ring number]

= 9025 - 329

= 8697

Thus the zero degree angle from which cycle/ring number 47 begins is 8697.

Step 5:- What is the angle between 8697 and 8797?

Angle = Sum (Price - Zero angle)/ Ring number÷45

$$= \frac{(8797-8697)}{\frac{47}{45}}$$

= 95.75°

Hence 8797 is at an angle of approx 96 degrees.

Step 6:- What is the Number which is at 45 degrees to the number 8797.

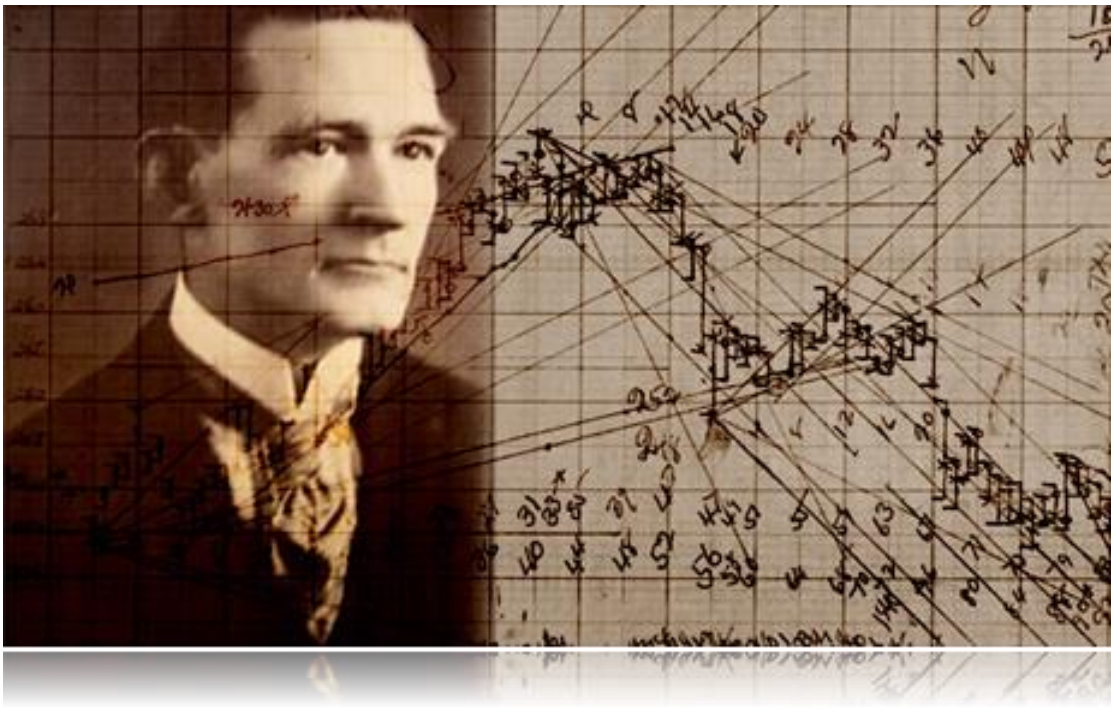
= 95.75 + 45

= 140.7°

Step 7: = (Ring Number * 2 +1)² - (7 * Ring number) + ($\frac{Ring\ Number}{45}$ * Angle)

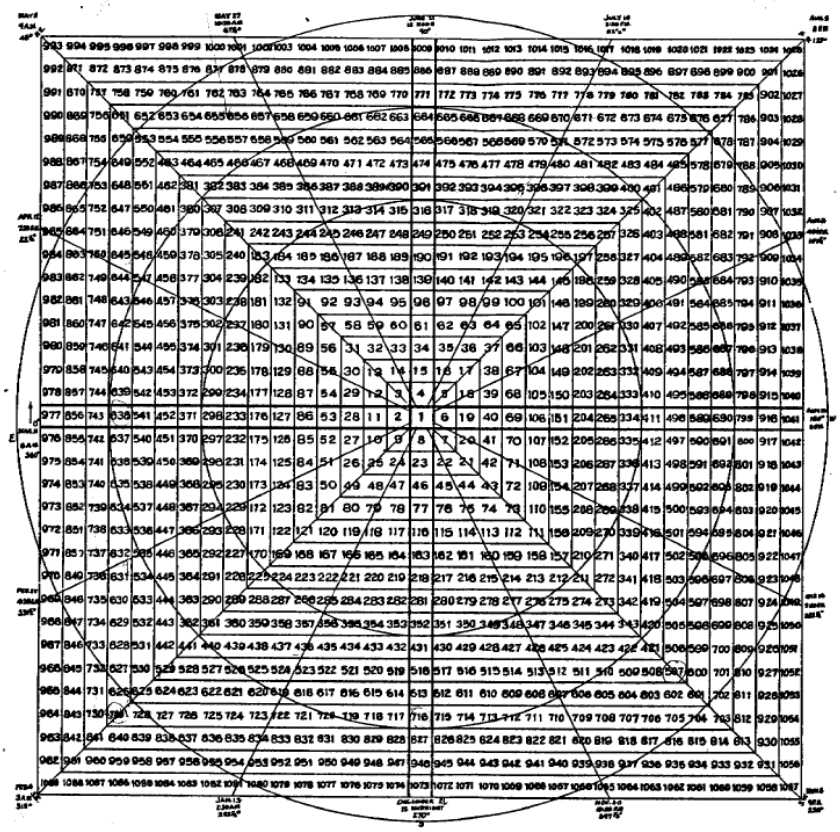
= 8843.

It can be said that 45 Degree being the most important angle, there will be a trend reversal obtained when the index touches 8843 level.



C) The Gann Square of Nine-- A square root calculator.

1) Gann Wheel & Squares, one of the cornerstones of Gann: Part of Gann's methodologies, had to do with the idea of " Squaring Price & Time". When trying to graph using a Gann tool, the charts should be set to a 1x1 ratio or your results will not be true.
2) Results from your Square of Nine are telling you the next most likely Resistance Price levels up and/or down from price measured. This would be your basic calculator.
3) Another concept is " Squaring the Circle", the box containing the square of nine should also have a circle around it, so that each corner of the box, touches the inside of the circle, this allows us to divide the square up in degrees of 360.
4) Blue cross (Cardinal Cross),+ sign, and the yellow diagonals or the ordinal cross (X shape),numbers lying on these two crosses, are considered very important numbers, when looking for next move up or down, and it divides the square into 45 degree increments. 13 is 45 degrees from 11.





5) Focussing on the Price, is only one-half of what he square of nine represents, the degrees here are also associated with time. A complete 360 degrees rotation is equal to adding 2 to the root of a number, then a 1 degree will correspond to a movement which would be 2/360 which is 0.00056 added or subtracted from the root number.

Illustration:- Same case of Nifty 8797 as on 3rd February 2015.

Let us assume a start value of 8797

a) root of 8797 = 93.79 ~ 94.

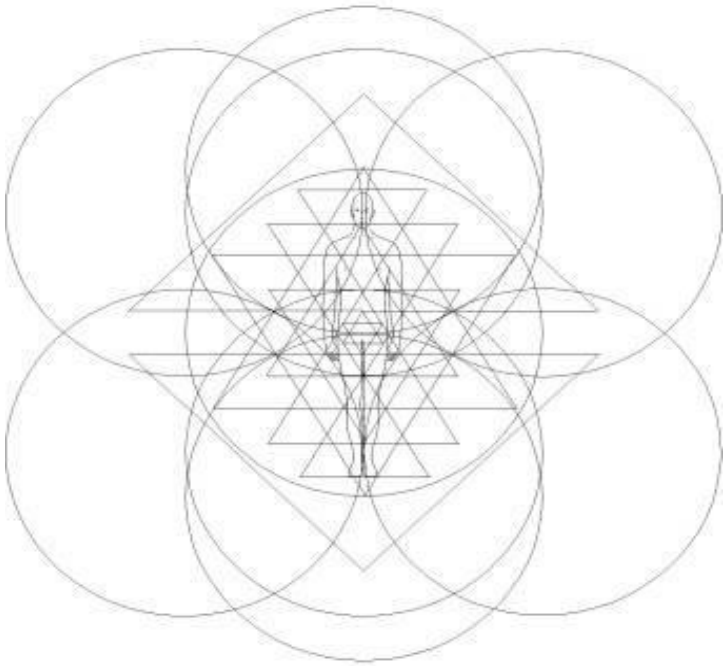
b) increments of 45 degrees, we add 0.25 (to root)

Degree	Working	Outcome
0	$(94)^2$	8836
45	$(94.25)^2$	8883.0625
90	$(94.50)^2$	8930.25
135	$(94.75)^2$	8977.5625
180	$(95)^2$	9025
225	$(95.25)^2$	9072.5625
270	$(95.50)^2$	9120.25
315	$(95.75)^2$	9168.0625
360	$(96)^2$	9216

These would be the significant levels found on the crosses every 45 degrees. If we wish to work the levels below our starting value, we would subtract 0.25 increments instead of adding it. This is one of Gann's Basics. What is missing is time element, to match up the prices with. When both time and price are squared the technique becomes even more better at Forecasting likely outcomes in the stock prices and Index levels.

c) Since start point is 8797, a target of 8883 would then be the trade you would be looking for.

d) Air in sacred geometry is represented by an Octahedron(Made up of 8 triangles)



S'rî Chakra around the human body

e) W.D. Gann Time cycles: W. D. Gann's forecasting methods involved looking back at the past with time cycles of various lengths from annual seasonal trends of 1 year to 5,7,10,20,30,45,60,84,90 and 100 year cycles. Behind these cycles are planetary periods of various lengths, and harmonics of their cycles, and sinusoidal cycles through the 360 degrees of the Zodiac-- wheels within wheels. **Each planet has an energy, vibration, number and scale. Price always seeks the gravity centre.**

f) [1] The Earth is a magnet, which is surrounded by a vast sea of Electromagnetic energy. Most of this energy comes from the Sun. Humans also produce electromagnetic energy through their nervous systems. Water covers, most of the earth and our bodies contain 85% water. The Moon affects the water on Earth (tides), and eclipses have a drastic effect on the Earth's magnetic field. Then is it illogical to conclude that these cosmic events, could also have an effect on human behaviour, and Investor Psychology? Where does the word "Lunatic" come from? John. Kepler, known as one of the founders of Astronomy stated: " The Planets forming angles (Aspects), upon the earth, by their luminous beams of strength tostirup the virtue of sublunary things, have compelled my unwilling belief".

Patrick Mikula:- book on " Definitive guide to Forecasting using W.D.Gann's square of nine



" Spring Equinox on March 21 is aligned on 0° - 360°.

Summer Solstice on June 21 is aligned to 90°.

Autumnal Equinox on September 22 is positioned on 180°.

Winter Solstice on December 21 is placed on 270°.

From Spring Equinox to Summer Solstice there are 92 days, and from Summer Solstice to Autumnal Equinox there are 93 days, and 90 days each from Autumnal

[1] Source:- Hans Hannula, Ph.D- " Using Gann with Astrophysics to validate turning points"

Equinox to Winter Solstice & from Winter Solstice to Spring Equinox, except in a leap year.

When Gann used 24 hours of a day, he assigned 6am to 0° - 360° mark. The Earth rotates 1 degree every 4Minutes, so 24 hours are divided evenly into 360° , 4 minutes increments around the circle. 1 year equals 365.24 days.

0° March 21, 6 am , Spring (Vernal) Equinox, East, Aries.

1° March 22, 6.04 am

9° March 30, 6.36 am

g) Fibonacci numbers[2] :- 44, 67.5, 266, 360 degrees. Gann taught us that at the beginning of each annual Earth cycle commencing at the Spring Equinox (Vernal Equinox), Gann indicated that by counting days from March 21st, that many of Nature's, invisible secrets would be revealed. By no means was the Stock Markets divorced from, this natural calendar rhythm.

h) **Eleventh Commandment**

Please grasp this universal law." Life deals out no Random Events". "More you scratch at the truth, the more it will itch".

Take a closer look at the number 365.24, multiply by 7, and we get 2556.68 days, which is equal to 7 years of course, and notorious **seven year itch**.

Mind boggling 2556.68 days equals to exactly 365.24 weeks. This new information totally vindicates **the perfect time cycle, as being 365.24** and not 360.

i) **SUN-MOON Confluence:**

The Sun & Moon are Conjunct at New Moon, and unless, overshadowed behaviour aspects, the Stock Markets can be expected to, move upward at that time. The Sun & Moon are in square aspects(90°), at 1st Quarter and last Quarter and a **Bear Market** is the normal outcome .When the angle between the Sun & Moon is 180°,they are said to be in opposition, at the Full Moon, which usually brings in its wake a somewhat

[2] Source:- Granville Cooley:- "The Gann Side of Fibonacci Number"

Bullish Market, but is not as positive as the New Moon. Sun & Moon Trine occurs at 120 ° , which comes half-way between opposition and conjunction, which are indicators of **Bull Markets.**

j) Gann divided the square into eight equal parts to produce eight triangles. The strongest (Support/Resistance), point is at the centre where all angles cross. Four angles cross at these point .For example if the top of a stock is say 28, this square of 28x28, would represent squaring the price by time, for the simple reason that if we have 28 points up in Price, and we move over 28 spaces in time, we Square the Price with Time. Hence when the stock has moved over 28 days, 28 weeks, or 28 months, it will be squaring its price range of 28.As Gann rightly says, there are three types of angles: The vertical, The Horizontal, and the Diagonal, which we use to measure Price & Time. **We use the Square of Odd & Even Numbers to get not only, the proof of Market Movements, but the cause.**

References

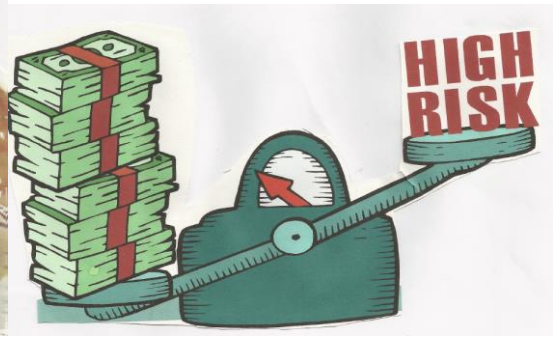
1) Source:- Hans Hannula, Ph.D- " Using Gann with Astrophysics to validate turning points"

2) Source:- Granville Cooley:- "The Gann Side of Fibonacci Number"

APPENDIX 8

Portfolio Management







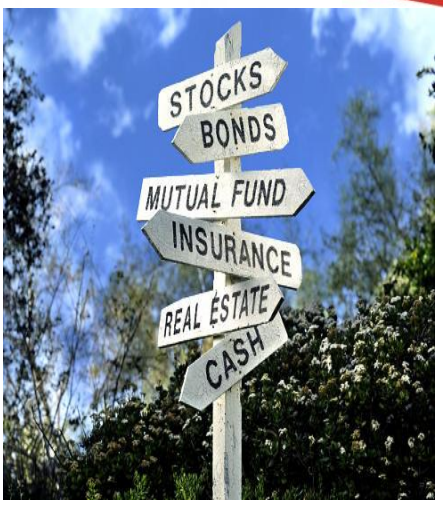


Exhibit 1[1]

A. Summary Of Various Investment Options (Investment Universe)

	RETURN		RISK	LIQUIDITY/	TAX	CONVENIENCE
AVENUES/	**CURRENT**	**Capital**		**MARKETABILITY**	**SHIELD**	
OPTIONS/	**YIELD**	**gain/loss**				
VEHICLES	**(Income ÷**	**(clg-opg)**				
	pur.price)	**÷opg price**				
A) Equity Shares	low	high	high	fairly high	high	high
B) Non Convertible						
Debentures-N.C.D.)	high	negligible	low	average	nil	high
C) Equity Schemes	low	high	high	high	high	very high
D) Debt Schemes	moderate	low	low	high	no tax on sum	very high
E) Bank Deposits	moderate	nil	negligible	high	nil	very high
F) Public Provident						
Fund(PPF)	nil	moderate	nil	average	sec 80 c	very high
G) Life Insurance						
Policy (LIC)	nil	moderate	nil	average	sec 80 c	very high
H) Residential House	moderate	moderate	negligible	low	high	fair
I) Gold & Silver	nil	moderate	average	average	nil	average

B.

	INVESTOR	SPECULATOR	GAMBLER
1) Investor planning horizon	1 year or more	few days to month	ephemeral
2) Risk disposition	risk averse	risk lover	artificial risk
3) Return expectation	Modest	very high	for fun,not income
4) Decision Making	Fundamentals	Technical analysis	less impact
5)Leverage	own funds,	borrows to suppl-	own
	eschews borrowing	ment own source.	

C. Investors decision making approaches

1) Fundamental
2) Psychological
3) Academic
4) Eclectic.

D. <u>Common Errors in Investment Management</u>

1) Inadequate comprehension of Risk and Return.
2) Investment policy vague.

[1] Investment Analysis and Portfolio Management second edition, Prasanna Chandra, Tata McGraw Hill, Pg 9

3) Naïve extrapolation of past performance.

4) Cursory Decision Making.

5) Simultaneous Switching.

6) Misplaced love for cheap stocks.

7) Over or Under Diversification.

8) Buying familiar company shares.

9) Wrong attitude towards losses and gains.

10) Speculative tendencies

Portfolio construction, management and performance evaluation metrics, assuming each portfolio can be taken as a mutual fund.

- The tighter, or more peaked, the probability distribution, the more likely it is that the actual outcome will be close to the expected value, and consequently the less likely it is that the actual return will end up far below the expected return. Thus tighter the probability distribution, lower the risk assigned to a stock.
- In a Market dominated by risk-averse Investors, Riskier securities must have higher expected returns, as estimated by the Marginal Investor, than less risky securities. If this situation does not exist, buying and selling in the Market, will force it to occur. Diversification, does nothing to reduce risk, if the Portfolio consists of perfectly positively correlated stocks. As a rule, risk of a Portfolio, will decline, as the number of Stocks in the Portfolio increases. It is impossible to form completely riskless stock portfolios. Almost half of riskiness, in an average individual stock can be eliminated, if the stock is held in a reasonably well diversified portfolio, which is one containing 20 odd stocks, in a number of different sectors/industries. The part of a stock's risk, that can be eliminated is called Diversifiable risk, while the part that cannot be diversified away or eliminated is called Market Risk. Diversifiable risk, is caused by such random events as law suits, strikes, successful and unsuccessful marketing programs, winning or losing a major contract and other events that are unique to a firm. As these events are random , their effects on a portfolio, can be eliminated by diversification--- bad events in one firm will be offset by good events in another. Market risk, stems from factors, that systematically affect most firms: War, Inflation, Recession, High Interest Rates. Since most stocks are negatively affected by these factors, market risk cannot be eliminated by diversification.
- **C.A.P.M**. :- " The relevant risk of an individual stock, is its contribution to the risk of a well diversified portfolio (which is much smaller than stand alone risk). Why

accept risk, that can easily be eliminated ? The risk that remains after diversification, is market risk, or risk that is inherent in the market, and it can be measured by the degree to which a given stock tends to move up or down, with the Market.

Basic Assumptions of C.A.P.M

1) All Investors focus on a single holding period, and they seek, to maximize, the Expected Utility of their Terminal Wealth by choosing, among alternative portfolios on the basis of each portfolio, expected return, and standard deviation.
2) All Investors, can borrow or lend, an unlimited amount at a given risk-free rate, and there are no restrictions on short sales, of any asset.
3) All Investors have identical estimates of expected return, variances, and covariance among all assets, that is, Investors have homogenous expectations.
4) All assets are perfectly divisible, and perfectly liquid (Marketable at the going price).
5) There are no transaction costs.
6) No taxes
7) All Investors are price takers, that is, all investors assume that their own buying or selling activity, will not affect stock prices.
8) Quantities of all assets are given and fixed.

*__Beta__:- The benchmark for a well diversified stock portfolio, is the market portfolio, which is a portfolio, consisting of all stocks, therefore, the relevant risk of an individual stock, which is called its beta coefficient, is defined under the CAPM, as the amount of risk, that the stock contributes to the market portfolio . $\boldsymbol{\beta_i = r_{im} * [\frac{\sigma_i}{\sigma_m}]}$

*__SML__:- Graphical representation of the CAPM. Represents on the vertical (y axis), return on the individual security or portfolio and on the horizontal (x axis), is the beta of the security/portfolio

Slope of the S.M.L = $\frac{R_{p-R_f}}{\beta_p} = \frac{R_{m-R_f}}{\beta_m}$

Therefore ;- $\boldsymbol{R_p - R_f = \beta_p * [R_m - R_f].}$

*** C.A.L** :- Is the locus of portfolios constructed by adjusting the proportion of wealth invested in risky assets.CAL & Utility Indifference curves, depicts how investors choose different portfolios.

U = R_p - 0.005 A σ_p^2 (For a risk neutral investor A =0)..... (A)

1) Each Individual investor must find Investment on the CAL, that maximizes Utility (Objective).
2) Portfolio Return : $R_p = R_f + y(R_s - R_f)$
3) 3) Portfolio Risk $\sigma_P = y\ \sigma_s$

Putting 2 & 3 in A, above we get:- $U = R_f + y(R_s - R_f) - 0.005 * A * (y^2\sigma_s^2)$ ------ (4)

$\frac{\partial U}{\partial y} = 0$, we get $\boxed{y = \frac{R_s - R_f}{0.01 A \sigma_s^2}}$

***CML:-** 1) Generates a line on which efficient frontiers can lie. 2) Preferred Investment strategies, plot along a line, representing alternative combo of risk and return obtainable by combining the market portfolio with borrowing or lending called CML. 3) Slope of CML is considered as reward per unit of risk borne. 4) In essence, CML, provides a place where time and risk can be traded and their prices determined by forces of Demand & Supply. Internal rate of return, can be thought of as price of time, and slope of CML, as price of risk. 5) Equilibrium in the Capital Market, can be characterized by R_f (y intercept, reward for waiting) & slope of CML (Reward per unit of risk borne).

Slope of the CML : $\frac{R_{m-R_f}}{\sigma_m} = \frac{R_{p-R_f}}{\sigma_p}$

Equation of CML: $\boldsymbol{R_p - R_f = \sigma_p * \left[\frac{R_{m-R_f}}{\sigma_m} \right]}$

* CML is a special case of SML Relationship.

* Diversification is the difference between Returns corresponding to beta implied by total risk of Portfolio and return corresponding to its actual beta.

* Why does risk matter if it does not hurt the Investor?. Given that an Investment made money, what difference does it make how the money was made.

*As time passes, the value of the portfolio composition changes, and value of the composition beta also changes, that is the beta of a self-contained stock, or a portfolio often declines, hindsight is an inappropriate perspective of Investment Decision Making.

- If Markets are efficient there is no such thing as undervalued and overvalued assets.
- Beta must be estimated, and this estimate is shrouded with substantial uncertainty.

- Approaches to Investment Decision Making

- **Fundamental**:- 1) Conduct Fundamental Analysis to establish certain value anchors. 2) Earn superior returns by buying undervalued securities (Securities whose Intrinsic Value is greater than the current quoted latest market price of the asset, and selling overvalued securities, which has a lower intrinsic worth as compared to the quotation of the stock price now.
- **Technical**:- Assesses state of Market Psychology, mood of Investors, and relative strengths of supply and demand forces. Burton. G. Malkiel :- " Castles-in-the-Air."
- **Psychological:** J. M. Keynes:- " A conventional Valuation, which is established as an outcome of the Mass Psychology, of a large number of ignorant individuals, is liable to change violently as a result of a sudden fluctuation of opinion due to factors which do not really make much of a difference to the prospective yield.".
- **Academic:-** 1) Stock Markets quickly react quite reasonably efficient and rationally to flow of information. Hence stock prices reflect Intrinsic values fairly well. 2) Stock Price Behavior corresponds to a Random Walk that is, successive price changes are independent that is, we cannot use past prices to predict future price behavior. 3) There seems to be a positive relation between risk and return in the capital markets., $E[R] \propto$ Systematic risk/ Market Risk/Non-Diversifiable Risk.
- **Eclectic:** Uses all approaches. 1) Fundamental (Basic Standards/ Benchmarks) 2) Technical:- Mood of Investors 3) Market is neither well ordered, as Academic Nor as Speculative as Psychological. It is characterized by some imperfections, it seems to react reasonably efficiently and rationally to flow of information.
- SENSEX:- A Simple Arithmetic Average of Price Relatives of 30 sensitive shares. Factors attributable to Sensex movements are :-a) Industrial growth, in real terms. b) Secular inflation rate c) Shift in the average P/E: More mature the market more meaningful the risk-return parity.
- Risk:- Business risk-- default risk, Inflation risk-- reduction in purchasing power, Interest rate risk- increase in interest rate lower is the price, and market risk:- investor's psychology.

- **Burton. Malkiel**:- ' Risk and Risk alone, determines the degree to which Returns will be above or below average and thus decides the valuation of any stock relative to the market.

TECHNICAL ANALYSIS	UNDERVALUED	OVERVALUED
WEAK	WAIT	SELL
STRONG	BUY	WAIT

1) Buy only stocks that are expected to have above-average earnings growth for five or more years. 2) Never pay more for a stock than its firm foundation value. 3) Look for stocks, whose stories of anticipated growth are the kind on which investors can build castles in the air.

- **Francis Galton** (Cobb Douglas Production function)- " In probability theory, a log-normal distribution is a cumulative probability distribution function of a random variable(takes only positive real values), whose log is normally distributed. Therefore if Random Variable is log-normally distributed then X = log Y has a normal distribution. Similarly if X has a normal distribution, Y=exp (X) has log-normal distribution. Multiplicative product of many positive independent random variables, then that variable is modelled as log-normal. l n N (μ , σ^2).
- Security analysts are not paid to be historians , they are paid to be prophets.
- Use of Leverage, can dramatically shift an Investor's return.
- Logarithms reduce the effect of extraordinary deviations from Normality. Logs reduce the impact of extreme values that distorts true distribution. A safe $ is worth more than a risky $.
- Greater the dispersion in number series, greater gap between the Arithmetic Mean & Geometric Mean, use of Geometric Mean, reduces the likelihood of nonsense answers with Financial Rates of Returns. Mostly in finance we are interested in rate of return that equates a Present Value with a series of future expected values.
- Standard Error (S.E.), is Standard Deviation of a ' would be' distribution of Mean values computed from many different samples of exactly the same size from the same population.
- 68% of the distribution lie within 1 S.E of Mean, 95% within 2 S.E, and 99% within 3 S.E from the mean.

- **Asset Pricing Models**

1) Homogenous risk return expectations of investors:- Harry. Markowitz (US Economist)--pioneer of Modern Portfolio Theory, " Portfolio Selection (1952), and his 1959 book, " Portfolio Selection Efficient Diversification. (John Von Neumann Theory Prize in 1989 and Nobel Prize in Economics in 1990." Risk averse investors can develop portfolios that optimize or maximize expected returns based on particular level of Market Risk. There are four steps in Portfolio construction 1) Security Valuation 2) Asset Allocation 3) Portfolio Optimization 4) Performance Measurement & Appraisal.

2) **Exhibit 2: Portfolio Theory**

Portfolio theory suggests, that if all investors have the same (homogenous) expectations about returns and their (co) variances and they wish to trade-off risk against return, then they will all hold Market Portfolio.

Fair Value and Efficient Frontier. The Fair Value (V), of a stock is the Discounted Present Value (D.P.V), of future expected dividends, as future dividends are uncertain (**Fig:1),** the discount rates (k),should reflect the riskiness of these dividend payments.

$V = E [\{ D_1 \div (1+k) + D_2 \div (1+k)^2 + \text{- - - - - - - - } \}]$ ---------- (1)

where D_t are dividend payment (t = 1,2,3--- years),k is risk adjusted discount rate for year (t = 1, 2, 3,- - -- years).

E is the "Expected Value", with expectations formed at time t=0. (Refer Appendix 1**),**and as per this formula, it does not require investors to consider holding the stock forever.

Efficient Market Hypothesis (E.M.H.)—(The current price is correct price and reflects expected future earnings from project) :-

- **Rational Expectations (RE**):- Investors use all available relevant information, to forecast asset returns (or prices) and they do not make systematic forecast errors (i.e. their forecast errors are random, with a mean of zero).
- **Informational Efficiency (I.E**.):- Equilibrium excess returns (i.e. returns adjusted for risk and transaction costs) are independent of currently available information.
- **Abnormal Profits:- (A.P**.):- It is impossible to consistently make abnormal profits (i.e. profits adjusted for risk and transaction costs) using a ' stock picking' strategy.

If P < V (Then 'buy' the stock, and If P > V (Then short (sell) the stock.) Invest in stocks if the N.P.V (Net Present Value) is positive.

Calculating the 'Fair Value'

Case:-1 : Using the 'Yield Curve'

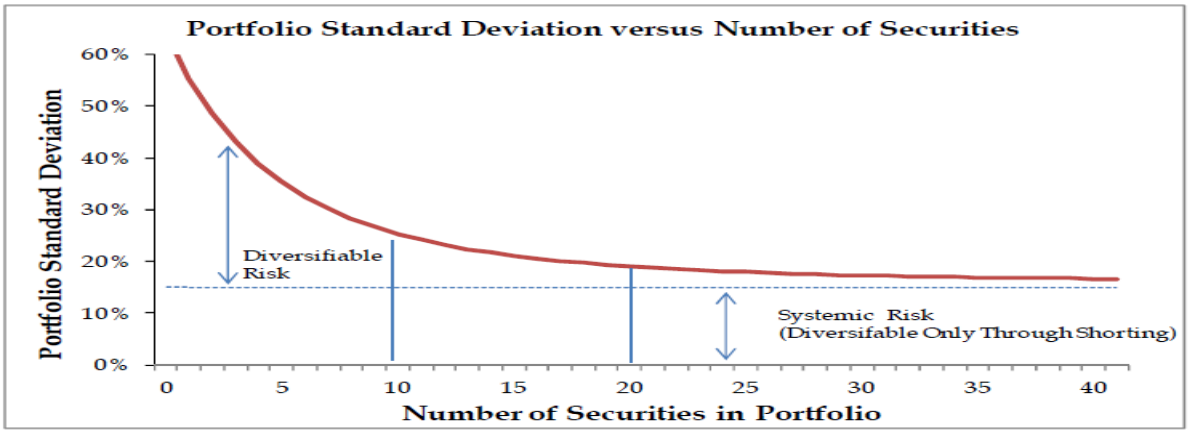
Case:- 2: Using the CAPM(Capital Asset Pricing Model.)

Case:- 3: Using the ' SML (Security Market Line)

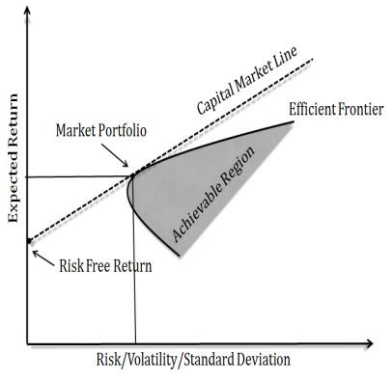
Case :- 4: Modigliani-Miller Theorem.

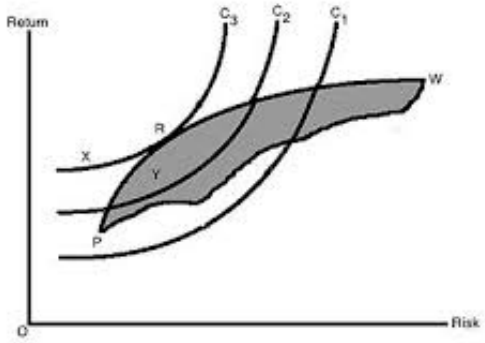
- Individuals do not have different comparative advantages in the acquisition of information.
- These rational traders instantaneously ' move' market prices to equal 'Fair Value' , as found by the PV (Present Value) of future dividends.
- If current and past information is immediately incorporated into current prices, then new information or 'news' should cause changes in prices.' News' by definition , is un-forecastable, then price changes (or returns) should be un- forecastable, which means no information at time t , or earlier should help improve the forecast of returns (to reduce the forecast error made by individual). E.M.H., provides a ' benchmark ' , in Finance literature, against which, we can judge the actual behavior of asset returns (and prices).

Exhibit: 3 Naive Diversification

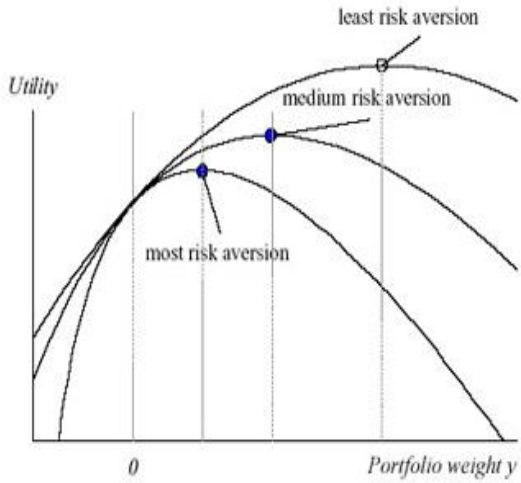


Graph 7 A :Capital Market Line **Graph 7 B: Efficient Frontier**





Graph 7 C: **Graph 7 D**



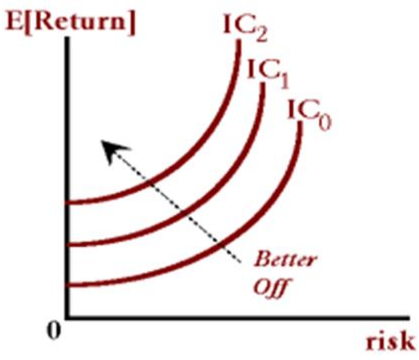


Exhibit 4: SHARPE'S SINGLE INDEX MODEL (MARKET MODEL)

Rĩ = aĩ+ ßĩ * Rm+ eĩ.

Where:- Rĩ is the return on security I, Rm is the return on the market index.

aĩ is the constant return (Y intercept)

ßĩ is the measure of sensitivity of the security I's return to the return on the market index.

eĩ is the error term/Stochastic disturbance term/Noise term/Residual Variance?

Assumptions:-

1) The error term has an expected value of zero and has finite variance .

2) The error term is not correlated with the return on the market portfolio

   Covariance (Rĩ , Rm) = zero

3) Securities are related only through their common response to the return on the market index.

   Which implies that the error term of security I and security j are uncorrelated or

   Covariance (Rĩ , Rj)= zero

4) As constant term (aĩ) and ßĩ*Rm are uncorrelated, the variance of the stock returns can be expressed as

   Variance (Rĩ) = Variance (aĩ +ßĩ* Rm + eĩ)

   i. = Variance (ßĩ * Rm) + Variance (eĩ)

   ii. = ßĩ² σm² + σ² (eĩ)

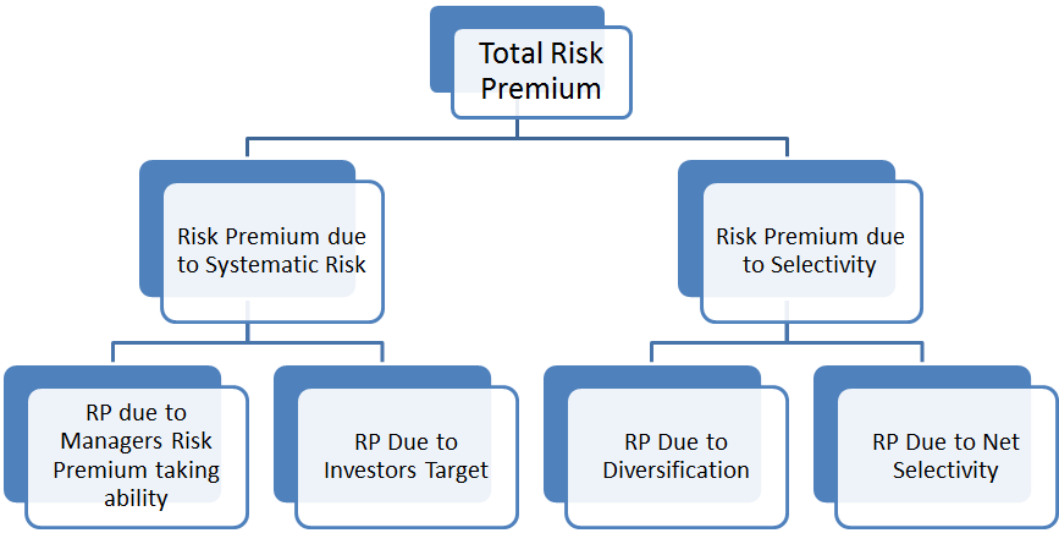
   iii. = Systematic Risk + Idiosyncratic Volatility.

   Based on Sharpe's Single Index Model, we can arrive at the inputs required for applying the Markowitz Model.

   1. E (R ĩ) = aĩ +ßĩ * E (Rm)
   2. Variance (Rĩ) = ßĩ² [Variance (Rm)] + Variance (eĩ)
   3. Covariance (Ri,Rj) = ßi*ßj*Variance (Rm)

Exhibit 5: EUGENE. FAMA's DECOMPOSITION OF EXCESS RETURNS.

Fama's Decomposition of Excess Returns is a performance attribution of Excess Returns i.e. Rp (Return of Portfolio) less Rf (risk free returns). This method can be used when an investor specifies a particular target level of risk (i.e., beta) is given then we can further decompose the systematic risk into investor's risk and manager's risk.



1. **RP due to manager's Risk premium taking ability**: If the manager actually takes a different level of risk than the target level (i.e., the actual beta was different than the target beta) then part of the risk premium was dure to the extra risk that the manager's took.

$$RP_{\text{manager's risk}} = (\beta_p - \beta_T)(R_m - R_f)$$

2. **RP due to Investors Target**: It is the Risk Premium that portfolio earns due to the target beta of the investor (risk taken by the invetor).

$$RP_{\text{investorRisk}} = \beta_T(R_m - R_f)$$

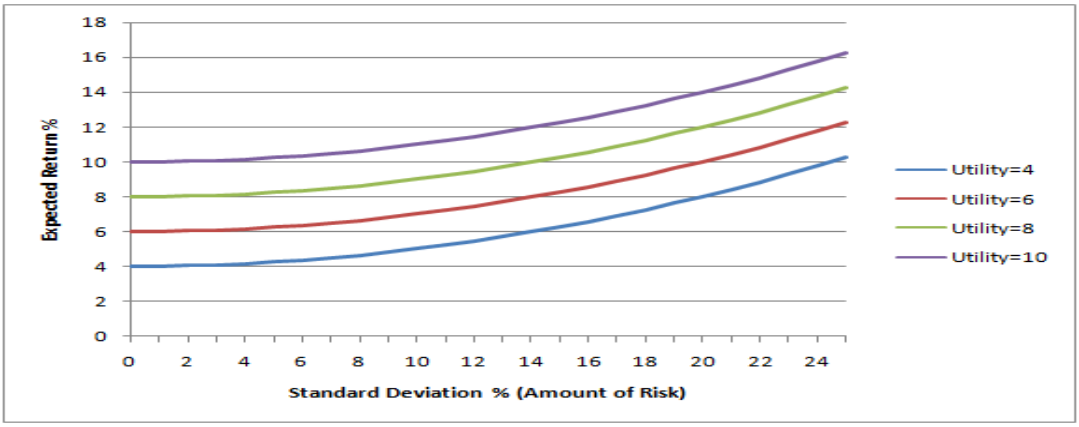
3. **RP due to Diversification**: It is RP tahat the portfolio earns due difference bêtween the return that should have been earned according to the CML and the retyrn that should have been earned according to the SML. If the portfolio is perfectly diversified, this will be equal to 0. It shows the return due to unsystematic risk in the portfolio.

$$RP_{\text{Diversification}} = [RFR + \sigma_p/\sigma_m(R_M - RFR)] - [RFR + \beta_p(R_M - RFR)$$

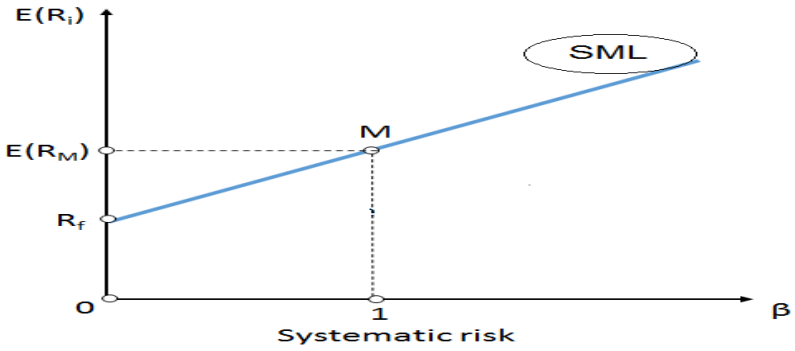
$$RP_{\text{Diversification}} = (R_M - RFR)\,(\sigma p/\sigma m - \beta_p)$$

4. **RP due to Net selectivity**: It is RP that the portfolio earns due ability of managers to select stocks. $RP_{\text{Netselectivity}} = R_P - [RFR + \sigma_p/\sigma_m(R_M - RFR)]$

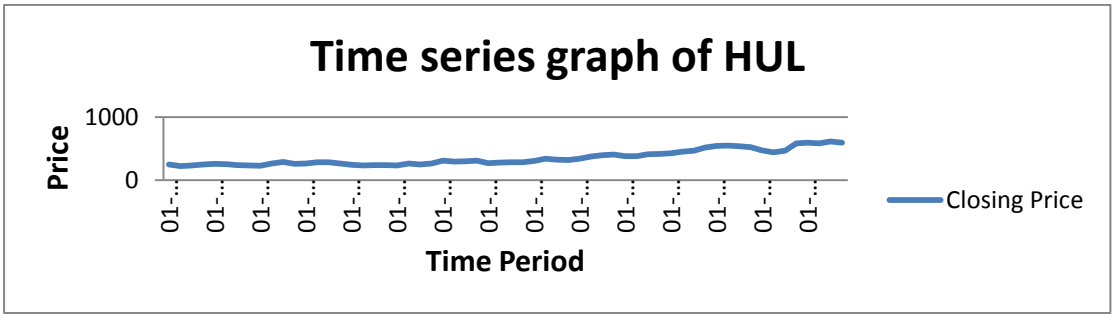
Graph 7 E : Utility Indifference Curves

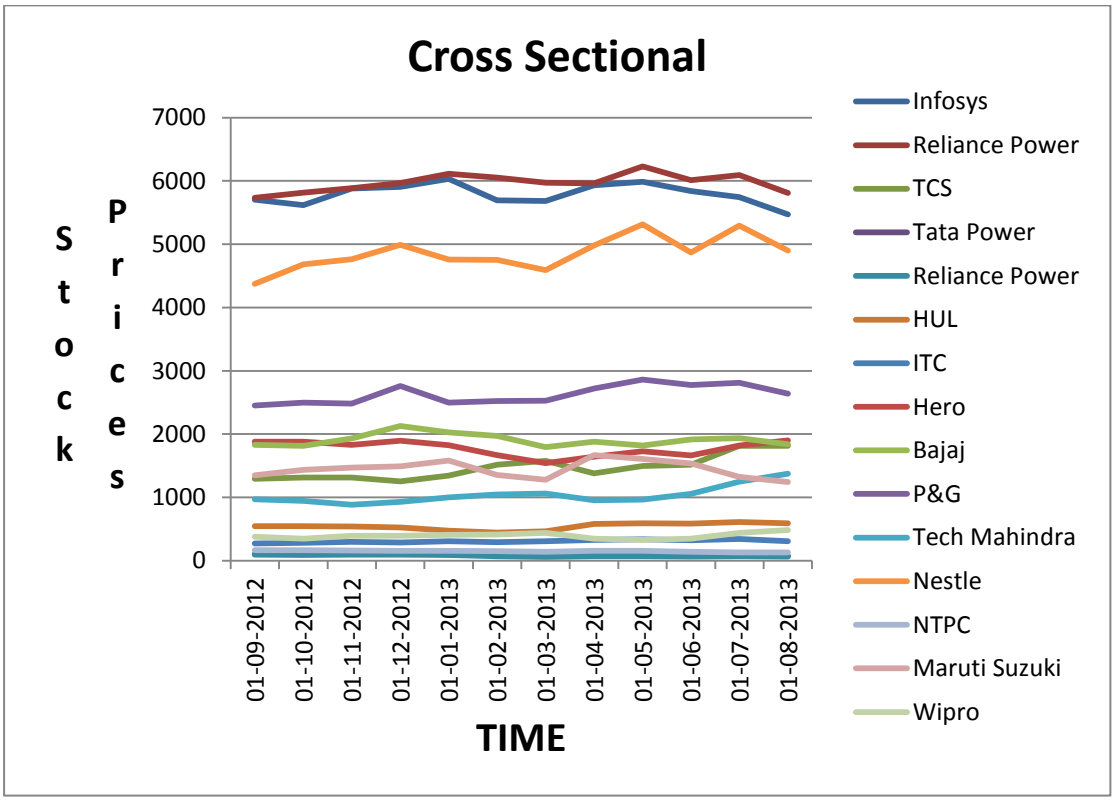


Graph 7F :Security Market Line

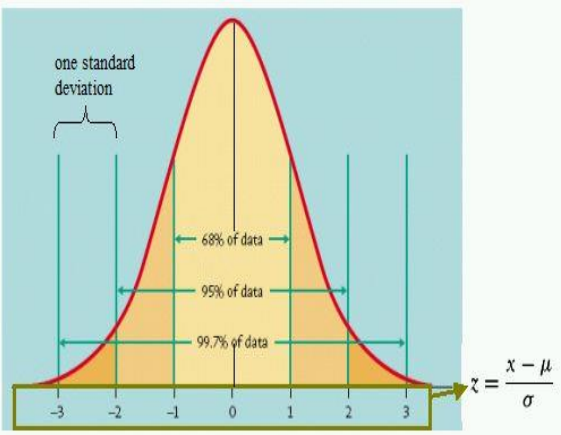


Graph 7G : Time Series and Cross Sectional

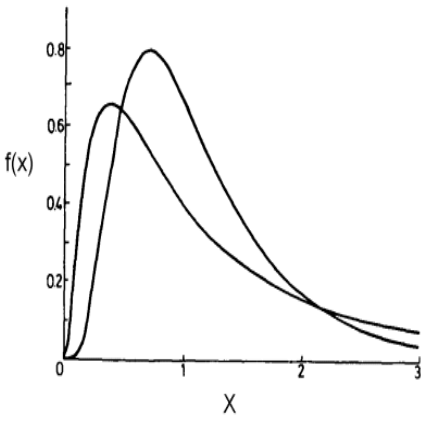




Graph 7H :Normal Distribution



Graph 7I: Log Normal Distribution



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PH.D – Questionnaire for Collection & Analysis of Primary Data

Dear Respondents,

This Questionnaire is aimed to describe the traditional (Economic) & behavioral factors that influences individual decision making process in the Indian Stock Market. Data collected through this process will be kept confidential as it is purely an Academic Research.

* Required

Name *

1. Age group (In Years) *

- [ ] 18 - 25
- [ ] 26 - 35
- [ ] 36 - 45
- [ ] 46 - 55
- [ ] 56 – 65
- [ ] 65 & Above

2. Gender *

- [ ] Male
- [ ] Female

3. Qualification *

- [ ] Under graduate
- [ ] Graduate
- [ ] Post graduate
- [ ] Doctorate
- [ ] Other:

4. Occupation *

- [ ] Business
- [ ] Housewife
- [ ] Retired
- [ ] Student
- [ ] Professional
- [ ] Employee
- [ ] Other:

5.Annual Income (In Indian Rupees) *

- [ ] NIL
- [ ] Less than 2 Lacs
- [ ] 2 – 5 Lacs
- [ ] 5 – 10 Lacs
- [ ] 10 – 15 Lacs
- [ ] 15 – 20 Lacs
- [ ] 20 – 30 Lacs
- [ ] 30 – 50 Lacs
- [ ] 50 Lacs – 1 Crore
- [ ] Above 1 Crore

6.What is your investment objective? *

- ○ Income
- ○ Growth
- ○ Stability
- ○ Capital preservation
- ○ Increased Terminal Wealth
- ○ Other:

7.What is/are your preference(s) & Investment Constraints? *

- ○ Liquidity
- ○ Investment Horizon
- ○ Taxes and Regulatory
- ○ Unique Circumstances

- Cash Needs

8.Generally, what proportion of your Income / Wealth is invested? *

- Below 25%
- 25 – 50%
- 50 – 75%
- 75 – 100%
- More than 100%

9.What are your preferences in terms of various Investment Avenues available? *

- Equity Shares
- Money Market Instruments
- Life Insurance Policies
- Precious Objects
- Non - Marketable Financial Assets
- Bonds
- Mutual Funds Schemes
- Real Estate
- Financial Derivatives
- Commodities Market

10.What criteria (if any) do you adopt for evaluation of an Investment Avenue? *

- Rate of Return
- Risk
- Marketability
- Tax Shield / Shelter
- Convenience
- Liquidity
- Safety / Security
- None

11.What is your source of investment advice? *

- News/ TV channels
- Newspapers
- Advisers / Certified Financial Planners

- Internet (Research reports)
- Family / Friends / Relatives
- Gut Feelings

12. If you are an Investor, what induces you to stay invested in a particular stock? *

- Dividend Paying Stock
- Organic Growth
- Inorganic Growth
- Future Prospects
- Principles & Policies

13. From how many years are you investing in the Stock Market? (In Years) *

- [ ] Less than 1
- [ ] 1 – 3
- [ ] 3 – 5
- [ ] 5 – 10
- [ ] More Than 10

14. What are your preferences when it comes to Sectoral Investments? *

- Banking
- Pharmaceuticals
- FMCG
- Telecom
- Oil / Gas / Power
- Diversified
- I.T.
- Venture Funds
- Other:

15. What are the annual average returns delivered by your fund in the last 3 years? *

- [ ] 5-10%
- [ ] 10-25%
- [ ] 25-50%
- [ ] 50-100%
- [ ] NIL or Negative Returns

16.During the next five years, you expect your annual revenue to? *

- [ ] Decline significantly
- [ ] Decline slightly
- [ ] Remain about the same
- [ ] Increase slightly
- [ ] Increase significantly

17.If you reinvest the amount earned from your portfolio, how much percentage of it would you plan to reinvest? *

- [ ] Less than 10 %
- [ ] 10-25 %
- [ ] 25-50 %
- [ ] Greater than 50 %
- [ ] 100 %

18.What proportion of your Investment during a given period, you generally wish to liquidate? *

- [ ] Upto 75% within 12 Months
- [ ] Upto 25% within 12 Months
- [ ] Between 50 – 75% in the next 2 – 3 Years
- [ ] Between 25 – 50% in the next 2 – 3 Years
- [ ] Won't be selling for atleast the next 5 Years

19.Once withdrawal of Money from the Investment begins, how long do you expect the withdrawals to continue? *

- [ ] Less than 1 Year
- [ ] 1-3Years
- [ ] 3-6 Years
- [ ] 6-10 Years
- [ ] More than 10 Years

20.What is your biggest concern in terms of your Investments getting affected? *

- ○ Political Situation & Government Policies
- ○ Fall in Market Index
- ○ Rise in GDP / National Income

- Inflation
- International Effects / F.D.I / F.I.I
- No Concern

21. Your general preference (If any), in the kind of stocks you would Trade /Invest in? *

- Blue Chip
- Large Cap
- Mid Cap
- Small Cap
- Mixed / Diversified
- Venture Funds
- International Investments

22. What is your take on Investment risks V/S Investment objectives? *

- [ ] To get back the Amount Deposited / Invested
- [ ] To get Investment Returns above savings & time deposit rates (upto 10%)
- [ ] To achieve Low to Moderate Capital Appreciation on Investments (10-15%)
- [ ] To achieve Moderate to High Capital Appreciation on Investments (15-25%)
- [ ] To achieve Good Capital Appreciation on Investments (25-40%)
- [ ] To achieve Super Normal Capital Appreciation on Investments (40% and above)

23. What kind of Risk Appetite do you perceive to possess? *

- [ ] No Risk
- [ ] Low Risk
- [ ] Medium Risk
- [ ] High Risk
- [ ] Very High Risk

24. What is the source of funds employed to invest / trade in the Stock Market? *

- Savings
- Loan
- Pledge / Hypothecation of Asset
- Inheritance
- Goodwill

25. What is the frequency of Trading / Investing in Investments in the Stock Market? *

- [ ] Daily
- [ ] Weekly
- [ ] Monthly
- [ ] Seasonal
- [ ] Cyclical
- [ ] Occasionally
- [ ] Rarely
- [ ] Never

26. What do you think determines the choice of Asset Mix in your Portfolio? *

- [ ] Proportion of Stocks & Units / Shares of equity oriented mutual funds.
- [ ] Proportion of Bonds (Fixed Income)
- [ ] Appropriate stock – bond mix
- [ ] Risk Tolerance
- [ ] Investment Horizon

27. What portfolio strategy (if any) you adopt, once the asset mix decision is made? *

- [ ] Active Portfolio
- [ ] Passive Portfolio
- [ ] Constant Proportion Portfolio Insurance
- [ ] Constant Mix
- [ ] Naive
- [ ] No Strategy

28. What do you think is your commonly used approach to Investing? *

- [ ] Fundamental
- [ ] Technical
- [ ] Eclectic
- [ ] Academic
- [ ] Practical
- [ ] Behavioural
- [ ] None of these

29. What do you think are the qualities required for successful Investing? *

- [ ] Patience
- [ ] Composure
- [ ] Flexibility & Openness
- [ ] Contrary Thinking (Counter Intuitive Trading)
- [ ] Decisiveness
- [ ] Risk Taking Ability
- [ ] Option 7

30.What approaches, according to you, can be adopted by Investors to succeed in the Investment Game? *

- ○ Naïve
- ○ Physically Difficult
- ○ Intellectually Difficult
- ○ Psychologically Difficult
- ○ Mix of Traditional & Behavioural Approaches

31.Your reactions when there is a drastic reduction in the value of your Investments? *

- [ ] Buy more of Such Investments
- [ ] Wait for the Market to Correct / Recover
- [ ] Panic Button
- [ ] Worry Compounded
- [ ] Liquidate Immediately

32.Your personal experience on realized returns on your Investments vis-à-vis Horizon (Time Frame)? *

- [ ] Long-Term Investments in Stocks always pays
- [ ] Short-Term Investments Pays
- [ ] Intuition
- [ ] Burnt my fingers in the Stock Market
- [ ] No Gain / No Losses Overall

33.If you are a Global Investor, which type of risk according to you exists? *

- [ ] Political
- [ ] Currency
- [ ] Custodial

- [ ] Liquidity
- [ ] Market Volatility

34.Share Prices according to you are influenced by? *

- ○ Fundamental Factors
- ○ Technical Factors
- ○ Psychological Factors
- ○ All of these
- ○ None of these

35.What Screening Criteria, do you adopt (if any) for considering Investing in shares in the Secondary Market? *

- ○ Size of the Company more than Rs. 100 Crores & Equity Base of over Rs. 20 Crores
- ○ Competitive Position
- ○ Industry Prospects
- ○ Price - Earing Ratio
- ○ Dividend & Bonus Records
- ○ Reputation of Management

36.Have you ever felt that in Investing, human beings display irrationality? *

- [ ] Yes
- [ ] No
- [ ] Can't Say

37.Selecting stocks, according to you is somewhat Confusing, Difficult & Frustrating? *

- [ ] Strongly Agree
- [ ] Agree
- [ ] Neutral
- [ ] Disagree
- [ ] Strongly Disagree

38.Stock Prices are much more volatile than Dividends? *

- [ ] Strongly Agree
- [ ] Agree
- [ ] Neutral

- [ ] Disagree
- [ ] Strongly Disagree

39. What Risk Management Techniques do you generally employ in Stock Investing? *

- ○ Sustainable Competitive Advantage
- ○ Low Price Stock Availability
- ○ Hungry Management Dominance
- ○ Huge External Opportunities for a company
- ○ No Government Regulation on Pricing

40. What is the Investment philosophy of your firm? *

- ○ Value Investing
- ○ Fundamentals Investing
- ○ Growth Investing
- ○ Socially Responsible Investing
- ○ Technical Investing

41. In your opinion, if an Investor's focus is only on growth stocks, his investment philosophy should revolve around? *

- ○ Sound Benchmarking for Selecting Growth Stocks
- ○ Invest in Growth Stocks without much concern for the price
- ○ Hold Growth Stocks as long as they remain Growth Stocks
- ○ Identify Growth situations which have not been fully discounted by the market

42. How do you track the Status & Progress of your Investments? *

- ○ Manual Reports
- ○ Spreadsheets
- ○ Quickbooks & Accounting Packages
- ○ CRM or Database tools
- ○ Other: _____

43. Do you make use of any statistical tools while calculating expected returns on your portfolio? *

- [ ] Yes
- [ ] No

- [ ] Don't Know

44.Does your portfolio have any shares traded in the NASDAQ or DOW JONES? *

- [ ] Yes
- [ ] No
- [ ] Don't Know

45.Do you think that you have adequate Insurance Coverage, in case you face huge losses in your Investments? *

- [ ] Yes
- [ ] No
- [ ] Don't Know

46.Are you Bullish or Bearish on the Indian Stock Market? *

- [ ] Bullish
- [ ] Bearish
- [ ] Depends

47.What best describes your Investment Experience? *

- [ ] Beginner (No Investment Experience)
- [ ] Moderate (Comfortable with Fixed Income Securities)
- [ ] Knowledgeable (Involved in Equity Trading)
- [ ] Experienced (Exposed to Sophisticated Tools & Instruments)

48.Just a few weeks after you have invested in a stock, its price declines by 20%, what would you do, if the fundamentals of the stock have not changed? *

- [ ] Sell
- [ ] Buy
- [ ] Do Nothing

49.Refer to the Previous Question, If that stock is part of a portfolio designed to meet investment goals, what would you do, if it were 5 Years away? *

- [ ] Sell
- [ ] Buy
- [ ] Do Nothing

50.Refer to the Previous Question, What would you do, If the goal were 15 Years away? *

- [ ] Sell
- [ ] Buy
- [ ] Do Nothing

51.Refer to the Previous Question, what would you do, If the goal were 30 Years away? *

- [ ] Sell
- [ ] Buy
- [ ] Do Nothing

52.You bought a stock as a part of your Retirement Portfolio. Its price rises by 20% after 4 weeks, what would you do if the fundamentals of the stock have not changed? *

- [ ] Sell
- [ ] Buy
- [ ] Do Nothing

53.You are investing for Retirement which is say atleast 15 Years away, What would you do? *

- [ ] Invest in Money Market Mutual Fund or a Guaranteed Investment Contract
- [ ] Invest in a Balanced Mutual Fund that has a Stock : Bond mix of 1:1
- [ ] Invest in an Aggressive Growth Mutual Fund

54.As a prize winner, you have been given some choice, which one would you choose? *

- [ ] Rs. 5 Lacs in Cash
- [ ] A 50% Chance to get Rs. 12.5 Lacs
- [ ] A 20% Chance to get Rs. 37.5 Lacs

55.A Good Investment Opportunity has come by your way. To participate in it, you have to borrow money. Would you take a Loan? *

- [ ] No
- [ ] Yes
- [ ] Perhaps

56.If you are working in a company, which is planning to go public after 3 years, is offering stock to the employees. Until it goes public you cannot sell your shares, your Investment however has a potential of multiplying 10 times when the company goes public how much money would you invest? *

- [ ] Nothing

- [ ] 3 Months' Salary
- [ ] 6 Months' Salary

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