3. Research Methodology

3.1 Introduction

Research methodology is the way to solve the research problem systematically. It is required to understand the assumptions underlying various techniques and methods to apply according the problem. It shows the relevant and irrelevant techniques from the all statistical methods. It varies according to problem of the research. In this study, researcher compared the awareness level among the retails investors regarding machine based trading or investment through quantitative techniques. The researcher also tried to found the different factors which affect investors trading style and pattern in the market. Researcher also wants to know the investors mind set and psychology regarding technology and other evolutionary factors now-a days.

3.2 Researcher’s Preparation for the study

Researcher is MBA in Finance from Banasthali University. She has curiosity for research in financial market then she has gone through some books like The Handbook of News Analytics in Finance, Applied Quantitative Methods for Trading and Investment, Quantitative Trading: How to Build Your Own Algorithmic Trading Business. She came to know about the quantitative trading though algorithm. She found it very interesting and upcoming technique in financial market. She consulted some financial experts like Mr. Amiteshwar Choudhary, Executive director, Indiabulls Venture ltd., Dr. Harsh purohit, Dean wisdom, Bansthali University, CA Rajkumar Gupta, VP, indiabulls securities ltd., Mr. Rajesh gupta, VP, indiabulls securities ltd. to have some clear picture and prospects of the technique. Researcher goes through lots of research work for the related topic but found some research gap to work on algorithm trading in Indian stock market. Then, researcher decided to work for this upcoming topic in stock market.

3.3 Statement of problem
Researcher goes through more than 100 relevant papers for investments techniques and different model to predict the stock price movement. All the researchers were from out of India and very few of them discussed about the algorithm trading. After getting the conceptual knowledge about the topic, initiated this study. Algorithmic trading awareness and popularity were not studied anywhere. No paper showed perception of investors and stock brokers for algo trading in India. Therefore, the researcher taken the topic an empirical study of alternative investment strategy through quantitative analysis in financial market and extent of its popularity among financial brokers and investors in Mumbai region. Basically, Researcher would like to watch the weather emerging and alternative technique like algo trading are really have benefit whether there are substantial number of takers or followers in India.

3.4 Objectives of the Study

The primary objective of the study is to investigate whether the alternative investment technique through quantic models to value complex securities is efficient in the Indian stock market or not. The success of algorithmic trading (quant model) will be tested with the help of the following specific objectives.

i. To examine the factors involved in the creation of quantitative /algorithmic trading model.

ii. To analyse the awareness level, acceptance and influence of Quant techniques of investment among the retail investors in Mumbai.

iii. To investigate the impact of correct quantitative model on investor’s perception against the stock market.

iv. To study the comparison between traditional approach and the modern approach (Quantitative model) of investment techniques.

3.5 Research Questions

Researcher interviewed 10 stock broking dealers and 10 individual investors for case study to find out the answer of the question which cannot extracted from the questionnaire. Researcher framed the questions for personal interview for individual are as follows:
1. What is the meaning of algo for you?
2. What is the role of technology automation in trading?
3. Who is your personal advisor for trading unofficially?
4. In your trading, whose influence is more other than you?
5. How did you handle your sentiments in trading?
6. Do you find any changes in profit or trading pattern from last 3 years?
7. Can you differentiate conventional/traditional investment style with modern/algorithmic trading now-a-days?
8. What are the major issues in algo trading?
9. How did you solve the issue for algo trading?
10. What is the role of stock broker/dealer in your trading?
11. Do you have filed any grievance till date for algo trading?
12. What do you think about the risk, return, safety, speed, price improvement, cost, consistency, convenience?
13. What are your criteria to choose your stock broking dealer?
14. Do you have any suggestions for dealers, SEBI, government and investors?

Researcher also interviewed 10 stock broking firms who facilitate the retails investors to trade in stock market. These are:

1. Which type of trading customer usually prefer?
2. Who is your target customer?
3. What are the different ranges of product offering for retail investors?
4. Which software you used for the online trading?
5. How do you maintain your software?
6. What is the standard time gap for software updating in your firm?
7. How do you inform your client for software update?
8. Do you have any trading journal?
9. Do you have the research facility?
10. Do you facilitate your research tips to customers?
11. How long have you firm been in algo trading?
12. How many total customers in your firm?
13. What is the strength of algo user in your firm?
14. Have you noticed any changes in algo trading turnover since inception in your firm?
15. How did you promote algo trading?
16. What is the reaction or behavior of investors for algo now-a-days?
17. What is the role of technology in your working pattern?
18. How many enquiry and grievance you received for algo trading on daily/monthly basis?
19. What is the main issue in complaint for algo trading?
20. Have you ever change the software for algo, if yes then why?
21. How frequently you change the software due to technology advancement?

3.6 Data Collection

1) **Primary data** - Primary data is collected through personal interview of top 10 stock broker companies and 10 retail investors that use quantitative trading and about 400 retail investors (through judgement sampling and snow ball sampling), in the financial market of Mumbai through questionnaire and personal interviews would be targeted. The investors would be classified on the basis of age, income level, profession, return, and how long in the investment market, etc. Snowball sampling is also called as chain sampling or referral sampling. It is a non probability sampling where sample builds up to gather enough data for the research. It is used to find the hidden population of retail investors in stock market. These samplings are subject to numerous biases for example the sample that have many friends are more likely to be the part of sample.

2) **Secondary data** - It is collected through internet (websites sources, books, magazine, journals, publications, corporate annual reports etc. for 18 years from 1998 to 2016. The variables identified are macroeconomics factors like interest rate, exchange rate, GDP, inflation rate, time value of money, cash flow, discounted cash flow, present value, future value, net present value, etc.

Research design

In this study, the researcher tried to find out the awareness level of alternative investment through quantitative techniques. The researcher also found the opinion of stock brokers about the investment through quantitative techniques. The correlation between age, gender, income level, educational qualification with usage of quantitative techniques also seen. The study is descriptive, quantitative and qualitative. Casual explanation will also be used to determine the effect of the various factors like macroeconomic, company and industry specific, risk (beta), behavioural variables (herding, overconfidence, overreaction to earnings announcements, and momentum trading), historical data, time value of money and discounted cash flow used in quant model to determine the asset prices, market movements, and portfolio returns, etc by
secondary data analysis. A questionnaire will be prepared to know the popularity and knowledge about the quant industry among the brokers and the investors, and pilot testing is conducted and cronbach’s alpha is used for authenticity and validity.

**Sample selection**

The data will be collected for those companies which are used Quantitative Model for the trading and the individual who are the frequent investor in the stock market. To construct the data companies will be randomly selected. The individual were the frequent investors of the Indian stock market. It covers the fictionalization of the independent and dependent variables, observed data gathering process, process of identifying the background category of the company as well as the analysis methods of the dependent variables. Last part of this chapter evaluates the reliability and validity of this research.

To obtain sample for the study, the firms who use quantitative investment through quant model for financial investment in the Mumbai region will be identified. To identify the quantitative technique of investment through mathematical mode, the researcher will explain the steps involved in preparation of a mathematical model and also the factors involved in this model to determine the accurate result. I will focus on the different variables (input and output) and parameters on which return of the investment depends.

Today’s quantitative techniques use factors as fundamental building blocks for trading strategies. For the purpose of the study will discuss the major calculation involve in the quantitative investment techniques. These are

1. Time value of money
2. Discounted cash flow
3. Covariance, Correlation and Regression
4. Estimation of Beta (risk: correlated volatility)
5. Financial statement Information (cash flow, working capital, book-to-market value, earnings growth rates, dividend policy, and debt-to-equity ratios)
6. Macroeconomics of the country (interest rates, current account deficits, government spending and economic cycles)

From all the above factors the researcher explained that return on investment
depends upon different factors and in different condition. For example, the money available at the present time is worth more than the same amount in the future due to its potential earning capacity. It is also referred to as present discounted value.

\[
\text{Future Value (FV)} = \text{Present Value} \times (1 + \text{risk free interest rate})^N
\]

\[
FV = PV \times (1+r)^N
\]

\[
PV = FV \times (1+r)^{-N}
\]

Discounted cash flow estimate the attractiveness of an investment opportunity. It uses future free cash flow and discounts them to arrive at a present value which is used to evaluate the potential for investment. Despite the complexity of the calculations involved, the purpose of DCF analysis is just to estimate the money receive from an investment and to adjust for the time value of money.

\[
\text{DCF} = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \ldots + \frac{CF_n}{(1+r)^n}
\]

Where,

\( CF\) = Cash flow

\( r \) = Discount rate

Covariance and correlation are the measure of linear dependence between data. It measures a special type of relationship between two real-valued variables. Suppose that \(X\) and \(Y\) are real-valued random variables for the experiment with means \(E(X)\), \(E(Y)\) and variances \(\text{var}(X)\), \(\text{var}(Y)\), respectively (assumed finite). The covariance of \(X\) and \(Y\) is defined by
\[
\text{cov}(X, Y) = E[(X - E(X))(Y - E(Y))]
\]

and (assuming the variances are positive) the correlation of \(X\) and \(Y\) is defined by

\[
\text{cor}(X, Y) = \frac{\text{cov}(X, Y)}{\text{sd}(X) \text{ sd}(Y)}
\]

Correlation is a scaled version of covariance. The two parameters always have the same sign (positive, negative, or 0). When the sign is positive, the variables are said to be **positively correlated**; when the sign is negative, the variables are said to be **negatively correlated**; and when the sign is 0, the variables are said to be **uncorrelated**. As these terms suggest, covariance and correlation measure a certain kind of dependence between the variables. The covariance between two variables is normalized with respect to the mean of the variables so that it is not affected by shifts in the mean value other variables. However, it depends on the size of the fluctuations. The linear correlation coefficient measures the strength of the eventual linear relationship between two variables but it does not measure the strength of an eventual nonlinear functional relationship between the variables. Regression determines the functional link between the two or more random variables. It involves identifying the relationship between a dependent variable and one or more independent variables.

Correlated volatility of an asset is calculated as beta of a stock. It can be calculated in two ways: Regression and Capital asset pricing model (CAPM). CAPM is used more commonly in academic finance; investment practitioners more often use the regression technique.

\[
Y \approx f(X, \beta)
\]

Where:
- The unknown parameters, denoted as \(\beta\), which may represent a scalar or a vector.
- The independent variables, \(X\).
- The dependent variable, \(Y\).

The formula for the beta of an asset within a portfolio is

\[
\beta_a = \frac{\text{Cov}(r_a, r_b)}{\text{Var}(r_b)},
\]
Where, \( r_a \) measures the rate of return of the asset, \( r_b \) measures the rate of return of the portfolio benchmark, and \( \text{cov}(r_a, r_b) \) is the covariance between the rates of return.

For the understanding of quantitative investing, glass box approach would be used. It is transparent to help the investors the models and how they are designed to work. It is somehow complex by nature but better strategy for accuracy. Quant strategies are generally more scientific in the way they rely on actual backtests of financial ratios, the way they remove emotion, gut feelings about certain stocks, and human bias from the investment process.

**Sampling Techniques**

- **Probability Sampling**
  - Simple random sampling
  - Stratified random sampling

- **Non-Probability Sampling**
  - Quota sampling
Snowball sampling (also known as chain-referral sampling) is a non-probability (non-random) sampling method used when characteristics to be possessed by samples are rare and difficult to find. There are following three patterns of snowball sampling:

**Incidental sampling**

**Purposive sampling**

**Systematic sampling**

**Cluster sampling**

**Snowball sampling**

**Linear Snowball sampling**

**Exponential discriminative Snowball sampling**

**Exponential non-discriminative Snowball sampling**

**Fig. 3.2**

For this study, convenient sampling technique was used. In convenience sampling we select only the most conveniently available elements of the population of interest e.g. friends, relatives, colleagues, shoppers on the mall, school-mates etc. For this research, researcher got filled forms from retails investors of stock market who are easily available and willing to fill the form. The researcher also visit various stock broking firms in Mumbai and navi mumbai region to get the more details about the investors and the brokers response. Researcher used snowball sampling technique to collect the data. It is also called as Referral sampling. In this sampling we don’t have a prior knowledge of the elements of population; therefore we take help from the first element we select for the sample.

Sample size
The sample size was collected from 400 retails investors of stock market in mumbai and 10 stock broking firms in mumbai. 8 retail investors are personally interviewed by the researcher to know about the qualitative aspects of the investigation.

3.6.1. Tools used for data collection

Questionnaire
The researcher used the structured questionnaire to collect the data. The respondents are frequent investors in stock market in mumbai region. Respondents were from mumbai, navi mumbai and sub-urban mumbai. The questionnaire based survey targeting security market investors in mumbai to investigate the basic and advanced information and awareness of algorithmic trading in india. Questionnaire designed in Likerts 5-point scale, ranging from 5-strongly agree/most important/ know very well, 4-agree/important/know well, 3-neither agree nor disagree/neutral/know something, 2-disagree/least important/know little, 1-strongly disagree/not important/do not know.

Personal Interview
The researcher took personal interview from the managers of stock broking firm to get the data. Researcher visited all 10 stock broking firms to collect the data from questionnaire as well as from personal interview. She has been interviewed 10 retail investors also to get more idea about perception for algorithm trading and machine based trading in India.

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<td>2</td>
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</tr>
<tr>
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<td>Adopted as it is</td>
</tr>
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<td>Researcher has created</td>
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</table>

3.7. Tools and techniques for Data Analysis

3.7.1 Hypothesis

Hypothesis is a proposed explanation for an event. It can be tested with the help of statistical inference from a set of random variables. It is proposed for the statistical relationship between the two data sets. A hypothesis test examines two opposing hypotheses about a population. These are:

Null hypothesis: It is denoted by H0. It is the statement being tested of no effect or no difference.
**Alternative hypothesis:** It is denoted by H1 or Ha. It is the sample observations are influenced by some non-random cause which research wants to be able to conclude is true.

Hypothesis testing is used to found what outcomes of a study would lead to a rejection of the null hypothesis for a pre-specified level of significance. The main process of differentiating between the alternative hypothesis and the null hypothesis is rectified by identifying two conceptual types of errors: type 1 & type 2, and by specifying parametric limits on e.g. how much type 1 error will be permitted.

**Type I and type II errors:** when we are going through hypothesis testing, a type I error is the incorrect rejection of a true null hypothesis i.e. a false positive, while a type II error is the failure to reject a false null hypothesis i.e. a false negative. In simple word, we can say that type I error is detecting an effect that is not present, while a type II error is failing to detect an effect that is present. If we try to minimize the error in I then automatically the error II will increase. As these error rates are traded off against each other. If we want to reduce both error rates, there is only one way to do it is to increase the sample size.

A type I error, also known as an error of the first kind, occurs when the null hypothesis (H0) is true, but is rejected. It is asserting something that is absent, a false hit. A type I error may be compared with a so-called false positive i.e. a result that indicates that a given condition is present when it actually is not present in tests where a single condition is tested for.

The type I error rate or we can say significance level is the probability of rejecting the null hypothesis given that it is true. It is denoted by the α (alpha) and is also called the alpha level. Often, the significance level is set to 0.05 (5%), implying that it is acceptable to have a 5% probability of incorrectly rejecting the null hypothesis.

A type II error, also known as an error of the second kind or power of the test, occurs when the null hypothesis is false, but erroneously fails to be rejected. It is failing to assert what is present, a miss. A type II error may be compared with a so-called false negative i.e. where an actual 'hit' was disregarded by the test and seen as a 'miss' in a test checking for a single condition with a definitive result of true or false. A Type II error is committed when we fail to believe a truth.

The rate of the type II error is denoted by the β (beta) and related to the power of a test (which equals 1−β). Type I or type II error are basically depends directly upon the null hypothesis. Negation of the null hypothesis causes type I and type II errors to switch roles.

The main goal of the test is to determine if the null hypothesis can be rejected. A statistical test can either reject or fail to reject a null hypothesis, but never prove it true.

**3.7 Hypothesis Testing**

The general idea of hypothesis testing involves:

- Making an initial assumption.
- Collecting evidence (data).
- Based on the available evidence (data), deciding whether to reject or not reject the initial assumption.
These are some certain process for hypothesis testing. These are:

- First we need to formulate the null hypothesis $H_0$ where the observations are the result of pure chance and the alternative hypothesis $H_a$ where the observations show a real effect combined with a component of chance variation.

- Next, we need to identify a test statistic that can be used to assess the truth of the null hypothesis.

- Then, we need to compute the $P$-value, which is the probability that a test statistic at least as significant as the one observed would be obtained assuming that the null hypothesis were true. Where, the smaller the $P$-value, the stronger the evidence against the null hypothesis.

- And in last, we need to compare the $p$-value to an acceptable significance value alpha sometimes called an alpha value. If $p \leq \alpha$ (alpha), that the observed effect is statistically significant, the null hypothesis is ruled out, and the alternative hypothesis is valid.

**One-Tailed and Two-Tailed Tests**

A test of a statistical hypothesis, where the region of rejection is on only one side of the sampling distribution, is called a one-tailed test. For example: suppose the null hypothesis states that the mean is less than or equal to 5. The alternative hypothesis would be that the mean is greater than 5. The region of rejection would consist of a range of numbers located on the right side of sampling distribution; that is, a set of numbers greater than 5. A test of a statistical hypothesis, where the region of rejection is on both sides of the sampling distribution, is called a two-tailed test. For example, suppose the null hypothesis states that the mean is equal to 5. The alternative hypothesis would be that the mean is less than 5 or greater than 5. The region of rejection would consist of a range of numbers located on both sides of sampling distribution; that is, the region of rejection would consist partly of numbers that were less than 5 and partly of numbers that were greater than 5.

**3.7.2 Chi-Square Tests**

Chi-square is a statistical test usually used to compare observed data with specific hypothesis. It is is used to test the statistical significance of the observed association in a cross tabulation. It was developed by Karl Pearson in 1990. It is continuously probability distribution range from zero to infinity. It provides a platform that can be used to ascertain whether theoretical probability distributions coincide with empirical sample distribution. It is the function of their degree of freedom. The null Hypothesis $H_0$ is that there is no interrelated between the variables. The test was conducted by computing the cell frequencies.
3.7.3 ANOVA

The analysis of variance or ANOVA is a technique of testing hypothesis about the significant difference in several population means. This technique was developed by R.A Fisher. Researcher used analysis of variance to detect the difference among various population means based on the samples or sampling means of the respective populations. The total variation in the sample data are distributed in two parts, namely, variance between the samples and variance within the samples.

3.8 Hypotheses of the study

1. \( H_0 \): There is no significant association between investor’s demographic and socio-economic variables and their knowledge about the algorithmic trading/machine based trading.

   \( H_1 \): There is a significant association between investor’s demographic and socio-economic variables and their knowledge about the algorithmic trading/machine based trading.

1.1 \( H_0 \) There is no significant association between investor’s age and types of trading.

   \( H_1 \) There is a significant association between investor’s age and types of trading.

1.2 \( H_0 \) There is no significant association between investor’s income and types of trading

   \( H_1 \) There is a significant association between investor’s income and types of trading

1.3 \( H_0 \) There is no significant association between investor’s age and awareness of algorithmic trading

   \( H_1 \) There is a significant association between investor’s age and awareness of algorithmic trading

1.4 \( H_0 \) There is no significant association between investor’s income and awareness of algorithmic trading

   \( H_1 \) There is a significant association between investor’s income and awareness of algorithmic trading

1.5 \( H_0 \) There is no significant association between investor’s age and efficiency of algorithmic trading

   \( H_1 \) There is a significant association between investor’s age and efficiency of algorithmic trading

2. \( H_0 \): There is no significant association between investor’s demographic and socio-economic variables and reason for acceptance, influence and barrier, popularity, year of experience, source of awareness

   \( H_1 \): There is significant association between investor’s demographic and socio-economic variables and reason for acceptance, influence and barrier, popularity, year of experience, source of awareness
2.1 H0: There is no significant association between investor’s gender and barrier for choosing algo trading  
H1: There is significant association between investor’s gender and barrier for choosing algo trading

2.2 H0: There is no significant association between investor’s gender and reason for choosing algo trading  
H1: There is significant association between investor’s gender and reason for choosing algo trading

2.3 H0: There is no significant association between investor’s gender and perception for choosing algo trading  
H1: There is significant association between investor’s gender and perception for choosing algo trading

2.4 H0: There is no significant association between investor’s age and source of awareness of algo trading  
H1: There is significant association between investor’s age and source of awareness of algo trading

2.5 H0: There is no significant association between investor’s gender and source of awareness of algo trading  
H1: There is significant association between investor’s gender and source of awareness of algo trading

2.6 H0: There is no significant association between investor’s age and Popularity of algo trading  
H1: There is significant association between investor’s age and Popularity of algo trading

2.7 H0: There is no significant association between investor’s gender and Popularity of algo trading  
H1: There is significant association between investor’s gender and Popularity of algo trading

2.8 H0: There is no significant association between investor’s gender and Year of experience in algo trading  
H1: There is significant association between investor’s gender and Year of experience in algo trading

2.9 H0: There is no significant association between investor’s age and Year of experience in algo trading  
H1: There is significant association between investor’s age and Year of experience in algo trading

2.10 H0: There is no significant association between investor’s age and reasons for effectiveness of algo trading
H1: There is significant association between investor’s age and reasons for effectiveness of algo trading

2.11 H0: There is no significant association between investor’s income and reasons for effectiveness of algo trading
H1: There is significant association between investor’s income and reasons for effectiveness of algo trading

2.12 H0: There is no significant association between investor’s year of experience and awareness for processing of algo trading
H1: There is significant association between investor’s year of experience and awareness for processing of algo trading

3.9 Period of Study

The period of this study is from 1998 to 2016. The researcher has taken 18 years for the related study.

3.10 Reliability and Normality of data

3.10.1. Reliability of Measurement

Reliability is an evaluation of the degree of uniformity between numerous dimensions of a variable (Hair et al., 2009). It has to do with the precision and accuracy of a dimension procedure (Cooper and Schindler, 2008).

The evaluation of the uniformity of the whole scale can be measured through reliability coefficient. The most broadly used dependability measure is Cronbach’s alpha. Cronbach’s alpha is the standard of all potential split half coefficients resulting from diverse ways of the scale objects. Hair et al. (2009) suggested the usually agreed upon lower boundary for Cronbach’s Alpha is 0.7, although it may reduce to 0.60 in exploratory research (Hair et al., 2009)

The reliability of 20 samples was checked with Cronbach’s alpha and was 0.736 which is greater than 60% and acceptable.

Table 3.2: Case Processing Summary

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Table 3.3: Reliability Statistics

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3.10.2 Normality check

Table 3.4: Tests of Normality

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<sup>a</sup> Lilliefors Significance Correction

Chapter Summery

This chapter explain the importance and scope of research methodology. It further discussed about the researcher’s preparation for the study. Researcher found the algorithmic trading very interesting and demanding technique in the stock market. It creates curiosity to precede this research after consulting some experts, literature review and related books. It also explained the statement of problem where research gap execute this research. It also covered the question which were not included in the questionnaire but entertained in personal interview of the samples. It has mentioned period for the researcher study for 18 years. It also includes tools and techniques of data analysis and data collection. It further added a table for demographic distribution of respondent.
References


