

# Cluster Analysis of Indian Stock Market during the 90 Day Period after 4 June 2024 Crash

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**Abstract**— 4, June 2024 can be considered as a unique market event in the history of Indian stock markets. Prior to this event, Indian share markets were upbeat and steadily growing due to a prevailing market sentiment that a third term election win for the BJP/NDA alliance is certain. This sentiment was supported by multiple opinion polls and odds data released by illegal betting markets. However, as vote counting started on June 4, 2024 and live results started percolating, markets realized that BJP will not be in a position to cross the midway mark and obtain a simple majority to form the government. Stock markets crashed by the end of the day at 3.30 pm on Tuesday, BSE Sensex lost 4389.73 points (-5.74%) to close at 72,079.05, and Nifty 50 ended at 21,884.50, lower by 1,379.40 (-5.93%). Both NIFTY and SENSEX indices recovered very fast and within a few days regained their last traded levels of 3, June, 2024. Recovery of all the stocks is not uniform and the market event resulted in triggering a correction phase. This paper is a detailed analysis of the stock market from 4, June 2024 to 4 September 2024. Detailed cluster analysis is done and results are reported. Clustered Heat maps (Double Dendrograms) are presented along with traditional quantitative analysis. Heat Maps and Dendrograms can be considered as visual statistics/analytical tools. The objective of this research is to study clusters of shares and industry segments and the pattern of their recovery. Historically, Indian stock markets went through many such crashes. However, only high-level details are available in the literature. It is very difficult for individual retail investors to obtain stock market historical data which is older than three years. This research paper attempts to document granular details which can be used in the future. The study of outliers in the data will give insights into specific stocks/ industry sectors and their resilience. The results of the analysis presented in this paper can be used by investors and financial institutions to handle future crashes, reduce panic selling and limit their losses.

**Index Terms**—4th June-2024 India Stock market crash, Cluster Analysis, Dendrograms, Heat Maps, Hierarchical Clustering, Panic Selling, Post-crash recovery, Quantitative Analysis, Stock Market Crashes, Visual analytics, Visual statistics.

## I. INTRODUCTION

Stock Market crashes and booms are regular features of stock markets across the globe. Indian stock markets experience many booms and crashes. Important major crashes of the Indian stock market are summarized below.

- Stock Market Crash of 1865 is prior to the formation of Bombay stock exchange in the year 1875 (BSE, 2024).

Parsee and Gujarati traders manually traded in global stock prior to the formation of Bombay stock exchange. Speculation regarding prolonged American civil war resulted in irrational increase of share prices of new Indian companies. End of the American civil war led to a major crash of these shares in the year 1865 (Mampatta & Bhayani, 2015).

- Crash of 1982 was a result of aggressive short selling by the Bengal cartel of Reliance Industries shares (Groww, 2024).
- In April 1992 Indian stock markets crashed by 12.77% triggered by the Harshad Mehta scam (Jaiswal, 2024) (Kumar, 2024).
- Crash of 2004, on 17, May, 2004 stock markets fell by 15.52 % triggered by the shock defeat of Vajpai led BJP government by Sonia Gandhi led congress (CNN, 2004).
- Crashes of 2008 was triggered by the fear of US economy entering into a long recession period (Wikipedia, 2024)
- Crash of 2020-COVID 19 Pandemic triggered stock market crashes across the globe in the year 2020. Indian stock markets experienced a major crash on 28<sup>th</sup>, February, 2020 based on WHO warning of a global Pandemic situation. Free fall of the markets continued for several months. On March 9<sup>th</sup>, 2020 NIFTY fell by 538 points, March 12<sup>th</sup> and 16<sup>th</sup> recorded close to 8% fall and on 23 March 2024 SENSEX lost 3,934 points (13.15%) and NIFT lost 1,135 points (12.98%) as coronavirus related lockdowns were clamped across the globe.
- Crash of Indian stock markets on 4, June, 2024 is the topic of this research work

4, June 2024 can be considered as a unique market event in the history of Indian stock markets. Prior to this event, Indian share markets were upbeat and steadily growing due to a prevailing market sentiment that a third term election win for the BJP/NDA alliance is certain.

This sentiment was supported by multiple opinion polls and odds data released by illegal betting markets. However, as vote counting started on June 4, 2024 and live results started percolating, markets realized that BJP will not be in a position to cross the midway mark and obtain a simple majority to form the government. Stock markets crashed by the end of the day at 3.30 pm on Tuesday (June 4, 2024), BSE Sensex lost 4389.73 points (-5.74%) to close at 72,079.05, and Nifty 50 ended at 21,884.50, lower by 1,379.40 (-5.93%).

## II. LITERATURE SURVEY

Why Stock Markets Crash: Critical Events in Complex Financial Systems written by Didier Sornette (Sornette, 2017) is a fascinating book on global stock Markets and it offers deep technical insights into reasons and events before the market crash. Bulls, Bears and Other Beasts (5th Anniversary Edition): A Story of the Indian Stock Market, a book written by Santosh Nair (Nair, 2022) chronicles the major events of the Indian stock market in the last 40 years.

The following articles are reviewed for the purpose of this research work:

- How Abraham Lincoln triggered India's first stock market crash (Mampatta & Bhayani, 2015).
- History of Stock market crashes in India- Known and Unknown (Groww, 2024).
- Scam 1992- Harshad Mehta Scam (Jaiswal, 2024).
- Indian Stock Market Scam-The Complete Case Study of Harshad Mehta (Kumar, 2024).
- Investors flee Gandhi's India (CNN, 2004).
- Stock Market Crashes in India (Wikipedia, 2024).

## III. OBJECTIVES OF THE RESEARCH STUDY

As of July 24, retail investors own 10% of the Indian stock market and they contribute to about 35% of cash segment trade. This group of investors is steadily growing and may reach 25% market share in the next few years (Vyas, 2024).

Bulk of the retail investors depend on publicly available information to take their investment decisions. Mutual fund houses and other asset management companies have teams of research associates and their research is meant for their paid customers. It is very difficult to obtain historical stock price data which is more than three years old.

Retail investors have to depend on scanty data and anecdotal blogs to understand major stock exchange events which have occurred in the past. Deep understanding of past events will make them prepared to handle future stock market crashes and also be alert to irrational market bubble growths and anticipate imminent crashes. Furthermore, in any crash few companies get adversely affected, few survive and few recover soon and few never recover from the crash. These inputs can significantly alter the retail investor behavior by moderating panic selling and frenzy buying eventually safeguarding their investments.

The objective of this research is to gather, analyze and report granular level details of the stock market crash that happened on 4<sup>th</sup> June 2024 document the results for future use.

## IV. SIGNIFICANCE OF THE RESEARCH

Deep dive research and reports generated will go a long way to assist investors in the future to plan their exit/hold/buy on dips strategy during future market crashes. The granular and detailed analysis will mitigate the risk of lack of historical data beyond three years from the public domain.

## V. CLUSTER ANALYSIS OF INDIAN STOCK MARKET CRASH ON 4 JUNE 2024

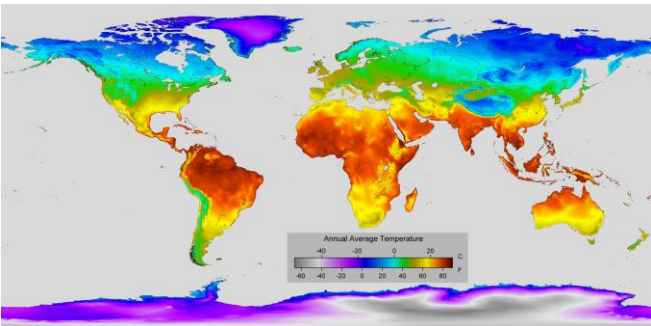
### A. Cluster Analysis

Visual Analytics is a multidisciplinary science and technology field evolved from theory of information visualization and scientific visualization. It facilitates analytical reasoning by using interactive visual software tools. Currently, many such commercial software tools are available (Wikipedia, 2024). Visual Statistics is an emerging field. It can be considered as a visual analytics method. Book titled: Visual Statistics: Seeing Data with Dynamic Interactive Graphics (Young et al., 2011), gives us an excellent insight into the topic.

Stock market investors who use technical trading as opposed to fundamental trading extensively use charts and candlestick charts. Candlestick charts were developed in the 18th century by Munehisa Homma, a Japanese rice trader and later entered into stock markets across the globe as analytical tools (Canvass, 2023). Below is *Figure 1: An example of the Candlestick chart (Wikipedia, 2024)*.



Heat Maps are a regular feature of weather reporting tools. Occasionally, stock markets use heat maps (Intraday Screener, 2024). HEAT MAPS are extensively used in weather reporting. Visually they are very easy to interpret.



The following example explains how heat maps can be generated. Each cell is colored according to the value and the color gradient is given as a legend. When data is colored as per the gradient, it becomes an effective visual analytics tool.



This paper proposes to use heat maps extensively to cluster the data related to stock market crashes.

For analysis and reporting Clustered heat map (also called double dendrogram) is extensively used in this research paper. Data is organized as variables (columns) and variable values are presented as rows.

A cell in the table represents one of the data points of the variable. Based on the values of the cell, a color gradient is created. Individual cells are displayed as colored rectangles. The color of the cell is proportional to its value on the graded color gradient. The order of the rows is determined by performing hierarchical cluster analyses of the rows. This tends to position similar rows together on the plot. The order of the columns is determined similarly.

The following table has scores of 5 student's scores in five subjects:

STUDENT	SUBJECT 1	SUBJECT 2	SUBJECT 3	SUBJECT 4	SUBJECT 5
1	40	40	50	60	60
2	50	60	60	70	70
3	60	70	60	50	50
4	40	50	45	60	70
5	40	70	60	40	40

Heat map analysis is performed using statistical tool NCSS (NCSS, 2024)

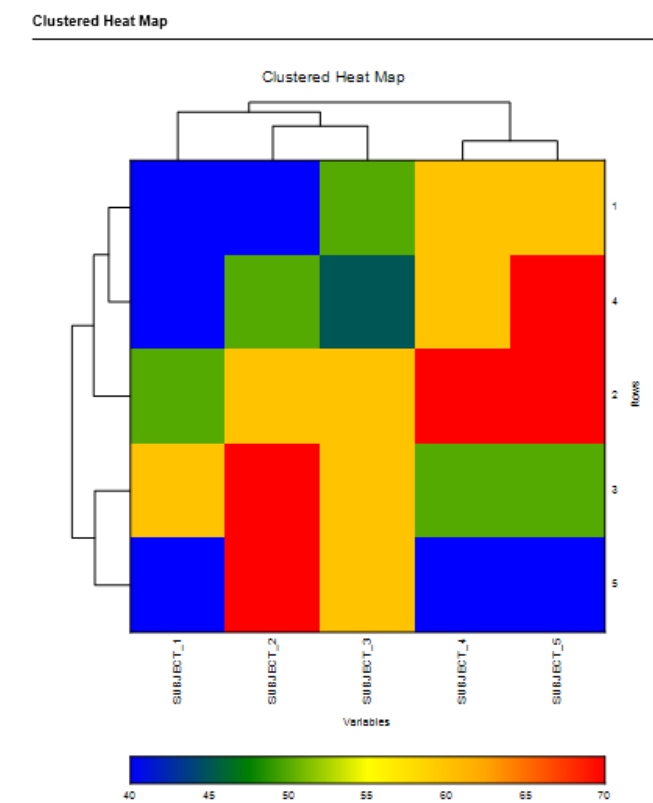


Figure 2: Heat map derived from NCSS software (NCSS, 2024)

Color gradient is given at the bottom of the image for the scores range from 40-70. Students are represented in rows and subjects as variable columns.

Algorithm classifies variables as the following clusters

Cluster	Variables in this Cluster
1	SUBJECT_4, SUBJECT_5
2	SUBJECT_2, SUBJECT_3
None	SUBJECT_1

Students with similar marks are as indicated in the rows are clubbed together. The following references give us more details about dendrogram :

- What is Dendrogram (Bock, 2024)
- Hierarchical clustering explained by Prasad Pai (Pai, 2021).

**B. Data Preparation for the analysis**

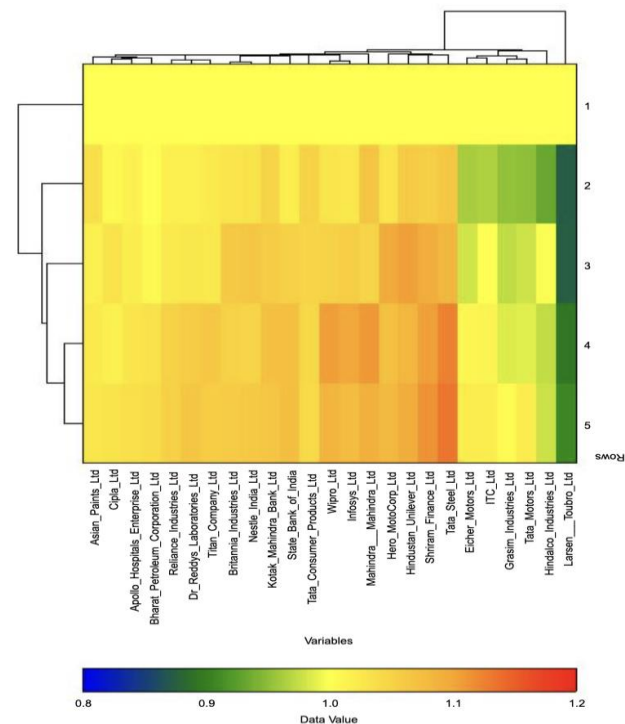
The following steps were followed to :

- Categorize the companies first into small manageable groups like NIFTY 50, NIFTY Next 50, NIFTY BANK etc.
- Obtain historic closing price date from 3, June, 2024 (day before the crash) till 3, September 2024 the target period chosen for this research
- Divide the closing stock of each day's closing stock price with the closing stock price of the respective stock on 3, June,2024. This will lead to a base value of 1 for every stock on 3, June, 2024. On subsequent days, a value of 0.9 will indicate a 10% fall and a value of 1.1 will indicate 10% increase in the stock value.
- This approach will give us a quick technique on whether stocks have fallen/rose from the pre-crash day.

**VI. NIFTY COMPANIES ANALYSIS**

**A. NIFTY 50 company analysis from 3/June/2024 to 3/September/2024**

**NIFTY50- First Set of 25 companies first few days after the crash**



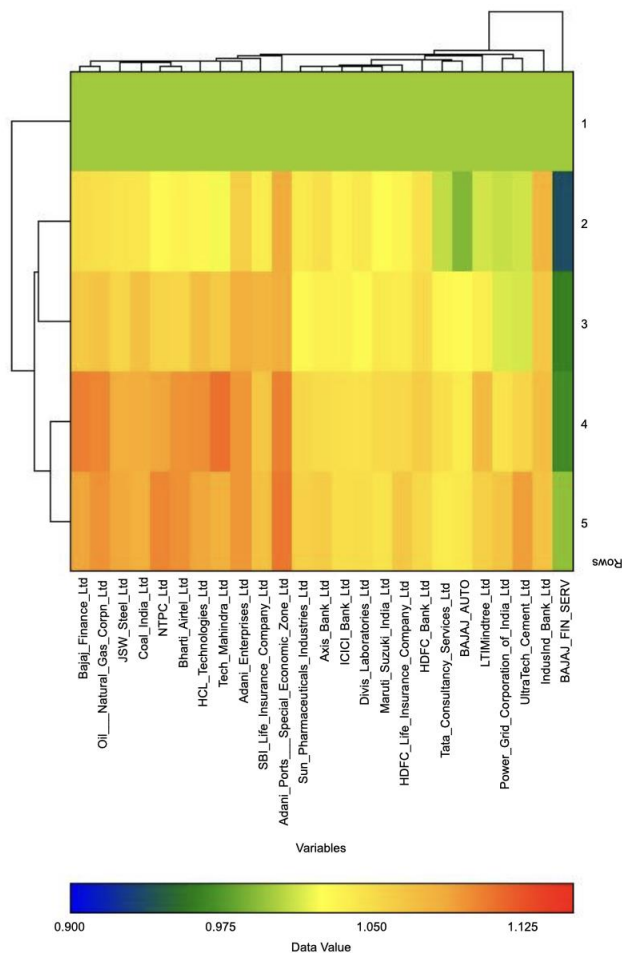
**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

### Cluster Variables in this Cluster

- 
- |      |   |
|------|---|
| 1    | Asian_Paints_Ltd, Britannia_Industries_Ltd, Cipla_Ltd, Nestle_India_Ltd, Hero_MotoCorp_Ltd<br>Hindustan_Unilever_Ltd, Mahindra___Mahindra_Ltd, Reliance_Industries_Ltd, Tata_Consumer_Products_Ltd<br>Tata_Steel_Ltd, Wipro_Ltd, Apollo_Hospitals_Enterprise_Ltd, Dr_Reddys_Laboratories_Ltd<br>Titan_Company_Ltd, State_Bank_of_India, Shriram_Finance_Ltd, Bharat_Petroleum_Corporation_Ltd<br>Kotak_Mahindra_Bank_Ltd, Infosys_Ltd |
| 2    | Eicher_Motors_Ltd, Grasim_Industries_Ltd, Hindalco_Industries_Ltd, ITC_Ltd, Tata_Motors_Ltd   |
| None | Larsen___Toubro_Ltd   |
- 

### NIFTY50- Second Set of 25 companies



### Cluster Detail Report when Clustering Variables

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Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

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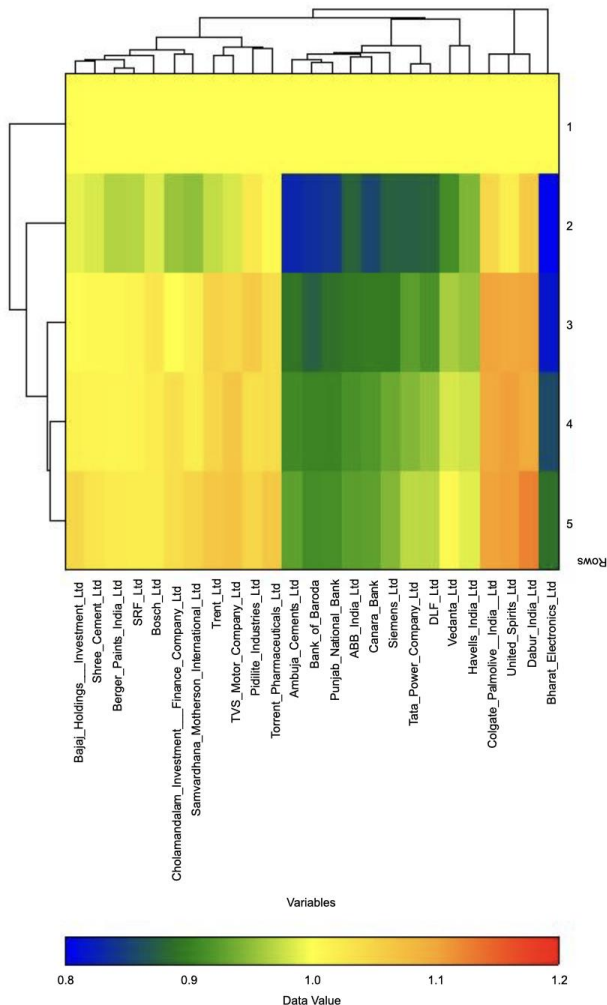
### Cluster Variables in this Cluster

- 
- |   |   |
|---|---|
| 1 | Bajaj_Finance_Ltd, Adani_Enterprises_Ltd, Sun_Pharmaceuticals_Industries_Ltd, JSW_Steel_Ltd<br>HDFC_Bank_Ltd, Tata_Consultancy_Services_Ltd, ICICI_Bank_Ltd, Power_Grid_Corporation_of_India_Ltd<br>Maruti_Suzuki_India_Ltd, Axis_Bank_Ltd, HCL_Technologies_Ltd, Oil___Natural_Gas_Corpn_Ltd |
|---|---|
-

NTPC\_Ltd, Coal\_India\_Ltd, Bharti\_Airtel\_Ltd, Tech\_Mahindra\_Ltd, LTIMindtree\_Ltd,  
Divis\_Laboratories\_Ltd  
Adani\_Ports\_\_\_Special\_Economic\_Zone\_Ltd, HDFC\_Life\_Insurance\_Company\_Ltd,  
SBI\_Life\_Insurance\_Company\_Ltd  
UltraTech\_Cement\_Ltd, BAJAJ\_AUTO  
None IndusInd\_Bank\_Ltd, BAJAJ\_FIN\_SERV

### B. NIFTY NEXT 50 company analysis from 3/June/2024 to 3/September/2024

#### NIFTY NEXT 50 company analysis from 3/June/2024 to 3/September/2024



#### Cluster Detail Report when Clustering Variables

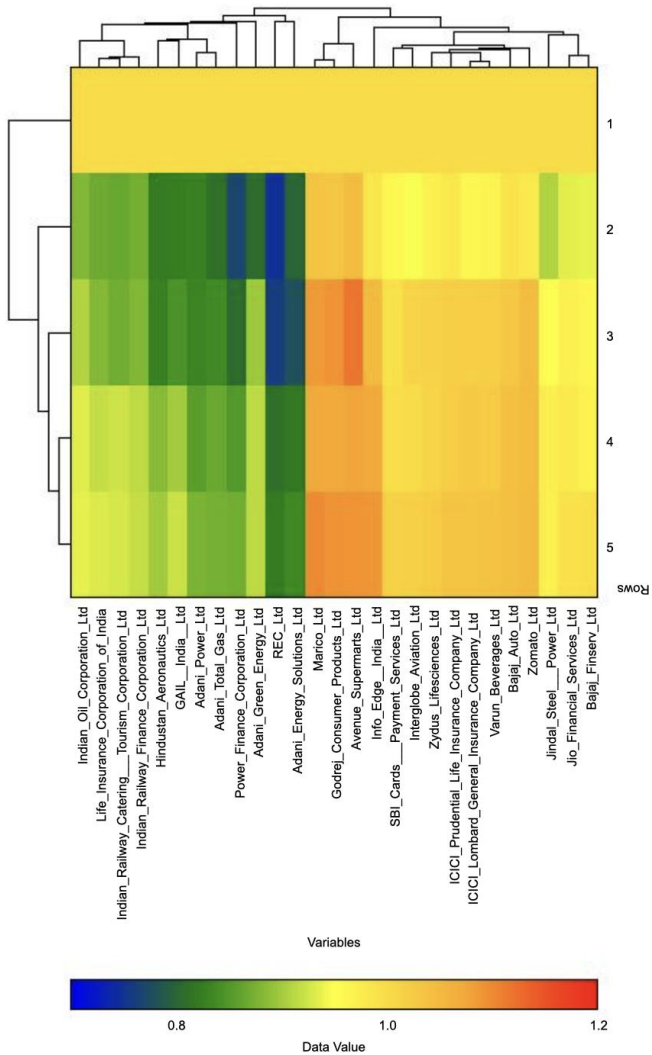
Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

#### Cluster Variables in this Cluster

1 Bajaj\_Holdings\_\_\_Investment\_Ltd, Berger\_Paints\_India\_Ltd, Ambuja\_Cements\_Ltd, ABB\_India\_Ltd  
Trent\_Ltd, Bosch\_Ltd, Vedanta\_Ltd, Shree\_Cement\_Ltd, SRF\_Ltd, Siemens\_Ltd, Tata\_Power\_Company\_Ltd  
Cholamandalam\_Investment\_\_\_Finance\_Company\_Ltd, Samvardhana\_Motherson\_International\_Ltd  
Pidilite\_Industries\_Ltd, Havelis\_India\_Ltd, Torrent\_Pharmaceuticals\_Ltd, Bank\_of\_Baroda

Canara\_Bank, DLF\_Ltd, Punjab\_National\_Bank, TVS\_Motor\_Company\_Ltd  
2 Colgate\_Palmolive\_\_India\_\_Ltd, Dabur\_India\_Ltd, United\_Spirits\_Ltd  
None Bharat\_Electronics\_Ltd

NIFTY Next 50- Second Set of 25 companies first few days after the crash



Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

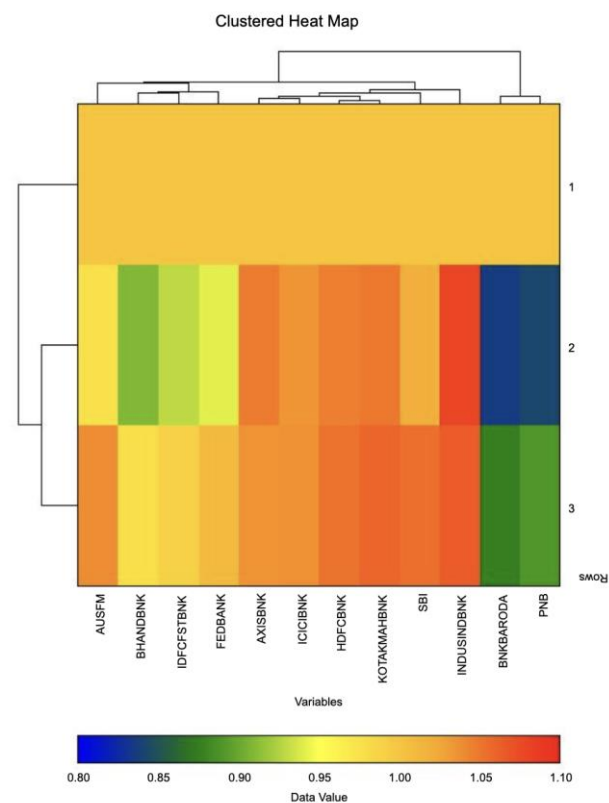
Cluster Variables in this Cluster

- 1 Indian\_Oil\_Corporation\_Ltd, Life\_Insurance\_Corporation\_of\_India, Hindustan\_Aeronautics\_Ltd  
Power\_Finance\_Corporation\_Ltd, GAIL\_\_India\_\_Ltd, Indian\_Railway\_Finance\_Corporation\_Ltd  
Adani\_Power\_Ltd, Indian\_Railway\_Catering\_\_Tourism\_Corporation\_Ltd, Adani\_Total\_Gas\_Ltd  
Adani\_Green\_Energy\_Ltd
- 2 Marico\_Ltd, Info\_Edge\_\_India\_\_Ltd, SBI\_Cards\_\_Payment\_Services\_Ltd, Jindal\_Steel\_\_Power\_Ltd  
Jio\_Financial\_Services\_Ltd, Zydus\_Lifesciences\_Ltd, Godrej\_Consumer\_Products\_Ltd,  
ICICI\_Prudential\_Life\_Insurance\_Company\_Ltd



ICICI\_Lombard\_General\_Insurance\_Company\_Ltd, Varun\_Beverages\_Ltd, Bajaj\_Auto\_Ltd,  
Bajaj\_Finserv\_Ltd  
Interglobe\_Aviation\_Ltd, Avenue\_Supermarts\_Ltd, Zomato\_Ltd  
3 REC\_Ltd, Adani\_Energy\_Solutions\_Ltd

C. NIFTY BANK company analysis few days from 3/June/2024



Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

1 AUSFM, BHANDBNK, FEDBNK, IDFCSTBNK  
2 AXISBNK, HDFCBNK, ICICIBNK, INDUSINDBNK, KOTAKMAHBNK, SBI  
3 BNKBARODA, PNB

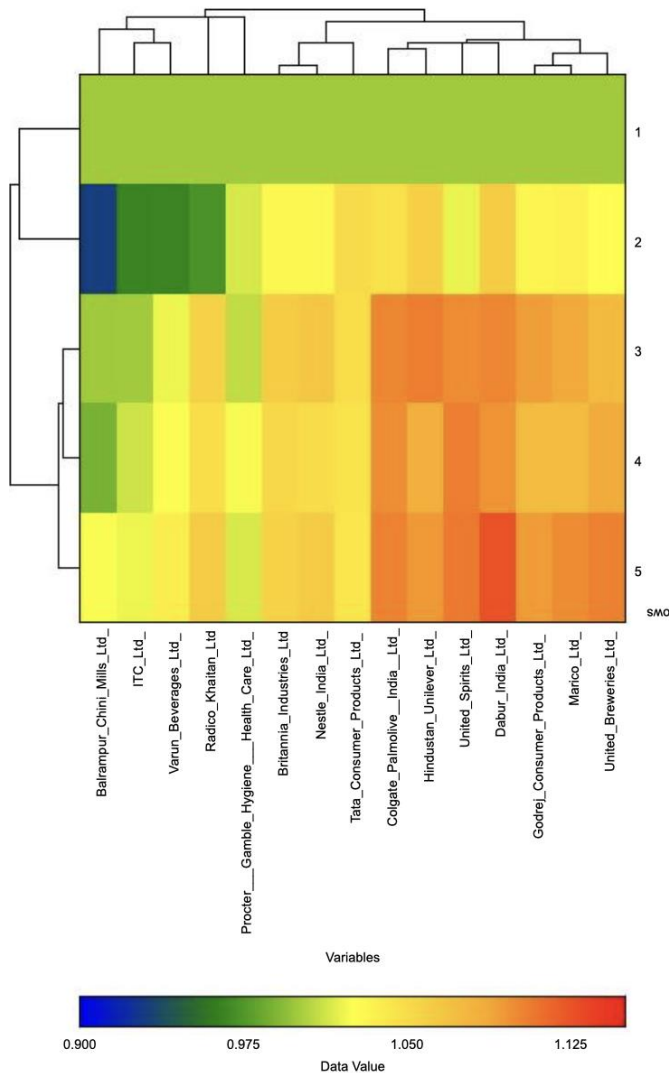
D. NIFTY FMCG company analysis few days from 3/June/2024

Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1 Balrampur\_Chini\_Mills\_Ltd\_, ITC\_Ltd\_, Procter\_\_Gamble\_Hygiene\_\_Health\_Care\_Ltd\_  
Radico\_Khaitan\_Ltd, Varun\_Beverages\_Ltd\_  
2 Britannia\_Industries\_Ltd, Colgate\_Palmolive\_\_India\_\_Ltd\_, Dabur\_India\_Ltd\_,  
Godrej\_Consumer\_Products\_Ltd\_  
Hindustan\_Unilever\_Ltd\_, Marico\_Ltd\_, Nestle\_India\_Ltd\_, Tata\_Consumer\_Products\_Ltd\_  
United\_Breweries\_Ltd\_, United\_Spirits\_Ltd\_



### E. NIFTY AUTO company analysis few days from 3/June/2024

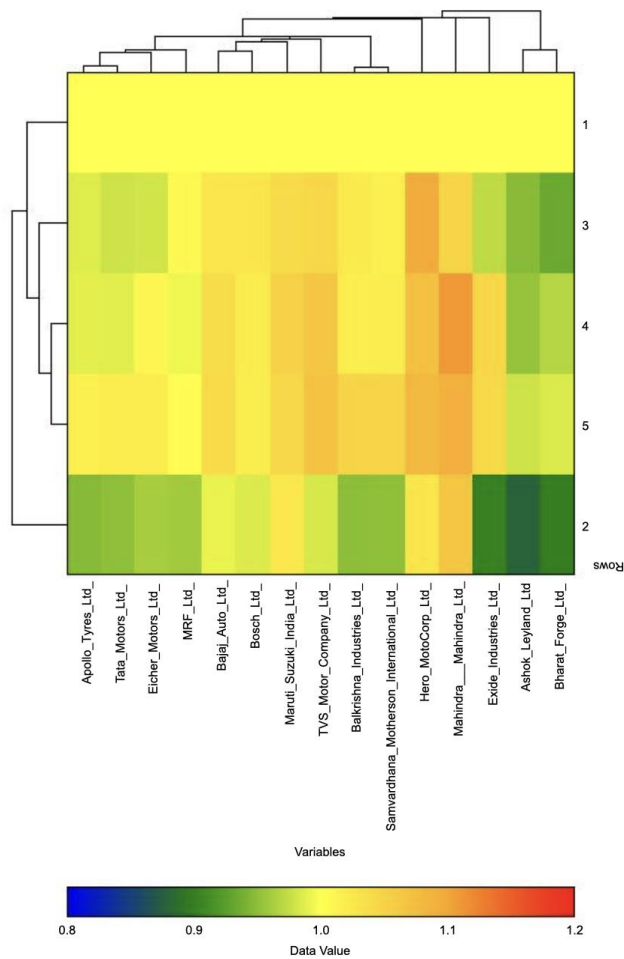
### Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

### Cluster Variables in this Cluster

- 1 Apollo\_Tyres\_Ltd\_, Bajaj\_Auto\_Ltd\_, Balkrishna\_Industries\_Ltd\_, Bosch\_Ltd\_, Eicher\_Motors\_Ltd\_  
Exide\_Industries\_Ltd\_, Hero\_MotoCorp\_Ltd\_, MRF\_Ltd\_, Mahindra\_\_\_Mahindra\_Ltd\_,  
Maruti\_Suzuki\_India\_Ltd\_

Samvardhana\_Motherson\_International\_Ltd\_, TVS\_Motor\_Company\_Ltd\_, Tata\_Motors\_Ltd\_  
2 Ashok\_Leyland\_Ltd, Bharat\_Forge\_Ltd\_



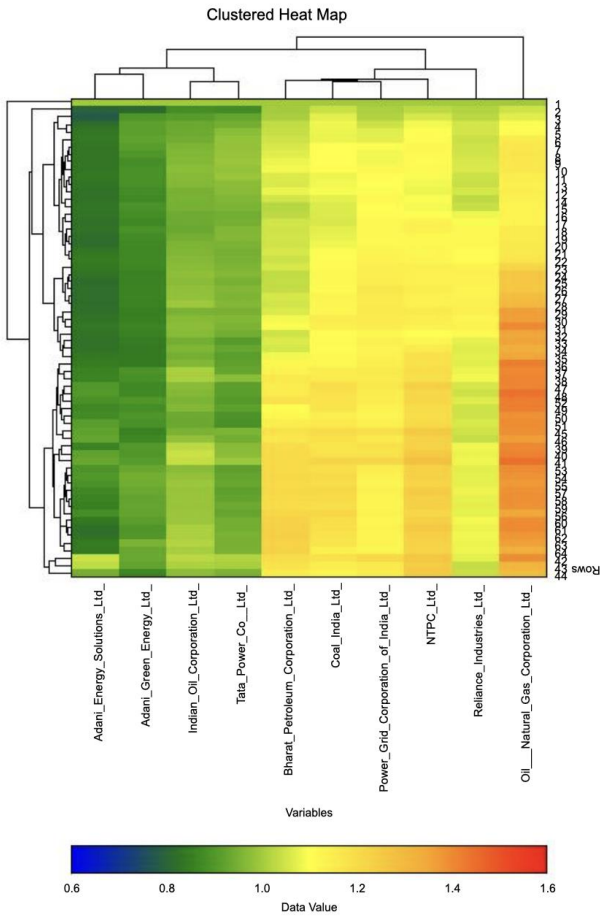
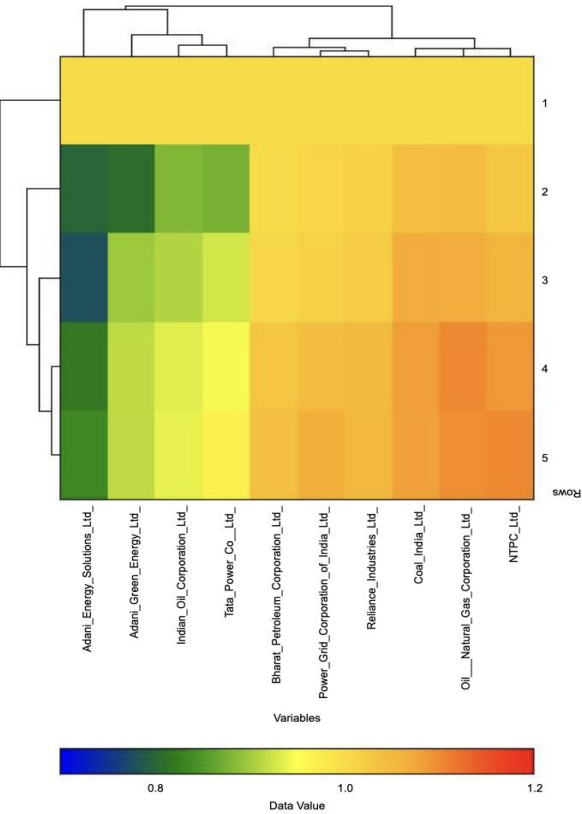
**F. NIFTY ENERGY company analysis first few days from 3/June/2024 and detailed cluster till 3/September/2024**

**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

- 1 Bharat\_Petroleum\_Corporation\_Ltd\_, Coal\_India\_Ltd\_, NTPC\_Ltd\_, Oil\_\_\_Natural\_Gas\_Corporation\_Ltd\_ Power\_Grid\_Corporation\_of\_India\_Ltd\_, Reliance\_Industries\_Ltd\_
- 2 Adani\_Green\_Energy\_Ltd\_, Indian\_Oil\_Corporation\_Ltd\_, Tata\_Power\_Co\_\_Ltd\_
- None Adani\_Energy\_Solutions\_Ltd\_



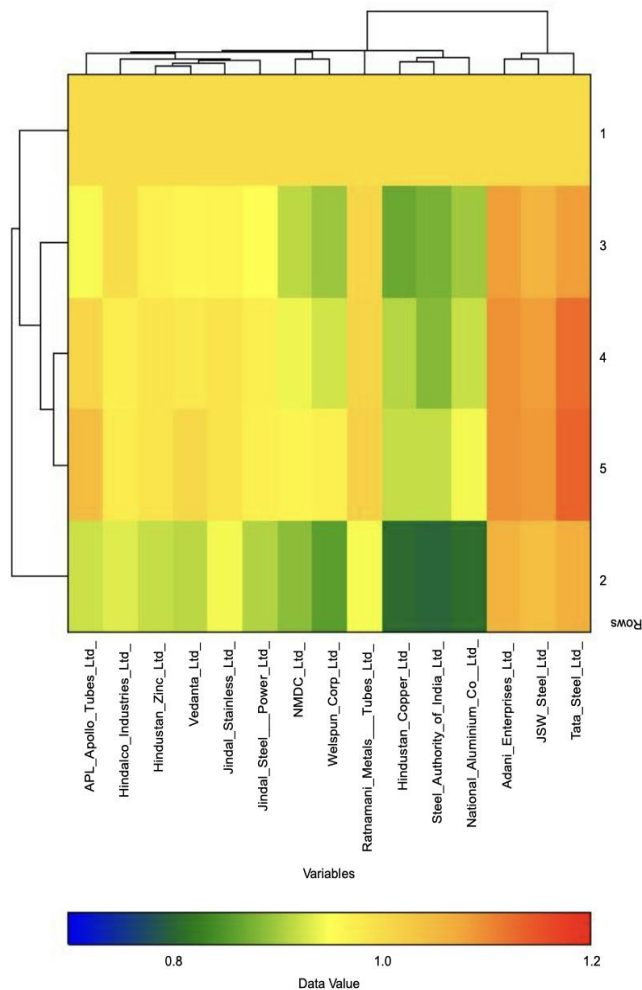
Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1Adani\_Energy\_Solutions\_Ltd\_, Adani\_Green\_Energy\_Ltd\_, Indian\_Oil\_Corporation\_Ltd\_  
Tata\_Power\_Co\_Ltd\_
- 2Bharat\_Petroleum\_Corporation\_Ltd\_, Coal\_India\_Ltd\_, NTPC\_Ltd\_, Power\_Grid\_Corporation\_of\_India\_Ltd\_  
Reliance\_Industries\_Ltd\_
- NoneOil\_\_Natural\_Gas\_Corporation\_Ltd\_

G. NIFTY METAL company analysis few days from 3/June/2024 and detailed cluster till 3, September 24

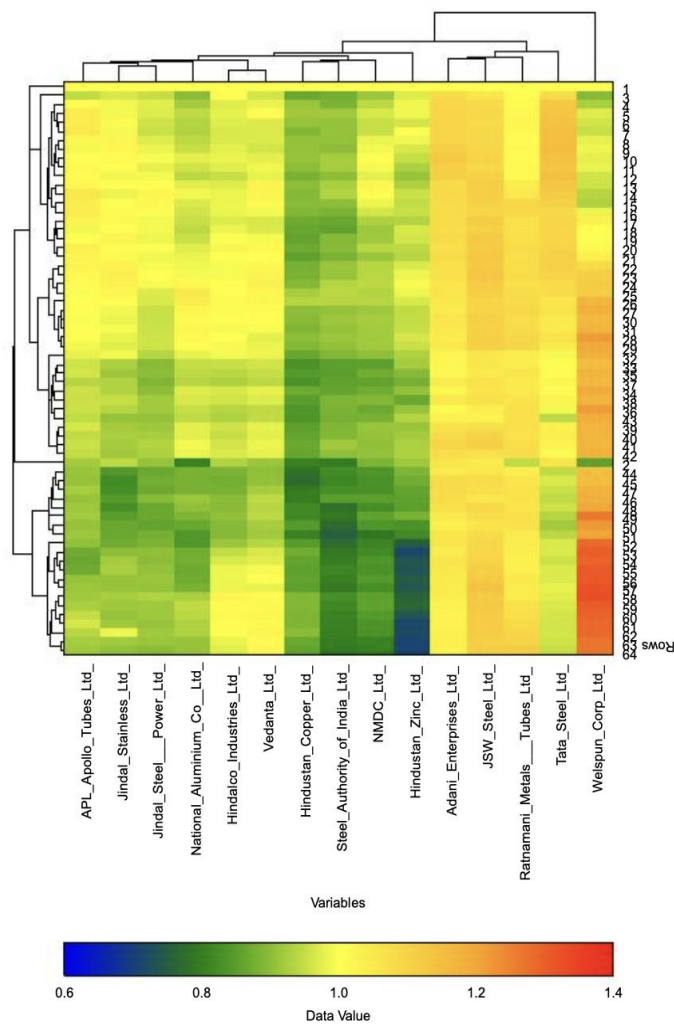


Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1
- APL\_Apollo\_Tubes\_Ltd\_, Hindalco\_Industries\_Ltd\_, Hindustan\_Copper\_Ltd\_, Hindustan\_Zinc\_Ltd\_  
Jindal\_Stainless\_Ltd\_, Jindal\_Steel\_Power\_Ltd\_, NMDC\_Ltd\_, National\_Aluminium\_Co\_Ltd\_  
Ratnamani\_Metals\_Tubes\_Ltd\_, Steel\_Authority\_of\_India\_Ltd\_, Vedanta\_Ltd\_, Welspun\_Corp\_Ltd\_
- 2
- Adani\_Enterprises\_Ltd\_, JSW\_Steel\_Ltd\_, Tata\_Steel\_Ltd\_



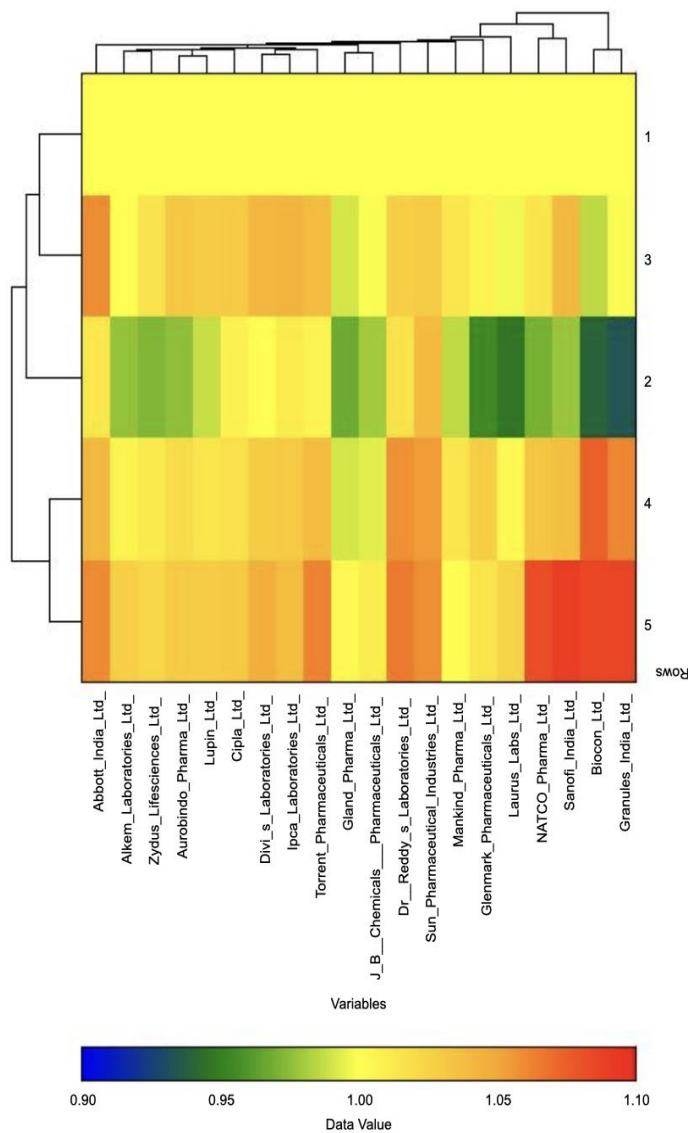
Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1
- APL\_Apollo\_Tubes\_Ltd\_, Hindalco\_Industries\_Ltd\_, Hindustan\_Copper\_Ltd\_, Hindustan\_Zinc\_Ltd\_  
Jindal\_Stainless\_Ltd\_, Jindal\_Steel\_Power\_Ltd\_, NMDC\_Ltd\_, National\_Aluminium\_Co\_Ltd\_  
Steel\_Authority\_of\_India\_Ltd\_, Vedanta\_Ltd\_
- 2
- Adani\_Enterprises\_Ltd\_, JSW\_Steel\_Ltd\_, Ratnamani\_Metals\_Tubes\_Ltd\_, Tata\_Steel\_Ltd\_
- None
- Welspun\_Corp\_Ltd\_

H. NIFTY PHARMA company analysis few days from 3/June/2024 and detailed clusters till 3, September 24

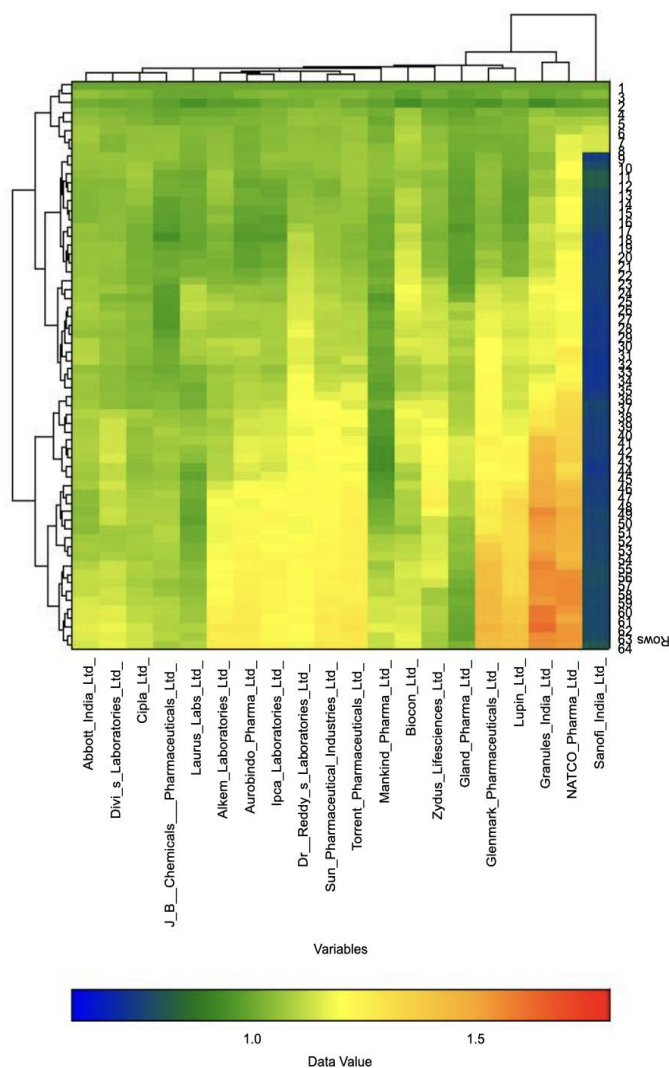


Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

1	Abbott_India_Ltd_,	Alkem_Laboratories_Ltd_,	Aurobindo_Pharma_Ltd_,	Cipla_Ltd_,
	Divi_s_Laboratories_Ltd_			
	Dr_Reddy_s_Laboratories_Ltd_,	Gland_Pharma_Ltd_,	Glenmark_Pharmaceuticals_Ltd_,	
	Ipca_Laboratories_Ltd_			
	J_B_Chemicals_Pharmaceuticals_Ltd_,	Laurus_Labs_Ltd_,	Lupin_Ltd_,	Mankind_Pharma_Ltd_
	Sun_Pharmaceutical_Industries_Ltd_,	Torrent_Pharmaceuticals_Ltd_,	Zydus_Lifesciences_Ltd_	
2	Biocon_Ltd_,	Granules_India_Ltd_		
3	NATCO_Pharma_Ltd_,	Sanofi_India_Ltd_		



Cluster Detail Report when Clustering Variables

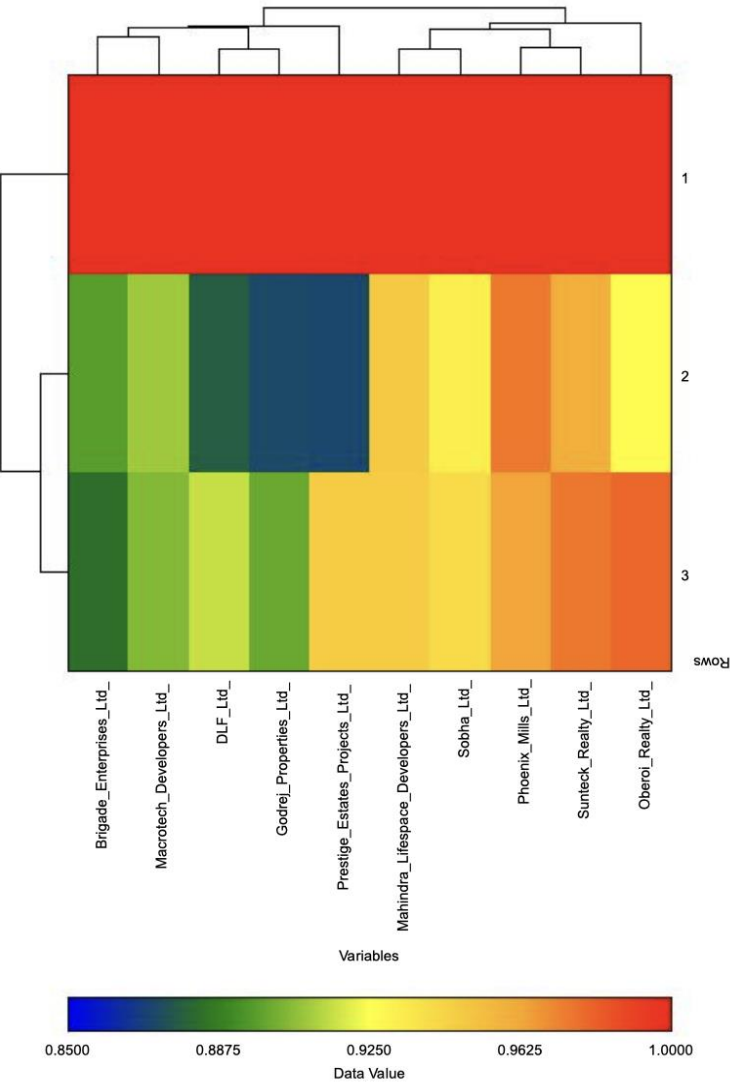
Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1 Abbott\_India\_Ltd\_, Alkem\_Laboratories\_Ltd\_, Aurobindo\_Pharma\_Ltd\_, Biocon\_Ltd\_, Cipla\_Ltd\_  
Divi\_s\_Laboratories\_Ltd\_, Dr\_Reddy\_s\_Laboratories\_Ltd\_, Gland\_Pharma\_Ltd\_,  
Glenmark\_Pharmaceuticals\_Ltd\_  
Ipca\_Laboratories\_Ltd\_, J\_B\_Chemicals\_\_Pharmaceuticals\_Ltd\_, Laurus\_Labs\_Ltd\_, Lupin\_Ltd\_  
Mankind\_Pharma\_Ltd\_, Sun\_Pharmaceutical\_Industries\_Ltd\_, Torrent\_Pharmaceuticals\_Ltd\_  
Zydus\_Lifesciences\_Ltd\_
- 2 Granules\_India\_Ltd\_, NATCO\_Pharma\_Ltd\_
- None Sanofi\_India\_Ltd\_



I. NIFTY REALTY company analysis few days from 3/June/2024 and detailed cluster till 3, September 24

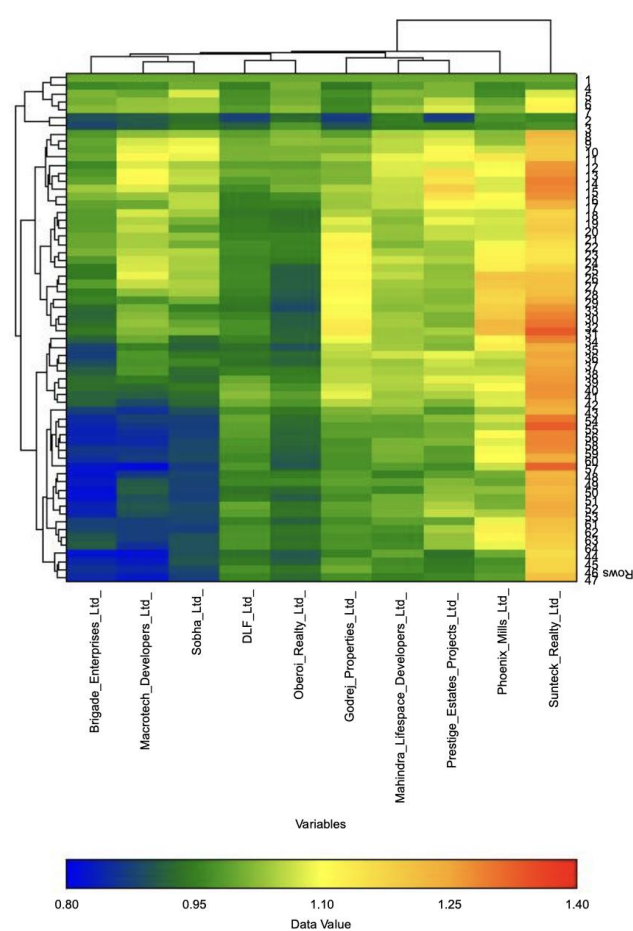


Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1 Brigade\_Enterprises\_Ltd\_, DLF\_Ltd\_, Godrej\_Properties\_Ltd\_, Macrotech\_Developers\_Ltd\_
- 2 Prestige\_Estates\_Projects\_Ltd\_
- 3 Mahindra\_Lifespace\_Developers\_Ltd\_, Phoenix\_Mills\_Ltd\_, Sobha\_Ltd\_, Sunteck\_Realty\_Ltd\_
- None Oberoi\_Realty\_Ltd\_



**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

- 1 Brigade\_Enterprises\_Ltd\_, DLF\_Ltd\_, Godrej\_Properties\_Ltd\_, Macrotech\_Developers\_Ltd\_, Mahindra\_Lifespace\_Developers\_Ltd\_, Oberoi\_Realty\_Ltd\_, Prestige\_Estates\_Projects\_Ltd\_, Sobha\_Ltd\_
- None Phoenix\_Mills\_Ltd\_, Sunteck\_Realty\_Ltd\_

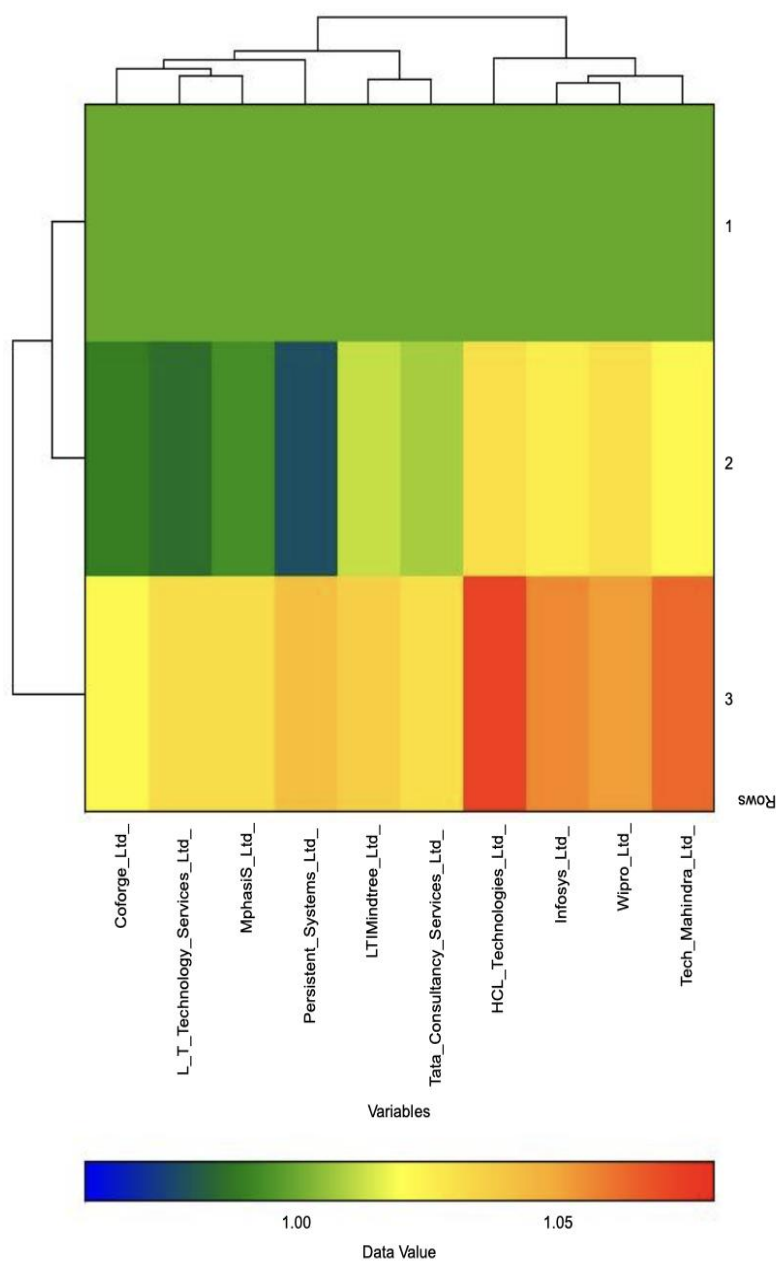
**J. NIFTY IT company analysis few days from 3/June/2024 and detailed cluster till 3, September 24**

**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

- 1 Coforge\_Ltd\_, L\_T\_Technology\_Services\_Ltd\_, MphasiS\_Ltd\_, Persistent\_Systems\_Ltd\_
- 2 HCL\_Technologies\_Ltd\_, Infosys\_Ltd\_, Tech\_Mahindra\_Ltd\_, Wipro\_Ltd\_
- 3 LTIMindtree\_Ltd\_, Tata\_Consultancy\_Services\_Ltd\_

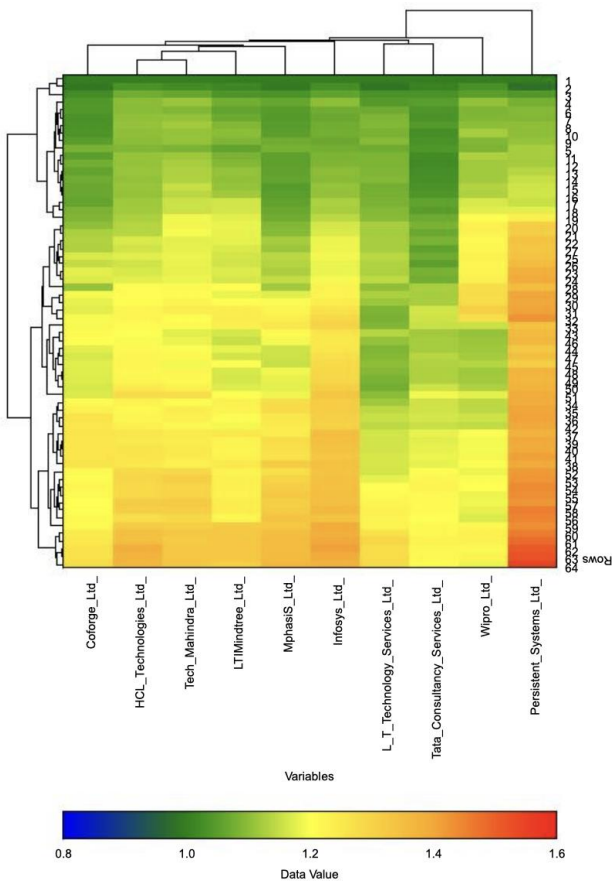


**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

1 Coforge\_Ltd\_, HCL\_Technologies\_Ltd\_, Infosys\_Ltd\_, L\_T\_Technology\_Services\_Ltd\_, LTIMindtree\_Ltd\_, MphasiS\_Ltd\_, Tata\_Consultancy\_Services\_Ltd\_, Tech\_Mahindra\_Ltd\_  
None Persistent\_Systems\_Ltd\_, Wipro\_Ltd\_



**K. NIFTY MID CAP 100 company analysis few days from 3/June/2024**

The heat map for NIFTY MID CAP 100 has been divided into four sectors, each constituting 25 companies.

- NIFTY MIDCAP F25
- NIFTY MIDCAP S25
- NIFTY MIDCAP T25
- NIFTY MIDCAP Four25

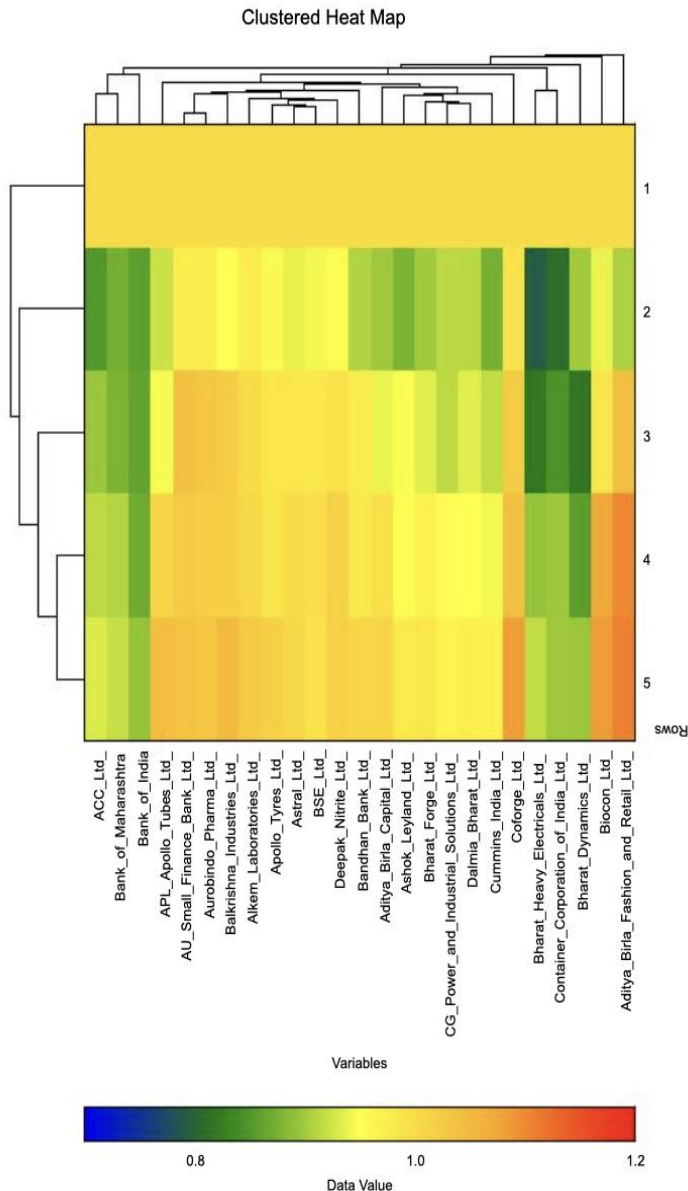
**L. NIFTY MID CAP 100: First set of 25 Companies (NIFTY MIDCAP F25)**

**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

- 1 ACC\_Ltd\_, APL\_Apollo\_Tubes\_Ltd\_, AU\_Small\_Finance\_Bank\_Ltd\_, Aditya\_Birla\_Capital\_Ltd\_,  
Alkem\_Laboratories\_Ltd\_, Apollo\_Tyres\_Ltd\_, Ashok\_Leyland\_Ltd\_, Astral\_Ltd\_, Aurobindo\_Pharma\_Ltd\_,  
BSE\_Ltd\_, Balkrishna\_Industries\_Ltd\_, Bandhan\_Bank\_Ltd\_, Bank\_of\_India, Bank\_of\_Maharashtra,  
Bharat\_Dynamics\_Ltd\_, Bharat\_Forge\_Ltd\_, Bharat\_Heavy\_Electricals\_Ltd\_,  
CG\_Power\_and\_Industrial\_Solutions\_Ltd\_,  
Coforge\_Ltd\_, Container\_Corporation\_of\_India\_Ltd\_, Cummins\_India\_Ltd\_, Dalmia\_Bharat\_Ltd\_,  
Deepak\_Nitrite\_Ltd\_,  
None Aditya\_Birla\_Fashion\_and\_Retail\_Ltd\_, Biocon\_Ltd\_



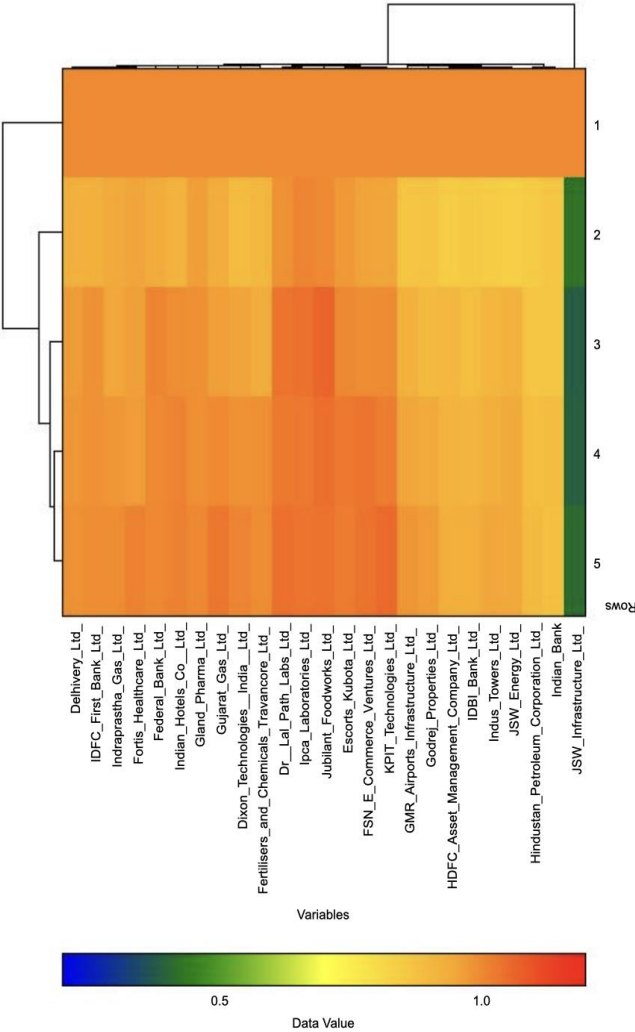
### M. NIFTY MID CAP 100: Second set of 25 Companies (NIFTY MIDCAP S25)

#### Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

#### Cluster Variables in this Cluster

- 1 Delhivery\_Ltd\_, Dixon\_Technologies\_India\_Ltd\_, Dr\_Lal\_Path\_Labs\_Ltd\_, Escorts\_Kubota\_Ltd\_  
FSN\_E\_Commerce\_Ventures\_Ltd\_, Federal\_Bank\_Ltd\_, Fertilisers\_and\_Chemicals\_Travancore\_Ltd\_  
Fortis\_Healthcare\_Ltd\_, Gland\_Pharma\_Ltd\_, Gujarat\_Gas\_Ltd\_, IDFC\_First\_Bank\_Ltd\_  
Indian\_Hotels\_Co\_\_Ltd\_, Indraprastha\_Gas\_Ltd\_, Ipca\_Laboratories\_Ltd\_, Jubilant\_Foodworks\_Ltd\_  
KPIT\_Technologies\_Ltd\_
- 2 GMR\_Airports\_Infrastructure\_Ltd\_, Godrej\_Properties\_Ltd\_, HDFC\_Asset\_Management\_Company\_Ltd\_  
Hindustan\_Petroleum\_Corporation\_Ltd\_, IDBI\_Bank\_Ltd\_, Indian\_Bank, Indus\_Towers\_Ltd\_  
JSW\_Energy\_Ltd\_
- None JSW\_Infrastructure\_Ltd\_



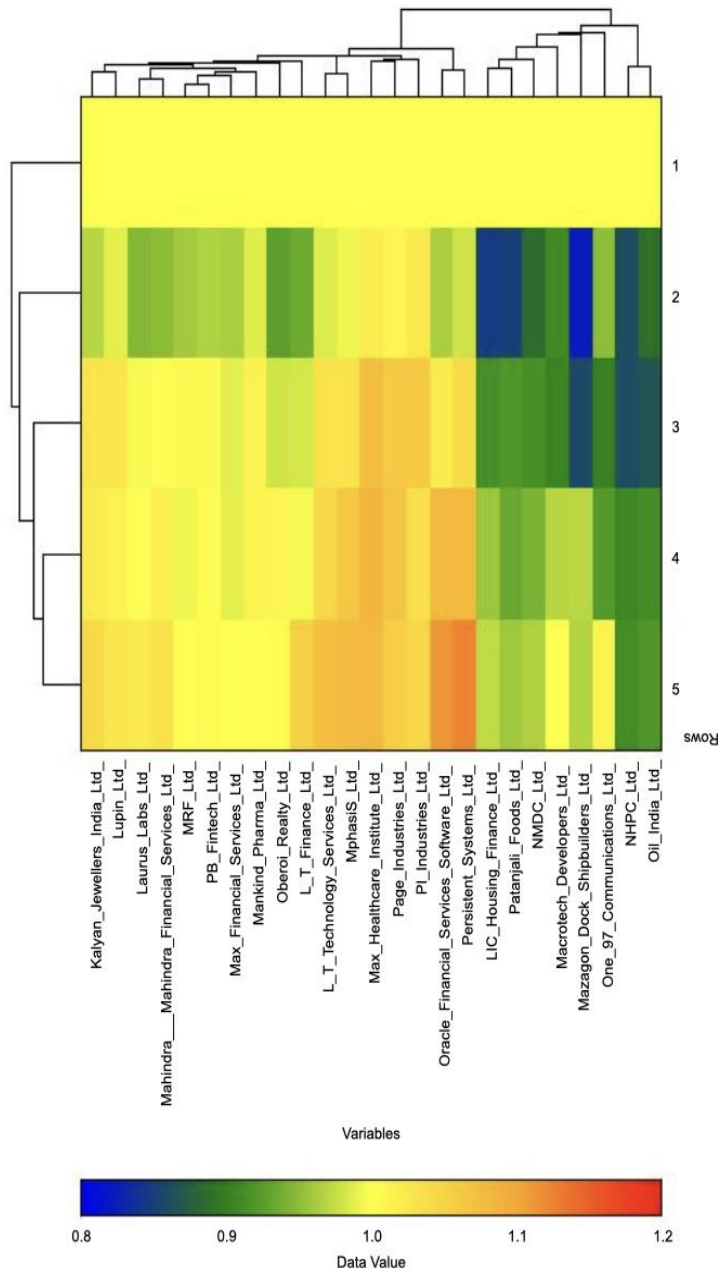
N. NIFTY MID CAP 100: Third set of 25 Companies (NIFTY MIDCAP T25)

Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1 Kalyan\_Jewellers\_India\_Ltd\_, L\_T\_Finance\_Ltd\_, L\_T\_Technology\_Services\_Ltd\_, Laurus\_Labs\_Ltd\_, Lupin\_Ltd\_, MRF\_Ltd\_, Mahindra\_\_Mahindra\_Financial\_Services\_Ltd\_, Mankind\_Pharma\_Ltd\_, Max\_Financial\_Services\_Ltd\_, Max\_Healthcare\_Institute\_Ltd\_, MphasiS\_Ltd\_, Oberoi\_Realty\_Ltd\_, Oracle\_Financial\_Services\_Software\_Ltd\_, PB\_Fintech\_Ltd\_, PI\_Industries\_Ltd\_, Page\_Industries\_Ltd\_, Persistent\_Systems\_Ltd\_
- 2 LIC\_Housing\_Finance\_Ltd\_, Macrotech\_Developers\_Ltd\_, Mazagon\_Dock\_Shipbuilders\_Ltd\_, NMDC\_Ltd\_, One\_97\_Communications\_Ltd\_, Patanjali\_Foods\_Ltd\_
- 3 NHPC\_Ltd\_, Oil\_India\_Ltd\_



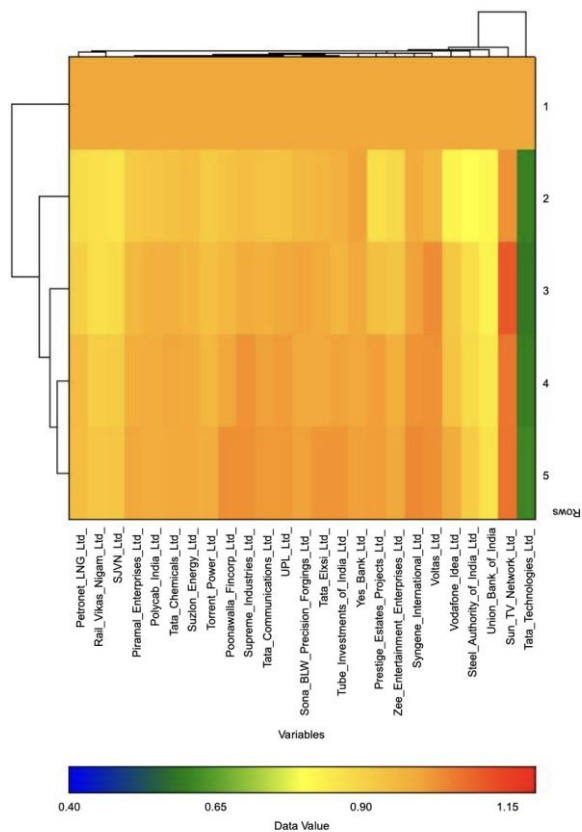
### O. NIFTY MID CAP 100: Fourth set of 25 Companies (NIFTY MIDCAP Four25)

#### Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

#### Cluster Variables in this Cluster

- 1 Petronet\_LNG\_Ltd\_, Piramal\_Enterprises\_Ltd\_, Polycab\_India\_Ltd\_, Poonawalla\_Fincorp\_Ltd\_, Prestige\_Estates\_Projects\_Ltd\_, Rail\_Vikas\_Nigam\_Ltd\_, SJVN\_Ltd\_, Sona\_BLW\_Precision\_Forgings\_Ltd\_, Steel\_Authority\_of\_India\_Ltd\_, Supreme\_Industries\_Ltd\_, Suzlon\_Energy\_Ltd\_, Syngene\_International\_Ltd\_, Tata\_Chemicals\_Ltd\_, Tata\_Communications\_Ltd\_, Tata\_Elxi\_Ltd\_, Torrent\_Power\_Ltd\_, Tube\_Investments\_of\_India\_Ltd\_, UPL\_Ltd\_, Union\_Bank\_of\_India, Vodafone\_Idea\_Ltd\_, Voltas\_Ltd\_, Yes\_Bank\_Ltd\_, Zee\_Entertainment\_Enterprises\_Ltd\_
- None Sun\_TV\_Network\_Ltd\_, Tata\_Technologies\_Ltd\_



**P. NIFTY SMALLCAP 100 company analysis few days from 3/June/ 2024**

The heat map for NIFTY SMALLCAP 100 has been divided into four sectors, each constituting 25 companies.

- NIFTY SMALLCAP F25
- NIFTY SMALLCAP S25
- NIFTY SMALLCAP T25
- NIFTY SMALLCAP Four25

**Q. NIFTY SMALLCAP 100: First set of 25 Companies (NIFTY SMALLCAP F25)**

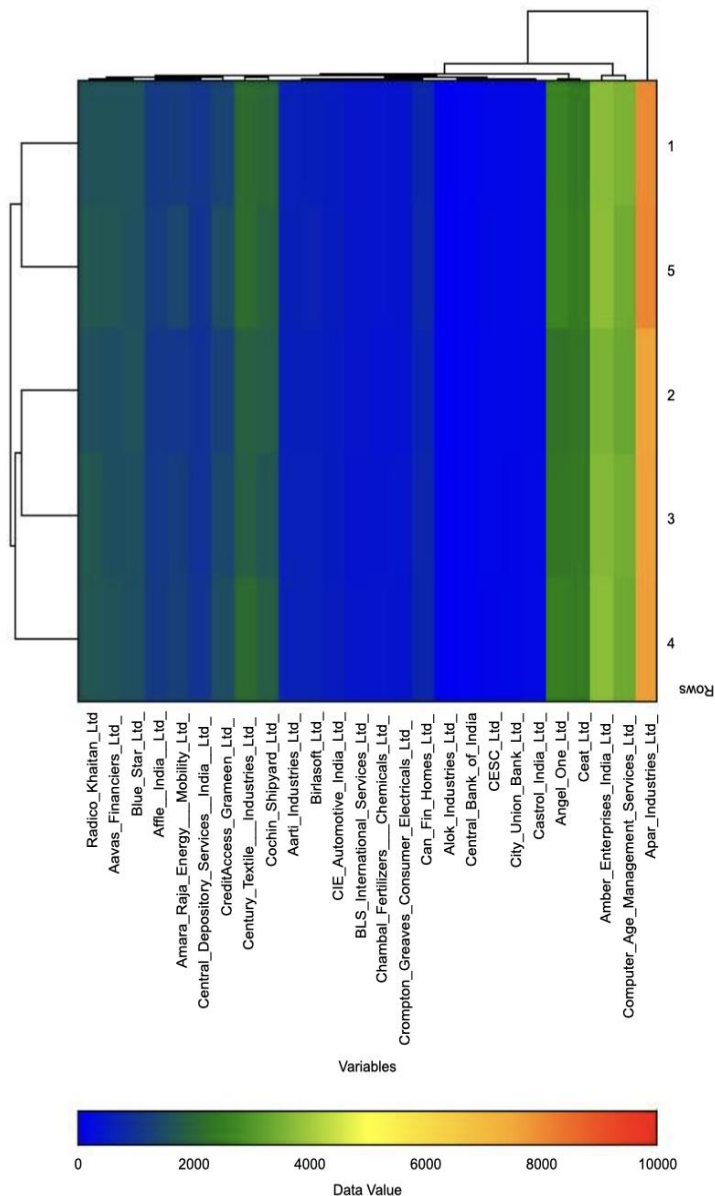
**Cluster Detail Report when Clustering Variables**

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

**Cluster Variables in this Cluster**

1	Radico_Khaitan_Ltd, Aarti_Industries_Ltd_, Aavas_Financiers_Ltd_, Affle__India__Ltd_ Alok_Industries_Ltd_, Amara_Raja_Energy__Mobility_Ltd_, Angel_One_Ltd_, BLS_International_Services_Ltd_ Birlasoft_Ltd_, Blue_Star_Ltd_, CESC_Ltd_, CIE_Automotive_India_Ltd_, Can_Fin_Homes_Ltd_ Castrol_India_Ltd_, Ceat_Ltd_, Central_Bank_of_India, Central_Depository_Services__India__Ltd_ Century_Textile__Industries_Ltd_, Chambal_Fertilizers__Chemicals_Ltd_, City_Union_Bank_Ltd_ Cochin_Shipyard_Ltd_, CreditAccess_Grameen_Ltd_, Crompton_Greaves_Consumer_Electricals_Ltd_
2	Amber_Enterprises_India_Ltd_, Computer_Age_Management_Services_Ltd_
None	Apar_Industries_Ltd_





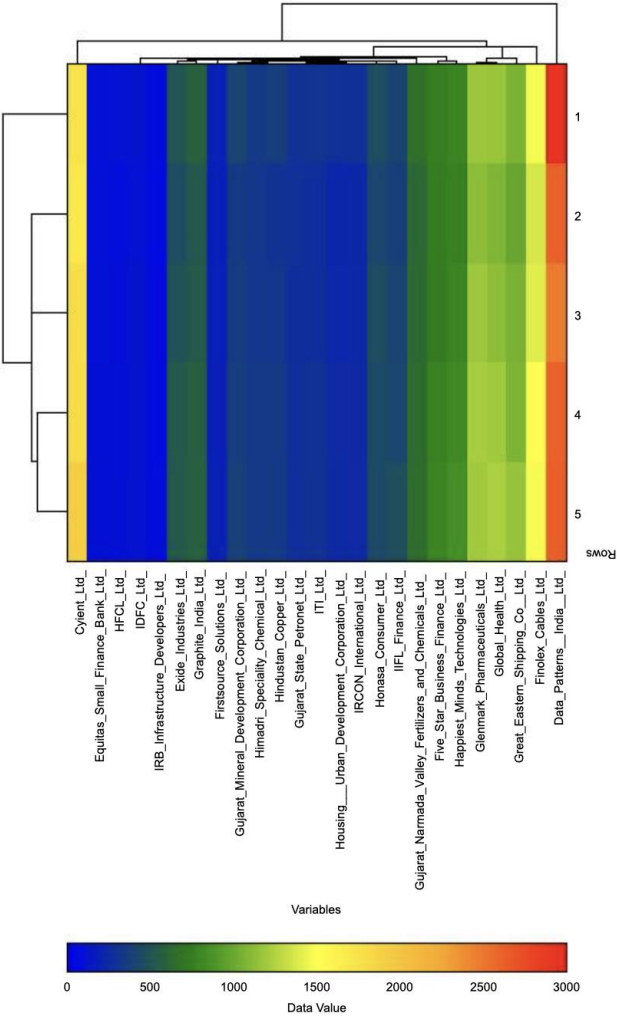
## R. NIFTY SMALLCAP 100: Second set of 25 Companies (NIFTY SMALLCAP S25)

### Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

### Cluster Variables in this Cluster

1 Equitas\_Small\_Finance\_Bank\_Ltd\_, Exide\_Industries\_Ltd\_, Finolex\_Cables\_Ltd\_, Firstsource\_Solutions\_Ltd\_  
Five\_Star\_Business\_Finance\_Ltd\_, Glenmark\_Pharmaceuticals\_Ltd\_, Global\_Health\_Ltd\_  
Graphite\_India\_Ltd\_, Great\_Eastern\_Shipping\_Co\_Ltd\_, Gujarat\_Mineral\_Development\_Corporation\_Ltd\_  
Gujarat\_Narmada\_Valley\_Fertilizers\_and\_Chemicals\_Ltd\_, Gujarat\_State\_Petronet\_Ltd\_  
HFCL\_Ltd\_, Happiest\_Minds\_Technologies\_Ltd\_, Himadri\_Speciality\_Chemical\_Ltd\_,  
Hindustan\_Copper\_Ltd\_  
Honasa\_Consumer\_Ltd\_, Housing\_Urban\_Development\_Corporation\_Ltd\_, IDFC\_Ltd\_, IIFL\_Finance\_Ltd\_  
IRB\_Infrastructure\_Developers\_Ltd\_, IRCON\_International\_Ltd\_, ITI\_Ltd\_  
None Cyient\_Ltd\_, Data\_Patterns\_India\_Ltd\_



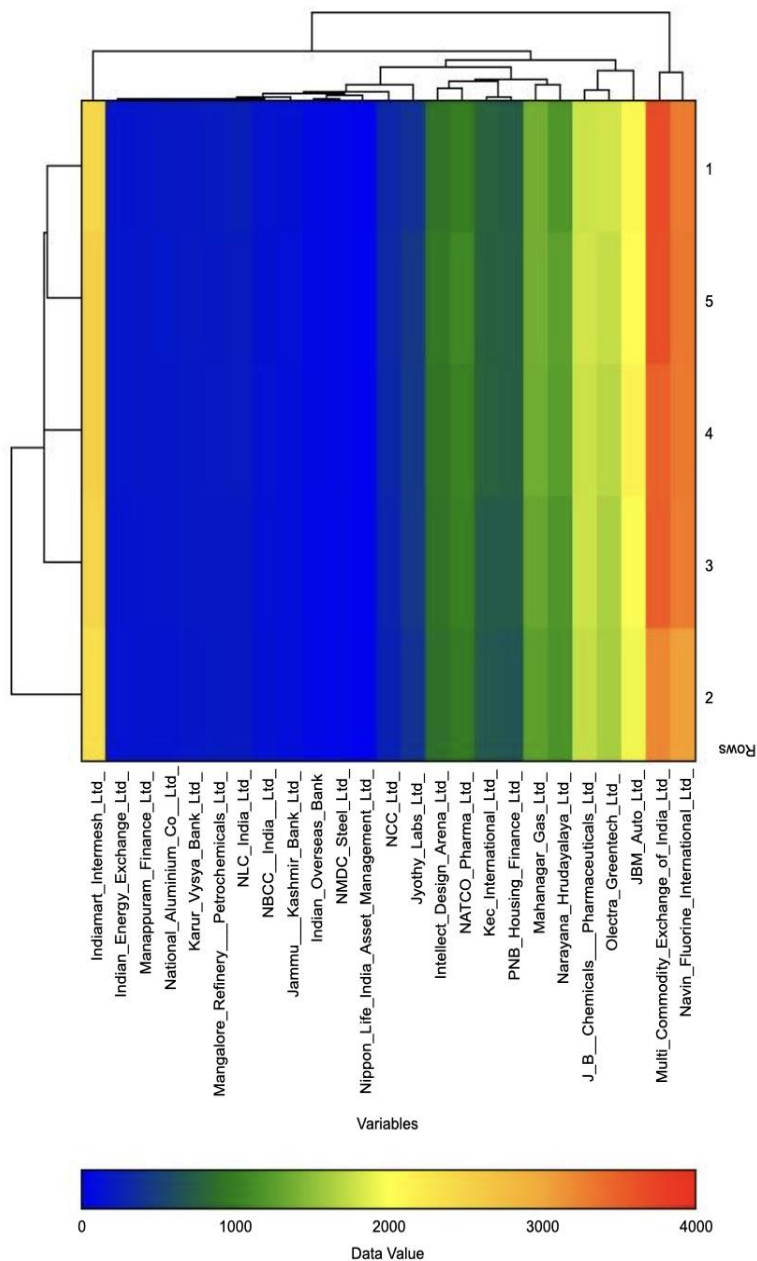
S. NIFTY SMALLCAP 100: Third set of 25 Companies (NIFTY SMALLCAP T25)

Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

Cluster Variables in this Cluster

- 1 Multi\_Commodity\_Exchange\_of\_India\_Ltd\_, Navin\_Fluorine\_International\_Ltd\_
- 2 Indian\_Energy\_Exchange\_Ltd\_, Indian\_Overseas\_Bank, Intellect\_Design\_Arena\_Ltd\_, J\_B\_Chemicals\_\_Pharmaceuticals\_Ltd\_
- JBM\_Auto\_Ltd\_, Jammu\_\_Kashmir\_Bank\_Ltd\_, Jyothy\_Labs\_Ltd\_, Karur\_Vysya\_Bank\_Ltd\_
- Kec\_International\_Ltd\_, Mahanagar\_Gas\_Ltd\_, Manappuram\_Finance\_Ltd\_, Mangalore\_Refinery\_\_Petrochemicals\_Ltd\_
- NATCO\_Pharma\_Ltd\_, NBCC\_\_India\_Ltd\_, NCC\_Ltd\_, NLC\_India\_Ltd\_, NMDC\_Steel\_Ltd\_, Narayana\_Hrudayalaya\_Ltd\_
- National\_Aluminium\_Co\_\_Ltd\_, Nippon\_Life\_India\_Asset\_Management\_Ltd\_, Olectra\_Greentech\_Ltd\_
- PNB\_Housing\_Finance\_Ltd\_
- None Indiamart\_Intermesh\_Ltd\_



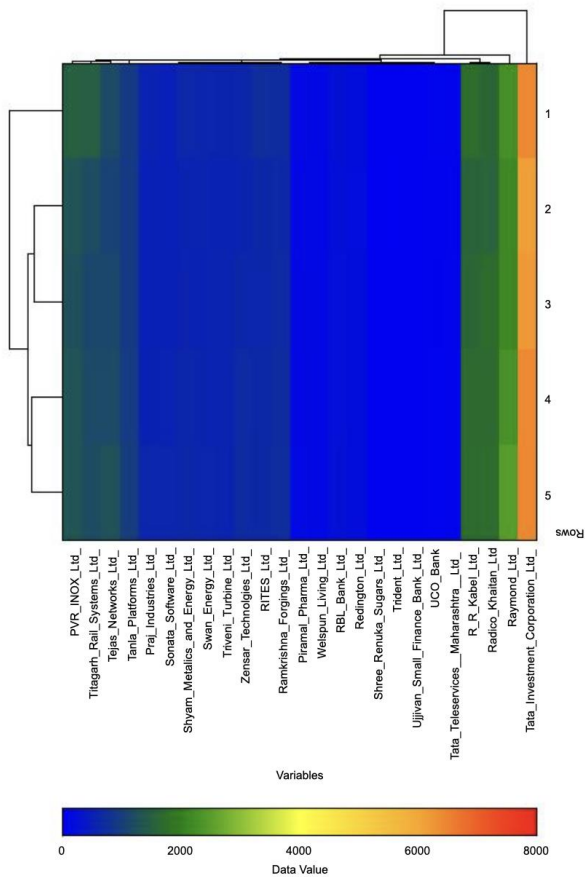
## T. NIFTY SMALLCAP 100: Fourth set of 25 Companies (NIFTY SMALLCAP Four25)

### Cluster Detail Report when Clustering Variables

Clustering Method: Single Linkage (Nearest Neighbor)  
Distance Type: Euclidean  
Scale Type: None

### Cluster Variables in this Cluster

1 PVR\_INOX\_Ltd\_, Piramal\_Pharma\_Ltd\_, Praj\_Industries\_Ltd\_, R\_R\_Kabel\_Ltd\_, RBL\_Bank\_Ltd\_  
RITES\_Ltd\_, Radico\_Khaitan\_Ltd, Ramkrishna\_Forgings\_Ltd\_, Redington\_Ltd\_, Shree\_Renuka\_Sugars\_Ltd\_  
Shyam\_Metalics\_and\_Energy\_Ltd\_, Sonata\_Software\_Ltd\_, Swan\_Energy\_Ltd\_, Tanla\_Platforms\_Ltd\_  
Tata\_Teleservices\_Maharashtra\_Ltd\_, Tejas\_Networks\_Ltd\_, Titagarh\_Rail\_Systems\_Ltd\_  
Trident\_Ltd\_, Triveni\_Turbine\_Ltd\_, UCO\_Bank, Ujjivan\_Small\_Finance\_Bank\_Ltd\_, Welspun\_Living\_Ltd\_  
Zensar\_Technolgies\_Ltd\_  
None Raymond\_Ltd\_, Tata\_Investment\_Corporation\_Ltd\_

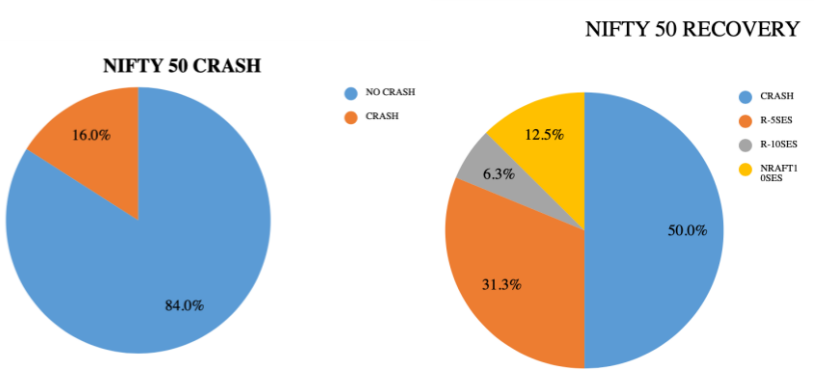


VII. CRASH RECOVERY ANALYSIS

The following data shows the analysis of Crash and recovery of companies from 3/June/2024 to 3/September/2024.

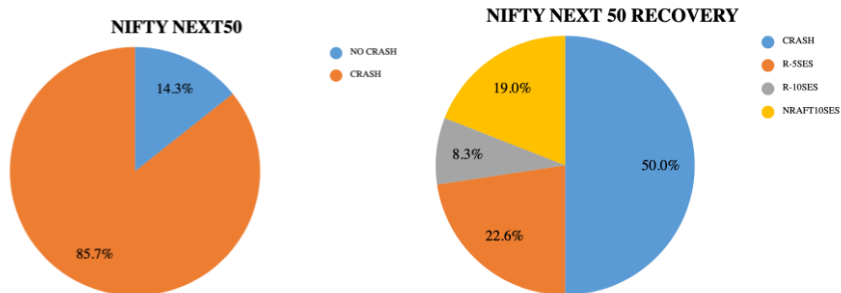
A. Nifty 50 Crash recovery

	No. of Companies
NO CRASH	42
CRASH	8
R-5 SES	5
R-10 SES	1
NRAFT10SES	2



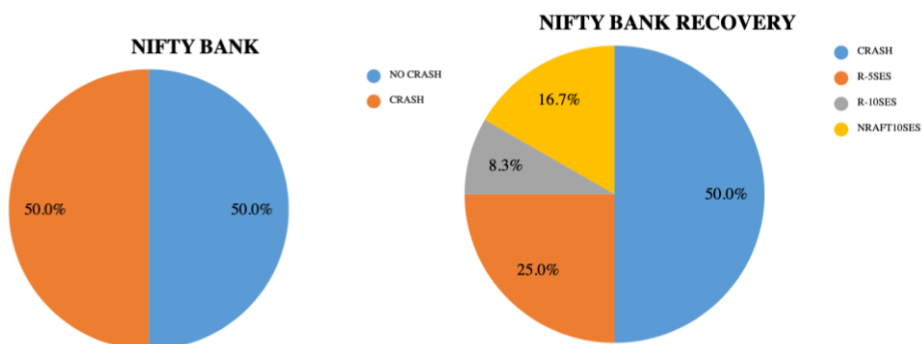
### B. Nifty Next 50 Crash recovery

	No. of Companies
NO CRASH	7
CRASH	42
R-5SES	19
R-10SES	7
NRAFT10SES	16



### C. Nifty BANK Crash recovery

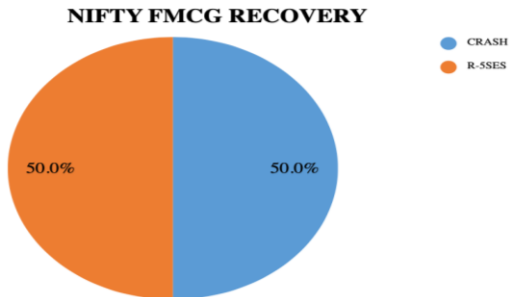
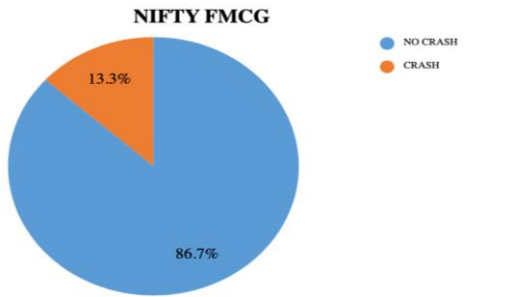
	No. of Companies
NO CRASH	6
CRASH	6
R-5SES	3
R-10SES	1
NRAFT10SES	2



### D. Nifty FMCG Crash recovery

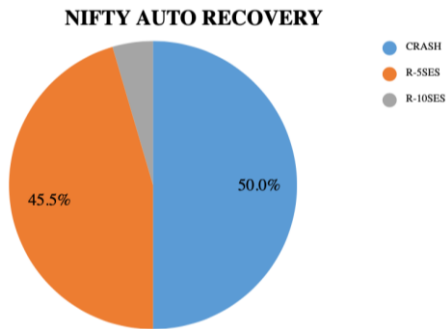
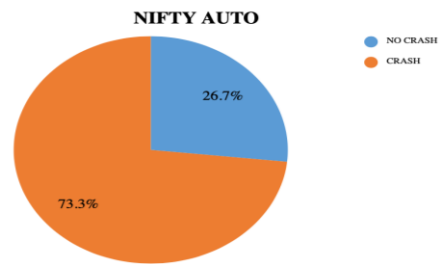
	No. of Companies
NO CRASH	13
CRASH	2

R-5SES	2
R-10SES	0
NRAFT10SES	0



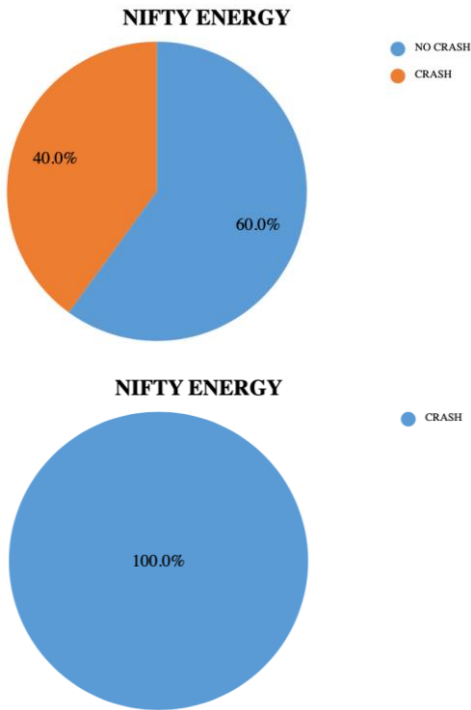
**E. Nifty AUTO Crash recovery**

	No. of Companies
NO CRASH	4
CRASH	11
R-5SES	10
R-10SES	1
NRAFT10SES	



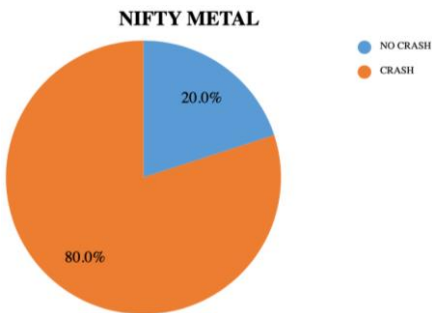
F. Nifty ENERGY Crash recovery

	No. of Companies
NO CRASH	6
CRASH	4
R-5SES	0
R-10SES	
NRAFT10SES	

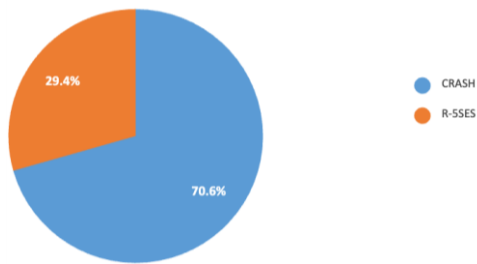


G. Nifty METAL Crash recovery

	No. of Companies
NO CRASH	3
CRASH	3
R-5SES	12
R-10SES	5
NRAFT10SES	



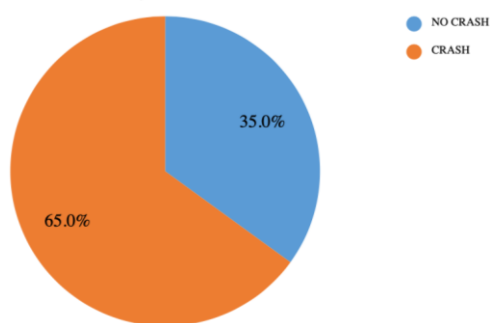
#### NIFTY METAL RECOVERY



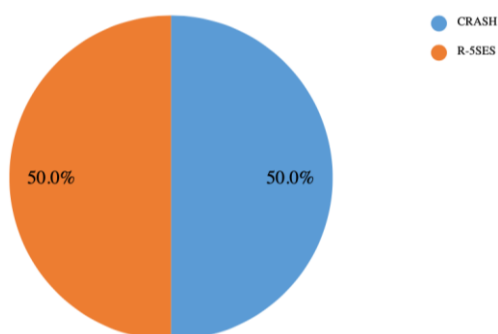
#### H. Nifty PHARMA Crash recovery

	No. of Companies
NO CRASH	7
CRASH	13
R-5SES	13
R-10SES	
NRAFT10SES	

#### NIFTY PHARMA



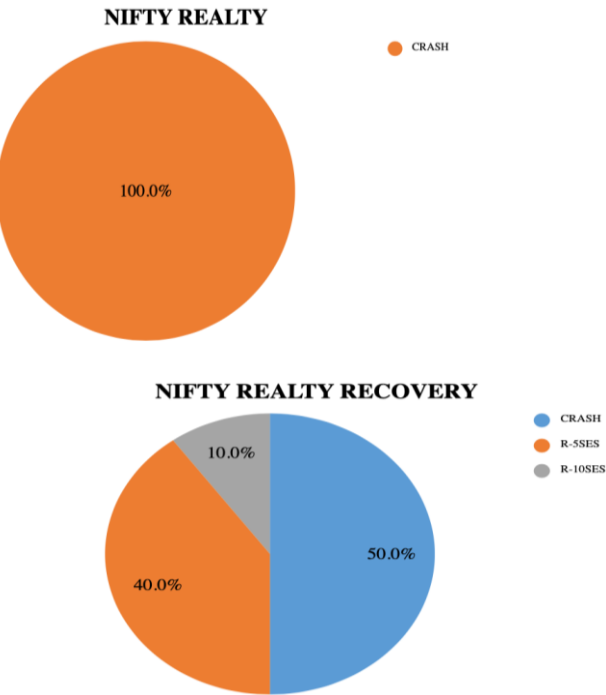
#### NIFTY PHARMA RECOVERY



#### I. Nifty REALTY Crash recovery

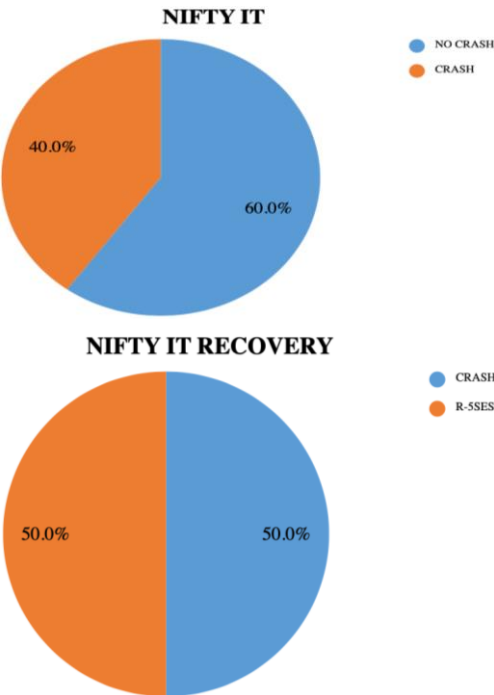
	No. of Companies
NO CRASH	0
CRASH	10
R-5SES	8
R-10SES	2
NRAFT10SES	





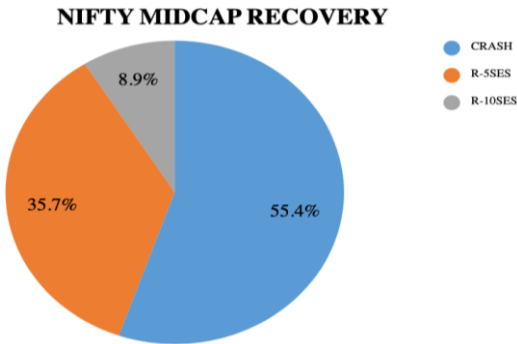
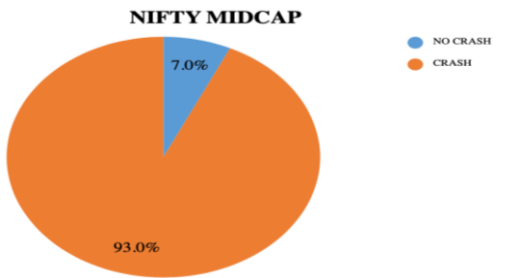
J. Nifty IT Crash recovery

	No. of Companies
NO CRASH	6
CRASH	4
R-5SES	4
R-10SES	
NRAFT10SES	



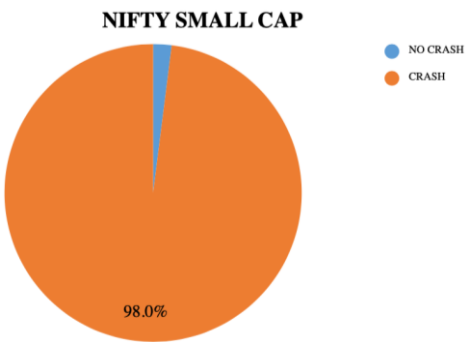
K. Nifty MIDCAP Crash recovery

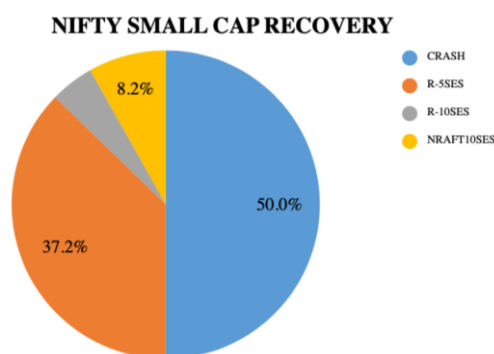
	No. of Companies
NO CRASH	7
CRASH	93
R-5SES	60
R-10SES	15
NRAFT10SES	



L. Nifty SMALLCAP Crash recovery

	No. of Companies
NO CRASH	2
CRASH	98
R-5SES	73
R-10SES	9
NRAFT10SES	16





## VIII. HIGHLIGHTS OF THE CRASH

- NIFTY REALTY companies crashed 100% on 4th June 2024, and recovered 100% within 10 trading sessions.
- NIFTY SMALLCAP companies crashed 98% on 4th June 2024. However, all of them recovered within 10 trading sessions after the crash.
- NIFTY MIDCAP 93% of the companies (93) crashed on 4th June 2024 and only 75 companies recovered within 10 trading sessions, while 18 companies did not recover even after 10 trading sessions.
- NIFTY 50 - Just 8 out of 50 companies had crashed on 4th June 2024 and recovered within 10 trading sessions.
- NIFTY NEXT 50 - 86% of the companies crashed on 4th June 2024 and all recovered within 10 trading sessions.
- Just 13% of NIFTY FMCG companies crashed, and all companies recovered within 5 trading sessions.
- 73% of NIFTY AUTO companies crashed and they recovered within 10 trading sessions.
- 60% of NIFTY ENERGY companies crashed and they never recovered within 10 trading sessions.
- 80% of NIFTY METAL companies crashed on 4th June 2024 and 5 companies recovered within 5 trading sessions, while 7 companies did not recover within 10 trading sessions.
- 65% of NIFTY PHARMA companies crashed on 4th June 2024 and all recovered within five trading sessions. 40% NIFTY IT companies crashed and recovered within five trading sessions.

## IX. LIMITATIONS & FUTURE SCOPE OF WORK

- NSE (National Stock Exchange) has around 2500 companies, and BSE (Bombay Stock Exchange) has around 5000 companies. However, this study is focused on NIFTY 50, NIFTY Next 50, NIFTY MIDCAP, NIFTY BANK, NIFTY FMCG, NIFTY AUTO, NIFTY METAL, NIFTY ENERGY, NIFTY PHARMA, NIFTY REALTY, NIFTY IT.
- In future, all companies can be included and use this data. This data along with other parameters will be used to build Bayesian Statistical forecasting models which is the author's area of research.

## CONCLUSION

- The crash is not uniform across various market segments.
- Many companies recovered in the first five trading sessions.
- Many MIDCAP, NIFTY ENERGY, NIFTY METAL and few Infrastructure, and public sector companies never recovered even after a 90 day period.
- The visual analytics presented in this research work can easily be interpreted by common investors.
- The granular data gathered and presented in this paper can go a long way in preparing investors to formulate strategy for future crashes (KBT, 2024).
- This research paper presents Heat Maps and Clusters to analyze Stock Market Crash which are easy to use and interpret.

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