CHAPTER I
INTRODUCTION AND DESIGN OF THE STUDY
1.1 INTRODUCTION

A financial system plays a very important role in the development of an economy. India is a fast growing country in terms of finance. The Indian financial system mainly focuses on the four segments, namely Financial Institutions, Financial Markets, Financial Instruments, and Financial Services. This study mainly focuses on financial markets. Khan M.Y (2013), Bharati V Pathak (2009), and Gurusamy, S. (2008), in their books focused on the Indian financial system. The stock market is a financial market that enables investors to buy and sell shares of Public Ltd companies. (www.investopedia.com). A stock market is a place where buying and selling of companies’ stocks and shares among the investors. The participants like Investors, traders, brokers and financial analyst are the major market players in the capital market. The financial market is divided in two segments, Capital market and Money market. For long term trading, the ‘Capital market’ is used and for short term trading, the ‘Money market’ is used. They are also divided into primary market and secondary markets. The Primary market deals with new issues or fresh issues of securities in the market. The Secondary markets allow the investors to buy and sell existing securities. The Secondary markets are traded in Stock Exchanges. Its function is to facilitate share trading.

The Market Efficiency is a major parameter in the field of stock market to decide the returns on investments. When money is invested in the stocks, the main goal is to generate a good return on investments. Many investors try not only to make a profitable return, but also to outperform, or beat, the market. Efficiency refers to two aspects of adjustment of stock price to new information and the speed and quality of the adjustment. As the Market efficiency is the new technique applied in the stock market. Today, investors obtain huge return with the help of this stock market efficiency. The market efficiency shows the predication on the securities. Market efficiency is very important for any stock market business, since investment decisions of an investor are very much influenced by this.
The ‘Allocation efficiency’ means the stock markets should allocate adequate capital resources into the most productive sectors. Allocation efficiency is divided into two types: Operational efficiency and Informational efficiency. Operational efficiency refers to the cost efficiency of the financial markets and financial institutions described in terms of charges to investors. Informational efficiency refers to the extent to which market prices of securities fully incorporate information and react to changes to information so that abnormal negative returns may not occur. Saloni Gupta (2010). Today, Informational efficiency is named as Market efficiency or stock market efficiency.

The term market efficiency was first introduced by Eugene F. Fama, in 1969. He defines market efficiency as: “A market in which prices always fully reflect all available information is called efficient”. He classified the market efficiency into three types. They are as follows, Weak form efficiency, Semi-strong form efficiency, and the Strong form efficiency. Weak form efficiency shows the past or historical information of the stock prices. This is also called as Random Walk Model. Semi-strong form efficiency shows the publicly available information. (i.e., Companies Dividend announcement, Bonus issue, Right issue, Stock splits, Buy-back announcements, Mergers and Acquisitions). And strong form efficiency shows the public as well as private information. Eugene F. Fama, (1969). E.F. Fama (1976) explained, the term market efficiency is used to explain the relationship between market information and the stock prices. Asheesh Pandey (2014) stated an efficient market hypothesis is “today’s price is the best estimate of tomorrow’s price, after present-valuing tomorrow’s price at the appropriate rate of return.”

The Event studies concept was introduced by Eugene Fama, Fisher, Jensen, and Roll (FFJR) in 1969. Event studies are part of market efficiency and many of the event studies are based on the Semi-strong form method. The Semi-strong form efficiency means publicly available information. The Public information are called the events. The events may be corporate events such as Bonus issue, Right issue, Stock splits, Buy-back announcements, Mergers and Acquisitions. In India, only few researchers have analysed on the event studies. In this study, dividend earning announcements are carried out using the Market Model. The Market model is sometimes called as single index model. The market model says that the return on stocks depends on the market portfolio and the extent of the stocks reaction as measured by alpha and beta. The dividend announcements of the BSE-SENSEX select companies have been taken for this research work.
1.2 DEFINITION OF THE PROBLEM

Stock market is a major institution that facilitates for the development of a country’s economy. Now-a-days, so many parties are interested in knowing the efficiency of the Indian stock market. Indian stock market confronts some ups and downs; because of market information reflect to the stock prices. The content of information or events will determine the efficiency of the stock market. That is how quickly and correctly security prices reflect to the information which shows the stock market efficiency.

The major problem is only a few investors or traders know how to predict the stock prices based on the market information. In the developed countries, many research studies have been conducted to test the Stock Market efficiency with respect to information (events). Whereas in India, very few research studies have been conducted to test the Stock market efficiency with respect to information (events) like Dividend announcement, Bonus issue, Right issue, Stock splits, Buy-Back announcements and Mergers & Acquisition. This stock market efficiency technique will give plan to investors and reduce the future losses from the investments.

This study also addresses the following problems related to the market efficiency. Whether stock return predictability is possible in weak form method or not? Is Semi-strong form efficiency useful to investors for the market prediction? Whether investors can earn an abnormal return from the investment using this method? Which stock is better for long term investment? And In India, we use different market efficiency prediction tools and techniques of foreign financial experts. Another, reason is developed countries stock market investors or traders can predict based on three forms of market efficiency and make abnormal profit from the investment. But, in developing countries stock markets can only predict from Weak and Semi-strong method for an abnormal return. Hence, the present study attempts to test the stock market efficiency of BSE’S SENSEX companies.

1.3 SCOPE OF RESEARCH WORK

The scope of present study is confined only to all stocks listed on the BSE’S SENSEX for a period of ten years (i.e.,) from 1st April 2007 to 31st March 2017. This study gives stronger evidences on the Semi-strong form efficiency in the BSE-SENSEX companies. Analysis of this study will help the investors to look for an abnormal return from investment.
The outcome of this research will help participants like investors, stock traders, brokers, and financial analysts (fund or portfolio managers) in identifying the behaviour of Indian stock market.

The stock traders can have the chances to earn an abnormal return from highly efficient stocks as per the results obtained. This study helps the brokers who can recommend for stock selection to the investors or traders, so that, broker will get maximum brokerage from the trading activities. This study suggests whenever companies come up with dividend announcement, the financial analyst like fund or portfolio managers should take immediate decision (whether to buy or sell the stocks).

1.4 OBJECTIVES OF THE STUDY

The overall objective of this study is to test the Market Efficiency of Indian Stock Market through BSE-SENSEX Companies. The following are the more specific objectives. They are:

1. to examine the Stationarity of BSE-SENSEX Companies;
2. to study the weak form efficiency of BSE-SENSEX companies by using Normal Distribution, Random Distribution, and Serial Correlation;
3. to Predict the Stock return of BSE-SENSEX Companies; and
4. to examine whether the Semi-strong form efficiency in the Pre and Post dividend announcements of BSE-SENSEX companies will affect the stock prices.

1.5 HYPOTHESES OF THE STUDY

The present study tests the following null hypotheses. The following hypotheses were put to test the above objective.

H₀1: There is no stationarity in the returns series of BSE-SENSEX companies.
H₀2: There is normal distribution in the return series of BSE-SENSEX companies.
H₀3: There is random distribution in the return series of BSE-SENSEX companies.
H₀4: There is serial correlation in the return series of BSE-SENSEX companies.
H₀5: There is no predictability in the return series of BSE-SENSEX companies.
H₀6: The Pre and Post Dividend announcements of BSE-SENSEX companies that are fully reflected on the stock prices.
1.6 METHODOLOGY OF THE STUDY

A. SAMPLE DESIGN

1. For testing of Weak form efficiency, the study is restricted to stock returns of only 23 BSE-SENSEX companies, for which data are available continuously for the past ten years.

2. For testing of Semi-Strong form efficiency, the study is restricted to only one corporate event (i.e., dividend) of 215 announcement dates of final and interim dividend, Side-lining other events such as Bonus issue, Right issue, Stock splits, Buy-back announcements, Mergers and Acquisitions, because of lack of continues and intermittent occurrences of related data.

3. For testing of Strong form efficiency, only stock exchanges in developed countries bring out Strong form efficiency. As such this study deals with Indian context only.

4. All the 30 BSE-SENSEX companies are available in NSE Nifty index also. As such this study focuses only on Bombay Stock Exchange 30 SENSEX companies.

5. The data for the study have been collected from Prowess IQ, a corporate database preserved by Centre for Monitoring Indian Economy Private Limited. Hence, the data are reliable for accuracy.

B. SAMPLE SELECTION

BSE has the large number of liquid stocks and indices in comparison to other exchanges. As on 15th January, 2018 BSE contains seventeen Market Cap / Broad Indices(http://www.bseindia.com/sensexview/IndexHighlight.aspx?expandable=2&type=1). For the purpose of analysis, benchmark index were chosen for this study. That index is called ‘Sensitive Index’ (SENSEX). The SENSEX consists of 30 companies with 12 different sectors. As on 9th April, 2017 shows the list of BSE-SENSEX companies of 10 different sectors are given in the Table No. 1.1,
<table>
<thead>
<tr>
<th>S.NO</th>
<th>COMPANY NAME (30)</th>
<th>CODE</th>
<th>SECTOR (10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hero Motocorp Ltd</td>
<td>HEROMOTOCO</td>
<td>AUTOMOBILE</td>
</tr>
<tr>
<td>2</td>
<td>M&amp;M Ltd</td>
<td>M&amp;M</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Maruti Suzuki Ltd</td>
<td>MARUTI</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Tata Motors Ltd</td>
<td>TATAMOTORS</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bajaj Auto Ltd</td>
<td>BAJAJ-AUTO</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Tata Steel Ltd</td>
<td>TATASTEEL</td>
<td>METALS</td>
</tr>
<tr>
<td>7</td>
<td>Coal India Ltd</td>
<td>COALINDIA</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Dr. Reddy's Laboratories Ltd</td>
<td>DRREDDY</td>
<td>PHARMA</td>
</tr>
<tr>
<td>9</td>
<td>Lupin Ltd</td>
<td>LUPIN</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sun Pharmaceutical Industries Ltd</td>
<td>SUNPHARMA</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cipla Ltd</td>
<td>CIPLA</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>GAIL Ltd</td>
<td>GAIL</td>
<td>ENERGY</td>
</tr>
<tr>
<td>13</td>
<td>NTPC Ltd</td>
<td>NTPC</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Oil and Natural Gas Corporation Ltd</td>
<td>ONGC</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Reliance Industries Ltd</td>
<td>RELIANCE</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Power Grid Corporation of India Ltd</td>
<td>POWERGRID</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>State Bank of India</td>
<td>SBIN</td>
<td>FINANCE</td>
</tr>
<tr>
<td>18</td>
<td>Axis Bank</td>
<td>AXISBANK</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>HDFC</td>
<td>HDFC</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>HDFC Bank</td>
<td>HDFCBANK</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>ICICI Bank</td>
<td>ICICIBANK</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Infosys Ltd</td>
<td>INFY</td>
<td>IT</td>
</tr>
<tr>
<td>23</td>
<td>Tata Consultancy Services Ltd</td>
<td>TCS</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Wipro Ltd</td>
<td>WIPRO</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Asian Paints Ltd</td>
<td>ASIANPAINT</td>
<td>CONSUMER GOODS</td>
</tr>
<tr>
<td>26</td>
<td>Hindustan Unilever Ltd</td>
<td>HINDUNILVR</td>
<td>(FMCG)</td>
</tr>
<tr>
<td>27</td>
<td>ITC Ltd</td>
<td>ITC</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Larsen Ltd</td>
<td>LT</td>
<td>CONSTRUCTION</td>
</tr>
<tr>
<td>29</td>
<td>Bharti Airtel Ltd</td>
<td>BHARTIARTL</td>
<td>TELECOM</td>
</tr>
<tr>
<td>30</td>
<td>Adani Ports Ltd</td>
<td>ADANIPORTS</td>
<td>SERVICES - SHIPPING</td>
</tr>
</tbody>
</table>

Source: Compiled from www.bseindia.com

For the purpose of testing of market efficiency the researcher has selected 23 companies from six sectors based on data availability and Market Performance from 1st April, 2007 to 31st March, 2017. The BSE-SENSEX select companies with six select sectors are given in Table No.1.2,
### Table No. 1.2: BSE-Sensex Selects Six Sectoral Companies

<table>
<thead>
<tr>
<th>S.NO</th>
<th>CODE</th>
<th>COMPANY NAME (23)</th>
<th>SECTOR (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HEROMOTOCO</td>
<td>Hero Motocorp Ltd</td>
<td>AUTOMOBILE</td>
</tr>
<tr>
<td>2.</td>
<td>M&amp;M</td>
<td>M&amp;M Ltd</td>
<td></td>
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<tr>
<td>3.</td>
<td>MARUTI</td>
<td>Maruti Suzuki Ltd</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>TATAMOTORS</td>
<td>Tata Motors Ltd</td>
<td>PHARMA</td>
</tr>
<tr>
<td>5.</td>
<td>DRREDDY</td>
<td>Dr. Reddy's Laboratories Ltd</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>LUPIN</td>
<td>Lupin Ltd</td>
<td>ENERGY</td>
</tr>
<tr>
<td>7.</td>
<td>SUNPHARMA</td>
<td>Sun Pharmaceutical Industries Ltd</td>
<td></td>
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<tr>
<td>8.</td>
<td>CIPLA</td>
<td>Cipla Ltd</td>
<td>FINANCE</td>
</tr>
<tr>
<td>9.</td>
<td>GAIL</td>
<td>GAIL Ltd</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>NTPC</td>
<td>NTPC Ltd</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>ONGC</td>
<td>Oil and Natural Gas Corporation Ltd</td>
<td></td>
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<tr>
<td>12.</td>
<td>RELIANCE</td>
<td>Reliance Industries Ltd</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>SBIN</td>
<td>State Bank of India</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>AXISBANK</td>
<td>Axis Bank</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>HDFC</td>
<td>HDFC</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>HDFCBANK</td>
<td>HDFC Bank</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>ICICIBANK</td>
<td>ICICI Bank</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>INFY</td>
<td>Infosys Ltd</td>
<td>IT</td>
</tr>
<tr>
<td>19.</td>
<td>TCS</td>
<td>Tata Consultancy Services Ltd</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>WIPRO</td>
<td>Wipro Ltd</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>ASIANPAINT</td>
<td>Asian Paints Ltd</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>HINDUNILVR</td>
<td>Hindustan Unilever Ltd</td>
<td>FMCG/CONSUMER GOODS</td>
</tr>
<tr>
<td>23.</td>
<td>ITC</td>
<td>ITC Ltd</td>
<td></td>
</tr>
</tbody>
</table>

Source: Compiled from www.bseindia.com

### C. Data Collection

The research study mainly depends on secondary data. The study analysed the Daily Returns of BSE-Sensex Six Select sectoral companies for the ten years from 1st April, 2007 to 31st March, 2017. The required data Daily adjusted closing price of BSE-Sensex companies are collected from Prowess IQ, a corporate database preserved by Centre for Monitoring Indian Economy Private Limited (CMIE) and also from the official website of Bombay Stock Exchange (BSE).
<table>
<thead>
<tr>
<th>S.No</th>
<th>Company Name</th>
<th>Sector</th>
<th>Ex-Date (Final and Interim Dividend) (1/04/2007 to 31/03/2017) (No of Events: 215)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>RELIANCE</td>
<td>ENERGY</td>
<td>- 08/05/2008 16/10/2009 10/05/2010 05/05/2011 31/05/2012 10/05/2013 16/05/2014 08/05/2015 - -</td>
</tr>
<tr>
<td>13</td>
<td>SBIN</td>
<td>FINANCE</td>
<td>- 29/05/2008 10/06/2009 09/06/2010 20/05/2011 24/05/2012 28/05/2013 29/05/2014 28/05/2015 03/06/2016</td>
</tr>
<tr>
<td>14</td>
<td>AXISBANK</td>
<td>FINANCE</td>
<td>- 22/05/2008 14/05/2009 20/05/2010 08/06/2011 14/06/2012 05/07/2013 12/06/2014 09/07/2015 07/07/2016</td>
</tr>
<tr>
<td>16</td>
<td>HDFCBANK</td>
<td>FINANCE</td>
<td>- 05/06/2008 22/06/2009 10/06/2010 20/06/2011 28/06/2012 13/06/2013 05/06/2014 02/07/2015 29/06/2016</td>
</tr>
<tr>
<td>17</td>
<td>ICICIBANK</td>
<td>FINANCE</td>
<td>- 10/07/2008 11/06/2009 10/06/2010 02/06/2011 31/05/2012 30/05/2013 05/06/2014 04/06/2015 16/06/2016</td>
</tr>
<tr>
<td>18</td>
<td>INFY</td>
<td>IT</td>
<td>- 29/05/2008 04/06/2009 26/05/2010 26/05/2011 24/05/2012 30/05/2013 29/05/2014 15/06/2015 09/06/2016</td>
</tr>
<tr>
<td>19</td>
<td>TCS</td>
<td>IT</td>
<td>- 18/06/2008 16/06/2009 15/06/2010 08/06/2011 07/06/2012 06/06/2013 06/06/2014 05/06/2015 06/06/2016</td>
</tr>
<tr>
<td>21</td>
<td>ASIANPAINT</td>
<td>FMCG</td>
<td>- 12/06/2008 17/06/2009 30/06/2010 09/06/2011 07/06/2012 06/06/2013 16/06/2014 24/06/2015 16/06/2016</td>
</tr>
<tr>
<td>23</td>
<td>ITC</td>
<td>FMCG</td>
<td>16/07/2007 16/07/2008 13/07/2009 09/06/2010 10/06/2011 11/06/2012 31/05/2013 03/06/2014 03/06/2015 30/05/2016</td>
</tr>
</tbody>
</table>

Source: Compiled from www.bseindia.com
The Table No. 1.3 shows the Dividend announcement event dates for the Semi-strong form efficiency. An event study method is used for the market model. The event window is used to show the impact on before and after the particular event day and to analyse information will affect the price or not. In this study, Pre and Post dividend announcements event days are generated. The daily adjusted closing prices are used with Pre and Post event days and event window at T-15 days before (Pre) and T+15 days after (Post) dividend announcement days are selected. The announcement day is represented by 0 and Estimation window is T-120 days before the event window. (T-15, 0, T+15) = t-15, t-14, t-13 …t-4, t-3, t-2, t-1, 0, t+1, t+2, t+3, t+4 ... t+13, t+14, t+15. There are 215 events from 23 BSE-SENSEX companies selected through BSE Annual and Interim dividend announcements. Whereas, for Weak form efficiency, the Daily adjusted closing prices of BSE-SENSEX 23 companies from 6 different sectors are taken.

1.7 TOOLS USED FOR THE STUDY

The data are analysed through Statistical and Econometrical methods. The following tools are used for the analysis.

A. STOCK RETURN CALCULATION

Stock return is calculated based on the current market price divided by previous closing price. The daily stock return is calculated as follows,

$$R_{lt} = LN \left[ \frac{P_{lt}}{P_{lt-1}} \right]$$

Where:

- $R_{lt}$ = the daily return on day t for indices l
- $P_{lt}$ = closing values for indices l
- $P_{lt-1}$ = closing values for indices l on day t-1
- $LN$ = Natural log

B. AUGMENTED DICKEY-FULLER (ADF) AND PHILLIPS-PERRON (PP) TEST

This unit root test was proposed by Dickey and Fuller in 1979 and Phillips and Perron in 1988. This test is used to measure the Data Stationarity for BSE-SENSEX companies and also find whether unit root exhibit or not. (See from Page No: 110 to 116)

An augmented Dickey–Fuller test (ADF) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. The augmented Dickey–Fuller (ADF) statistic, used in the test, is a negative number. The more negative it is,
the stronger the rejections of the hypothesis that there is a unit root at some level of confidence. It is an augmented version of the Dickey-Fuller test for a larger and more complicated set of time series models.

\[
\Delta y_t = \alpha y_{t-1} + x_t, \delta + \varepsilon_t
\]
\[
\Delta y_t = \alpha + \gamma y_{t-1} + \varepsilon_t \text{ (constant)}
\]
\[
\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \varepsilon_t \text{ (constant and intercept)}
\]

Where,

\( x_t \): are optional exogenous regressors which may consist of constant \( \alpha \): intercept, \( \beta \): trend and \( \gamma \): No Trend & Intercept values, \( \varepsilon_t \): are assumed to be white noise, if \( |\alpha| \geq 1 \), is a non-stationary series and the variance of \( y \) increases with time and approaches infinity. If \( |\alpha| < 1 \), \( y \) is a (trend) stationary series can be evaluated by testing whether the absolute value of \( \alpha \) is strictly less than one.

Phillips and Perron (1988) propose an alternative (nonparametric) method of controlling for serial correlation when testing for a unit root. The PP method estimates the non-augmented DF test and modifies the \( t \)-ratio of the \( \alpha \) coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic. The PP test is based on the statistic:

\[
t_\alpha = t_\alpha \left( \frac{y_0}{f_0} \right)^{\frac{1}{2}} - \frac{T (f_0 - y_0) (se(\alpha))}{2f_0^{1/2} s}
\]

Where,

\( \alpha \) is the estimate, and \( t_\alpha \) the ratio of \( \alpha \), \( (se(\alpha)) \) is coefficient standard error, and \( s \) is the standard error of the test regression. In addition, \( y_0 \) is a consistent estimate of the variance error. The remaining term \( f_0 \), is an estimator of the residual spectrum at frequency zero. (www.eviews.com/Unit_Root_Testing)

**TEST FOR WEAK FORM EFFICIENCY**

**C. DESCRIPTIVE STATISTICS (See from Page No: 117 to 140)**

The descriptive statistics consists of Mean, Median, Maximum, Minimum, Standard Deviation, Skewness, Kurtosis, Jarque-Bera test, and the Probability. Testing the return series whether it is normally distributed or not. When, the stocks are non-normal means there is chance for earning return from the stock. Similarly, when the stocks are normal means weak form efficiency plays in the stocks.
Descriptive statistics is the discipline of quantitatively describing the main features of a collection of data. Descriptive statistics are distinguished from inferential statistics (or inductive statistics), in that descriptive statistics aim to summarize a data set, rather than use the data to learn about the population that the data are thought to represent. This generally means that descriptive statistics, unlike inferential statistics, are not developed on the basis of probability theory. A complement of standard descriptive statistics is displayed along with the histogram. All of these statistics are calculated using the observations in the current sample.

**Mean** is the average value of the series, obtained by adding up the series and dividing by the number of observations.

**Median** is the middle value (or average of the two middle values) of the series when the values are ordered from the smallest to the largest. The median is a robust measure of the centre of the distribution that is less sensitive to outliers than the mean.

**Max** and **Min** are the maximum and minimum values of the series in the current sample.

**Std. Dev.** (Standard Deviation) is a measure of dispersion or spread in a series. The standard deviation is expressed by:

\[
s = \sqrt{\frac{\sum_{i=1}^{N} (y_i - \bar{y})^2}{(N - 1)}}
\]

Where,

\(N\) is the number of observations in the current sample and \(\bar{y}\) is the mean of the series.

**Skewness** is a measure of asymmetry of the distribution of the series around its mean. Skewness is computed as:

\[
s = \frac{1}{\hat{\sigma}} \sum_{i=1}^{N} \frac{(y_i - \bar{y})^3}{\hat{\sigma}}
\]

Where,

\(\hat{\sigma}\) is an estimator for the standard deviation that is based on the biased estimator for the variance. The skewness of a symmetric distribution, such as the normal distribution, is zero. Positive skewness means that the distribution has a long right tail and negative skewness implies that the distribution has a long left tail. The skewness of a symmetric distribution, such as the normal distribution, is zero.
Kurtosis - Measure of the relative peakedness of a distribution. $K = 3$ indicates a normal “bell-shaped” distribution (Mesokurtic). $K < 3$ indicates a Platykurtic distribution (flatter than a normal distribution with shorter tails). $K > 3$ indicates a leptokurtic distribution (more peaked than a normal distribution with longer tails)

$$\text{Kurtosis} = \sum_{i=1}^{N} \frac{(Y_i - \bar{Y})^4 / N}{s^4} - 3$$

Jarque-Bera test is a test statistic for testing whether the series is normally distributed. The test statistic measures the difference of the skewness and kurtosis of the series with those from the normal distribution. The statistic is thus computed

$$\text{Jarque-Bera} = \frac{N}{6} \left( S^2 + \frac{(K-3)^2}{4} \right)$$

Where, $S$ is the skewness, and $K$ is the kurtosis. Under the null hypothesis of a normal distribution, the Jarque-Bera statistic is distributed as $\chi^2$ with 2 degrees of freedom. The reported Probability is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis - a small probability value leads to the rejection of the null hypothesis of a normal distribution at the 5 per cent level but not at the 1 per cent significance level. (www.eviews.com/ Descriptive_Statistics Tests)

D. RUNS TEST (See from Page No: 141, 142)

The Runs test procedure tests whether the order of occurrence of two values of a variable is random. A run is a sequence of like observations. Examine the return series whether it shows random walk / Random Distribution or not. The Random walk means Weak form efficiency. If the stock price changes are random, then past prices cannot be used to forecast future prices (Weak form efficient). If the stock price changes are Non-random, then past prices can be used to forecast future price. (Not in weak form efficient).

Total expected number of runs can be estimated as:

$$E(R) = \frac{[N(N+1) - \sum_{i=1}^{3} n_i^2]}{N}$$
Where,

\( N \) is the total number of observations (price changes or returns) and \( n_i \) is the number of price changes (returns) in each category \((N = \sum_{i=1}^{23} n_i)\). For a large number of observations \((N > 30)\), the sampling distribution of \( m \) is approximately the standard error and normal of \( E \sigma_R(R) \) is given by:

\[
\sigma_R = \sqrt{\frac{\sum_{i=1}^{3} n_i^2 \left[ \sum_{i=1}^{2} n_i^2 + N(N + 1) \right] - 2N \sum_{i=1}^{2} n_i^2 - N}{N(N - 1)}}
\]

The formula for Z statistics is as follows,

\[
Z = \frac{R \pm 0.5 - E(R)}{\sigma_R}
\]

Where,

\( R \) is actual number of runs, \( E(R) \) is expected number of runs, and 0.5 is continuity adjustment in which sign of the continuity adjustment is positive (0.5) if \( R > E(R) \), and negative otherwise. Since there is proof of dependence among share returns when \( R \) is too large or too small, the test is a two-tailed one. If the \( z \)-value is larger than or equal to 1.96, the null hypothesis is rejected at 5 per cent level of significance. (www.statisticssolutions.com)

**E. AUTOCORRELATION (ACF) TEST (See from Page No: 143 to 189)**

The Autocorrelation (ACF) Test also called as Serial Correlation. Analysing the return series whether it shows Serial correlation or not. If the return series shows the Serial correlation means the market is in weak form efficient. Likewise, if the return series shows there is no serial correlation means the market is not in weak form efficient. In this study, Partial correlation also examined.

The autocorrelation of a series \( Y \) at lag \( k \) is estimated by: where \( \bar{Y} \) is the sample mean of \( Y \). This is the correlation coefficient for values of the series \( k \) periods apart. When the \( T_1 \) is nonzero it means that the series is first order serially correlated. If \( T_k \) dies off more or less geometrically with increasing lag \( k \), it is a sign that the series obeys a low-order autoregressive (AR) process. If \( T_k \) drops to zero after a small number of lags, it is a sign that the series obeys a low-order moving-average (MA) process.
Auto Correlation test: 

$$T_k = \frac{\sum_{t=k+1}^{T} ((Y_t - \bar{Y})(Y_{t-k} - \bar{Y}_{t-k})) / (T-K)}{\sum_{t=1}^{T} (Y_t - \bar{Y})^2 / T}$$

Where,

$$\bar{Y}_{t-k} = \frac{\sum Y_{t-k}}{T-k}$$

the difference arises since, for computational simplicity, EViews employs the same overall sample mean $\bar{Y}$ as the mean of both $Y_t$ and $Y_t - k$. While both formulations are consistent estimators, the EViews formulation biases the result toward zero in finite samples. The dotted lines in the plots of the autocorrelations are the approximate two standard error bounds computed as $\sqrt{\pm 2/(T)}$. If the autocorrelation is within these bounds, it is not significantly different from zero at (approximately) the 5 percent significance level.

The partial autocorrelation at lag $k$ is the regression coefficient on $Y_t - k$ when $Y_t$ is regressed on a constant, $Y_{t-1}, \ldots, Y_{t-k}$. This is a partial correlation since it measures the correlation of $Y$ values that are $k$ periods apart after removing the correlation from the intervening lags. If the pattern of autocorrelation is one that can be captured by an auto regression of order less than $k$, then the partial autocorrelation at lag $k$ will be close to zero.

The PAC of a pure autoregressive process of order $p$, $AR(p)$, cuts off at lag $p$, while the PAC of a pure moving average (MA) process asymptotes gradually to zero. EViews estimates the partial autocorrelation at lag $k$ recursively by

$$\phi_k = \begin{cases} \tau_1 & \text{for } k = 1 \\ \frac{\tau_k - \sum_{j=1}^{k-1} \phi_{k-1,j} \tau_{k-j}}{1 - \sum_{j=1}^{k-1} \phi_{k-1,j} \tau_{k-j}} & \text{for } k > 1 \end{cases}$$

Where,

$$T_k$$ is the estimated autocorrelation at lag $k$ and where,

$$\phi_{k,j} = \phi_{k-1,j} - \phi_k \phi_{k-1,j}$$

This is a consistent approximation of the partial
autocorrelation. The algorithm is described in Box and Jenkins (1976, Part V, Description of computer programs). To obtain a more precise estimate of $\varphi$, simply run the regression:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \cdots + \beta_{k-1} Y_{t-(k-1)} + \phi_k Y_{t-k} + \epsilon_t,$$

where $\epsilon_t$ is a residual. The dotted lines in the plots of the partial autocorrelations are the approximate two standard error bounds computed as $\pm 2/(\sqrt{T})$. If the partial autocorrelation is within these bounds, it is not significantly different from zero at (approximately) the 5 per cent significance level.

The last two columns reported in the correlogram are the Ljung-Box (1976) $Q$-statistics and their p-values. The $Q$-statistic at lag $k$ is a test statistic for the null hypothesis that there is no autocorrelation up to order $k$ and is computed as:

$$Q_{LB} = T(T + 2) \sum_{j=1}^{k} \frac{\hat{\gamma}_j^2}{T - j}$$

Where,

The $Q$-statistic is often used as a test of whether the series is white noise. $T_j$ is the $j^{th}$ autocorrelation and $T$ is the number of observations. If the series is not based upon the results of ARIMA estimation, then under the null hypothesis, $Q$ is asymptotically distributed as a $\chi^2$ with degrees of freedom equal to the number of autocorrelations. (www.eviews.com/Correlogram)

F. GARCH FAMILY MODELS (TESTING FOR RETURN PREDICTABILITY)

Eugene Fama (1970) was changed the Weak form for return predictability. Testing for return predictability GARCH models are used. The GARCH family models are GARCH (1,1), EGARCH (1,1) and TARCH / TGARCH (1,1). These models investigating that the return series of BSE-SENSEX shows stock prediction or not. If the stocks display Positive shock means there is predictability in the return series and we can say market is not in Weak form efficient. Whereas, if the stocks display Negative shock means there is unpredictability in the return series and we can say market is in weak form efficient. The following are the GARCH family model equations

Autoregressive Conditional Heteroskedasticity (ARCH) models are specifically designed to model and forecast conditional variances. The variance of the dependent variable is modelled as a function of past values of the dependent variable and independent or exogenous variables. ARCH models were introduced by Engle (1982) these models are widely used in various branches of econometrics, especially in financial time series analysis
and generalized as GARCH (Generalized ARCH) by Bollerslev (1986) and Taylor (1986). First, you may need to analyse the risk of holding an asset or the value of an option. Second, forecast confidence intervals may be time-varying, so that more accurate intervals can be obtained by modelling the variance of the errors. Third, more efficient estimators can be obtained if heteroskedasticity in the errors is handled properly. In developing an ARCH model, you will have to provide three distinct specifications one for the conditional mean equation, one for the conditional variance, and one for the conditional error distribution. The following are the GARCH family model equations 1, 2 and 3 are used for the study.

I. GARCH (1,1) MODEL

We begin with the simplest GARCH (1,1) specification:

GARCH (1,1) MODEL EQUATION 1:

\[ \sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \]

Where, \( \sigma_t^2 \) is the one-period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation has three terms, \( \omega \): constant in the model represents a long-run average; \( \alpha \): The ARCH term which is the lag of the squared residuals from the mean equation, represents news about volatility from the previous period; \( \beta \): The GARCH term is the last periods forecast variance.

The GARCH (1,1) refers to the presence of a first-order autoregressive GARCH term (the first term in parentheses) and a first-order moving average ARCH term (the second term in parentheses). An ordinary ARCH model is a special case of a GARCH specification in which there are no lagged forecast variances in the conditional variance equation i.e., a GARCH (0,1). If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period. This model is also consistent with the volatility clustering often seen in financial returns data, where large changes in returns are likely to be followed by further large changes.

II. EXPONENTIAL GARCH (EGARCH) MODEL

The EGARCH or Exponential GARCH model was proposed by Nelson (1991). The specification for the conditional variance is:
EGARCH (1,1) MODEL EQUATION 2:

\[
\log \sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \log(\sigma_{t-j}^2) + \sum_{i=1}^{p} \alpha_j \frac{|\epsilon_{t-i}|}{\sigma_{t-i}} + \sum_{k=1}^{r} \gamma_k \frac{\epsilon_{t-k}}{\sigma_{t-k}}
\]

Where: \( \log \sigma_t^2 \): the log of the conditional variance. This implies that the leverage effect is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative. \( \omega \): constant in the model represents a long-run average; \( \alpha \): The ARCH term which is the lag of the squared residuals from the mean equation, represents news about volatility from the previous period; \( \gamma \): Correlation between the realized volatility and the historical return. (Leverage effect). The presence of leverage effects can be tested by the hypothesis that \( \gamma_i < 0 \). The impact is asymmetric if \( \gamma_i \neq 0 \). \( \beta \): The GARCH term is the last period’s forecast variance.

III. THRESHOLD GARCH (TARCH) MODEL

TARCH or Threshold ARCH and Threshold GARCH were introduced independently by Zakoïan (1994) and Glosten, Jaganathan, and Runkle (1993). The generalized specification for the conditional variance is given by:

TGARCH (1,1) MODEL EQUATION 3:

\[
\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_j \epsilon_{t-i}^2 + \sum_{k=1}^{r} \delta_k \epsilon_{t-k}^2 I_{t-k}
\]

Where, \( \omega \): constant in the model represents a long-run average, \( \alpha \): The ARCH term which is the lag of the squared residuals from the mean equation represents news about Volatility from the previous period, \( \delta \): Takes the value of 1 if \( \epsilon_t \) is negative, and 0 otherwise, identifying “good news” and “bad news” has a different impact, \( \beta \): The GARCH term is the last periods forecast variance. \( I_t = 1 \) if \( \epsilon_t < 0 \) and 0 otherwise. In this model, good news, \( \epsilon_{t-i} > 0 \), and bad news, \( \epsilon_{t-i} < 0 \), have differential effects on the conditional variance; good news has an impact of \( \alpha_j \), while bad news has an impact of \( \alpha_i + \gamma_i \). If \( \gamma_i < 0 \), bad news increases volatility, and we say that there is a leverage effect for the \( i^{th} \) order. If \( \gamma_i \neq 0 \), the news impact is asymmetric. (www.eviews.com/Farch_ARCH_and_GARCH) (See from Page No: 190-200)
TEST FOR SEMI-STRONG FORM EFFICIENCY

G. MARKET MODEL (See from Page No: 201 to 277)

The Market model is sometimes called the single index model. The market model says that he return on a security depends on the return on the market portfolio and the extent of the securities responsiveness as measured by beta. In addition, the return will also depend on conditions that are unique to the firm. Graphically, the market model can be depicted as a line fitted to a plot of asset returns against returns on the market portfolio. Estimating that whether an individual stock of BSE-SENSEX reacts to the Pre and Post Dividend Announcements or not. The Average Abnormal return (AAR) and Cumulative Average Abnormal return (CAAR) are calculated based on the Market Model equation. An equation for market model is given below. This model previously studied by Hasnain Manzoor (2015), Rajesh Khurana and Warne, D. P. (2016), and Tran Thi Xuan Anh et al., (2016).

I. CALCULATION OF MARKET MODEL (EXPECTED RETURN)

The market model is specified thus:

\[ E(R_i) = \alpha + \beta (R_m) \]

Where:

- \( E(R_i) \): returns on a stock i at time period t
- \( \alpha \): Alpha; \( \beta \): Beta
- \( (R_m) \): Market return

From this model, we can find out Actual Return, Abnormal Return (AR), Cumulative Abnormal Return (CAR), Average Abnormal Return (AAR), Cumulative Average Abnormal Return (CAAR), and T-Statistics for AAR and CAAR. This model results are leads to market is in Semi-strong form or not in Semi-strong form.

II. CALCULATION OF ACTUAL RETURN

The Actual or Daily stock return was calculated as follows,

\[ R_t = LN \left( \frac{L_t}{L_{t-1}} \right) \]

Where:

- \( R_t \): the daily return on day t for indices l
- \( L_t \): closing values for indices l
- \( L_{t-1} \): closing values for indices l on day t-1
- \( LN \): Natural log
III. CALCULATION OF ABNORMAL RETURN (AR)

In order to analyse the behavior of market for the announcements, estimate abnormal returns (AR) at the time of the announcement, and pre and post the announcement. The abnormal return is finding as:

\[ ASR_{it} = AR_{it} - E(R_{it}) \]

Where:
- \( ASR_{it} \) = Abnormal return
- \( AR_{it} \) = Actual return
- \( E(R_{it}) \) = Expected return

IV. CALCULATION OF CUMULATIVE ABNORMAL RETURN (CAR)

In order to make generalizations and to draw an overall inference for the market reactions to earnings announcements, the cumulative abnormal returns (CARs) for the 31-day event window, from the start of the event period \( t-15 \) (day - 15) up to the time \( t+15 \) (day + 15) as follows:

\[ CAR_{it} = \sum ASR_{it} \]

Where:
- \( CAR_{it} \) = Cumulative Abnormal Return
- \( ASR_{it} \) = Sum of all Abnormal return

V. CALCULATION OF AVERAGE ABNORMAL RETURN (AAR)

Then the cross sectional average abnormal return at time “t” is measured by averaging abnormal returns at day “t” overall the firm of BSE-SENSEX companies.

\[ AAR_{it} = \frac{\sum_{t=1}^{n} ASR_{it}}{n} \]

Where:
- \( AAR_{it} \) = Average Abnormal Return
- \( ASR_{it} \) = Abnormal Stock Returns on security i at time t

VI. CALCULATION OF CUMULATIVE AVERAGE ABNORMAL RETURN (CAAR)

The cumulative average abnormal return was calculated by aggregating the Average Abnormal Return over the event window period.
\[ CAAR_{it} = \sum_{t=1}^{n} \frac{AAR_{it}}{n} \]

*Where:*
- \( CAAR_{it} \) = Cumulative Average Abnormal Return
- \( AAR_{it} \) = Average Abnormal Return on security \( i \) at time \( t \)

**VII. CALCULATION OF T-STATISTICS FOR AVERAGE ABNORMAL RETURN (AAR)**

The AARs test for statistical significance using the T-statistic:

\[ T(AAR_{it}) = \frac{AAR_{it}}{\sigma \sqrt{n}} \]

*Where:*
- \( T(AAR_{it}) \) = T-Statistics for Average Abnormal Return
- \( AAR_{it} \) = Average Abnormal Return on security \( i \) at time \( t \)
- \( \sigma \sqrt{n} \) = Standard Error

*Note:* Standard Error calculated using standard deviation of event window divided by total number of companies.

**VIII. CALCULATION OF T-STATISTICS FOR CUMULATIVE AVERAGE ABNORMAL RETURN (CAAR)**

The CAARs test for statistical significance using the T-statistic:

\[ T(CAAR_{it}) = \frac{CAAR_{it}}{\sigma \sqrt{n}} \]

*Where:*
- \( T(CAAR_{it}) \) = T-Statistics for Cumulative Average Abnormal Return
- \( CAAR_{it} \) = Cumulative Average Abnormal Return on security \( i \) at time \( t \)
- \( \sigma \sqrt{n} \) = Standard Error

*Note:* Standard Error calculated using standard deviation of event window divided by total number of companies.

These tools are used to test the market efficiency of Indian stock market. The computation of data for this study was made by using E-Views (Version 9.0), SPSS (Version 23.0) and Ms Excel.
1.8 LIMITATIONS OF THE STUDY

This research study has certain constraints like the following limitations.

1. The study has covered only 23 BSE-SENSEX companies from six sectors and did not consider all the 30 BSE-SENSEX companies due to lack of data availability and lack of market performance continuously for ten years.

2. This study has been restricted to 23 BSE-SENSEX companies return series for testing of Weak form efficiency.

3. This study covers only Dividend announcements factor and do not consider all the factors like, Bonus issue, Right issue, Stock Split, Mergers and Acquisitions due to lack of continues events and length of the study.

4. This study has been limited to 215 events of Dividend announcements for testing of Semi-strong form efficiency.

5. All the limitations, associated with various tools like Unit root test: ADF and PP test, Descriptive Statistics, Runs Test, Autocorrelation Function (ACF) Test, GARCH family Models, and Market Model are also applicable to this study.

However encompassing the limitations of the study, a detailed review of literature has been done, to clarify the concepts involved, and is dealt in the next chapter.
CHAPTER SCHEME

Chapter I : It deals with Introduction and Design of the study - Definition of the Problem, Scope of the Research work, Objectives, Hypotheses, Methodology, Tools and Limitations.

Chapter II : Express the theoretical and empirical reviews of Weak form, Semi-strong form and Strong form.

Chapter III : Provides the study area of Bombay stock exchange and the BSE-SENSEX 23 Stocks with six select sectors growth, history and financial reports and so on.

Chapter IV : Showing the results of Weak form and Semi-strong form in the BSE market.

Chapter V : The researcher presents the findings, suggestions (to the Investors, Stock Traders, Brokers, & Financial analysts) and conclusion, thereon.
REFERENCES


