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 in 1952, 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:

\[ R_t = \frac{p_t - p_{t-1}}{p_{t-1}} \], 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:

\[ R_t = \sum R_t = \sum \frac{p_t - p_{t-1}}{p_{t-1}} \].

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 ($\Delta t$)

$$ R_t = \lim_{\Delta r \to 0} \sum R_t = \lim_{\Delta r \to 0} \sum \left( \frac{\Delta P}{P_t} \right) $$

In the limiting case as $\Delta t$ tends to zero, then $\Delta P_t$ changes to $dP$ & summation sign changes to the integral sign (Using Integral Calculus), thus we have:

$$ R_t = \int_0^t dP/P = \ln P_t - \ln P_0 = \ln [P_t/P_0] $$

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**

![Investment Approaches Chart]

- Financial and Mercantile Astrology
- Behavioral
- Fundamental
- Technical
- Academic
- Neuro-Science