A STUDY ON STOCK PERFORMANCE USING RUNS TEST
(With Special Refer to BSE Information Technology Index)

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ABSTRACT
The Bombay Stock Exchange Information Technology Index, consisting of IT Stocks. The study examines the efficient market hypothesis using the runs test to assess the weak form or semi-strong or strong. According to the efficient market hypothesis idea, stock markets are efficient and security prices completely represent all available information. Because EMH reveals that efficient markets are impossible to achieve, it is impossible for any investor to get above-average profits by trading in the stock market. It indicates that all accessible information is absorbed into stock prices, therefore no investor can exceed the stock market. Using the runs test of randomness, the article investigates just the dependency of consecutive price fluctuations on their past. Secondary data, including of 05 BSE-listed companies, is used to test the hypothesis. The monthly adjusted closing prices of these 05 firms were considered during a 14-month period. The updated closing prices are shown in the results.
KEYWORDS: *Efficient Market Hypothesis, Bombay Stock Exchange (BSE), Runs test, Information Technology, Stock Market.*

I. INTRODUCTION

"Efficient Market Hypothesis" is also called as efficient market theory. "Efficient market hypothesis" (EMH) is a crucial approach in finance, which understands cost of capital market, The Marketplace efficiency used to explain the inventory costs mirror statistics at any time, this is said to be capital market place idea.

The present study attempts to understand the stock price movement for 1 year from April 2021 to May 2022. The study aims to analyse on stock prices increase or decrease monthly wise. The study has been analysed using Runs test to verify information technology of BSE Index based Companies. Phases of performance from upper to a lower limit. Thus, the study helps to understand the Volatility of the IT Index Stocks.

II. STATEMENT OF THE PROBLEM

The present study is based on "Efficient Market Hypothesis", to identify weak, semi-strong and strong form of 'efficient' of selected stock using runs test, previously the study are not found particular to short period analysis.

III. NEED OF THE STUDY

The present study will help to investors to enter and exit from good quality of stocks. The study consider sample of 06 companies listed at BSE which are safe for investors to start investing, because runs test gives an idea, information which yield more and stock has less volatility compares to others. The sources for study is, period of look at it is from April 2021 to May 2022, the stock charges had been taken from 'BSE' and ten companies from Information Technology industries using runs test .

IV. OBJECTIVE OF THE STUDY

- To identify price changes of selected stocks of BSE Information Technology Index.
- To analyse the mean and standard deviation for selected Information Technology company.
- To determine the efficiency of the stock using runs test.
- To test hypothesis between upper and lower limit of runs test.

V. LITERATURE REVIEW

- **Dr. Leela M H et al (2020),** The research examines the randomness of the price movements of six healthcare stocks on the Bombay Stock Exchange and analyses the efficiency of the stocks using the Runs test, which includes observed runs, upper and lower limits. The closing price data is collected for three months, from January to March 2020.
- **Sadanand Vijay kumar, Asmath Ruhi (2020),** This study aims to evaluate the firms listed on the Bombay Stock Exchange's SENSEX for Weak Form EMH from 1 April 2017 to 31 March 2018. Using parametric and non-parametric statistical

techniques such as the Autocorrelation, Correlogram, and Runs Test, as well as descriptive statistics on the weekly closing prices of the 31 SENSEX businesses.

- **Anil Kumar Goyal (2019),** This research examines the efficient market hypothesis using the runs test to test the weak form of the efficient market hypothesis by using the runs test of randomness from companies selected at BSE, is employed to test the Hypothesis.
- **Babitha Rohit, Prakash Pinto (2017),** The current study examines weaker version of EMH of individual equities listed on the Bahrain Bourse, For the period 2011 to 2015. The Kolmogorov-Smirnov goodness of fit test, run test, and autocorrelation test are used to assess the weak version of EMH.

VI. RESEARCH GAP

After going through literature review, it's found that fewer studies are available on EMH particular to service sector. Therefore, the present study is an attempt to exhibit weak form or semi-strong form or strong form situation on respective stocks

VII. HYPOTHESIS OF THE STUDY

Null Hypothesis (H_O): The observed runs lies between upper and lower limit of stock prices of the Information Technology of BSE Index.
Alternate Hypothesis(H_A): The observed runs does not lies between upper and lower limit of stock prices of the Information Technology of BSE Index.

VIII. RESEARCH DESIGN

The present study is descriptive and Analytical in nature, the data has been collected through Bombay Stock Exchange Exclusively. The closing price and opening price of stock were used as a data for analysis.

IX. SAMPLING TECHNIQUES

The present study has employed the systematic random sampling approach at the probability sampling techniques in the selection of Information Technology companies from BSE 'SENSEX'.

X. SAMPLE SIZE

Sample size is ten IT companies from BSE Information Technology Index from SENSEX as per Systematic Random Sampling Test.

XI. STATISTICAL TOOLS AND TECHNIQUES

This runs test use to check whether 'Market Efficient' is of 3 kinds or not. This is random walk theory. This test is calculated as below,

- 'R' stands for observation of number of runs
- 'N1'=number of positive runs
- 'N2'=number of negative runs
- 'n1+n2'=number of observations in each category
- Upper limit =μ+1.96*standard deviation
- Lower limit =μ-1.96*standard deviation
- Mean = $(2n_1 * n_2 / n_1 + n_2)$ +1
- 'Standard deviation' of runs =$\sqrt{[(2n_1 * n_2)(2n_1 * n_2 - n_1 - n_2)]/[(n_1 + n_2)(n_1 + n_2 - 1)]}$
- Here the determined run fall between 'Upper' and 'Lower' limit, so the H_o is accepted and H_a is rejected.

A. DATA ANALYSIS ON THE CLOSING PRICE OF INFOSYS LTD.

Null Hypothesis (H_O): There is no statistical difference between upper and lower limit and observed runs of Infosys Ltd.
Alternate Hypothesis(H_A): There is a statistical difference between upper and lower limit and observed runs of Infosys Ltd.

Months	Closing prices	Price changes
Apr 2021	1,353.90	****
May 2021	1,393.65	+
Jun 2021	1,581.25	+
Jul 2021	1,610.25	+
Aug 2021	1,704.15	+
Sep 2021	1,675.40	_
Oct 2021	1,668.60	_
Nov 2021	1,714.45	+
Dec 2021	1,889.65	+
Jan 2022	1,736.70	_
Feb 2022	1,717.30	_
Mar 2022	1,907.20	+
Apr 2022	1,567.90	_
May 2022	1,527.55	_

Calculation of Infosys ltd.

Total runs (r) = 6

Number of positive runs (n_1) = 7

Number of negative runs (n_2) = 6

Mean $\mu(r)$: $[2(n_1*n_2)/n_1+n_2]+1$

$\quad\quad$ = $[2(7*6)/7+6]+1$ $\;(\mu) = 7.46$

Standard deviation $\sigma(r)$: $\sqrt{[2n_1*n_2 (2n_1*n_2-n_1-n_2)/(n_1+n_2) (n_1+n_2-1)]}$
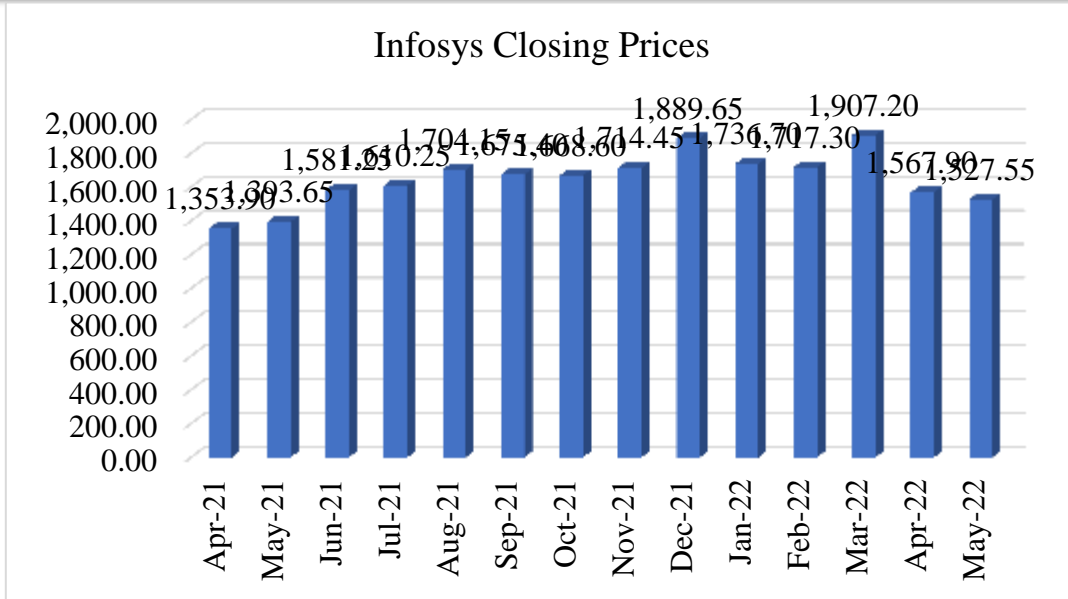
$\quad\quad$ = $\sqrt{[2*7*6 (2*7*6-6-7-6)/(7+6) (7+6-1)]}$ $\;(\sigma) = 1.71$

Upper limit: $\mu+1.96*$standard deviation

$\quad\quad$ = 7.4+1.96*1.71 =10.82

Lower limit: $\mu-1.96*$standard deviation

$\quad\quad$ = 7.46-1.96*1.71 = 4.10

Infosys Closing Prices

Interpretation:
From the above table, the study shows that the observed number of runs 6 falls within 10.82 and 4.10 of upper and lower limit, so there is no significant difference between observed runs lies between 'upper' and 'lower' limit. Hence 'null hypothesis' is accepted. Therefore, there is no statistical difference between upper and lower limit and observed runs of Infosys Ltd. There is a statistical difference between upper and lower limit and observed runs of Infosys Ltd.

B. DATA ANALYSIS ON THE CLOSING PRICE OF TATA ELXSI LTD.

Null Hypothesis (H_O): There is no statistical difference between upper and lower limit and observed runs of Tata Elxsi Ltd.
Alternate Hypothesis(H_A): There is a statistical difference between upper and lower limit and observed runs of Tata Elxsi Ltd.

Months	Closing Prices	Price Changes
Apr 2021	3,480.10	****
May 2021	3,642.85	+
Jun 2021	4,296.75	+
Jul 2021	4,223.95	_
Aug 2021	4,776.60	+
Sep 2021	5,594.60	+
Oct 2021	5,871.00	+
Nov 2021	5,790.85	_
Dec 2021	5,867.80	+
Jan 2022	7,604.55	+
Feb 2022	6,431.55	_
Mar 2022	8,840.25	+
Apr 2022	7,745.10	_
May 2022	8,076.10	+

Calculation of Tata Elxsi Ltd.

Total runs (r) = 9

Number of positive runs (n1) = 9

Number of negative runs (n2) = 4

Mean $\mu(r)$: $[2(n_1*n_2)/n_1+n_2]+1$

$= [2(9*4)/9+4]+1$ (μ) = 6.54

Standard deviation $\sigma(r)$: $\sqrt{[(2n_1*n_2)(2n_1*n_2-n_1-n_2)]/[(n_1+n_2)(n_1+n_2-1)]}$

$= \sqrt{[2*9*4(2*9*4-9-4)/(9+4)(9+4-1)]}$ (σ) = 1.45

Upper limit: $\mu+1.96*$standard deviation
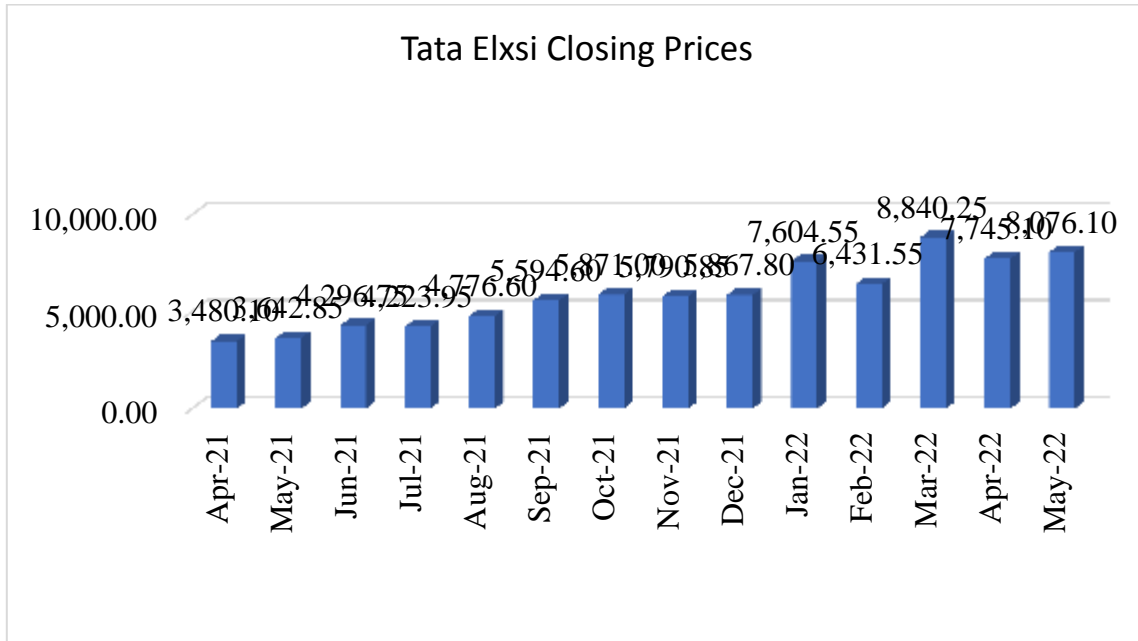
= 6.54+1.96*1.45   = 9.38

Lower limit: μ-1.96*standard deviation

= 6.54-1.96*1.45   = 3.70

Interpretation:
From the above table, the study shows that the observed number of runs 9 falls within 9.38 and 3.70 of upper and lower limit, so there is no significant difference between observed runs lies between 'upper' and 'lower' limit. Hence 'null hypothesis' is accepted. Therefore, There is no statistical difference between upper and lower limit and observed runs of Tata Elxsi Ltd. There is a statistical difference between upper and lower limit and observed runs of Tata Elxsi Ltd.

C. DATA ANALYSIS ON THE CLOSING PRICE OF BRIGHTCOM GROUP LTD.

Null Hypothesis (H_O): There is no statistical difference between upper and lower limit and observed runs of Brightcom Group Ltd.
Alternate Hypothesis(H_A): There is a statistical difference between upper and lower limit and observed runs of Brightcom Group Ltd.

Months	Closing prices	Price changes
Apr 2021	7.63	****
May 2021	8.49	+
Jun 2021	22.74	+
Jul 2021	46.20	+
Aug 2021	38.25	_
Sep 2021	58.50	+
Oct 2021	72.75	+
Nov 2021	137.20	+
Dec 2021	179.05	+
Jan 2022	180.90	+
Feb 2022	119.05	_
Mar 2022	97.40	_
Apr 2022	84.10	_
May 2022	67.60	_

Calculation of Brightcom Group ltd.

Total runs (r) = 4

Number of positive runs (n_1) = 8

Number of negative runs (n_2) = 5

Mean $\mu(r)$: $[2(n_1 * n_2)/n_1 + n_2] + 1$

$\qquad = [2(8*5)/8+5]+1$ $(\mu) = 7.15$

Standard deviation $\sigma(r)$: $\sqrt{[2n_1 * n_2 (2n_1 * n_2 - n_1 - n_2)/ (n_1+n_2)(n_1+n_2-1)]}$

$\qquad = \sqrt{[2*8*5 (2*8*5-8-5)/ (8+5)(8+5-1)]}$ $(\sigma) = 1.63$

Upper limit: $\mu + 1.96 *$standard deviation

$\qquad = 7.15 + 1.96 * 1.63 = 10.34$

Lower limit: $\mu + 1.96 *$standard deviation

$\qquad = 7.15 - 1.96 * 1.63 = 3.97$

Brightcom Group Closing Prices
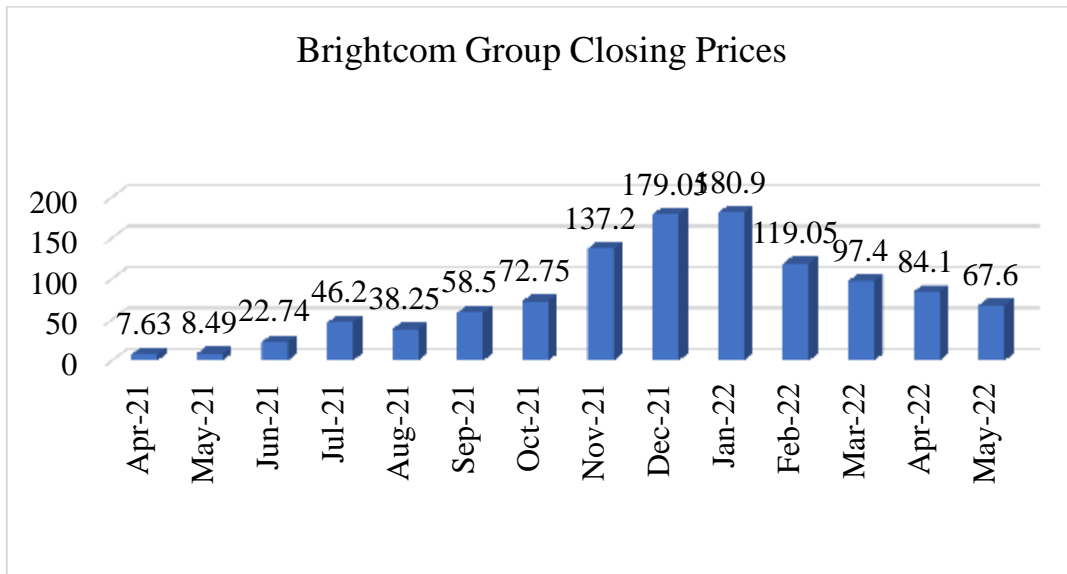
Interpretation:
From the above table, the study shows that the observed number of runs 4 falls within 10.34 and 3.97 of upper and lower limit, so there is no significant difference between observed runs lies between 'upper' and 'lower' limit. Hence 'null hypothesis' is accepted. Therefore, there is no statistical difference between upper and lower limit and observed runs of Brightcom Group Ltd. There is a statistical difference between upper and lower limit and observed runs of Brightcom Group Ltd.

D. DATA ANALYSIS ON THE CLOSING PRICE OF INDIAMART INTERMESH LTD.
Null Hypothesis (H_O): There is no statistical difference between upper and lower limit and observed runs of IndiaMart InterMesh Ltd.
Alternate Hypothesis(H_A): There is a statistical difference between upper and lower limit and observed runs of IndiaMart InterMesh Ltd.

Months	Closing prices	Price charges
Apr 2021	7,931.15	****
May 2021	7,357.75	_
Jun 2021	6,989.60	_
Jul 2021	7,144.70	+
Aug 2021	7,832.30	+
Sep 2021	8,386.10	+
Oct 2021	7,148.05	_
Nov 2021	7,419.95	+
Dec 2021	6,473.95	_
Jan 2022	4,998.10	_
Feb 2022	4,772.50	_
Mar 2022	4,323.20	_
Apr 2022	4,922.05	+
May 2022	4,544.40	_

Calculation of Indiamart Intermesh ltd.

Total runs (r) = 7

Number of positive runs (n1) = 5

Number of negative runs (n2) = 8

Mean $\mu(r)$: $[2(n_1{_*}n_2)/n_1+n_2]+1$

$\qquad = [2(5*8)/5*8]+1 \quad (\mu) = 7.15$

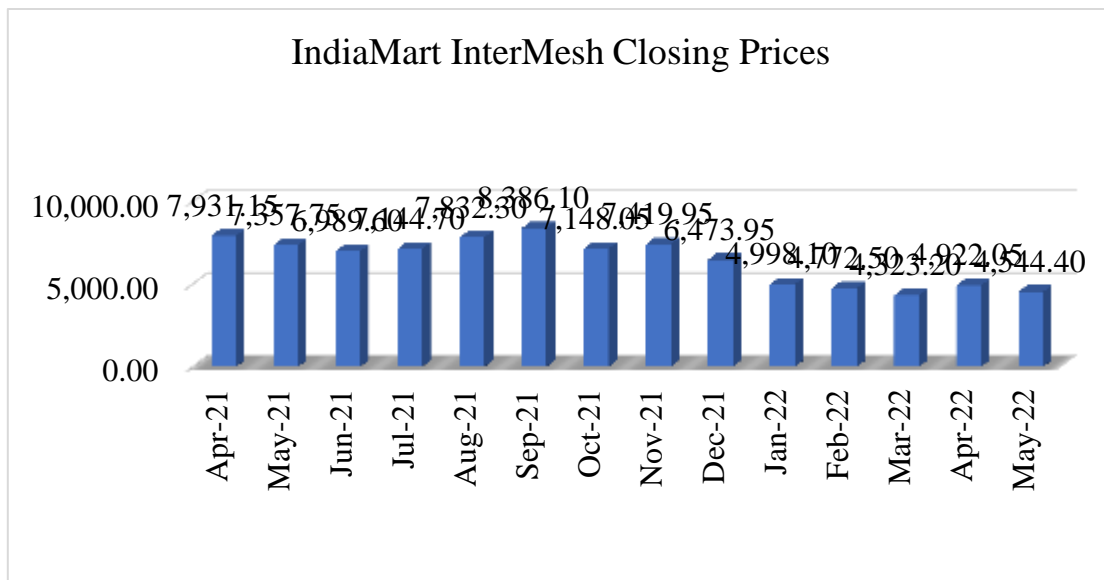Standard deviation $\sigma(r)$: $\sqrt{[2n_1*n_2(2n_1*n_2-n_1-n_2)/(n_1+n_2)(n_1+n_2-1)]}$

$\qquad = \sqrt{[2*5*8(2*5*8-5-8)/(5+8)(5+8-1)]} \quad (\sigma) = 1.63$

Upper limit: $\mu+1.96*$standard deviation

$\qquad = 7.15+1.96*1.63 = 10.34$

Lower limit: $\mu-1.96*$standard deviation

$\qquad = 7.15-1.96*1.63 = 3.97$

IndiaMart InterMesh Closing Prices

Interpretation:
From the above table, the study shows that the observed number of runs 7 falls within 10.34 and 3.97 of upper and lower limit, so there is no significant difference between observed runs lies between 'upper' and 'lower' limit. Hence 'null hypothesis' is accepted. Therefore, there is no statistical difference between upper and lower limit and observed runs of IndiaMart InterMesh Ltd. There is a statistical difference between upper and lower limit and observed runs of IndiaMart InterMesh Ltd.

E. DATA ANALYSIS ON THE CLOSING PRICE OF CYIENT LTD.

Null Hypothesis (H_O): There is no statistical difference between upper and lower limit and observed runs of Cyient Ltd.
Alternate Hypothesis(H_A): There is a statistical difference between upper and lower limit and observed runs of Cyient Ltd.

Months	Closing prices	Price changes
Apr 2021	736.05	****
May 2021	823.85	+
Jun 2021	860.60	+
Jul 2021	986.35	+
Aug 2021	977.90	_
Sep 2021	1,062.60	+
Oct 2021	1,067.60	+
Nov 2021	1,011.85	_
Dec 2021	1,023.35	+
Jan 2022	936.15	_
Feb 2022	814.90	_

Mar 2022	929.15	+
Apr 2022	884.85	_
May 2022	808.65	_

Calculation of Cyient ltd.

Total runs (r) = 8

Number of positive runs (n1) = 7

Number of negative runs (n2) = 6

Mean $\mu(r)$: $[2(n_1*n_2)/n1+n2]+1$

$\qquad = [2*(7*6)/7+6]+1$ $(\mu) = 7.46$

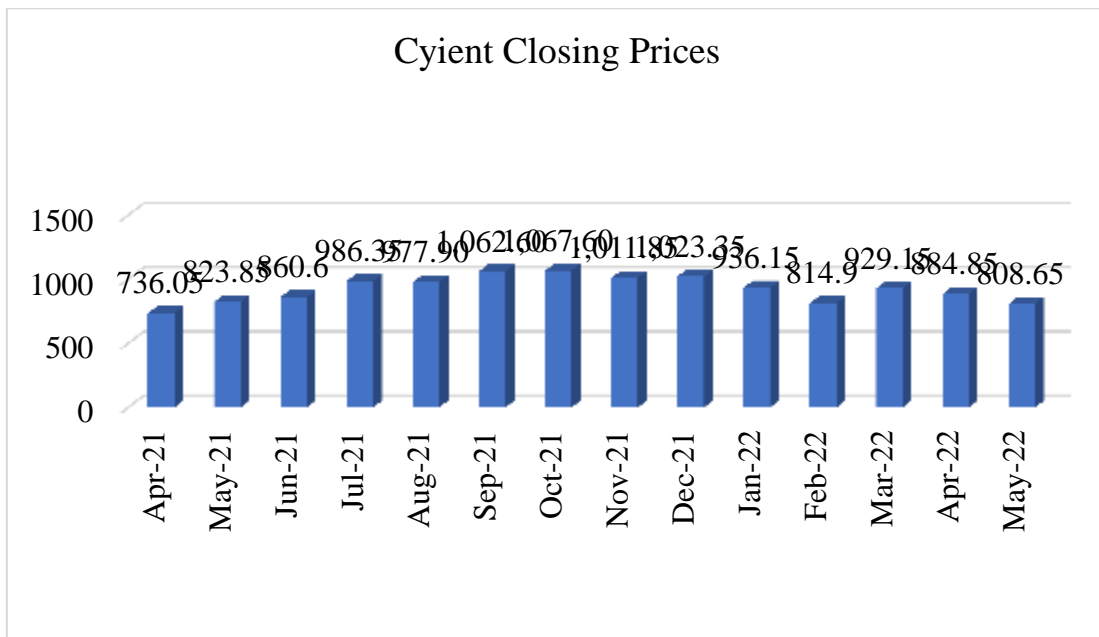Standard deviation $\sigma(r):\sqrt{[2n_1*n_2(2n_1*n_2-n_1-n_2)/(n_1+n_2)(n_1+n_2-1)]}$

$\qquad = \sqrt{[2*7*6(2*7*6-7-6)/(7+6)(7+6-1)]}$ $(\sigma) = 1.71$

Upper limit: $\mu+1.96*$standard deviation

$\qquad = 7.46+1.96*1.71 = 10.82$

Lower limit: $\mu-1.96*$standard deviation

$\qquad = 7.46-1.96*1.71 = 4.10$
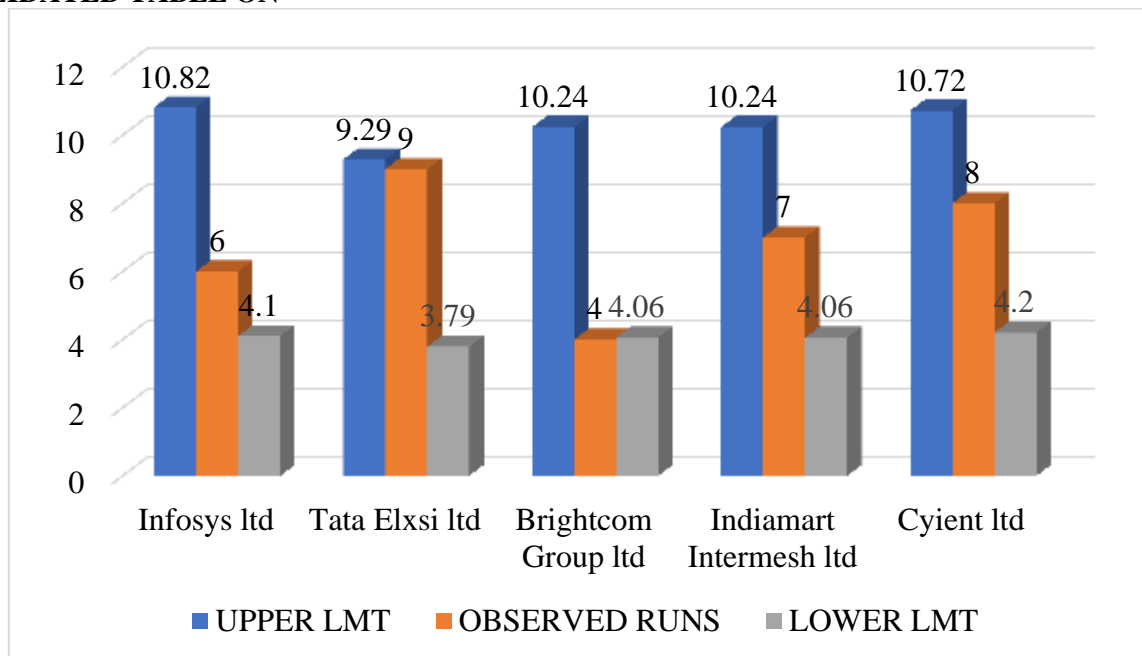

Interpretation:
From the above table, the study shows that the observed number of runs 8 falls within 10.82 and 4.10 of upper and lower limit, so there is no significant difference between observed runs lies between 'upper' and 'lower' limit. Hence 'null hypothesis' is accepted. Therefore, there is no statistical difference between upper and lower limit and observed runs of Cyient Ltd. There is a statistical difference between upper and lower limit and observed runs of Cyient Ltd.

HYPOTHESIS TESTING ON SELECTED FIVE IT STOCKS

Company name	n1	n2	μ	Standard deviation	Upper limit	Lower limit	Observed runs	Hypothesis testing at a given level of significance
Infosys ltd	7	8	7.46	1.71	10.82	4.10	6	H_0 accepted
Tata Elxsi ltd	9	4	6.54	1.45	9.29	3.79	9	H_0 accepted
Brightcom Group ltd	8	5	7.15	1.63	10.24	4.06	4	H_0 accepted
Indiamart Intermesh ltd	5	8	7.15	1.63	10.24	4.06	7	H_0 accepted
Cyient ltd	7	6	7.46	1.71	10.72	4.20	8	H_0 accepted

CONSOLIDATED TABLE ON

Interpretation:
The above chart shows the result of runs test for 06 companies, using the upper and lower limit. All the observed runs falls within upper & lower limit, Infosys Ltd has '6' runs, Tata Elxsi Ltd has '9' runs, Mindtree ltd has '6' runs , Brightcom group Ltd has '4' runs, IndiaMart InterMesh Ltd '7' runs, Oracle Financial Service Software Ltd has '5' runs, Cyient ltd has '8' observed runs, so there is no significant difference between observed runs lies between upper and lower limit. So null hypothesis is accepted.

XII. FINDINGS
- "INFOSYS LTD" has both bull and bear prices from April 2021 to May 2022, the firm has shown increased market value around 7 times between April 2021 to May 2022, therefore this stock is positive optimistic.
- "TATA ELXSI LTD" has shown high opening market price and low market prices from April 2021 to May 2022. The demand of company stock has gone up 9 times between April 2021 to May 2022 therefore this stock is positive optimistic.
- "BRIGHTCOM GROUP LTD" has both bull and bear prices from April 2021 to May 2022. The firm has shown increased market value around 8 times between April 2021 to May 2022 therefore this stock is positive optimistic.
- "INDIAMART INTERMESH LTD" has both increasing and decreasing market prices from April 2021 to May 2022. The firm has shown decreased market value around 5 times between April 2021 to May 2022 therefore this stock is negative optimistic.
- "CYIENT LTD" has both increasing and decreasing market prices from April 2021 to May 2022, the demand of company stock has gone up 7 times between April 2021 to May 2022 therefore this stock is positive optimistic.
- In this study there is no significant difference between observed runs lies between 'upper' and 'lower' limit so 'null hypothesis' is accepted.

XIII.   CONCLUSION

The present study analysed to understand the stock price movement for 1 year from April 2021 to May 2022. The study applies Runs test to verify Information Technology of BSE Index Efficient Market Hypothesis, to identify weak, semi-strong and strong efficiency position. Phases of stock performance were derived from stock market historical date shows positive and negative company price. From the study found that Tata Elxsi ltd and Cyient ltd companies stock are trustable to suggest to the investors to place their investment for future. Overall, the entire study reveals the semi-strong position of IT Stock at BSE Index.

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